CONTENTS

The Comparison of response inhibition, planning and reconstitution of thought in ADHD and normal children

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Abstract: Attention deficit disorder/hyperactivity (ADHD) is the most common childhood disorders. In explaining ADHD is referred to deficits in executive functions. Hence, the objective of the current study is to compare some executive functions in ADHD and normal children. In this present study, 25 ADHD children of combined subtype, 25 ADHD children of inattentive subtype and 25 normal children were selected. In this study, the children symptom inventory, Raven's Coloure Progressive Matricies Test (RCPM), Stroop Color- Word Test, Tower of Hanoi puzzle, and Vygotsky's test were used. In order to analyze data, the researcher used MANOVA and follow-up test. The results indicated that there is significant difference between response inhibition, planning and reconstitution of thought in ADHD and normal children. The result also indicates that the function of ADHD children with combined subtype were weaker than attention ADHD children with inattentive subtype. It can be concluded that ADHD children have deficit in executive functions. But it is necessary to note that there are different executive functions in subtypes of this disorder.

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Key words: Response inhibition, Planning and reconstitution of thought, ADHD

1. Introduction

Attention deficit disorder /hyperactivity (ADHD) is the most common childhood disorders. According to Diagnostic and American Psychiatric Association's and statistical Manual (DSM) estimated prevalence of this disorder in children between 3 to 7 percent (APA, 2000). This disorder is defined through three primary symptoms of Inattention, Hyperactivity and Impulsivity. In recent years, these three signs in the form of both individual behavior and the dimensions of inattention, hyperactivity/ impulsivity have shown by using the results of the factor analysis (Barkley, 2006). With respect to two dimensions, DSM considered three different subtypes including predominantly inattentive subtype (ADHD-I), Impulsivity subtype, and combined subtype (ADHD-C). The conducted research in behavioral, genetic, neuropsychological areas and the studies relating to Structural imaging and brain interaction, prefrontal lobe frontal and executive dysfunction support this disorder.

Executive functions is an umbrella term covered many cognitive process which serve the targeted behaviors and actions (Barkley, 2006; Nig, 2006). From the point of view of Nero- psychology, executive functions are a part of activities that patients suffering from frontal lobe hurts are not able to do them (Tehranidost, 2002). Penington and Qzonoff (1996) by reviewing researches which were related to the executive functions of children suffering from ADHD, found out that about 15 to 18 surveys have pointed to the significant differences between people suffering from ADHD and ordinary people in one or more executive function's measures. Inhibition is main components which are under the umbrella of executive functions (Gorfein & MacLeod, 2007). Lack of inhibition is mostly related to attention's constructions and impulsivity (Schachar et al. 2000). Many studies have shown that inhibition in people with this disorder is a failure. Lezak et al. (2004) defined this executive action as the ability to identify and organize the required steps and elements to accomplish a purpose or achieving a goal. Since the planning ability is a part of excellent actions of cortex prefrontal, it is believed that hurt or disorder in prefrontal areas and some areas of brain `s cortex is significantly related to the children' s planning ability (Lezak et al. 2004; Fuster, 2008). In most researches that have measured planning ability in people who are suffered from ADHD, found out significant difference between their function compared with normal children (Nigg et al. 2002; Vilkat et al. 2005; Kopesky et al. 2005; Young, Toone , Tyson& Morris, 2007). It is necessary to note that Geurt et al (2005) in their research found that there is not significant difference among subtypes. In addition, reconstitution of thought is one of the executive functions that referred to conceptual model of Barkely (1998). This empowerment is a goal-oriented creativity that enables individual to cross from

situations that be needed to problem solving. Functions of reconstitution of thought also includes of another competence entitled verbal fluidity (Barkely, 1998). Geurts et al (2005); and Shallice (2002) conducted a research. They found that there is no significant difference among two groups of reconstitution of thought. Barkely (2003, 2005) maintain that hyperactive children in response to the events have less ability to analyze and synthesize and so purposeful creativity reduce. Since different results cited in the relevant literature, therefore; the objectives of the present study is study executive functions such as response inhibition, planning and reconstitution of thought in ADHD and normal children.

2. Methods

The present study is causal- compare experiment. The study sample consisted of ADHD children with ages between 8 and 11 years old of Tabriz city. The sample consisted of 75 children which composed of 50 ADHD children. Among these 50 children with ADHD, 25 individuals were ADHD-C children and the rest were 25 ADHD-I children. In order to collect data, the researcher used the children symptom inventory and clinical interview in the present study. 25 normal children whom their age were between 8 and 11 years old were selected with respect to variables such as age, intelligence, gender. The sampling method of the ADHD children was available sampling and normal children (control group) were selected randomly. In this study, the children symptom inventory, Raven progressive matrices test, and Strop Color- Word Test, Tower of Hanoi puzzle, and Vygotsky test were used.

2.1. Instrument

Children symptom inventory (CSI-4): This inventory is behavioral rating scale which was developed by Gadow and Sprafkin (1984). In order to screening emotional and behavioral disorders of children, this inventory was designed and edited by Gadow and Sprafkin (2007). Children symptom inventory (CSI-4) consisted of two forms relating to parents and teacher. In this study, parents form was used which consisted of 97 items for screening 15 emotional and behavioral disorders. Eremis (2009) reported the reliability of this inventory 0.72% and construct validity also was confirmed by Suveg (2009). In Tavakolizade research in Iran (1376) the validity of parent`s form got with test – retest method and it`s validity up holded by using expert `s ideas according to the correct translation and adapting it with the main content too. Raven's Coloure Progressive Matricies Test (RCPM): This test is a non-verbal intelligence test and was originally developed by John C. Raven in 1936. In each test item, the subject is asked to identify the missing element that completes a pattern. Many patterns are presented in the form of a 4x4, 3x3, or 2x2 matrix, giving the test its name. Stroop Color-Word Test: In psychology, the Stroop effect is a demonstration of the reaction time of a task. When the name of a color (e.g., "blue," "green," or "red") is printed in a color not denoted by the name (e.g., the word "red" printed in blue ink instead of red ink), naming the color of the word takes longer and is more prone to errors than when the color of the ink matches the name of the color. The effect is named after John Ridley Stroop who first published the effect in English in 1935. The effect had previously been published in Germany in 1929. The original paper has been one of the most cited papers in the history of experimental psychology, leading to more than 700 replications. The effect has been used to create a psychological test (Stroop Test) that is widely used in clinical practice and investigation. Tower of Hanoi Puzzle (TOH): is a mathematical game or puzzle. It consists of three rods, and a number of disks of different sizes which can slide onto any rod. The puzzle starts with the disks in a neat stack in ascending order of size on one rod, the smallest at the top, thus making a conical shape.The objective of the puzzle is to move the entire stack to another rod, obeying the following rules:

- Only one disk may be moved at a time.
- Each move consists of taking the upper disk from one of the rods and sliding it onto another rod, on top of the other disks that may already be present on that rod.
- No disk may be placed on top of a smaller disk.

With three disks, the puzzle can be solved in seven moves.

Vygotsky Test:

In order to how to measure reconstitution of thought, the researcher used Vygotsky Test. The aim of vygotsjy test is to show concept formation test, how to combine ideas and consider them to be rebuilt. The test is made of 22 wooden beads in the shape, color, size and height of the four types. The scoring of this test is performed by using the formula and record the running time and the number of test piece. Hashemi and Alipour (2000) calculated relaibility cronbach's alpha 0.76% in their study.

2.2. Procedure

In order to identify ADHD children, from among 9-11 year-old boys who as children were

suspected of having the disorder, individuals were selected and after obtaining written consent from the parents and complete CSI-4 parent form and clinical interviews with children, and the disorder subtypes were determined. Then, the selected tests were performed on children and the results were registered. It is necessary to note that children's IQ was at lest 90 on the Raven test. In order to analyzes and interpret, the researchers used MANOVA and leasa significant difference (LSD) follow- up test.

3. Results

As it can be seen, the table (1) indicates mean and standard deviation different test-takers performance on Tower of Hanoi Puzzle (TOH), Stroop Color-Word Test, Vygtosky test.

In order to investigate difference group's performance in these tests, multiple analyses of variance (MANOVA) were used. As the table (2) indicates that there is significance difference between group's performance on planning, response inhibition and reconstitution of thought.

In order to pair sample comparisons on group's performance Leasa Significant difference (LSD) in variables (including, planning, response inhibition and reconstitution of thought) were used.

Table 1. Mean and Standard deviation different test-takers performance of normal and ADHD Children

Subjects		Variables	N	Mean	St. dev
ADHD-	Planning (Hanoi Puzzle)	Numbers of errors	25	4.48	2.46
		Time off pattern	25	84.08	52.76
		Number of moves	25	15.24	6.75
	Response inhibition (Stroop test)	Numbers of errors	25	9.84	4.99
		Time off test	25	129.72	36.28
	Reconstitution of Thought	(VigotskyTest)	25	371.88	110.33
ADHD-C	Planning (Hanoi puzzle)	Numbers of errors	25	16.16	9.85
		Time off pattern	25	146.8	76.26
		Number of moves	25	31.96	13.34
	Response inhibition (Stroop test)	Numbers of errors	25	28.68	6.47
		Time off test	25	178.12	52.95
	Reconstitution of Thought	(Vigotsky Test)	25	565.96	131.87
Normal	Planning (Hanoi puzzle)	Numbers of errors	25	0.24	0.435
		Time off pattern	25	30.84	19.07
		Number of moves	25	7.4	0.654
	Inhibition Response (Stroop test)	Numbers of errors	25	0.80	1.25
		Time off test	25	61.04	12.66
	Reconstitution of Thought	(Vigotsky Test)	25	255.6	51/64

Table 2. Multiple analyses of variance (MANOVA) in difference group's performance

	Trace	Trace rate	F	Df	Mean St. dev.	Sig	Co Eta
Group	Pillai's trace	1.104	13.97	12	0.136	0.001	0.552

Table 3. pair sample comparisons

Dependent variable		Group A	Group B	Average differences	Mean St. dev	Sig
Planning	Number of errors (Hanoi puzzle)	Normal	ADHD-I	4.24	1.66	0.013
			ADHD-C	15.92	1.66	0.001
		ADHD-I	ADHD-C	11.68	1.66	0.001
	Time off pattern	Normal	ADHD-I	53.24	15.59	0.001
			ADHD-C	115.96	15.59	0.001
		ADHD-I	ADHD-C	62.72	15.59	0.001
	Number of moves	Normal	ADHD-I	7.84	2.44	0.002
			ADHD-C	24.56	2.44	0.001
		ADHD-I	ADHD-C	16.72	2.44	0.001
Response inhibition	Numbers of errors (Stroop test)	Normal	ADHD-I	9.04	1.350	0.001
			ADHD-C	27.88	1.35	0.001
		ADHD-I	ADHD-C	18.84	1.35	0.001
	Time off test (Stroop test)		ADHD-I	68.68	1.35	0.001
		Normal	ADHD-C	117.08	10.68	0.001
		ADHD-I	ADHD-C	48.40	10.68	0.001
	Reconstitution of thought (Vigostsky Test)	Normal	ADHD-I	116.28	10.68	0.001
			ADHD-C	310.36	29.31	0.001
		ADHD-I	ADHD-C	194.08	29.31	0.001

As it can be seen, the above table shows components of number of errors and spent time on Stroop test in response inhibition. Based on the obtained results, there is significant difference between normal and ADHD children. The result also indicates that there is significant difference between ADHD-I children and combined subtype (ADHD-C). According to results, there are significant difference between normal children and ADHD children in components of number of errors (Hanoi puzzle), Time off pattern and Number of moves (Planning variable).Also above results observed between ADHD-I and ADHD-C children. In general, ADHD children in comparison with normal children, had worse performance in each all third variables. This worse performance also observed in ADHD-C children in comparison with ADHD-I children. The result also indicated that there is significant difference among groups in reconstitution of thought at 0.01 levels.

4. Discussion

Attention deficit disorder / hyperactivity (ADHD) is the most common childhood disorders (Barkely, 2006; Fuster, 2008). The main core of many explanatory theories is deficit in response inhibition (Barkely, 1997, 2005, 2006; Nigg, 2006). In order to study response inhibition, the researcher used Stroop Color-Word Test. In general, the duration of card reading time and reading errors in the ADHD group was significantly more than the control group. Since children with ADHD are less of attention, so they spend more time reading. On other hand, reading out color card involves two functions: first, conceptual inhibition and second change to another field. Since this function requires attention and concentration, ADHD children spend more time on reading it. On other hand, reading color cards involves two performances: First refers to conceptual skill which comes from mind and second refers to changing into another area. Hence, since this function requires attention and concentration, ADHD children spend more time on reading it.These findings are consistent with the findings of Sergent et al (2002), Shouwiger et al (2007); Lasenberg et al (2007); Shalis et al (2002); Golden et al (2002). This subject of the present study can be supported by Barkely theory. The results also suggest that performance on ADHD combined subtype is worse than ADHD inattention subtype children. This result is consistent with the findings of Nigg et al (2002), Klerman et al (1999), Lokkod et al (2001). However, this result is not consistent with the findings of Murphy et al (2001), Guerts et al (2005). The results also indicate that there is significant difference in comparison of planning with ADHD children and normal children. These findings are consistent with the findings of Sergent et al (2002), Klerman et al (1999), Papa douplos et al (2005), Wilkat et al. (2005), but these findings are not consistent with Hokton et al. (1999), Skeres et al. (2004). On other hand, the result shows that ADHD children's performance with combined subtype in proportion to inattention subtype is weaker. These findings are consistent with the findings of Brakley et al. (2005), Nigg et al (2005), Kopeski et al (2005), and Wikat et al (2005). However, Geurts et al (2005) conducted a research on subtypes by using meta-analysis. They found that there is not significant difference among subtypes. Barkely's theory (2008) is an explanation for this difference. The Barkley model is a system of hierarchy. Response inhibition locates at the top of the hierarchy and executive functions at the bottom. He believes that the response inhibition causes delayed response to an event. During delaying in responding, the actions of executive are formed. In other words, response inhibition leads to executive functions occur and keep them from interfering. Barkley (2005) stated that ADHD-C due to executive dysfunction in inhibition and planning recognized. The analysis of data indicated that there is significant difference among these three groups in reconstitution of thought. Meanwhile, these findings are not consistent with the findings of the Guerts et al (2005), Murphy et al (2001). These scholars did not see the significant difference between attention inhibition subtype and combined subtype. In explaining these findings, it can be found in Barkley's theoretical predictions. Response inhibition plays a crucial role for the formation of re-thinking. Barkley(2003 , 1998) stipulated that children suffering ADHD have less combination and analysis ability in responding events because of deficit in behavioral inhibition system , it means that these children are unable to create multiple projects for helping to purposeful behavior and so their creativity will decrease. As a result, the findings of the present study are consistent with Barkely's Theoretical predictions. In general, the results of the present study suggest that performance of ADHD children compared with normal children in response inhibition tasks, planning and reconstitution of thought is weaker. It is hoped that in the further researches by use of large sample grope and control variables such as comorbid disorders with ADHD, executive function exactly are studied.

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Contribution of Climbing up to High Altitudes Subsequent to Co-enzyme Q10 Completing on Mallon-di-aldehyde Variations in the Serum of Male Mountaineers

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Abstract: The aim of this research was to study the climbing effect into high altitude contribution as subsequent to supplement of Q10 coenzyme on Mallon-di-aldehyde rate in male mountaineers' serum. Thus, 14 experienced and skilled male mountaineers (average 181 cm height, 25.5 years old, 75 kg, Body mass index 22, Percent of hypodermic fat 10 cm in Ave., VO_{2Max} 80.5 lit/min, with experience of 5-15 years) were selected randomly and divided into 2 Experimental and Control groups. Before climbing, they consumed Q10 supplement and Placebo for 14 days. Their blood samples were analyzed in 4 different altitudes; 1500m, 2800m, 4300m and 5671m during climbing to Damavand summit. The results were considered by special kits of laboratory and auto-analyzer machine. Data were analyzed by F Test (as variance test with repeating in related factor). The relation among Q10 supplement hasn't a meaningful relation with Mallon-di-aldehyde rate but altitude variations are in meaningful relationship for both of the groups.

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Key words: high altitude, coenzyme of Q10, Mallon-di-aldehyde, mountaineering

1. Introduction

Mountaineering is an exercise with useful benefits and effects such as increasing and improving in Hemoglobin rate or a great resistance in cardiovascular system. Also, there are other harmful and negative effects as particular disorders like acute mountain sickness (AMS) or high altitude brain edema. Some of the mountaineers face with following disorders and problems, too: Diarrhea, Headache, Vomiting and Oxygen deficit around of the site (Armstrang, 2000; Bahrami, 2004). In the summer of 1968, during of the Olympics games of Mexico-City, altitude contribution on athletes" performance was noted by the media and reporters seriously (Fox and Mathius, 1992). Based on the reports, Hypoxia emanates from high altitude climbing and this event plays a considerable role to make oxidative stress (Dosek, 2007). Getting more and excessive exercises will increase the need for oxygen and hence your body will consume a lot of oxygen. Excessive oxygen consuming means more free radicals formation. This problem cause to damage and obliterate the cells and lastly physical fatigue at this time, our body begins to use from the anti-oxidants in our around to defend against the oxidants and free radicals. There is no problem if we provide our need for these substances well. But if the body faced with anti-oxidants deficit in inner site then we couldn't get any hope to save the cells against of oxidation danger (Safari, 2005). So, practice and exercise in high altitude could be effective to make free radicals (Cooke et al., 2008). Using anti-oxidative supplements such as vitamins and semi vitamins nutrients are very important factors basically (Subudhi et al., 2004). Due to the reports, anti-oxidant Q10 effects and vitamin E are considered for fighting against free radicals resulted from excessive exercises (Cooke et al., 2008). Co-enzyme Q10 is a kind of dissoluble vitamin in the fat and it is available in all of the cells. In fact, co-enzyme Q10 plays a great role for electrons' transmit in mitochondria site, oxidation cycle, ATP producing and a strong anti-oxidant in reproducing of other anti-oxidants (Damia et al., 2001; CPDDP, 2007). In other hands, i.e., measuring index of Mallon-di-aldehyde states oxidative stress rate and free radicals in altitude and shows the peroxidation rate of the fats (Malek Zadeh 2004; Benzie, 2004). According to the studies in 2005 about of anti-oxidants and their relationship with oxidative stress and free radicals, it was found that anti-oxidants are as defensive factors and they reduce the cells as a resistant force against of free radicals and oxidative stress (Anjana, 2005). They prevent from the anti-oxidants' changes against oxidative stress. Also, they can create a balance among of the cells and play an important role as an

agent substance inside of the cells (Inhumanexperiment, 2008). Generally, they have two important roles as follows:

1. To participate and provide of the oxygen in the cell and oxygen synthesizing with the cells during of the cell reactions and their activities.

2. To maintain and protect of the cell against of oxidative stress effects and another oxidative factors in the cell (Inhumanexperiment, 2008).

By the previous studies, Free radicals could get damage for the brain and blood cells and lastly cause altitude disorders like AMS (Benzie & strain, 1996). In athletes, Q10 shortage made metabolic stress as free radicals increasing in severe practices (Nazirolu et al., 2004). Due to the studies done in 2005 about of vitamin E effect on the serum of six mountaineers in Himalaya region(after climbing into Pomori summit,7161m , for 3weeks), it was shown that vitamin E as an oxidant can prohibit from mitochondria disorder arising from Hypoxia (12). Although Cook et al studied co-enzyme Q10 contribution on exercised people and not exercised ones' performance, but they could conclude that short time consuming of the supplement can increase viscosity of inner muscles of Q10 and decrease oxidative stress. Also, MDA rate increasing during of the practice and after that would be possible (Cooke et al., 2008). Another researcher man as named of Magalhase et al reported that Hypoxia and oxygen deficit have been made increasing the oxidative stress and free radicals in mitochondria of the cell and decreasing of oxidative phosphorylation capacity (Magalhase et al, 2005). Whereas Subdehi et al (2004) reported that anti-oxidants couldn't get any effects on oxidative stress indices and free radicals in high altitudes (Subdehi et al, 2004). Contrastive results about anti-oxidants effects on mountaineers' practice in high altitudes are great reasons for the recent researcher to pay attention to this study and it encouraged me to study on possible effects of supplement Q10 consuming with climbing into Damavand summit on Mallon-di-aldehyde changes rate in the serum of male mountaineers.

2. Methods

Recent research is a semi-experimental study and 24 experienced male mountaineers with climbing record of 5-15 years, with no disorder at the height were chosen randomly. Some of them were chosen with following specifications:

Anthropometric and physiological indices such as VO2max, BMI, Hypodermic, Fat, Age, size, weight, type and procedure in mountaineering sport, experience, knowledge and educational level about of the height and mountaineering, strength of body, cardio-vascular power, body fitness for mountaineering and activity on the height. They were divided into two groups based on anthropometric and physiological factors: experimental group (n=12) and controlling group (n=12). According to the team specialist and physician advice, experimental group consumed pure Q10 coenzyme made in Webber naturals Factory of Canada, with 100mg daily (consumed concentration was considered by the age) for two weeks before climbing into the height. Placebo group consumed placebo Dextrose with 100mg in a day for two weeks before climbing into the height.

Blood sampling was considered with 5cc rate in each stage under the completely controlling of nutrition in the test before climbing to the summit and during of the climbing and also with consuming of Q10 and placebo as follows:
(from anticobital of the tests in 4 steps).

For two weeks before climbing into the height in fasting status with 1500m.

In the base camp of Damavand at the height of 2800 m in fasting status.

Before climbing into Damavand at the height of 4300 m and in fasting status.

After climbing into the summit in the height of 5671m and backing.

Blood samples of persons were taken to the laboratory after safe packing and freezing. They were put into the special kits such as blood sugar kit, Frap kit from Germany brand with 0.0001 as an accuracy and sensitivity. Expected results obtained through auto-analyzer machine (cell counter) from U.S.A manufacturer after the related experiments doing.

2.1. Statistical methods

Firstly, we used Kolmogorov- Smirnov test for data homogeneity and then it was used from F test (variance with test operation) at the following stage. Following test (Bonferroni Test) was also considered for meaningful data values. All the statistical estimations were analyzed by Spss16 with $a<0.05$, as a meaningful level. We used descriptive report to detect the statistics, data and individual species for the athletes.

3. Results

Test F (variance analyzing with iteration test evaluating) in stage 4 showed that there wasn't a meaningful difference between co-enzyme Q10 completing and Mallon-di- aldehyde changes rate ($P<0.05$). But the altitude as independent factor and separated from Q10 co-enzyme showed a meaningful difference on Mallon-di-aldehyde changes rate

Table 1. Difference between co-enzyme Q10 completing and Mallon-di- aldehyde changes in both groups

Group		Control (N=7)			
Altitude	1500 m	2800 m	4300m	5671m	
Mallon-di-aldehyde	2.5 ± 0.18	2.77 ± 0.2	2.9 ± 0.23	2.47 ± 0.18	
Group		Experimental (N=7)			
Mallon-di-aldehyde	2.51 ±0.2	3.5 ± 0.41	2.7 ± 0.19	2.51 ± 0.3	
P≥ 0.05		St. dev.		Mean	
Within group	Within Altitude	Control	Experimental	Control	Experimental
0.33	0.029	0.98	0.14	2.64	2.78

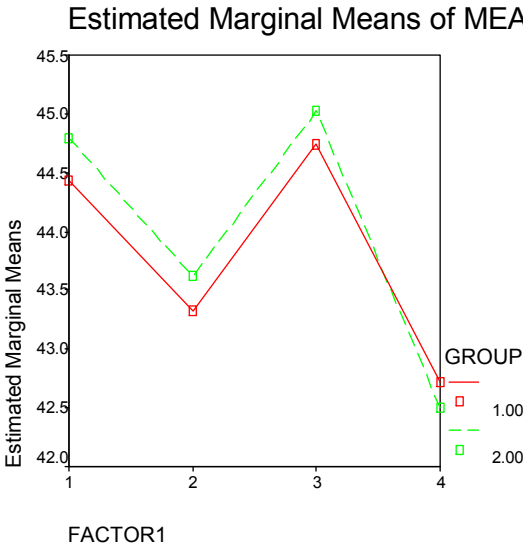

Figure. Co-enzyme Q10 completing and Mallon-di-aldehyde changes in both groups

4. Discussions

Due to the results from the recent research, it isn't observed any meaningful difference between co-enzyme Q10 completing and Mallon-di-aldehyde changes rate of male mountaineers after climbing up to high altitude (Damavand summit, P<0.05). But there was a meaningful difference in Mallon-di-aldehyde changes rate of the groups by increasing or decreasing of altitude and its effect as an independent variable. It was related to altitude effects without of the supplement interference at this case. Perhaps, relation of co-enzyme Q10 completing and Mallon-di-aldehyde changes rate of male mountaineers after climbing up to high altitude isn't meaningful but it is meaningful among of altitude changes in blood serum which it isn't observed changes in fats peroxidation rate since it depends to stability, practice rate of people or cortisol hormone secretion in altitude (Damian et al., 2001; Armstrang, 2000). Studies have been shown that balance of oxidant and anti-oxidant decays in the body by altitude (Magalhaes et al., 2005). (As oxygen deficit) Finally, signs of oxidative stress will be possible in the cells and body. Oxidative stress in altitude is a kind of oxygen reaction in the cell that it can get damage to the cell contents such as: lipid membrane, mitochondria, practical and structural proteins and even the cell nucleus and DNA (Magalhaes et al., 2005). Carl Marshal studies detected that people who they live in low altitudes or mountaineers face with Hypoxia states, have more stress hormones as cortisol whereas low altitude residents have more cortisol rate rather than people who they live in high altitudes. Some of effective factors are: altitude diseases, to increase of climbing up speed, spent distance of altitude, stability time in altitude and physiological states (Armstrang, 2005). Moreover, another problems and disorders such as water deficit, decomposition of protein, diet variation, unfavorable food situation, ultra violet ray, air pollution, low pressure site of oxygen and weight lost and etc., help to form (increase/decrease) oxidative stress and anti-oxidant power in the body (Armstrang, 2005; Magalhaes, 2005). In fact, measurement index of Mallon-di-aldehyde rate defines oxidative stress, free radicals producing in altitude and peroxidation rate in the fats (Benzie & Strain, 2004; Malek Zadeh, 2004). Peroxidation of the fats occurs when oxidative stress rate or free radicals producing in the cells increases Subsequently, this event breaks double bonds of the fats (Malek Zadeh, 2004). When we are dealing to mountaineering in high altitudes and since we are climbing from low sites to high ones, thus cortisol hormone secretion increases because of oxygen shortage and some of variations in central nervous system. This state is also increasing by stability rate and activity severe in altitude. So there is a direct relation between cortisol rate of plasma and duration time in altitude. More duration in altitude make to increase its rate. It is possible that co-enzyme Q10 could be an effective factor as ideal anti-oxidant on blood serum of male mountaineers and save and protect them against of damages into the cells and tissues. When exercise activity is in low or moderate level, there isn't any change in cortisol secretion rate but in inverse state, it differs. As above mentioned, it seems that increasing of cortisol secretion could be a general response to physical stress (Armstrang, 2000). So, it is possible that this study is adapted with other studies. In fact, cortisol hormone is responsible of the liver's fats conducting and using for quick energy making in the cells (MalekZadeh, 2004). This research case hasn't any coordination with the studies dated on 2008 about Mallon- di-aldehyde rate in sports (Inhumanexperiment, 2008). Since this study and other ones have been done in

normal conditions whether they are adapted with our new study or not, following cases could be effective factors in the fats peroxidation perfectly: Water deficiency, unfavorable food situation, glucose rate of the blood, air stiff, contamination, emotional state of a person, hormones' secretion, disorders in central nervous system as a result of high altitude (Armstrang, 2000). Hence, Q10 supplement hasn't a meaningful relation with Mallon-di-aldehyde rate but altitude variations are in meaningful relationship for both of the groups. Main reason is related to "Altitude" about of meaningful difference in Mallon-di-aldehyde rate of the groups. At the end and after the recent study findings in a short conclusion, it was recognized climbing up contribution to high altitude subsequent to Q10 supplement on Mallon-di-aldehyde variations rate of male mountaineers' serum obviously. The results showed that there is no evidence on meaningful relation between climbing up to the summit of Damavand and Q10 supplement consuming on Mallon-di-aldehyde variations rate. By supposing of altitude as an important and independent variable at this study, we could define a meaningful difference in Mallon-di-aldehyde variations rate subsequent to altitude variations. The aim of this research was to study the effect of Q10 co-enzyme contribution on Mallon-di-aldehyde variations rate by climbing to Damavand summit and to detect of effective factors like altitude on Mallon-di-aldehyde rate in male mountaineers' serum. Hopefully, we could detect other effective factors and decrease damages into human's body in mountain sites and altitudes. So, mountaineers will be able to improve and promote their abilities and sports activities against of Hypoxia, diseases and stresses from climbing to high altitudes.

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Evaluating and comparing the effectiveness of sport sponsorship among the selective teams of the football premier league of Iran

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Abstract: The aim of this study was to evaluate and compare the effectiveness of sport sponsorship among the selective teams of Iranian football premier league. All fans of three teams in football premier league were selected as a population size. By using a formula, 216 individuals for Esteghlal, 245 individuals for Traktor and 291 individuals for Persepolis were selected randomly. Smith's questionnaire was used to collect the data and validity of it approved by 6 professional of sport management and the reliability by Choronbach alpha coefficient and obtained 0.73. Finally, 752 questionnaires were collected and analyzed. Data were analyzed by t test, ANOVA and Scheffe. The results showed that sport sponsorship among the selective teams was effective. Furthermore, result of ANOVA showed that there is significant different between the effectiveness of sponsorship among the selective teams. It is recommended to the club managers to improve the enhancement factors of fan attendance, and they should inform the sponsors its effectiveness.

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Keywords: sponsorship, effectiveness, football premier league, purchase intentions

1. Introduction

Many people consider that marketers are referring to buyers who know that they are trying to coax people into buying their goods. Others also think that all the propaganda activities of a company are as its marketing efforts. But the reality is that marketing is beyond of its definition than sale activities or even advertisement (11). In fact, marketing is the series of activities which is included in the case of goods and distribution that advertisement and sale are only part of it (Eshghi, 2009; Amis et al., 1999). There are different definitions for marketing such as a group of related businesses, a business phenomenon, the economic process, the exchange or transfer of ownership of products, supply and demand adjustment process and many other meanings. Each of these definitions represent a corner of the marketing activities; today, experts define the marketing as the process of satisfying human needs and requirements (Rousta, 2010). Philip cutler defines marketing as follows:

"Marketing is defined as a social and managerial process by which individuals provide and meet their needs and demands through the process of production and exchanging goods with each other" (Eshghi, 2009; Amis et al., 1999). Marketing involves a range of activities and decisions (Eshghi, 2009). A combination of marketing elements can be defined as follows: "a set of controllable marketing variables that companies combine them in target market and create the required response in their own compositions"(Kutler, 2010).

In a general classification, they can be summarized in four groups:
1. product, 2. Price, 3. promotion, 4. distribution (Eshghi, 2009).

In today's markets, companies are seeking new methods and approaches to raise their potentiality of marketing being different than their opponents and competitors; thus, they are spending huge expenses in this regard. One of these methods is the sport financial support that companies make the in sponsorship for the related teams or sport event to reach to their ideal targets in the field of marketing (Grohs et al., 2004). The increasingly competition of markets and rising costs of traditional advertising tools has led to increased demand for sports sponsorship (Khosromanesh, 2009). Many researchers consider financial support as a communicative tool similar to advertisement, whereas financial supports act their performance combined with marketing communications. One of these differences is that the advertisements represent a clarified and direct message controlling by a sender, whereas this message is being less controlled in the field of financial supports and that communication is connected by the commercial brand and goods influencing on the audiences (Eshghi, 2009).

Experimental evidences show that the advertisements aware customers only through the aspects of commercial productions not social aspects. In other words, the advertisements do not have any emotional nature whereas the emotional response generated by an event plays a key role in the understanding of customers' message (Cingiene & Gobikas, 2006). Financial support means providing or meeting any financial and production assistances into an activity through a commercial organization in the aim of reaching to commercial targets (Seyyed Ameri, 2010). Exercise is one of the phenomena that companies and private factories support it a lot. Shunk defines the sport financial support as follows: "investment in sport entity (athlete, team, league or sport programs) to support overall organizational goals, commercial or advanced navigatory purposes (Seyyed Ameri, 2010). Team fanatics know their sponsor's productions attractive their similar productions (Grohs et al., 2004). In addition to media coverage and the fans, their emotional feelings towards the team increase the investment return (turnover) of financial supporters (Cingiene & Gobikas, 2006). In the other hand, financial support of sport through the large companies provides the success of the clubs and sponsors that both sides can benefit together (Grohs et al., 2004). Today businesses and industrial owners have found that financial support is as a powerful promotional tool for their businesses (Seyyed Ameri, 2010; 23). Financial support of sport also is the unique features of the sport economy (Shalbari et al., 2012). In fact, one of the most important elements binding the sport and economical events together is the sport financial support in the advertisement of fanatic and sponsor companies (Seyyed Ameri, 2010; Smith et al., 2008). Today, having sponsor is an integral part of income for the clubs (Grohs et al., 2004). Financial support is one of the most important sources of income in today's sports. It also benefits the owners and the goods and services that directly and indirectly contribute to the development of sport (Seyyed Ameri, 2010). One way of providing adequate funding for the particular activities like championship athletic activities is the use of funding companies and private factories (Seyyed Ameri, 2010; Nufer & Bühler, 2010). Sponsored sports have risen dramatically in the past two decades and in most other major non sport companies such as shell, coca cola and Emirates and Dafone have been considered as an important part of marketing strategy. Variety of sports organizations and entities such as individual athletes, clubs and teams, events, leagues, unions, federations and competitions may be supported due to special targets and positions (Grohs et al., 2004). Sponsored sports have attracted the attention of domestic and foreign companies in Iran. The financial support of professional sports according to the sport in Iran is soaring. Today, most sporting events that are conducted in the country have a sponsor showing the growth of this industry as well (Eshghi, 2009); companies sponsoring on their teams are increasingly growing right now. The sport financial support is an appealing tool for companies attracting their customers' purposes (McKelvey & Grady, 2008). In the season 2008-2009, Mary Brown chain restaurants was introduced as the main sponsor of Perspolis soccer club with USD3 billion contraction. Also, Iranian furniture market in the first half of the season with 500 million and Iranian mobile market with 800 million in the second half of the season were the supporters of Esteghlal soccer team; other teams in the premier league were not exception in this regard, for example, Iran Khodro factory was the sponsor of Qazvin Peykan football club with 4 billion in the same season (2008- 2009) (Eshghi, 2009; Grohs et al., 2004). Sponsors hope to raise the awareness of their customers through the investment in sport and hence they make a special value for their brands. Given that the agreement between the parties is unpredictable, so the risk of investing in sport is very height; for example, there is no any guarantee for the high rate of selling or the high rate of selling or the high perception of the customers (Seyyed Ameri, 2010). Due to the significant growth of sport sponsorship, the effectiveness of financial support is very important for the sport marketers and sponsors. Today, most organizations are looking to measure the effectiveness of their marketing activities and be able to make better decisions on it. Companies spending huge amount of money are seeking their investments back but how to evaluate the effectiveness of their marketing activities has become an issue. In spite of companies' tendency towards sport financial support reaching to their goals, the impacts of these activities and their effectiveness have been less considered in this regard (Grohs et al., 2004). Many definitions have been proposed for effectiveness: the rate of reaching to organizational goals (Etzione), the degree of supplying the requirements or criteria evaluation of individuals outside the organization (Pfeffer and Salansyk; Hamidi, 2003). The effectiveness of sponsor to devoted goals depends to financial sponsor sponsoree. Hans and Skatoien (1995) have identified four levels of sponsorship effectiveness:

1. Being exposed to, 2. Attention, 3. Recognition, 4. Purchasing behavior (Shalbari et al., 2012).

Being exposed refers to the number of measurements that is being displayed by an organization or a commercial brand; for example,

exposed to the TV viewers will be calculated by multiplying the number of seconds. The second level of effectiveness is that how people pay attention to the brand or organization. The attention can be measured by the member of target market based on changes in the retention of the same market members. The third level of assessment of the effectiveness of financial support is the measurement of the cognitive effects.

These effects can be evaluated in tests of recalling; for example, it can be asked that, which sponsor does support this event or team financially? Cognitive tests as a qualitative research are suitable for the evaluation of financial sponsor's effectiveness because they provide information that will allow researchers to pay to explain consumer behavior. Last level is the buying behavior. The most direct method to measure the effective ness of the sponsor is the purchasing behavior (Shalbari et al., 2012). Pits and Slatter (2004) have mentioned the amount of sales as a suitable tool for measuring the effectiveness of financial support. They consider any increase of sales and purchase intentions as a sign of success of financial support (Eshghi, 2009). Usually it is difficult to measure precise amount of sales due to the financial support. A solution to this problem is to examine the purchase intentions. So, we can say that the intention of purchasing is an appropriate replacement for sales (8). Harvey (2001) in a research titled, "the measurement of financial support effects", found that financial support increases the intention of buyers; he also stated that this increase is not only due to the production features, but also financial support plays a key role in this field. Gross et al (2004) in a research titled," the study of financial supporters effects", found that , the proportion between financial sponsors and events, the degree of displaying and the level of fans participation in the event have different impacts on the effectiveness of financial sponsors activities. Sin jin (2006) in a research titled, "the significance of financial support effectiveness among Lithuanian Basketball league financial sponsors, found that financial support has a positive impact on the sponsors of "Litous Witt" sales, whereas, this effectiveness was weak for the financial sponsors of Zalgiris. Nufer et al (2010) in a research concerning the effectiveness of financial activities from the world cup matches found that, the effectiveness was very profitable for some companies but others could not benefit a lot. They expressed, it seems that financial support is an effective communication tool. Eshghi (2009) in reviewing the effectiveness of financial support found a positive impact on the intention of fans purchasers of both Perspolis and Esteghlal football teams; The results showed that, financial support dose not influence on purchasing intention in two Esteghlal and Perspolis football teams. Ghilaninia (2010) in examining the structure of financial support found that the awareness of fans from sponsors and their impacts on purchasing intention has a positive and direct effect; Given to the important role of financial support in the creation of income for clubs and the expected return on investment and increased sales by club sponsors have been considered as the most vital factors of the present study and the comparison of financial support effectiveness among three fanatic teams of Iranian premier football league. So, this study aimed to answer whether the activities of financial sponsors in the field of supporting football clubs are effective, and if the effectiveness of financial supports among the selected premier football league have any differences or not.

2. Methods

The present research is descriptive- Comparative following the applied targets; the research community was consisted of three selected premier football league teams (Esteghlal, Perspolis and Traktor). Since the number of adherents of these three teams are coveted by millions, the infinite population size was considered. The sampling method is Random- class and to determine the sample size, the sampling size formula was used for the infinite population (Bal et al., 2009).

$$n = \left(\frac{Z_{\alpha/2} \cdot \sigma}{\varepsilon} \right)^2$$

In above – mentioned formula, Z in the 95% confidence interval is 1.96; the error rate is considered 0.05. Since the variance of fans was not determined among three selected teams in the present study, 30 questionnaires among fans of each teams was analyzed in a preliminary study and these were 0.38, 0.40, and 0.43 respectively. Thus, the size of sample is 216 ones for Esteghlal, 245 ones Traktor and 291 ones for Perspolis was calculated the data collection tool of purchasing intention questionnaire is all the fans in which its reliability is 0.80 calculated by smith; after translation of questionnaire validity with surveys of 6 professor of sport management and its reliability using Cronbach's alpha coefficient as calculated, 0.73. After collecting the questionnaires, a total of 752 questionnaires were analyzed. First, for the study of normalized data distribution, the tilt and strain data were used in which the team of Esteghlal, 1.783 (Skewness) and -1.028 (kurtosis), Traktor, 1.183 (Skewness) and 1.28 (Kurtosis), and Perspolis, -1.113 (Skewness) and 0.713 (Kurtosis) were obtained. This data is necessary for normal distribution coefficients between – 2 and 2.

Therefore, the data distribution was normal' then, the single- sample t- test was used for assessing the effectiveness of activities sponsored by the fans were selected. To compare the effectiveness of the activities sponsored by the teams, the test of variance analysis (ANOVA) was used.

3. Results

The results of descriptive statistics that describe the demographic characteristics of Iran's football team is given in Table 1.

Table 1. Results of descriptive statistics

Components	Groups	N	Percentage
Team	Perspolis	291	36
	Traktor	245	33
	Estehlal	216	29
History of fanatic	Less than 1 year	18	2.4
	2-5	113	15
	6-10	115	15.3
	11-15	142	18.9
	Above than 15 years	363	48.3
Age	18-25	414	55
	26-35	266	35.4
	36-45	58	7.7
	Above than 46	14	1.9
Education	Under diploma	206	27.4
	Diploma	146	19.4
	B.A	171	22.7
	M.A and higher	126	16.8
Following-up All matches	Yes	677	90
	No	45	10
Total attendance in a season	1-3	315	41.9
	4-6	194	25.8
	7-10	72	9.6
	Higher than 10	169	22.5
	total	752	100

As shown in Table 1, the largest number of supporters in the sample relating to Perspolis (36%) and the lowest number is Esteghlal team (29%). In terms of age, the largest number relating to a group of 18-25 year old (55%) and the lowest rate is 46 year old (1.9%); the results show that 48.3% of the fans are higher than 15 year old. About 41.9% of these fans are present in the stadium only 1-3 times during a season. The table also shows %90 of fans follow their favorite team in all games (through media).
The subject's educational level was found:

27.4% diploma (Maximum) and 13.7% under diploma (minimum). Table 2 shows the results of the single- sample t-test. This test has been carried out for assessing the effectiveness of financial supporter activities among fans of the premier football league.

Table 2. Results of single- sample t- test

Team	Average purchase behavior	Average difference	Standard deviation	T	Df	Sig	Lower	Upper
Perspolis	4.097	1.097	0.973	19.234	290	0.001	0.985	1.209
traktor	4.420	1.420	0.897	24.783	244	0.001	1.307	1.532
Estegehlal	4.012	1.012	1.050	14.162	215	0.001	0.871	1.153
Total	4.178	1.78	1.248	32.758	751	0.001	1.107	1.248

Since the scale of research questionnaire was five worth, single – sample t- test, hypothetical mean value of average was considered 3 and the positive and significant difference of this hypothetical mean representing the high- level of selected teams purchasing intention from clubs financial productions (Habibpour & Safari, 2010).

Since the most direct measuring effectiveness of sponsor is the buying intention indicating the effectiveness of financial support. As shown in Table 2, the results of t- test is significant for each selected teams these results indicate the effectiveness of financial support activities in each function Iranian premier football league?

Perspolis (sig= 0.001, t=19.234), Traktor (sig= 0.001, t= 24.783) and Esteglal (sig= 0.001, t=14162).

Also the data of fourth array in Table 2 show that all activities related to Iranian premier league are effective (sig= 0.001, t=32.758). In order to compare the effectiveness of carried financial Support for the selected football teams (Esteglal, Perspolis and Traktor), the one- way ANOVA was used. Given to the variance homogeneity test results (levene test), the inequality of variance assumption was rejected (statistic Leven =2.821, sig=0.06, df2= 749, df1=2), As a result of fist row of Table 1, analysis of variance output was established in Table 3.

Table 3. Results of variance analysis test

Variable	Source of changes	Sum of squares	Df	Mean Sq	F	Sig
Buying production of financial sponsors	Within group	22.216	2	11.108	11.745	0.001
	Between group	70.8.351	749	0.946		
	Total	730.567	751			

According to the results of variance analysis test, the effectives of financial sponsors among the three selected Iranian premier football league (Esteglal, Perspolis and Traktor) has a significance difference. (F=11.745, sig=0.001< 0.05).

If we want to compare the mean of unequal group size, the Scheffe method is the most appropriate in this field (Spss). Because of the inequality of groups size (the number of fanatics) in this research, the Schaffe follow – up test was used to compare two teams together. The result of Scheffe test is given in Table 4.

Table 4. Result of Scheffe test

Team 1	Team 2	Mean difference	Standard error	sig
Traktor	Esteglal	0.408	0.090	0.001
Traktor	Perspolis	0.323	0.084	0.001
Perspolis	Esteglal	0.085	0.087	0.623

According to the results in Table 4, the effectiveness of financial support activities among Traktor and Esteglal football clubs is 0.408 mean difference, (Sig=0.001) and also between two Traktor and Perspolis football teams there is significant difference with 0.323 mean difference, (Sig=0.001). In case of Traktor and Esteglal, Traktor and pespolis, the mean difference is positive representing that the effectiveness of financial support activities in Traktor football club is significantly higher than two other teams. In comparison of financial support activities between Esteglal and Persepolis, there are no observed any significant differences in these teams (Sig=0.623, mean difference= 0.085).

4. Discussion and conclusion

The main purpose of this study was to examine the effectiveness of financial support activities among the fans of Iranian premier football league. The results of descriptive statistic showed that 41.9% of fans attend 1 to 3 times during a season, which is very low' because the attendance of fans increases ticket sales and in the other hand, the number of attendance in the stadiums expose the name and brand of financial sponsors to huge number of people there? (Shalbari et al., 2012). The increasing number of fans causes to increase the effectiveness of financial support activates among sport teams. These descriptive results must be an alert for all managers of clubs because financial supporters hope to increase their consumer's awareness in terms of their productions (Seyyed Ameri, 2010); however, when they feel the lack of any investment in the field of sport is going to be ineffective, they immediately reject their finance in this regard; because again, one of the most important ways of providing sport budget especially sport championship activities refers to the support of companies and private factories (Seyyed Ameri, 2010; Smith et al., 2008). Managers should examine the effective factors of fans participation to be able to increase both the rate of selling tickets as wee; as effectiveness of financial sponsors; in one hand, the descriptive results show that 90% of fans follow their favorite team in all matches (through media). Given to the measurement of multiplying the seconds in viewers of TV relates to the degree of expose (Grohs et al., 2004), what the number of viewers gets high, the degree of expose is also increasing showing the raised effectiveness of financial support activities in this regard. The results of single- sample t- test showing the effectiveness of financial support activities in each selected and fanatic teams of Iranian football league. This finding is matched with the results of Nufer et al (2010), Eshghi (132009) and Gilanina (2010) researches.; of course this finding is also matched with the findings of Sin jin research (2006) in the Lithunian Basketball league, but the related results are not matched with Zalgiris Basketball club; the reason may refer to the differences of two football and basketball fields. Also, it may be due to the Zalgiris weak function in the basketball league. According to the present research findings, it is suggested to all managers of the clubs to aware these financial support activities effectively to all sponsors to make their sponsorship through the related activities and try to increase the expense of their contraction. Based on variance analysis test results, the effectiveness of financial support activities has a significant difference among three selected Iranian football teams. The results of Scheffe follow-up test showed that the effectiveness of financial support activates among Traktor and Esteglal and also Traktor and Perspolis is significant and in two cases the mean difference is positive indicating that the effectiveness of financial support activities in Traktor significantly is higher than two Perspolis and Esteglala football teams. These results are not matched to the finding of Eshghi (2009). Eshghi (2009) in examining the effectiveness of financial support activities among football funs found that the effectiveness of financial support on purchasing intention does not have difference in two Esteglal and Perspolis football teams. The reason for this mismatch may be the Traktor football club has not been studied in Eshghi's research (2009); it is suggested to examine a lot of football clubs to get the more precise results in this field. Traktor football club has a best position in the premier league arrangement table making the team superiorly better effectiveness of financial support activities among two other teams (Perspolis and Esteglal). (This research has been carried on the selected team fans during 2010-2011season). Although it is struggled in the present research to neutralize the research results with collecting questionnaires in different times of performance impact on a team in a special competition (win or lose in a match) and also the number of played competitions (when approaching to the end of- the season and the number of games

increasing, the fans get familiar with brands and logos of team sponsors more and more. The limitations of the research refer to the less number of clubs. It's suggested to all researchers to select the highest number of teams to overcome the present research deficiencies and try to distribute questionnaires in this regard. Also, commenting from financial supports and club managers in the field of financial support activities provide beneficial result in this regard.

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Direct method for solving $1D$ convection-diffusion by block pulse functions with error analysis

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Abstract: In this paper, we introduce new numerical method to deal with convection-diffusion problem.The proposed method is based on two dimensional block pulse functions under the framework of projection method.In this approach, we use operational matrices instead of partial derivatives, thus any PDEs problem is converted to linear or nonlinear system of Algebra. Error analysis for this method are given. Numerical examples demonstrate the efficiency and accuracy of this method.

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1. Introduction

A stochastic process $X(t)$, associated with the convection-diffusion equation obey the stochastic differential equation

$$dX + V(X)dt = \sqrt{2D}dW, \quad (1)$$

where dW is the differential of a wiener process with unit variance. The above stochastic equation can be solved by finite difference method [7]. Although stochastic method do not suffer from the numerical diffusion on grid-based methods, they typically lose accuracy in the vicinity of interfacial boundaries. By Feymann-Kac theorem, equation (1) convert to $1D$-convection-diffusion equation [7]

$$\frac{\partial u}{\partial t} + c\frac{\partial u}{\partial x} = \varepsilon\frac{\partial^2 u}{\partial x^2}, \quad 0 \le x \le 1, t \ge 0 \quad (2)$$

subject to the initial and boundary conditions:

$$\begin{aligned} &u(x,0) = f(x), \quad 0 \le x \le 1, \\ &u(0,t) = g_1(t), \quad t \ge 0, \\ &u(1,t) = g_2(t). \quad t \ge 0. \end{aligned} \quad (3)$$

The convection-diffusion equation is a parabolic partial differential equation combining the diffusion equation and the advection equation, which describes physical phenomena where particles system due to two processes: diffusion and convection.Convection refers to the movement of a substance within a medium (e.g., water or air). Diffusion is the movement of the substance from an area of high concentration to an area of low concentration, resulting in the uniform distributed of the substance[2].

The numerical methods for solving convection-diffusion model have been an active subject of research during the last thirty years [1, 4, 15]. The development of the new techniques which can solve the model still attract substantial attention. Numerical grid-based methods such as the finite element method (FEM) [6, 16], the finite difference method (FDM) [9, 10, 11], the finite element method (FVM) [14] and spectral method [18, 19], were widely applied these last decades and remain most popular. However, the methods suffer from some limitations (difficulties on irregular or complex geometry and on mesh distortion or large deformation problems).This paper led to the development of a methods based on series expansion and piecewise constant functions.

In this paper, we use two dimensional block pulse functions $(2DBPFs)$ to solve convection-diffusion model.By applying $(2DBPFs)$ based on direct method, any PDEs convert to linear or nonlinear system of Algebra. We use operational matrices for partial derivatives. This method is simple and it's applicable for any PDEs.

An outline of the paper is as follows:In section 2, we introduce $2DBPFs$ and their properties.In section 3 we present operational matrices for partial derivatives. Direct method for solving convection-diffusion equation are given in section 4. Error analysis for proposed method are investigated in section 5. Finally, in section 6,we apply the proposed method on some examples showing the accuracy and efficiency of the method.

2. Two dimensional Block-Pulse functions

A set of two dimensional Block-Pulse functions $\Phi_{i_1,i_2}(x,t)(i_1 = 0,1,2,\ldots,m_1-1, i_2 = 0,1,2,\ldots,m_2)$

is defined in the region $x \in [a,b)$ and $t \in [0,T)$ as:

$$\phi_{i_1,i_2}(x,t) = \begin{cases} 1 & (i_1)h_1 \le x < (i_1+1)h_1, (i_2)h_2 \le t < (i_2+1)h_2 \\ 0 & otherwise. \end{cases} \quad (4)$$

where m_1, m_2 are arbitrary positive integers, and $h_1 = \frac{b-a}{m_1}, h_2 = \frac{T}{m_2}$. There are some properties for $2DBPFs$ as following:

The $2DBPFs$ are disjoint, orthogonal and complete set [3,5,12,13].

We can also expand a two variable function $u(x,t)$ into $BPFs$ series:

$$u(x,t) \cong \sum_{i_1=0}^{m_1-1} \sum_{i_2=0}^{m_2-1} u_{i_1,i_2} \phi_{i_1,i_2}(x,t), \quad (5)$$

through determining the block pulse coefficients:

$$u_{i_1,i_2} = \frac{1}{h_1 h_2} \int_{(i_1)h_1}^{(i_1+1)h_1} \int_{(i_2)h_2}^{(i_2+1)h_2} u(x,t)dxdt, \quad (6)$$

Also, for vector forms, consider the m^2 elements of $2DBPFs$

$$\Phi(x,t) = [\phi_{0,0}, \phi_{0,1}, ..., \phi_{0,m-1}, ..., \phi_{m-1,0}, ..., \phi_{m-1,m-1}]^T(x,t). \quad (7)$$

The two important properties of 2DBPF's are given as

(i):

$$\Phi(x,t)\Phi^T(x,t)V = \tilde{V}\Phi(x,t), \quad (8)$$

where V is an m^2 vector and $\tilde{V} = diag(V)$. Moreover, it can be clearly concluded that for every $m^2 \times m^2$ matrix B:

(ii):

$$\Phi^T(x,t)B\Phi(x,t) = \hat{B}^T\Phi(x,t), \quad (9)$$

where $\hat{B}$ is an m^2 column vector with elements equal to the diagonal entries of matrix B. For simplicity, we use $m_1 = m_2 = m$.

Let $D_T = \{(x,t): a < x < b, 0 < t < T\}$, where $-\infty \le a < b \le \infty$, and $\partial_p D_T$ be the parabolic boundary of D_T. If a, b are finite,

$$\partial_p D = \{x = a, x = b, 0 \le t \le T\} \cup \{a \le x \le b, t = 0\},$$

If a, b are infinite,

$$\partial_p D = \{x \in \Re, t = 0\}$$

and

$$L^{2,1}(D_T) = \{u(x,t): u, \frac{\partial u}{\partial x}, \frac{\partial u}{\partial t}, \frac{\partial^2 u}{\partial x^2} \in L^2(D_T)\}. \quad (10)$$

without loss of generality, set $a = 0, b = 1$ and $T = 1$. The inner product $<.,.>$ and norm $\|.\|$ in $L^{2,1}(D_T)$ are defined as follows:

$$<u(x,t), v(x,t)> = \int_0^1 \int_0^1 u(x,t)v(x,t)dxdt, \quad (11)$$

$$\|u(x,t)\| = (\int_0^1 \int_0^1 u^2(x,t)dxdt)^{\frac{1}{2}}. \quad (12)$$

Let P_m be the projection operator defined on $L^{2,1}(D_T) \to \mathbb{B}$, where $\mathbb{B}$ is finite m^2 −dimensional, as:

$$u_m(x,t) = P_m u(x,t) = \sum_{j=0}^{m-1} \sum_{i=0}^{m-1} u_{i,j}\phi_{i,j}(x,t). \quad (13)$$

First, we find an estimation of $\|u - P_m u\|$ for arbitrary $u \in L^{2,1}(D_T)$.

Lemma 1 Let $u(x,t)$ be defined on $L^{2,1}(D_T)$ and P_m be projection operator defined by (13) then

$$\|u - P_m u\| \le \frac{max|u|}{2\sqrt{3}m}, \quad (14)$$

where $\max|u| = \max_{0 \le i,j \le m-1} |u_{ij}|$ for $0 \le i,j \le m-1$.

Proof: The integral $\int_0^t \int_0^1 u_{i,j}\Phi(x,y)dxdy$ is a ramp $\frac{u_{i,j}}{m}(t - \frac{i}{m})$ on the subinterval $[\frac{i}{m}, \frac{i+1}{m}) \times [\frac{j}{m}, \frac{j+1}{m})$ with average value $\frac{u_{i,j}}{2m^2}$.

The error in approximating the ramp by this constant value over the subinterval $[\frac{i}{m}, \frac{i+1}{m}) \times [\frac{j}{m}, \frac{j+1}{m}) = I_{ij}$ is

$$r_{i,j}(s,t) = \frac{u_{i,j}}{2m^2} - \frac{u_{i,j}}{m}(t - \frac{i-1}{m}), \quad (15)$$

hence, using E_{ij} as least square of the error on I_{ij}, we have

$$E_{i,j}^2 = \int_{\frac{j-1}{m}}^{\frac{j}{m}} \int_{\frac{i-1}{m}}^{\frac{i}{m}} (r_{i,j}(s,t))^2 dsdt \le \frac{|u_{i,j}|^2}{12m^3}, \quad (16)$$

$$E_{i,j} \le \frac{\|u_{i,j}\|}{2\sqrt{3}m^{\frac{3}{2}}}, \quad (17)$$

and on the interval D_T we have

$$\|u - P_m u\| = max E_{i,j} \le \frac{max|u|}{2\sqrt{3}m}. \quad (18)$$

Operational matrix for partial derivatives

The expansion of function $u(x,t)$ over D_T with respect to $\phi_{i,j}(x,t), i,j = 0,1,\dots m-1$, can be written as

$$u(x,t) \cong \sum_{i=0}^{m-1}\sum_{j=0}^{m-1} u_{i,j}\phi_{i,j}(x,t) = U^T\Phi = \Phi^T U, \quad (19)$$

Where

$$U = [u_{0,0}, u_{0,1}, \dots, u_{0,m-1}, u_{1,0}, \dots, u_{1,m-1}, \dots, u_{m-1,m-1}]^T,$$
$$\Phi = [\phi_{0,0}, \phi_{0,1}, \dots, \phi_{0,m-1}, \phi_{1,0}, \dots, \phi_{1,m-1}, \dots, \phi_{m-1,m-1}]^T$$

, and

$$\phi_{i,j}(x,t) = \begin{cases} 1 & \frac{i}{m} \le x < \frac{i+1}{m}, \frac{j}{m} \le t < \frac{j+1}{m} \\ 0 & otherwise, \end{cases} \quad (20)$$

$$u_{i,j} = \frac{1}{h^2}\int_{\frac{j}{m}}^{\frac{j+1}{m}}\int_{\frac{i}{m}}^{\frac{i+1}{m}} u(x,t)dxdt. \quad (21)$$

Now, expressing $\int_0^1\int_0^t \phi_{i,j}(s,y)dsdy$, in terms of the $2DBPFs$ as :

$$\int_0^1\int_0^t \phi_{i,j}(s,y)dsdy \cong [0,0,\dots,0,\frac{h^2}{2},h^2,\dots,h^2], \quad (22)$$

in which $\frac{h^2}{2}$, is ith component. Thus

$$\int_0^1\int_0^t \Phi(s,y)dsdy \cong P\Phi(x,t), \quad (23)$$

where P is $m^2 \times m^2$ matrix and is called operational matrix of double integration and can be denoted by $P = \frac{h^2}{2}P_2$, where

$$P_2 = \begin{pmatrix} 1 & 2 & 2 & \dots & 2 \\ 0 & 1 & 2 & \dots & 2 \\ 0 & 0 & 1 & \dots & 2 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \dots & 1 \end{pmatrix}$$

so, the double integral of every function $u(x,t)$ can be approximated by:

$$\int_0^1\int_0^t u(s,y)dsdy \cong \frac{h^2}{2}U^T P_2\Phi(x,t), \quad (25)$$

by similar method $\int_0^1 \Phi_{ij}(s,t)ds$, in terms of $2DBPFs$ as:

$$\int_0^1 \phi_{ij}(s,t)ds \cong [0,0,\dots,h,0,0,\dots,0]^T\Phi(.,.), \quad (26)$$

and

$$\int_0^1 \Phi(s,t)ds \cong hI\Phi(.,.). \quad (27)$$

Now, we compute operational matrix for $\frac{\partial u}{\partial t}$

Lemma 2 Suppose $u \in L^{2,1}(D_T)$ and u is defined on parabolic boundary $\partial_p D_T$ then operational matrix for $\frac{\partial u}{\partial t}$ by 2DBPFs is approximated as:

$$\frac{\partial u(x,t)}{\partial t} \cong (U_t^d)^T\Phi(x,t) \quad (28)$$

that:

$$U_t^d = \frac{2}{h}(U^T - U_f^T\Delta_1)P_2^{-1}, \quad (29)$$

where Δ_1 is the following $m^2 \times m^2$ matrix as:

$$\Delta_1 = \begin{pmatrix} H_{m\times m} & & & \\ & H_{m\times m} & 0 & \\ & & \ddots & \\ 0 & & & H_{m\times m} \end{pmatrix}, \quad (30)$$

with

$$\mathbf{H_{m\times m}} = \begin{pmatrix} 1 & 0 & 0 & \dots & 0 \\ 0 & 0 & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \dots & 0 \end{pmatrix}. \quad (31)$$

that U_f is initial boundary vector of $\partial_p D_T$.

Proof: By applying approximation $\frac{\partial u}{\partial t} \cong (U_t^d)^T\Phi$ in (23) instead of u we have:

$$\int_0^1\int_0^t \frac{\partial u(sy)}{\partial y}dsdy \cong \frac{h^2}{2}(U_t^d)^T P_2\Phi(x,t), \quad (32)$$

and

$$\begin{aligned} &\int_0^1\int_0^t \frac{\partial u(sy)}{\partial y}dsdy = \int_0^1 (u(s,t) - u(s,0))ds \\ &= \int_0^1 (U^T\Phi(s,t) - U_f^T\Phi(s,0))ds \\ &= hU^T I\Phi(x,t) - hU_f^T\Delta_1\Phi(x,t), \end{aligned} \quad (33)$$

from (32) and (33) we can conclude:

$$U_t^d = \frac{2}{h}(U^T - U_f^T\Delta_1)P_2^{-1}. \quad (34)$$

by the same method, operational matrix for $\frac{\partial u}{\partial x}, \frac{\partial^2 u}{\partial x^2}$ are given as follows.

Lemma 3 If $u \in L^{2,1}(D_T)$ and defined in parabolic boundary $\partial_p D_T$ then operational matrix for $\frac{\partial u}{\partial x}$ and $\frac{\partial^2 u}{\partial x^2}$ by 2DBPFs are approximated as:

$$\frac{\partial u}{\partial x} \cong (U_x^d)^T \Phi(x,t), \qquad (35)$$

$$\frac{\partial^2 u}{\partial x^2} \cong (U_{xx}^d)^T \Phi(x,t), \qquad (36)$$

where

$$U_x^d = \frac{1}{h}(U_{g_2}^T \Delta_3 - U_{g_1}^T \Delta_2) P_2^{-1}, \qquad (37)$$

$$U_{xx}^d = \frac{1}{h^2}(U_{g_2}^T \Delta_3 - U_{g_1}^T \Delta_2) P_2^{-1} (\Delta_3 - \Delta_2) P_2^{-1}, \qquad (38)$$

and Δ_2, Δ_3 are the following $m^2 \times m^2$ matrices:

$$\Delta_2 = \begin{pmatrix} I_{m\times m} & 0 & \dots & 0 \\ 0 & 0 & & 0 \\ \vdots & & \ddots & \vdots \\ 0 & \dots & \dots & 0 \end{pmatrix}, \qquad (39)$$

$$\Delta_3 = \begin{pmatrix} 0 & 0 & \dots & 0 \\ 0 & 0 & & 0 \\ \vdots & & \ddots & \vdots \\ 0 & \dots & \dots & I_{m\times m} \end{pmatrix}, \qquad (40)$$

and U_{g_1}, U_{g_2} are boundary vectors of $\partial_p D_T$.

Direct method for solving nonlinear PDEs

The results obtained in previous section are used to introduce a direct efficient and simple method to solve equations $(2)-(3)$. We consider equations $(2)-(3)$ of the form:

$$\frac{\partial u}{\partial t} + c\frac{\partial u}{\partial x} = \varepsilon \frac{\partial^2 u}{\partial x^2}, (x,t) \in D_T \qquad (41)$$

$$\begin{aligned} u(x,0) &= f(x), \\ u(0,t) &= g_1(x), \\ u(1,t) &= g_2(x). \end{aligned} \qquad (42)$$

By substituting the equations (29), (37) and (38) into (41) and using boundary and initial conditions, we obtain a linear system with $u_{i,j}(i,j = 0,1,\dots,m-1)$ as unknowns:

$$(U_t^d)^T - \varepsilon (U_{xx}^d)^T) + c(U_x^d)^T = 0. \qquad (43)$$

Error analysis

Let the problem be of the form

$$\begin{aligned} &\frac{\partial u}{\partial t} + c\frac{\partial u}{\partial x} = \varepsilon \frac{\partial^2 u}{\partial x^2}, (x,t) \in D_T \\ &u(x,0) = f(x), \\ &u(0,t) = g_1(t), \\ &u(1,t) = g_2(t), \end{aligned} \qquad (44)$$

where $f(x)$, $g_1(t)$, $g_2(t)$ belong to $L^2[0,1)$.

By using (13), the discrete approximation of (41) is :

$$\frac{\partial u_m}{\partial t} + c\frac{\partial u_m}{\partial x} = \varepsilon \frac{\partial^2 u_m}{\partial x^2} + e, \qquad (45)$$

where, for each (x,t), $P_m u(x,t)$ belongs to an m^2 −dimensional subspace $\mathbb{B}$.

Theorem 1 Let $u(x,t)$ and $f(x,t)$ be in $L^{2,1}(D_T)$ and $u_m(x,t)$ be approximate solution by 2DBPFs of (13)

$$\begin{aligned} &\frac{\partial u}{\partial t} + \frac{\partial u}{\partial x} = \varepsilon \frac{\partial^2 u}{\partial x^2}, \\ &P_m \frac{\partial u}{\partial t} + cP_m \frac{\partial u}{\partial x} = \varepsilon P_m \frac{\partial^2 u}{\partial x^2} + e, \end{aligned} \qquad (46)$$

then

$$\|e\| \le \frac{1}{2\sqrt{3}m}(\max|\frac{\partial u}{\partial t}| + \varepsilon\max|\frac{\partial^2 u}{\partial x^2}| + c\max|\frac{\partial u}{\partial x}|) \qquad (47)$$

Proof: By using properties of projection operators,

$$e = \frac{\partial u(x,t)}{\partial t} - P_m\frac{\partial u(x,t)}{\partial t} - \varepsilon\left(\frac{\partial^2 u(x,t)}{\partial x^2} - P_m\frac{\partial^2 u(x,t)}{\partial x^2}\right) + c\left(\frac{\partial u(x,t)}{\partial x} - P_m\frac{\partial u(x,t)}{\partial x}\right) \qquad (48)$$

$$\|e\| \le \left\|(I-P_m)\frac{\partial u(x,t)}{\partial t}\right\| + \varepsilon\left\|(I-P_m)\frac{\partial^2 u(x,t)}{\partial x^2}\right\| + c\left\|(I-P_m)\frac{\partial u(x,t)}{\partial x}\right\| \qquad (49)$$

$$\|e\| \le \frac{1}{2\sqrt{3}m}(\max|\frac{\partial u}{\partial t}| + \varepsilon\max|\frac{\partial^2 u}{\partial x^2}| + c\max|\frac{\partial u}{\partial x}|) \qquad (50)$$

$$\|e\| \le \frac{A}{2\sqrt{3}m}$$

where $A = \max|\frac{\partial u}{\partial t}| + \varepsilon\max|\frac{\partial^2 u}{\partial x^2}| + c\max|\frac{\partial u}{\partial x}|$ for $(x,t) \in D_T$, so by hypothesis of the theorem, A is a finite number and $\|e\| = O(\frac{1}{m})$. So, if $m \to \infty$ then $\|e\|$ tends to zero.

Numerical example

We present results of some numerical experiments to illustrate the effectiveness of the proposed method. To this end we choose convection-diffusion equations taken from (Khojasteh Salkuyeh

2006) which are characterized by the fact of having parameter dependent solutions of the form

$$u(x,t) = \exp(\alpha x + \beta t), 0 \le x \le 1, t \ge 0,$$

where α, β are adjusted such that the condition $\varepsilon^2 - c\alpha - \beta = 0$ is satisfied.Initial and boundary conditions are in the case

$$u(x,0) = f(x) = \exp(\alpha x), u(0,t) = \exp(\beta t) = g_1(t), u(1,t) = g_2(t) = \exp(\alpha + \beta t).$$

To show the efficiently of the present method we report absolute error which is defined by

$$e_{ij} = \left\| u(x_i, t_j) - u_m\ (x_i, t_j) \right\|, \quad (51)$$

at the point (x_i, t_j) where $u(x_i, t_j)$ is exact solution and $u_{i,j}$ is numerical solution by 2DBPFs. Error surface are plotted for showing the accuracy for two examples.

Example 1 Parameters defining the problem (2)-(3) and the corresponding solution are

$$c = 3.5, \varepsilon = .022, \alpha = .02854797991928, \beta = -.0999.$$

Example 2 Parameters defining the problem (2)-(3) and the corresponding solution are

$$c = 1, \varepsilon = .09, \alpha = .001, \beta = -.00099.$$

Table 1: Error between exact and numerical solution for example 1 (m=10)

x_i	t_j	Exact solution	Numerical solution	Error
0.0	0.0	9.9279e-1	9.8332e-1	9.4636e-3
0.0	0.2	9.7372e-1	9.6366e-1	9.5508e-3
0.0	0.4	9.5392e-1	9.4455e-1	9.3617e-3
0.4	0.0	1.0072e-0	9.9972e-1	9.9715e-3
0.4	0.2	9.6771e-1	9.7736e-1	9.8724e-3
0.4	0.4	9.6771e-1	9.5803e-1	9.6771e-3
0.7	0.0	1.0158e-0	1.0057e-0	1.0058e-2
0.7	0.2	9.9573e-1	9.8576e-1	9.9573e-3
0.7	0.4	9.7604e-1	9.6627e-1	9.7603e-3

Table 2: Error between exact and numerical solution for example 2 (m=10)

x_i	t_j	Exact solution	Numerical solution	Error
0.0	0.0	1.000e-0	9.9015e-1	9.8050e-3
0.0	0.2	9.9980e-1	9.8989e-1	9.9030e-3
0.0	0.4	9.9660e-1	9.8969e-1	9.9010e-3
0.4	0.0	1.0005e-0	9.9059e-1	9.9050e-3
0.4	0.2	1.0003e-0	9.9030e-1	1.0003e-2
0.4	0.4	1.0001e-0	9.9010e-1	1.0001e-2
0.7	0.0	1.0003e-0	9.9039e-1	9.9080e-3
0.7	0.2	1.0001e-0	9.9010e-1	1.0006e-2
0.7	0.4	9.9991e-1	9.8990e-1	1.0004e-2

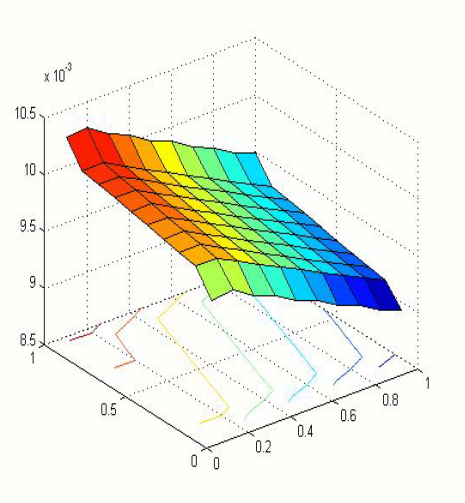

Figure 1: Error surface for example 1

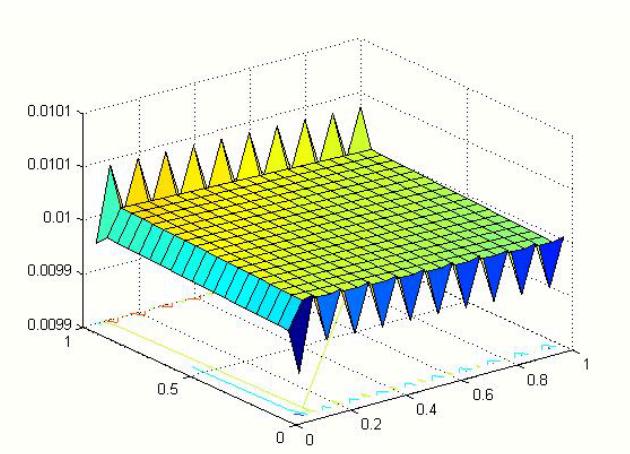

Figure 2 : Error surface for example 2

3. Discussion

In this paper, we introduced a new numerical scheme for convection diffusion equation by two dimension block pulse functions and their operational matrices for partial derivatives. This method can be used for any linear and nonlinear partial differential equations. We can say that this method is feasible and the error is acceptable. the implementation of the present method is a very easy, acceptable and valid. We can use other piecewise constant functions for example Haar, Walsh and wavelets.

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Effect of bicarbonate sodium supplement on skaters' performance

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Abstract: Bicarbonate is the body's most important extracellular buffer. Bicarbonate loading increases the muscle's extracellular buffering capacity and ability to dispose of excess hydrogen ions produced through anaerobic glycolises. The aim of this study was to determine the effect of sodium bicarbonate supplement on skaters' performance in young men. Sixteen skate players in the current study were selected and divided randomly into two groups: sodium bicarbonate (SB) and placebo (P).subject in the SB group orally ingested gelatin capsules that contained sodium bicarbonate at a dose of 300 mg·kg-1 b. w while subject in P group ingested the same osmolar dose of cellulose 60min before 5oom speed trial . Blood samples were obtained before and one hour after consuming supplementation and two min after the 500m skate trial. Blood pH, lactate, standard bicarbonate (SBC) and performance of skaters were measured. The subjects were fast for 12-14h. Results indicated that there were statistically significant difference in Blood lactate and pH at the post exercise state between the placebo and sodium bicarbonate trial ($p < 0.001$). Resting blood concentration of bicarbonate increased following the ingestion of sodium bicarbonate ($p<0.05$) and the result also showed there were statistically significant changes in average skating speed ($p<0.05$). These data demonstrate that pre-exercise administration of NaHCO3 improves performance, possibly by facilitating the efflux of hydrogen ions from working muscles and thereby delaying the fatigue at sprint performance. We recommend ingestion of sodium bicarbonate to enhance sprint performance.
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Key Words: skater, sodium bicarbonate, lactate, speed

1. Introduction

Energy foods are used in order to improve sport beyond a balanced dietary. In most of sports such as intense anaerobic exercise, short term or strengthen long term sports, body strength against exhausting is an important aspect. Athletes who get exhausted in short time cannot act as well as who get exhausted in long time. Therefore sport coaches and athletes seeking a way to improve their function and avoid increased exhausting. Most athletes especially skaters use drugs or materials that they claim these drugs or materials have energetic features and avoid exhausting (MacArdel, 2009). During last decade sodium bicarbonate has been common for avoiding fatigue during intense short term sports such as swimming, speed running and weightlifting and it is claimed that this matter improve function by neutralizing produced acids through training (Adam et al., 2009). Among many types of skate sport, 500m skate is sprint and anaerobic activity which well over 45 seconds needed for its finishing and it is said that in this type of sport and other powerful and strengthening activities, anaerobic glycolysis is the main energy source for muscle contraction that capacity of this system is limited as well as acidity of muscles increased and leads to gathering hydrogen ion inside muscles (MacArdel, 2009; Nielsen, 2003). Blood acidity increase avoids energy transfer and muscle contraction and enforce athlete to reduce intensity of his training (Kalis, 1998; Yunoki, 2000; Zoladz, 2005). There are reasons that using sodium bicarbonate before sport activities beside sever muscle contractions can reduce gathering H+ in skeletal muscle, blood and tissue water and delay exhausting (MacArdel, 2009; Wasserman, 1973; Shave et al., 2001). Benefits of using sodium bicarbonate in anaerobic activities that are 60-240 seconds and ergogenic benefits of using sodium bicarbonate in strengthening and sprint activates can be seen in professional athletes (McNaughton et al., 1992). More studies are done about different times and doses of using sodium bicarbonate in many sport protocols and its ergogenic effects on speed running and semi strengthening, rower, swimming, cycling are studied that function improving of athletes are reported (McNaughton et al., 1992). Nielsen et al. (2002) in studying reducing blood saturation by sodium bicarbonate in maximum training resulted that amount of acidosis is decreased after sodium bicarbonate injection by increase of blood buffering

and result in blood saturation of artery in maximum practice in return (Nielsen, 2002). In a study Fred et al. (2004) studied effect of using sodium bicarbonate on VO_2 kinetics in heavy exercise. Survey samples include 20 athletes that are divided into 2 control and experiment groups. Subjects' training in different days by ergometer in two 6 minutes and consumed 0.3 gram sodium bicarbonate per kilogram weight of body 1 hour before training. Using sodium bicarbonate increase PH significantly in blood before training in complementary group than control group (7.42, 7.51), by increase of blood PH, local flow of blood decreased and directed hemoglobin oxygen to active muscles that have low oxygen. Experiment results showed that oxygen diffusion is a factor during heavy training (Fred et al., 2004). Most of researchers have studied sodium bicarbonate in different doses from 100- 500 mg per each kilogram of body weight and said that sodium bicarbonate complement with doses less than 200mg per each kilogram of body weight change blood bicarbonate but don't improve athlete function and doses more than 300 mg per each kilogram of body weight can't increase alkaloses, then most of researchers propose that sodium bicarbonate usable solution with a dose of 300 mg per each kilogram of body weight is better for improving body weight (Yunoki, 2000). Sodium bicarbonate using time before resistance sport activity from 30-150 minutes is different and may be effect on Alkaloses amount before sport activity. There are other studies that have not seen effect of sodium bicarbonate consumption in improving athletes. In this case Putteiger et al. (1996) considered amount of used sodium bicarbonate in speedy running. Subjects include 9 persons of cyclers that consumed 0.10 gram sodium bicarbonate and 0.20 gram bicarbonate per each kilogram of body weight 1 hour before each test randomly. Practices program include 4 two minute time that done separately. Vein blood samples were gathered before training and in 3, 5, 10, 11 minutes after two minutes sprint training. Results showed that increase of 0/2gr/kg bicarbonate using increase blood bicarbonate but don't improve function of 2 minutes sprint training (Potteiger, 1996). According to some contradictions in researches and because of lack of resemble study on skaters in inside and outside of country, researcher implement this study.

2.Methods

2.1. Subjects

16 healthy 20-24 years old boy skaters will be selected as subjects. Firstly they were announced in different parts of Tabriz sport administrations and presence of researcher in skate mission, coaches and athletes. After announcing readiness and arbitrary participation of skaters, their health and satisfaction were studied by questionnaire completion and 16 skaters among 27 skaters were selected after confirming their health and readiness in order to cooperate with present study and after harmonization through questionnaire and based on their readiness. Then they were equally and randomly divided into two bicarbonate and placebo groups and were ready based on scheduled program in skate mission and implemented 500 m skate trial in a similar time. Subjects' selection parameter was their cardiovascular health, lack of diabetes, having skate training, lack of cigarette using and alcohol and all of stages of work, hardness and probable complications for subjects were explained.

2.2. Blood samples and measuring variables

5cc blood was obtained each time from elbow vein: 1. before complementary consumption, 1.5 hour after complementary consumption and 3.two minutes after 500m skate trial. Blood samples were poured in tubes including heparin and were sent to laboratory for analyzing. In order to measure blood parameters, enzymatic method were used.

2.3. Analytical approach

Firstly after natural assuring of measuring data by using K-S test, data related to any factors of sodium bicarbonate, lactate and blood PH were compared, in three stages including resting, 1hour after complementary using and two minutes after finishing 500m skate trial, using repeated measuring test and if there is difference, LSD test in order to further analyze. Additionally, 500m skate test were compared in two groups using independent T test.

3. Results

The results are shown by Figure 1-4.

4. Discussion

Complementary consumption of soda causes significant increase of blood bicarbonate toward the relaxing state, but it is return to its relaxing amounts after 500 m skate. However, in placebo consumption step, after 500 m skating, blood bicarbonate levels were less than relaxing levels. These foundations may express ergogenic effect due to generating metabolic alkalosis, which may be helpful to improve the application levels by increasing buffering resources. Alkalosis reduction as compared with placebo, avoids the reduction of blood bicarbonate content to less than relaxing levels during extreme exercise. And this case can be appeared in rapid and simpler recovery. This foundation corresponds well with result of last surveys (MacArdel, 2009; MacArdel, 2009; Shave, 2001; Nielsen, 2002; Fred,

2004; Sostaric, 2006). Other results of this survey are like this, there is no difference in relaxing lactate levels pursuant the bicarbonate consumption. Two transitional proteins of band3 and MCT-1, are involved in lactate displacement and acid-base equilibrium establishment in two sides of erythrosine membrane, that are responsible for 5 to 10 and 80 to 90 percent of lactate displacement respectively (Connes, 2004). By the effect of alkalosis, lactate existence amount from active muscle (Hood et al., 1988), but in a survey, increase of lactate blood stream from muscle to blood was observed without any change in lactate accumulation grade. It is suggested that increase of lactate transfer by the effect of increasing ion grade is due to alkalosis induction (Hood et al., 1998; Messonnier et al., 2007). So, by considering that relaxing lactate levels are constant except in pathologic conditions, lack of change in relaxing lactate amount is logical. There is also significant increase in blood lactate levels after doing 500 m skate. However alkalosis couldn't affect the amount of lactate existence to blood, this result is compatible with Cameron et al. (2010) and price et al. (2010) (Price & Simons, 2010; Cameron, 2010).

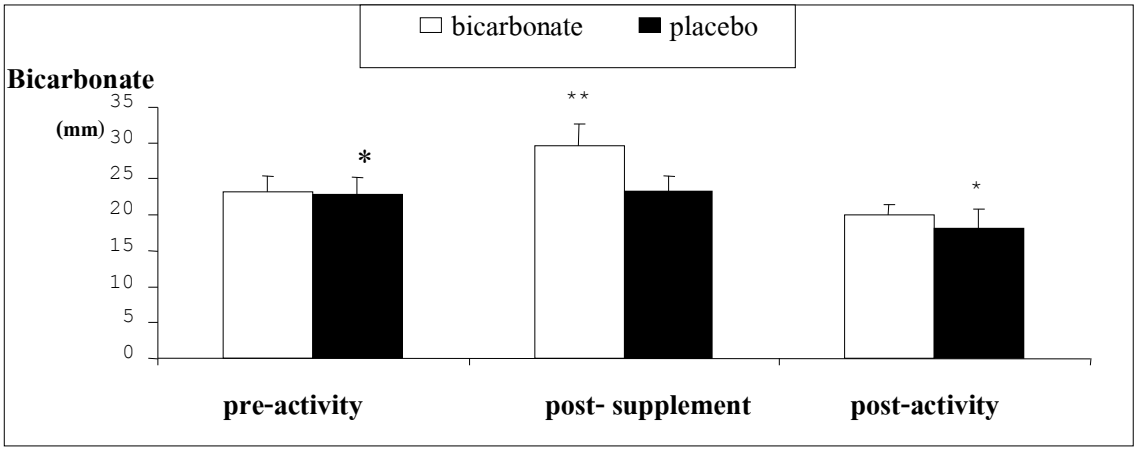

Figure 1: plasma bicarbonate levels diagram in each stage during three times of measurement.
*: Significant difference to pre-experiment and**: Significant difference to post-experiment (P<0.05).

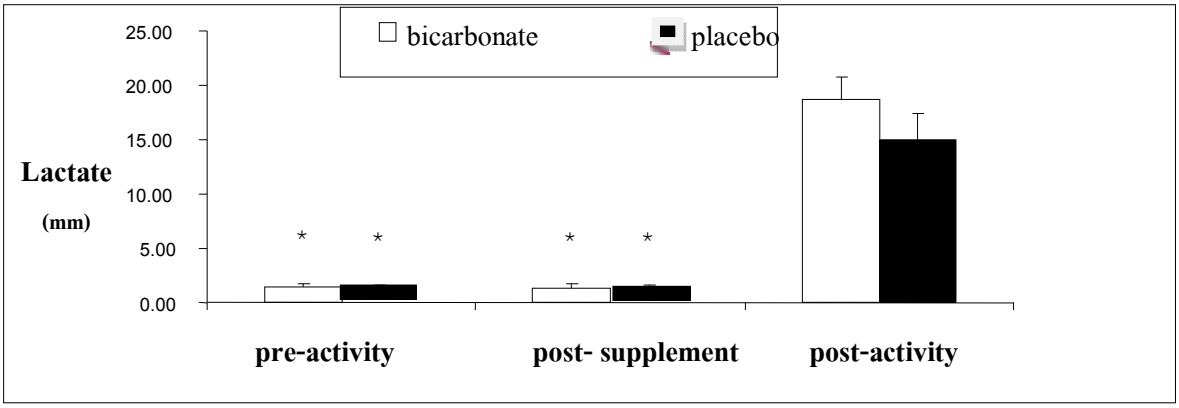

Figure 2. Plasma lactate levels in each stage during three times of measurement.*: Significant difference to post-activity (P<0.05).

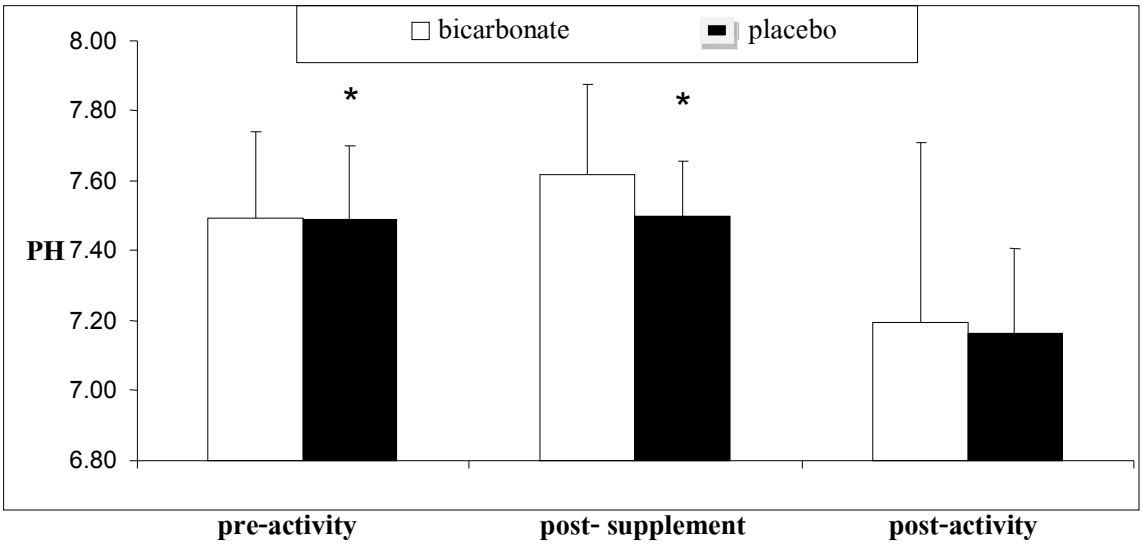

Figure 3. Blood PH level diagram during three times of measurement.*: Significant difference to post-complementary (P<0.05).

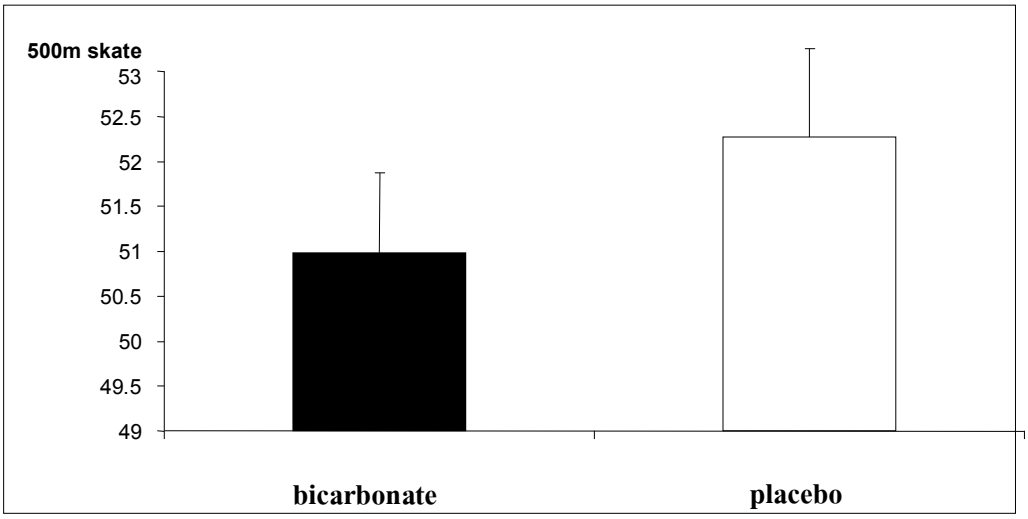

Figure 4. 500 m skate test time in each stage.*Significant difference to bicarbonate stage (P<0.05)

It is imagined that, in the first minutes after exercise, stream H+ existence from muscle to blood, involves more speed than lactate, (Ball & Maughan, 1997) and also it is observed about human that, speed of hydrogen ion stream is more than lactate (Bangsbo et al., 1993). Furthermore, lactate and hydrogen ion absorption by inactive muscles affect the amount of their existence from active muscles. (Bangsbo et al., 1995) There are reports that lactate stream in the direction of extra cellular liquids, are independent of acid and alkalosis conditions in among tissues water, and are usually constant(Ball & Maughan, 1997). So this case could be helpful to justify the lack of difference among groups in blood lactate levels after 500m skate performance.

Also the results demonstrate that blood PH has been decreased in two steps of alkalosis, placebo. But this reduction was significant during placebo step. In another words, alkalosis could modify the blood PH reduction after extreme anaerobic activity. Inducing metabolic alkalosis causes insignificant increase of relaxing PH and controls the anaerobic glycolic that may causes the increase of involving speed of oxidative phosphrylation in the beginning of activity (Ball & Maughan, 1997). Proton and lactate production during maximum exercise is higher than buffer and metabolic capacity of inside the muscle

and its rejection in out of call. So, PH can be decreased up to 6/4 in muscle, and 6/9 in blood (Messonnier et al., 2007). Maybe in this survey, PH and lactate variations don't have the same pattern due high cooperation of glycolic in producing energy of 500m skate. In the last part of result of this survey, skate performance in 500 m skate test is better than placebo consumption step. In this direction, there are a lot of evidences which prove that alkalosis can improve the intense short time activity (Adam et al., 2009; MacArdel, 2009; McNaughton & Cedaro, 1992; Messonnier et al., 2007). Finally, it is concluded that, inducing metabolic alkalosis can has positive effect on short time work out application, and also be helpful to reduce recovery time and to improve extreme exercise ability.

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Surface slope enhances anterior muscles fatigue in lower limb

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Abstract: In this human study, the effect of slopes changes of motion surface on four muscles fatigue of lower limb was investigated by surface electromyography. Zero, 10 and 20 degree slopes of a treadmill with constant speed of 5 km/h were used. Seven mature men were selected. Each man as walked on the treadmill at each slope for five minutes time. Then, muscles signals were recorded before and after walking on treadmill by surface electromyography. Time period of between tests for each person on different slopes of treadmill was 48 hours. It was revealed that between fatigue rate of muscles, at zero degree slope, was not significantly different ($P>0.05$). But, at 10 degree slope, between fatigue rate of Tibialis and others was significantly different ($P<0.05$) and was increased. Also, at 20 degree slope, between fatigue rate of Quadriceps and others was significantly different ($P<0.05$) and was increased too. It is concluded that slope changes of motion surface can increase anterior muscles fatigue of lower limb.

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Keywords: muscle, fatigue, electromyography, lower limb, slope

1. Introduction

Muscles activity has potentially important effects on the muscles fatigue. The results of human studies, suggest that after continuous contractions of less than ultimate limit in Quadriceps, forces generated by electrical stimulation in low frequencies were decreased that, it was determined fatigue with low frequency (Moxham et al., 1982). In affects of excessive practice on electromyography signal, concluded that average of fatigue rate was 8.6% and there was not significantly different in EMG amplitude and achieved significantly decrease in average of power frequency at more than 30 seconds range (Huner et al., 2003). Increase of muscles fatigue shift spectral model to low frequency (Sadoyama et al., 1981). Thus far, the effect of slope changes of motion surface on muscles fatigue of lower limb is not clear. Therefore, the results of the effect of muscles activity in cases reported in the literature regarding muscles fatigue may not be directly applicable to slope changes of motion surface. In this study, we investigated the effect of different slopes of motion surface on the muscles fatigue of lower limb.

2. Methods

Seven mature men, ageing 20-23 years old, height 170-180 cm and weighting 65-75 kg were chosen. In this study, selected muscles were Tibialis, Gastrocnemius, Quadriceps and Hamstring. The same athletic shoes for tests were used for all men (Roy et al., 2010; Kumer et al. 2003). Thus, two surface leads were used for each connection so as the distance between metal ports of leads was 2 cm. Before tests, ventricular location of each muscle was accorded to anatomical surface for each man. Then, the desired parts of ventricular muscles was completely shaved and cleaned by alcohol. Before and after tests, weight, height, blood pressure and body temperature of all men was recorded. It was emphasized that the men have not been any sport activity before the tests. Also, before starting the test, each man was seated on a chair to relax for five minutes. A standard wireless EMG system (Bluemyo, Germany) was used to record signals. EMG system's specifications were set to 8 input channels, input signal rate of ±5 V, channel amplification of 0.4- 50 v/v, sampling frequency of 1000 Hz per channel and wireless interface of Bluetooth class II. After the treadmill speed was

fixed on 5 km/h and the leads were connected to EMG, the first, each man was walked four steps and was stood in still position on the ground. Thus, muscles signals were recorded and saved. These signals were known as primary signals to muscles in rest position without fatigue. Then, each man was started walking on the treadmill at zero degree slope for five minutes. After that, immediately, the person was walked four steps and was stood in still position on the ground. Thus, muscles signals were recorded and saved. The same trend for each person at 10 and 20 degree slopes were repeated. Time period of between tests for each person on different slopes of treadmill was 48 hours. Obtained signals with 1000 Hz frequency were recorded and seventy Butterworth filter was used for removing noise from signals. In this research, mean frequency was used to display muscles fatigue (Xu et al., 1998). Mean value and standard deviation of measured mean frequency were computed in each slopes. Paired-samples T- test was performed to compare the means of the outcome measures in rest and stress position (SPSS, Ver. 18).

3. Results

The results showed that the anterior muscles were fatigued compared with the posterior muscles of lower limb. Statistical analysis on mean of mean frequency in Gastrocnemius and Hamstring showed that, between before and after walking on treadmill were not statistically different at different slopes ($P>0.05$). However, Difference between before and after walking treadmill in Quadriceps at zero and 10 degree slopes were not significant ($P>0.05$), but, at 20 degree slope was significant and decreased ($P<0.05$). However, no significant difference were found between before and after walking on treadmill in Tibialis at zero and 20 degree slopes ($P>0.05$), but, at 10 degree slope was significant and decreased ($P<0.05$). These data are presented in figure. The positive effect of slope on rate of fatigue in lower limb muscles at motion on treadmill was shown. This was concluded based on the results from an experimental study on human model. The effect of motion on muscles fatigue has long been under investigation. Motion and exercise cause muscles fatigue from different ways such as summation of Lactate and decreasing blood oxygen rate (Dengler et al., 1998). In EMG studies, muscles fatigue has shown by mean frequency of recorded signals (Hangbo et al., 2003). However, in these researches, the relation between slope of motion surface and muscle fatigue was not showed. In this study, results revealed that, mean of mean frequency decrease in anterior muscles of lower limb by increasing slope. But, the outcome decrease in Quadriceps at 20 degree slope and in Tibials at 10 degree slope and rise to significant differences between before and after walking on treadmill. Thus, we may conclude that, slope increases, increase fatigue rates in anterior muscles of lower limb. This may indicate that, at 10 degree slope, Tibialis does much more contraction, to do heel strike of stance phase. Also, at 20 degree slope, person bends his trunk forward for balance. So, it change body center of gravity site and it cause to change the path of force transmission from lower limb. At this time, Quadriceps endures much more pressure. Thus, it causes Quadriceps fatigue. The results of this study revealed a considerable effect of different slope on muscles fatigue by surface electromyography on human model. Similar positive effects have been reported in the literature at different position. The results from a study on males muscle fatigue in middle-distance running showed the fatigue measured by EMG, at maximal effort both pre and post time trial is more related to sprint performance than endurance performance (Nummela et al., 2009). Furthermore, ITO Akihiko et al., showed to increase muscles fatigue in lower limb during running by electromyography and suggested relation between running figure and muscles fatigue (Akihiko et al., 2003).

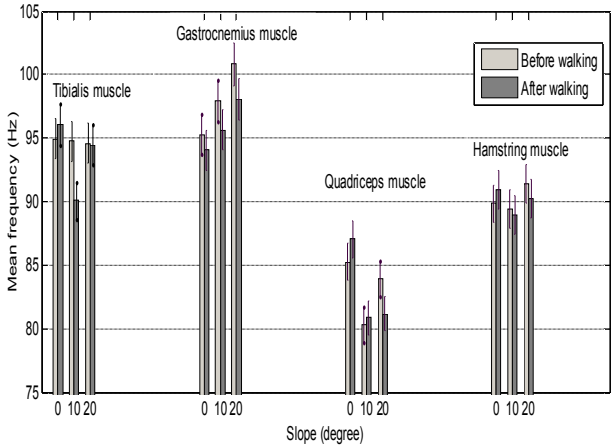

Figure: Mean and Standard deviation of mean frequency in before and after walking on treadmill at zero, 10 and 20 degree slopes in Tibialis, Gastrocnemius, Quadriceps and Hamstring muscles

4. Discussions

The effect of slope of surface on the lower limb muscles fatigue in human model was studied. It was found that slope changes can enhance fatigue rates in anterior muscles of lower limb and also, surface electromyography can record it.

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Comparing Impactof Two Types of The Exercising Preparation Programs On Indices of The Body Composition And Muscular Injuries Biomarkers Among Soccer Slayers

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Abstract: The purpose of this study was to compare the specific physiological effects of general preparation phases on the injured muscle blood biomarkers in elite soccer players before the competition. Thus, 22 elite football players have participated in this study. During this study in two stages, the blood sample collection was done before and after the general preparation phase, then before of the competition and the pre-seasonal matches. The collected data were studied by using the statisticalmethod of correlated *t* test at significance level of 0.05 ($\alpha = 0.05$). Results showed that there was no significant reduction in amount of the musculoskeletal masses of football players before and after of the various trainings phases (general and specific exercise ahead of the matches); and, there was indeed a significant reduction in amount of the bodymass values after different training phases than before the general preparation phase. In addition, there was a significant increasesin CPK values before and after the different training phases among the soccer players. And finally; there was a significant increases in LDH values before and after the different training phases in among the soccer players.
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Key words: Biomarkers of the injured muscle; Rhabdomyolysis*;* Cretin kinas ,Musculoskeletal structural injuries

1. Introduction

Previous studies have proven that heavy, unusual and high volume sportive activities may lead to the musculoskeletal structural injuries (Clarkson et al,19912). These injuries may appear as muscle pain, swelling, weakness and loss of power (Sayers et al,2010). In structure terms, sportiveactivities cause weakening the Sarcomer and Sarcolemma to rupture which result to the intracellular proteins reduction and to increase specifically concentration of Cretin kinas (CPK) and lactate dehydrogenase (LDH) in the blood stream; also where damage is extensive, it causes the muscle tissue necrosis and even Rhabdomyolysis (proske,2001 & magal,2010). Recently, Epstein et al. have showed that there is a strong relationship between the anaerobic exercises and the serum level of Cretin kinas after exercises (Epstein et al,2006). The soccer is anaerobic exercise. On the other hand, the conducted exercises during various phases in this field are at high risk of infection to such damages, due to tiny muscle injuries.

2. Methodology

In this study, 22 elite soccer with the age characteristics of 26.42 ±0.81 years, body weight of 76.18 ±1.93 kg, musculoskeletalmass of 38.30 ±0.99, the aerobic fitness level of 45.4 ±0.83 milliliters of oxygen consumption per kilogram of body weight, BMI ($kg.m^{-2}$): 23.4 ±0.3, and the exercise experiences of 10.5 years, have participated. During this two- staged study, the blood samples were taken before and after the general preparation phase and before the seasonal matches.

The study protocol had been developed based on non-linear period grading model, during which the individuals had to perform different exercises according to the training phases from 5 to 8 sessions per week. So the patterns of weekly exercise (micro cycle) were codified for 5 to 8 sessions per week. Accordingly, during the general preparation phase, the exercise volume would have been high, and as getting close to the competition phase, it would have proportionally lowered with higher density; in such a way that the highest micro cycle shock during the pre match phase (meso cycle) in the whole season of preparation training (micro cycle) would have been assigned to it.

3. Results

Results showed that there was no significant reduction in amount of musculoskeletal mass (t20=-0.264, p=0.794), before and after different training phases (general and specific fitness and ahead of the competition); and there was a significant reduction of the body mass values after different phases of exercises compared to the pre-phase values of general preparation phase (t20=2.91, p=0.009). Furthermore;

there was a significant increases in CPK value before and after various training phases (t20=-35.47, p=0.000); and finally, there was a significant increases in LDH value before and after various training phases (t20=-39.00, p=0.000).

Table 1.values of body composition and serum levels of the soccer players' CPK and LDH before and after phases of general and specific training,
and ahead of the competition.

Variable	Average		Standard deviation from average		t-Values	Level Of sig
	Before training phase	After training phase	Before training phase	After training phase		
Weight(Kg)	76.18	74.18	1.94	1.96	9.28	0.000*
Musculoskeletal mass (Kg)	38.30	38.41	0.99	1.14	-0.26	0.794*
Fat mass(Kg)	9.52	7.67	0.47	0.46	29.01	0.000*
Body mass profile ($Kg.m^{-2}$)	23.40	23.18	0.3	0.299	2.94	0.000*
Cretin kinas (IU/L) (CPK)	156.79	215.94	23.73	30.74	-4.1	0.001*
lactate dehydrogenase (U/L) (LDH)	227.39	318.95	9.98	10.19	-79.79	0.001*

* level of significance in $p < 0.05$

4. Discussion

According to this research's findings, it is clear that soccer players who perform different exercises during the various training phases (general and specific preparation before the competition) would have likely encountered the problems of tiny muscle injuries. Accordingly, the enzyme levels of CPK and LDH were also significantly increased which expresses/suggests that there is a damageto tiny muscle at the sarcomeres' location. Additionally; the amount of musculoskeletal mass of the elite soccer players had been significantly reduced which can be involved in incidence of muscle injuries. Siejo et al have described so when exercise intensity is proportional to the person's natural metabolism, the muscle tissue continues its activity function without significant changes in membrane permeability. However; when exercise intensity is increasing, the ATP production capacity would face disorders, and the created changes cause an increase of the membrane permeability which results to increase the CPK and LDH serums' activities (Seijo et al,1985).
The results showed that sportive activities, especially the various exercising phases lead to increase levels of the Cretin kinas and lactate dehydrogenase serums, so these biomarkers are indication of the muscle injuries. Thus; these findings may indicate that the incidence rate of musculoskeletal injuries among team players specially soccer players are high, that could be an indication of more pressure on the players regardless of the same exercise intensity. Also, a relatively longer preparation period of soccer players is an effective factor ion this phenomenon.

Consequently;thefootball coaches are recommended, especially the body building instructors who work in various leagues, to proportionate the activities Intensity and exercises of these athletes tailored to their ability level. And, since this tiny muscle injury has occurred in phases before entering athletic competitions, thus they are expected to provide powerful and all-round soccer players' entry into the competition, by adapting an appropriate recovery measures.

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Study on serum Leptin level of children with Asthma

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Abstract: Based on epidemiological studies, incidence of asthma and obesity is rising in parallel and the obesity is associated with severe asthma and its poor medical treatment response. The changes in immune system function by means of some mediators like Leptin is effective in coincidence asthma and obesity. The aim of this study was evaluation of Leptin levels in children with asthma and its relation with treatment and the affected children's Body mass index (BMI). In a cross sectional descriptive analytic study in pediatric disease department of Tabriz university of medical sciences, we evaluated the serum level of Leptin in children with asthma. The Leptin level in patients with asthma was 29.60 ± 29.25 and in control group was 6.34 ± 6.52 respectively which was significantly higher in the case group (P<0.001). Serum level of Leptin in patients with periodic asthma was 9.26 ± 10.90 and in patients with persistent asthma was 36.74 ± 30.38 that Serum level of Leptin was significantly higher in patients with persistent asthma than periodic asthma (P<0.001) and also Serum level of Leptin in patients with severed persistent asthma was 46.97 ± 33.88 that significantly higher (P<0.001). Mean of serum level of Leptin in patient's with good response to treatment was 9.26 ± 10.90, in patient's with moderate response to treatment was 22.74 ± 21.12 and in patient's with poor response to treatment 40.01 ± 29.25 that significantly higher in patient's poor response to treatment(P=0.004). In patients with asthma, a significant positive liner correlation was found between Serum level of Leptin with age, height, weight, weight Percentile-for-age and BMI. In patients of control group, a significant positive liner correlation was found between Serum level of Leptin with weight, Weight Percentile-for-age, BMI, BMI Percentile-for-age and BMI z-score-for-age.
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Keywords: Asthma, Leptin; Body mass index (BMI); Response to Treatment

1. Introduction

Based on epidemiological studies, incidence of asthma and obesity is rising in parallel (Ford, 2005) and the obesity is associated with severe asthma and its poor medical treatment response (Taylor, 2008).

The cause of coincidence of asthma with obesity is not defined exactly but the possible mechanisms included; life style with low mobility, nutritional factors, hormonal factors, systemic inflammation and reduced respiratory capacity due to obesity, insulin resistance, and Gastroesophageal reflux. The changes in immune system function by means of some mediators like Leptin is effective in coincidence asthma and obesity (Jartti, 2009).

Leptin is made by the adipose tissue cells and their serum level is associated with BMI and the thickness of skin folds especially in women. Leptin affects on production of different neuropathies by means of hypothalamus axis and this also affects energy production and consumption and neuroendocrine function, in the other hand Leptin is a modulator of the immune system and is a proinflammatory state in the body.

Leptin causes to increase in production of TNF-α and IL-6 by adipose tissue cells and amplifies the T – Helper cells and has a role in asthma pathogenesis by this mechanism.

The association of Leptin and asthma have been evaluated in several studies, in a cross sectional study by Asood and colleague, it was found that the increased Leptin levels are associated with an increased incidence of asthma in women (Sood, 2006).

Camargo and colleague have shown that there is higher risk for asthma in 4 upcoming years in women who gain weight after the age of 18(Castro-Rodríguez, 2007) and there is no significant relation between asthma incidence and the used calorie and physical activity (Camargo, 1999).

Rodriguez and colleagues stated that overweight and obesity increase the risk of asthma in females from 6 to 11 years old up to 7 times (Castro-Rodríguez, 2001).

Mai and colleagues stated that the level of Leptin in overweight children with asthma is two times more than children with asthma with normal weight (Mai, 2004).

Culer and colleagues investigated the role of Leptin in childhood asthma, and stated that a Leptin level in children with asthma is high and there is not

a relationship between serum Leptin and obesity in these children (Guler, 2004).

With regard to the fact that asthma and its recurrent attacks has a psychological and economic burden on the family and the serum levels of Leptin plays a role in childhood asthma and its response to medical treatment and the serum levels of Leptin is not measured in children with asthma yet, we designed a study to evaluate the Leptin levels of children with asthma and its relation with treatment and the affected children's BMI.

2. Material and Methods

In a cross sectional descriptive analytic study in pediatric disease department of Tabriz university of medical sciences, we evaluated the serum level of Leptin in children with asthma.

With simple sampling method, we studied all the children with asthma referring to pulmonology clinic of Tabriz children's hospital or Tabriz Azadi clinic after achieving the inclusion and exclusion criterias.

The inclusion criterias include:

1-Age below 12 yrs

2-At least 1 year from the time of diagnosis

3- No other underlying disease

4- Lack of acute infection within past 2 weeks

6 - Having a high BMI more than 5 percentiles of age and gender.

7 - Not receiving other drugs (except anti asthma drugs) in the last 6 months

Children with above criteria were enrolled to the study with informed consent

We enrolled 50 children to the study with asthma after achieving inclusion and exclusion criterias as the case group and a group of 50 healthy children who were selected by age and Sex matched without acute and chronic inflammatory diseases or infections that had no drug using history as control group. Accurate measurements of weight and height are done by Seca stadiometer.

After an overnight fasting (at least 8 hours), venous blood samples obtained from patients with Low-speed centrifugation serum was isolated in the laboratory and was freezes at -70 degrees Celsius in Eppendrof vials .Measurement of Serum Leptin was done with ELISA method using LDN Leptin ELISA Kits.

The number of asthma attacks and asthma severity was determined based on GINA 2008 protocol.

NCHS standard curves were used for converting height and weight to standard Deviation Score (SDS). The BMI percentile in the case and control group was also defined with regard to the age and sex BMI percentiles.

Statistical analysis:

All data were analyzed using descriptive and deductive statistics methods by SPSS Ver. 15. The relation between qualitative data was evaluated using Chi-square test. And the relation between quality and quantity data were evaluated using T-test, ANOVA tests and the relation between the variables were evaluated using Pearson and Spearman correlation coefficient. $P< 0.05$ was considered meaningful.

Table 1. Demographics parameter of patients between two groups

		Group		
		Case	Control	
Gender	Male	31	31	1
	Female	19	19	
Age		66.70 ± 33.05	65.44 ± 33.26	0.850
Height		112.74 ± 18.23	112.09 ± 18.60	0.860
Height Percentile-for-age		56.29 ±31.89	56.74 ± 32.51	0.944
Height z-score-for-age		0.27 ± 1.15	0.26 ± 1.24	0.985
Weight		26.05 ± 12.16	25.43 ± 11.26	0.791
Weight Percentile-for-age		79.75 ± 23.79	79.15 ± 24.39	0.904
Weight z-score-for-age		1.57 ± 1.61	1.59 ± 1.79	0.942
BMI		19.54 ± 4.39	19.45 ± 4.33	0.917
BMI Percentile-for-age		80.50 ± 24.79	80.88 ± 25.84	0.940
BMI z-score-for-age		1.89 ± 1.87	1.96 ± 2.05	0.855

Table 2. Evaluation of age, height, weight and BMI based on response to treatment in patients with asthma

	Response to treatment			P
	Good	Moderate	Poor	
Age	65.38 ± 32.49	86.14 ±41.32	62.73 ± 30.78	0.241
Height	111.00 ± 16.30	119.07 ± 21.11	112.02 ± 18.64	0.613
Height Percentile-for-age	53.45 ± 25.36	42.16 ± 36.05	60.81 ± 33.32	0.361
Height z-score-for-age	0.14 ± 0.83	-0.32 ± 1.32	0.46 ± 1.21	0.246
Weight	21.92 ± 10.16	33.79 ± 18.84	26.04 ± 10.56	0.114
Weight Percentile-for-age	64.79 ± 25.21	66.34 ± 32.36	88.26 ± 17.52	0.004
Weight z-score-for-age	0.67 ± 1.24	1.08 ± 1.94	2.03 ± 1.55	0.033
BMI	17.14 ± 3.89	21.79 ± 6.01	20.05 ± 3.85	0.044
BMI Percentile-for-age	61.20 ± 25.08	88.03 ± 17.93	87.11 ± 22.05	0.003
BMI z-score-for-age	0.68 ± 1.52	2.14 ± 1.55	2.36 ± 1.89	0.022

Table 3. Birth weight, Mother age at labor and Onset of asthma BMI based on response to treatment in patients with asthma

	Response to treatment			P
	Good	Moderate	Poor	
Birth weight	3.12 ± 0.49	3.07 ± 0.33	3.24 ± 0.43	0.510
Mother age at labor	27.23 ± 5.07	23.29 ± 4.35	24.30 ± 4.70	0.122
Onset of asthma	45.43 ± 18.20	45.86 ± 35.44	38.33 ± 30.85	0.687

3. Results

We studied the serum levels of Leptin in 50 Asthmatic patients with 50 healthy patients as control group. The two groups were matched for age, gender, weight and height. The demographic findings of both groups are shown in the table 1. Thirty one of patients in each group were male and 19 of them were female (P=1).

Mean age of patient's with asthma was 66.70 ± 33.05 month and in control group was 65.44 ± 33.26 month (P=0.850).

The Leptin level in patients with asthma was 29.60 ± 29.25 and in control group was 6.34 ± 6.52

respectively which was significantly higher in the case group(P<0.001) (Figure 1).

The family history of asthma was positive in 58% and 2% of asthmatic and non asthmatic patients, respectively that positive family history of asthma was significantly more in case group(P<0.001).

Evaluations of studied parameter based on response to treatment in patients with asthma were shown in tables 2 and 3.

Serum Leptin level of patients with asthma based on multi drug usage were shown in table 4. The demographic findings of both groups based on patient's gender are shown in the table 5.

Thirteen of asthmatic patients had periodic asthma and 37 of then had persistent asthma that of 37 patients with persistent asthma, 2 patients had mild persistent asthma, 13 patients had moderate asthma and 22 patients had severed persistent asthma. Serum level of Leptin based on asthma type was shown in figure 2 and serum level of Leptin in patients with periodic asthma was 9.26 ± 10.90 and in patients with persistent asthma was 36.74 ± 30.38 that Serum level of Leptin was significantly higher in patients with persistent asthma than periodic asthma (P<0.001) and also Serum level of Leptin in patients with severed persistent asthma was 46.97 ± 33.88 that significantly higher (P<0.001).

In patients with asthma, a significant positive liner correlation was found between Serum level of Leptin with age (P=0.025 and R=0.317), height (P=0.006 and R=0.380), weight (P=0.003 and R=0.4127), Weight Percentile-for-age (P=0.007 and R=0.393) and BMI (P=0.033 and R=0.302).

In patient's of control group, a significant positive liner correlation was found between Serum level of Leptin with weight (P=0.015 and R=0.344), Weight Percentile-for-age(P=0.017 and R=0.350) ,BMI(P=0.004 and R=0.398), BMI Percentile-for-age(P=0.016 and R=0.338) and BMI z-score-for-age(P=0.005 and R=0.391).

Mean of serum level of Leptin in patient's with good response to treatment was 9.26 ± 10.90, in patient's with moderate response to treatment was 22.74 ± 21.12 and in patient's with poor response to treatment 40.01 ± 29.25 that significantly higher in patient's poor response to treatment (P=0.004) (Figure 2).

4. Discussions

Obesity leads to more severe asthma symptoms in children (Yuksel, 2012). Asthma is linked with obesity in adults, but our results do not support a significant role for Leptin, adiponectin or any other obesity-related biomarker studied in this association (Jartti, 2009). The prevalence of asthma and obesity is increasing concomitantly (Jartti, 2009). The prevalence of asthma and obesity is increasing concomitantly, but many aspects of this link are unclear (Jartti, 2009).

Obesity is suggested as a risk factor for asthma, but the mechanisms are unclear (Mai, 2004). Obesity is not a factor in the ability to control asthma (Kwong, 2006). Adiposity is associated with poorer asthma control in female subjects. Adiponectin is associated with improved asthma control in male subjects (Kattan, 2010).

Table 4. Serum Leptin level of patients with asthma based on multi drug usage

		Leptin level	P
Ketotifen	Yes	116.40	0.002
	No	27.83 ± 26.71	
Theophylline	Yes	116.40	0.002
	No	27.83 ± 26.71	
cromolyn sodium Spray	Yes	89.80 ± 37.62	0.002
	No	27.10 ± 26.48	
Salbutamol Spray	Yes	27.63 ± 26.95	0.018
	No	76.95 ± 55.79	
Flixotide Spray	Yes	24.55 ± 20.55	0.202
	No	36.04 ± 37.09	
Serevent Spray	Yes	32.28 ± 33.69	0.781
	No	29.10 ± 28.76	
Hydrocortisone	Yes	39.10	0.747
	No	29.41 ± 29.52	
Atrovent Spray	Yes	28.64 ± 32.59	0.882
	No	29.94 ± 28.46	
Montelucaste	Yes	0.30	0.317
	No	30.20 ± 29.24	
Ventolin	Yes	32.30	0.927
	No	29.55 ± 29.55	

Obesity leads to more severe asthma symptoms in children. Moreover, Leptin, adiponectin, and ghrelin may play important roles in the inflammatory pathogenesis of asthma and obesity co-morbidity (Jartti, 2009). Moreover, Leptin, adiponectin, and ghrelin may play important roles in the inflammatory pathogenesis of asthma and obesity co-morbidity (Yuksel, 2012).

Leptin is an obesity gene product secreted by white adipose tissue; elevated serum levels are found in obese adults and children. Recently, Leptin has also been found to be associated with allergic rhinitis (AR) (Quek, 2010). Leptin might be involved in the pathogenesis of asthma in the overweight children, and IFN-gamma might be a pathway in the process of leptin-induced inflammation (Mai, 2004).

Leptin could aggravate airway inflammation featured by infiltration of neutrophils and enhancement of Th1 type inflammation (Cao, 2009). Leptin, via proliferation and activation of Th2 cells, may induce inflammation in asthma. It has also been demonstrated that Leptin mRNA expression and protein levels increase in response to inflammatory stimuli (Szczepankiewicz, 2009).

Table 5. Evaluation of parameter based patient's gender in each group

	Group					
	Case			Control		
	Male	Female	P	Male	Female	P
Leptin	30.16 ± 25.33	28.69 ± 35.48	0.865	6.47 ± 6.42	6.13 ± 6.87	0.882
Age(*month*)	70.45 ± 35.34	60.58 ± 28.78	0.310	67.68 ± 35.99	61.79 ± 28.81	0.549
Height	114.32 ± 17.72	110.16 ± 19.22	0.439	113.06 ± 19.09	110.50 ± 18.17	0.641
Height Percentile-for-age	55.79 ± 30.95	57.09 ± 34.21	0.891	55.65 ± 31.99	58.52 ± 34.14	0.765
Height z-score-for-age	0.18 ± 1.07	0.41 ± 1.28	0.501	0.20 ± 1.26	0.36 ± 1.24	0.667
weight	27.78 ± 12.18	23.24 ± 11.90	0.203	27.61 ± 12.20	21.88 ± 8.68	0.080
Weight Percentile-for-age	84.07 ± 21.82	73.63 ± 25.67	0.145	82.20 ± 24.76	74.81 ± 23.84	0.317
Weight z-score-for-age	1.92 ± 1.72	1.06 ± 1.32	0.073	2.10 ± 2.07	0.87 ± 0.93	0.009
BMI	20.45 ± 4.51	18.06 ± 3.87	0.061	20.75 ± 4.59	17.33 ± 2.90	0.002
BMI Percentile-for-age	85.37 ± 23.21	72.55 ± 25.85	0.076	85.19 ± 24.98	73.86 ± 26.35	0.134
BMI z-score-for-age	2.38 ± 1.99	1.10 ± 1.35	0.017	2.61 ± 2.25	0.91 ± 1.07	0.001
Birth weight	3.24 ± 0.44	3.10 ± 0.41	0.260	3.21 ± 0.44	3.07 ± 0.52	0.355

Levels of the adipocyte-derived hormones Leptin and adiponectin are significantly correlated with bronchial hyperresponsiveness (BHR) induced by exercise challenge in children with asthma (Baek, 2011). Szczepankiewicz and colleague demonstrate that increased serum Leptin levels have been observed in asthmatic patients (Szczepankiewicz, 2009). Guler and colleague demonstrate that A significant difference was observed in serum Leptin levels between asthmatic and healthy children (Guler, 2004).

In our study, serum Leptin level in patients with asthma was 29.60 ± 29.25 and in control group was 6.34 ± 6.52 and serum Leptin level in patients with asthma was significantly higher than healthy patients.

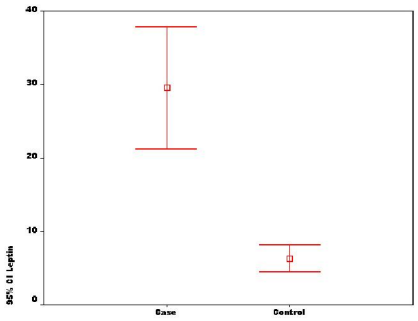

Figure 1. Distribution of serum Leptin level in both groups

Tanju and colleague show that Leptin levels correlated with the clinical severity of asthma and this was suggested to be associated with the severity of inflammation in asthma (Tanju, 2011). Data of Erel and colleague study demonstrate that the serum levels of Leptin and lipid profiles on allergic rhinitis and mild asthma were not different than those in controls (Erel, 2007).

In our study, Serum level of Leptin was significantly higher in patients with persistent asthma than periodic asthma (P<0.001) and also Serum level of Leptin in patients with severed persistent asthma was 46.97±33.88 that significantly higher (P<0.001).

Szczepankiewicz show that polymorphisms of the Leptin gene may be associated with asthma and higher BMI in asthmatic patients (Szczepankiewicz, 2009).

In our study and in patients with asthma, a significant positive liner correlation was found between Serum level of Leptin with weight (P=0.003 and R=0.4127), Weight Percentile-for-age (P=0.007 and R=0.393) and BMI (P=0.033 and R=0.302).

Guler and et al show that there was no significant sex difference in serum Leptin levels among asthmatic children, whereas healthy boys had significantly lower Leptin levels than healthy girls (P=.019) (Guler, 2004).

In my study significant difference was not found in Serum level of Leptin by patient gender in patients with and without asthma.

The results of Quek and colleague study indicate that a higher serum Leptin level has stronger association with mild-to-moderate persistent asthma compared with allergic rhinitis. Hence, serum Leptin may be a stronger predictor for childhood asthma compared with allergic rhinitis. Among the asthmatic children, higher serum Leptin levels also showed stronger associations with female gender and being overweight (Quek, 2010).

In our study, Serum level of Leptin significantly higher in patient's poor response to treatment and severed persistent asthma.

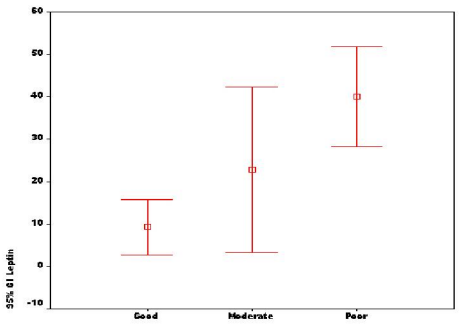

Figure 2. Distribution of serum Leptin level based on response to treatment in patient's with asthma

Conclusion

The Leptin level in patients with asthma was 29.60 ± 29.25 and in control group was 6.34 ± 6.52 and significantly higher in patients with asthma. Serum level of Leptin in patients with periodic asthma was 9.26 ± 10.90 and in patients with persistent asthma was 36.74 ± 30.38 that Serum level of Leptin was significantly higher in patients with persistent asthma and also significantly higher in patients with severed persistent asthma. Serum level of Leptin was significantly higher in patients with poor response to treatment.

In patients with asthma, a significant positive liner correlation was found between Serum level of Leptin with age, height, weight, weight Percentile-for-age and BMI.

In patients of control group, a significant positive liner correlation was found between Serum level of Leptin with weight, Weight Percentile-for-age, BMI, BMI Percentile-for-age and BMI z-score-for-age.

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Predictive value of biophysical profile in determining the immediate postpartum neonatal outcomes in preterm premature rupture of membranes (PPROM)

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Abstract: Evaluating predictive value of BPP and Non-stress test (NST) in determining immediate postpartum neonatal outcomes in PPROM patients. In an analytic-descriptive study on 156 PPROM singleton pregnancies at gestational age of 34-37 weeks in Al-Zahra Center, Tabriz, during a 13-month period, BPP and NST were conducted on all patients before pregnancy termination. ABG analysis was conducted in all newborns, categorizing them into two groups: normal or abnormal (acidosis or alkalosis). Abnormal BPP was considered as total score ≤6. Predictive value of BPP and NST was evaluated accordingly. In predicting immediate postpartum neonatal outcome based on ABG results, sensitivity, specificity, positive/negative predictive values, and accuracy of BPP was 52.9%, 91.1%, 62.1%, 87.4% and 81.1%, respectively. There was a significant positive correlation between total BPP score and Apgar scores on minutes 1, 3 and 5. In the same circumstances, sensitivity, specificity, positive predictive/negative predictive values, and accuracy of NST was 50%, 89.3%, 56.7%, 86.5% and 80.8%, respectively. Mean Apgar scores on minutes 1, 3 and 5 were significantly higher in cases with reactive NST result. Based on our results, although there was a significant relationship between fetal outcome of mothers with PPROM, and BPP and NST results, these two modalities may not be efficient in predicting final fetal outcome due to low sensitivity.
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Keywords: Premature Rupture of Fetal Membranes; Newborn; Outcome Assessment

1. Introduction

Premature Rupture of Membranes (PROM) is a condition in which the curtains are torn at any time before the beginning of labor contractions. If this occurs before 37 weeks of pregnancy, it is defined as preterm PROM (PPROM) (Martin, 2005). In such situation, 85% of neonatal morbidity and mortality is due to prematurity. PPROM is associated with 30 to 40 percent of preterm deliveries and known as the main detectable factor of this condition. Other factors threatening the fetus in PROM or PPROM include infection, torn placenta, fetal distress, deformity, pulmonary hyperplasia and death. Fetal death is observed in 1% of followed up expectant PROM cases (Mercer, 1998).

When PPROM occurs far after the term, the rate of maternal and neonatal morbidity and mortality significantly increase. Therefore, careful medical care in women with PPROM is of great importance (Kirpalani, 2006).

Biophysical profile (BPP) is a non-invasive method to assess the health of the fetus before birth. In this method, the possibility of asphyxia and risk of fetal death are investigated (Manning, 1999).
Evaluation of PPROM patients using BPP has been mostly performed for predicting the risk of maternal or fetal infection; yet, there is no unanimity about the efficacy of this method for this purpose (Del Valle, 1992; Lewis, 1999; Vintzileos, 1987; Miller, 1990; Devoe, 1994; Hovick, 1989; Romero Arauz, 2005).
Few studies have addressed the relationship between PPROM and BPP, according to which, contradictory results have been reported (Vintzileos, 1985; Ghidini, 2000; Vintzileos, 1986).

Regarding this fact, and given the importance of early prediction of neonatal outcome in PPROM pregnancies using a noninvasive test, we intended to evaluate the efficacy of BPP in predicting the outcome of such pregnancies.

2. Material and Methods

In a descriptive - analytical study, 156 pregnant women with preterm premature rupture of membranes (PPROM) were studied.

Non-stress Test (NST) and Biophysical Profile (BPP) and their value in predicting pregnancy outcome were determined in these patients. Place of research was Al-Zahra medical training of Tabriz. Study duration was 13 months from October 22, 2008 to November 21, 2009 and basic data collection and data analysis has been done.

Ratio estimation formula was used to determine the sample size. Given $\alpha = 0.05$, $d=0.04$ and $p=5\%$ and the study power of 80%, the number of patients were estimated to be 150.

Mothers were selected using numbers randomly generated by a computer (simple random sampling). In this study, 156 women with singleton pregnancies, gestational age of 37-34 weeks and confirmed PPROM were studied.

Immediately before the decision to terminate the pregnancy, biophysical profile (BPP) and non-stress test (NST) was done in all women; and after the termination of pregnancy, Umbilical Cord ABG was determined for all infants.

In this study, Abnormal BPP is considered as profile ≤ 6/10. According to the results of ABG of umbilical cord, infants were divided into two groups of normal and abnormal (with acidosis or alkalosis). Predictive value of the BPP and NST were separately calculated in this field. The correlation between infants' Apgar score and BPP score was also determined. Predictive value of the BPP and NST in the prognosis during hospitalization of infants was determined.

Exclusion criteria included a history of systemic diseases such as hypertension, diabetes mellitus, cardiac or renal diseases and connective tissue, fetal abnormality and intrauterine growth retardation (IUGR), any signs of infection such as fever, maternal and fetal tachycardia, pain and abdominal allergy, and symptoms of placental abruption including vaginal bleeding and abdominal pain and having active labor and discretion of fetal meconium. All women were included in this study signing a written consent.

No additional costs were charged on the people under study. For people with mental disabilities and those who were not able to read and sign the consent form, two first-degree relatives were assigned to fill the consent form.

This study has been approved by the Ethics Committee of Tabriz University of Medical Sciences. The issues studied included gestational age, overall score of biophysical profile (BPP), non-stress test (NST) result, birth weight, first minute Apgar score, third minute Apgar score, fifth minute Apgar score, the arterial blood gas (ABG) analysis result, and pregnancy outcome. The obtained data is expressed as Mean ± SD, frequency and percentage.

Statistical software used is SPSS™ ver.15. To compare quantitative data, Independent samples T-test or Mann-Whitney U-test were used. To compare qualitative data, Chi-square test or Fisher's exact test was used. Distribution of quantitative data was evaluated using Kolmogorov–Smirnov Z test. Spearman coefficient (rho) was calculated to determine the correlation. In all cases, $p \leq 0.05$ is considered significant. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of the tests are determined based on the following relationships.

3. Results

156 pregnancies with preterm premature rupture of membranes (PPROM) were studied. The mean gestational age was 35.5 ± 0.8 (34-37) weeks and the mean overall score of biophysical profile (BPP) was 7.5 ± 1.9 (2-10).

Accordingly, BPP score in 56 (35.9%) was about 8 to 10, in 71 (45.5%) cases was 6 to 8 and in 29 (18.5%) of cases was 6 or less.

The result of non-stress test (NST) was normal (reactive) in 126 (80.8) and abnormal (non-reactive) in 71 (45.5) cases. Mean birth weight was 2358.8 ± 284.8 (1959-2876) g, mean first minute Apgar score was 1.7 ± 1.8 (3-10), mean third minute Apgar score was 7.9 ± 1.6 (3-10) and mean fifth minute Apgar score was 8.8 ± 1.3 (2-10). According to the results of arterial blood gas (ABG) analysis, 122 (78.2) cases were normal and 34 (21.8) cases were abnormal. Accordingly, the cases with abnormal ABG Included: metabolic acidosis: 16 (47.1%) cases, metabolic alkalosis: 6 (17.6%) cases, respiratory acidosis: 7 (20.6%), and mixed disorder: 5 (14.7%) cases. All infants were discharged.

The relationship between infant's ABG and NST: Frequency percentage of cases with non-reactive NST was significantly higher in the group with abnormal ABG (50% vs. 10.7%;P<0.001 , OR=8.4)(Table I)

The relationship between infant's ABG and BPP: Frequency percentage of cases with BPP≤6 was significantly higher in the group with abnormal ABG (52.9% vs. 9%; P<0.001)(Table II).

The relationship between infant's Apgar score and ABG: The mean Apgar score of infants regarding their ABG condition is summarized in Table 1. Accordingly, the mean Apgar scores at minutes 1, 3 and 5 were significantly higher in the group with normal ABG(table III).

The relationship between NST and BPP: Frequency percentage of cases with BPP≤6 was significantly higher in the group with non-reactive NST (43.3% vs. 12.7%; P<0.001)(Table IV).

The relationship between NST and the Apgar score: The mean Apgar score of infants regarding their NST condition is summarized in Table 2. Accordingly, the mean Apgar scores at minutes 1, 3 and 5 were significantly higher in the group with reactive NST(Table V).

The relationship between BPP and the Apgar score: A moderate and significant positive correlation was observed between Apgar scores of minutes 1 (rho=0.371, P<0.001), 3 (rho=0.349, P<0.001), and 5 (rho=0.305, P<0.001).

Determining the predictive value of NST based on infant's ABG, sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 50, 89.3, 56.7, 86.5 and 80.8 percent respectively. Determining the predictive value of BPP based on infant's ABG, sensitivity, specificity, positive predictive value, negative predictive value and accuracy were 52.9, 91.1, 62.1, 87.4 and 81.1 percent respectively.

Table I: Result of ABG at the base of NST results

ABG	NST		*P-value*	*OR*
	Reactive	Non Reactive		
Normal	109(89.3%)	13(10.7%)	<0.001	8.39
Abnormal	17(50%)	17(50%)		

Table II: Result of ABG at the base of BPP results

ABG	BPP			*P-value*
	≤ 6	6-8	8-10	
Normal	11(9%)	59(47.5%)	53(43.5%)	<0.001
Abnormal	18(53%)	13(38.2%)	3(8.8%)	

Table III results of neonatal Apgar at minute 1, 3 and 5 at the bale ABG results

Apgar	ABG		*P-value*
	Normal	Abnormal	
Minute 1	7.9 ± 1.0	4.2 ± 0.8	<0.001
Minute 3	8.5 ± 1.0	5.7 ± 1.0	<0.001
Minute 5	9.3 ± 0.8	6.9 ± 1.3	<0.001

Table IV: NST results at the base of BPP

NST	BPP			*P-value*
	8-10	6-8	≤ 6	
Reactive	16(12.7%)	59(46.8%)	51(40.5%)	<0.001
Non Reactive	13(43.3%)	12(40%)	5(16.7%)	

Table V: Results of neonatal Apgar at minute 1, 3 and 5 at the base of NST results

Apgar	NST		*P-value*
	Reactive	Non Reactive	
Minute 1	7.4 ± 1.7	4.2 ± 0.8	<0.001
Minute 3	8.2 ± 1.5	7.0 ± 1.7	0.001
Minute 5	9.0 ± 1.1	8.0 ± 1.8	0.003

4. Discussions

In this study, the predictive value of biophysical profile (BPP) and non-stress test (NST) was examined in determining the immediate after birth consequences in pregnancies with preterm premature rupture of membranes (PPROM).

Frequency percentage of cases with abnormal umbilical cord ABG in the group with BPP≤6 and abnormal NST group was significantly higher than that in the group with BPP>6 and normal NST group.

Also, a moderate significant correlation was observed between overall BPP score and Apgar score at minutes 1, 3 and 5. Mean Apgar scores at minutes 1, 3 and 5 in the group with normal NST were also significantly higher than those in the group with abnormal NST.

Finally, sensitivity, specificity, positive predictive value, negative predictive value and accuracy predicting the immediate after birth consequences in PPROM pregnancies based on ABG results of umbilical cord were calculated 52.9, 91.1, 62.1, 87.4 and 81.1 percent respectively for BPP; and 50, 89.3, 56.7, 86.5 and 80.8 percent respectively for NST.

Although numerous studies have been done in this area, most studies have only examined the results in PROM pregnancies. On the other hand, the congenital or neonatal consequences have been limited to infection only. In this regard, based on the results, the related studies can be divided into two general categories:

A) Studies introducing BPP and NST to be useful in this situation and recommending them:

Vintzileo et al (1987) in a study on 13 PPROM cases showed that frequency percentage of cases with worse neonatal or maternal prognosis is higher in the group with abnormal BPP and NST (Vintzileos, 1987).

Hovick et al (1989) in another study showed that BPP can improve Apgar score and prevent infection predicting the fetal condition (Hovick, 1989).

Fleming et al (1991) in another study have recommended using BPP to follow up the cases with PPROM (Fleming, 1991).

Roussis et al (1991) in a study have studied 99 PPROM cases. Sensitivity and specificity of NST predicting neonatal infection or chorioamnionitis were reported 75% and 95% respectively(Roussis, 1991).

Accordingly, using BPP and NST to predict the risk of infection in these patients has been recommended (Leeman, 1996).

In the study by Arauz et al (2005), 75 patients with gestational age of 27-33 weeks with PROM were studied(Romero Arauz, 2005).

All cases were under conservative treatment. In this study, it was shown that the prevalence of infection in cases with BPP≤6 was significantly higher than that in other groups.

Sensitivity, specificity, positive predictive value and negative predictive value of BPP predicting pre-birth infection, were reported 80, 85, 64 and 85 percent respectively (Hannah, 2000).

B) Studies not recommending BPP and NST in this situation:

Gauthier et al (1992) in a study on 111 PPROM cases showed that, although cases with chorioamnionitis are significantly more in the group with abnormal BPP and non-reactive NST, none of them possess the sensitivity and specificity sufficient to predict the situation and therefore, should not be considered for this purpose (Gauthier, 1992).

Del Valle et al (1992) in another study investigated the cases with prolonged PPROM. In this study, there was no significant correlation between chorioamnionitis or fetal infection and abnormal BPP (≤6) or non-reactive NST. Finally, it was concluded that none of the two tests have the needed efficiency in this group of patients (Del Valle, 1992).

Devoe et al (1994) in a study on 50 PPROM cases showed that the sensitivity of BPP is low predicting the neonatal outcome (Devoe, 1994).

In another study, Carroll et al (1995) studied 89 patients with PPROM. This study showed that intrauterine infection can lead to lower BPP score and non reactive NST; however, regarding low predictive value of these tests, none have been recommended (Carroll, 1995).

In a study by Lewis et al (1999), 135 patients with PPROM were studied. In this study, BPP≤6 was considered abnormal. Sensitivity, specificity, positive predictive value and negative predictive value in predicting neonatal complications were reported 39.1, 84.6, 52.9 and 75.9 percent respectively for BPP, and 25, 92.6, 66.7 and 68.4 percent respectively for NST (Lewis, 1999).

Ghidini et al (2000) in another study on 166 PPROM cases showed that there is no significant relationship between the BPP score and incidence of acute infection, and this test is not recommended (Ghidini, 2000).

According to the results by the studies mentioned, it seems that our findings are more consistent with the results of the second category, which means that although the abnormal results of BPP and NST infants have been associated with worse neonatal prognosis, use of these two modalities is not a reliable predictor of neonatal outcome.

Should be noted that the studies mentioned in the first category either were some old reviews, or they had low sample size. More modern methods of support for pregnant mothers and infants after birth may have made the results by new studies distinct from previous studies (Vintzileos, 1987; Hovick, 1989; Leeman, 1996; MacDonald, 2005).

In the study by Arauz et al (2005), only patients with PROM have been studied and this led to improved results, and generally, prognosis (Romero Arauz, 2005).

Bobby et al (2003) compared the two tests in this regard and concluded that despite NST is a simple method, it has high false positive cases. In this study, the sensitivity of BPP has been reported higher than that of NST (Bobby, 2003).

In our study as well, the sensitivity of NST and BPP has been the main weak point of the two tests predicting neonatal outcome. Accordingly, these two tests are not recommended to predict the neonatal prognosis in these cases, although they may be helpful for follow-up and control.

Conclusion

Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of biophysical profile predicting immediate after birth consequences in pregnancies with preterm premature rupture of membranes based on ABG results of umbilical cord were 52.9, 91.1, 62.1, 87.4 and 81.1 percent respectively.

There was a direct and significant relationship between overall biophysical profile score and Apgar scores at minutes 1, 3 and 5 of this group of infants. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of NST predicting immediate after birth consequences in pregnancies with preterm premature rupture of membranes based on ABG of umbilical cord were 50, 89.3, 56.7, 86.5 and 80.8 percent respectively.

The mean Apgar scores at minutes 1, 3 and 5 were significantly higher in the group with a reactive NST.

Suggestions

According to the results of the present study, sensitivity of biophysical profile and non-stress test predicting immediate after birth consequences in pregnancies with preterm premature rupture of membranes based on ABG results of umbilical cord is low.

Therefore, the use of these two tests is not recommended in these groups of patients and for this purpose.

However, due to the relationship between the neonatal prognosis and the results of BPP and NST, the use of these two tests is helpful and still recommended for monitoring the patients and following up the condition of fetus.

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Study on prevalence of Helicobacter pylori infection in adolescents with failure to thrive to compare with control group

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Abstract: About 20-80% of the world population is infected with Helicobacter pylori (HP) infection in developing countries can be acquired at an early age, and this may lead to chronic diarrhea, malnutrition and growth retardation. The aim of this study was evaluating the prevalence of HP infection in the students of Tabriz which was in the age range of 13 to 15 yrs old and its correlation with physical growth factors. In a cross sectional and descriptive analytical study in Pediatric medicine department of Tabriz University of medical sciences on students in the age range of 13 to 15 yrs old in Tabriz we evaluated the prevalence of HP infection and its correlation with physical growth factors. Of 806 adolescents, 386 of them were male and 420 of then were female. The mean age of the boys was 175.87 ± 4.72 months and girls was 175.32 ± 4.51 months (P=0.095). The stool HP antigen was positive in 35.2% of adolescents with a mean level of 0.65±0.48.The HP stool antigen level was 0.70±0.49 in the adolescents with low socioeconomic and 0.55±0.42 in adolescents with high socioeconomic group (P<0.001). There was a negative reverse linear correlation between the level of income and HP stool antigen titers (P<0.001, R=-0.129). The HP stool antigen is higher in patients with lower socioeconomic level. There was a negative reverse linear correlation between the HP stool antigen titers and adolescent's, Height Percentile-for-age, Height z-score-for-age, Weight (*K gr*), Weight Percentile-for-age, Weight z-score-for-age, BMI ،BMI Percentile-for-age and BMI z-score-for-age, but there was not a meaningful linear correlation between the HP stool antigen titer and age of the adolescents.

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Keywords: Helicobacter pylori Stool antigen; adolescent; Height; Weight; BMI

1. Introduction

Helicobacter pylorus is a spiral gram-negative bacillus that causes gastritis, peptic ulcer and gastric carcinoma and has a role in etiology of MALT type lymphoma and has been identified as carcinogenic by the WHO (Tsar, 2006).

About 20-80% of the world population is infected with Helicobacter pylori (HP) infection in developing countries can be acquired at an early age, and this may lead to chronic diarrhea, malnutrition and growth retardation (Tsar, 2006).

Perri and colleague have stated that infection with Helicobacter pylori can cause malnutrition by releasing the certain cytokines and beside all of these Helicobacter pylori infection can cause growth deficiency like all other chronic diseases (Perri, 1997).

Protein exertioning enteropathies, gastroenteritis, malnutrition and iron deficiency anemia have been reported in children with Helicobacter pylori infection (Perri, 1997).

Perri and colleagues studied 216 children in the range of 2–14 years which Helicobacter pylori infection was confirmed in them by Urea Breath Test (UBT) they concluded that Helicobacter pylori infection is more prevalent in large families and is more common in lower socioeconomic levels and is associated with impaired growth (Perri, 1997).

Kuipers and his colleagues stated that there is a meaningful correlation between high titers of anti-Helicobacter pylori IgG antibody and height growth retardation (Kuipers, 1993).

Tatsuguchi and his colleague had stated that there is a reverse correlation between Gherlin levels and the severity of gastritis caused by Helicobacter pylori, this can cause loss of appetite and physical growth retardations in children(Tatsuguchi, 2004).

In the other site the infection with Helicobacter pylori may cause impaired physical growth by causing the impaired absorption of trace elements (i.e Iron,Vit B12,Vit C, Vit A, Vit E, folate, Zinc and selenium) (Cardenas, 2006).

With considering the high and global prevalence of Helicobacter pylori infection which affects more than 50 % of world population and since this infection is majorly asymptomatic. We designed a study for evaluating the prevalence of Helicobacter pylori infection in the students of Tabriz which was

in the age range of 13 to 15 yrs old and its correlation with physical growth factors.

2. Material and Methods

In a cross sectional and descriptive analytical study in Pediatric medicine department of Tabriz University of medical sciences on students in the age range of 13 to 15 yrs old in Tabriz we evaluated the prevalence of Helicobacter pylori infection and its correlation with physical growth factors.

With cluster sampling we enrolled 806 students between 13 to 15 yrs old who have referred to Tabriz health centers for assessment of student health plan in 2010 after achieving the inclusion criterias and obtaining informed consent.

Inclusion criteria include:

1- No known history of growth hormone deficiency.
2- No history of underlying, acute and chronic disease.
3- No history of using of antibiotics in recent 4 weeks.

After achieving the inclusion criteria we studied the students and the required information such as age, weight, parent's familial relation, parental education, and family income level, the milk supply in the first 2 years of life and during the first 2 years life was gathered. Accurate measurements of height and weight were performed with Seca stadiometer.

Adolescent's height and weight percentiles were determined with NCHS curves. Stool specimens obtained and were examined with ACON Helicobacter pylori stool ELISA Kit for the presence or absence of Helicobacter pylori.

Adolescents who the infection with HP was diagnosed for them were treated appropriately by the researcher.

Statistical analysis:

All data were analyzed using descriptive and deductive statistics methods by SPSS Ver. 15. The relation between qualitative data was evaluated using Chi-square test. And the relation between quality and quantity data were evaluated using T-test, ANOVA tests and the relation between the variables were evaluated using Pearson and Spearman correlation coefficient. P< 0.05 was considered meaningful.

3. Results

We studied 806 adolescents in the age range of 13 -15 yrs old in Tabriz that 386 of them were male and 420 of then were female.

The mean age of the boys was 175.87 ± 4.72 months and the mean age of the girls was 175.32 ± 4.51 which there was not significant difference between the mean ages in two gender(P=0.095).

The stool Helicobacter pylori antigen was positive in 284(35.2%) of adolescents with a mean level of 0.65±0.48. the Helicobacter pylori antigen levels is shown upon gender in figure 1.

Table 1. Demographic finding of patients based on gender

	Gender		P
	Male	Female	
Age(*month*)	175.87 ± 4.72	175.32 ± 4.51	0.095
Height(*cm*)	170.40 ± 6.38	163.30 ± 4.55	<0.001
Height Percentile-for-age	60.45 ± 25.36	59.02 ± 21.59	0.393
Height z-score-for-age	0.34 ± 0.85	0.29 ± 0.68	0.277
Weight(*K gr*)	61.01 ± 11.37	56.71 ± 9.14	<0.001
Weight Percentile-for-age	62.61 ± 27.24	63.71 ± 25.25	0.554
Weight z-score-for-age	0.43 ± 0.92	0.43 ± 0.80	0.979
BMI	20.88 ± 3.18	21.28 ± 3.14	0.076
BMI Percentile-for-age	57.67 ± 28.65	60.41 ± 26.70	0.160
BMI z-score-for-age	0.21 ± 10.00	0.30 ± 0.87	0.146

Table 2. Demographic finding of patients based on HP stool antigen titer

	HP stool antigen titer		P
	Positive	Negative	
Age(*month*)	175.74 ± 4.75	175.49 ± 4.54	0.465
Height(*cm*)	163.45 ± 5.82	168.47 ± 6.24	<0.001
Height Percentile-for-age	49.47 ± 23.99	65.27 ± 21.21	<0.001
Height z-score-for-age	-0.02 ± 0.76	0.49 ± 0.71	<0.001
Weight(*K gr*)	48.43 ± 4.38	64.39 ± 8.33	<0.001
Weight Percentile-for-age	38.78 ± 22.24	76.46 ± 17.08	<0.001
Weight z-score-for-age	-0.32 ± 0.71	0.83 ± 0.63	<0.001
BMI	18.72 ± 2.32	22.37 ± 2.80	<0.001
BMI Percentile-for-age	34.59 ± 24.17	72.43 ± 18.97	<0.001
BMI z-score-for-age	-0.53 ± 0.88	0.68 ± 0.65	<00.001

The Helicobacter pylori stool antigen level was 0.70±0.49 in the adolescents with low socioeconomic and 0.55±0.42 in adolescents with high socioeconomic group respectively which was significantly higher in low socio-economic levels(P<0.001).

Table 3. History of infection and treatment for infection in parents, Abdominal pain, Anorexia and Diarrhea based on gender

	Gender		P
	Male	Female	
History of infection in parents	13	23	0.148
History of treatment for infection in parents	11	20	0.158
Abdominal pains	14	35	0.005
Anorexia	16	23	0.379
Diarrhea	4	4	0.590

There was a negative reverse linear correlation between the level of income and Helicobacter pylori stool antigen titers(P<0.001 ,R=-0.129).

There was a negative reverse linear correlation between the Helicobacter pylori stool antigen titers and adolescent's, Height Percentile-for-age, Height z-score-for-age, Weight(*K gr*), Weight Percentile-for-age, Weight z-score-for-age, BMI ،BMI Percentile-

for-age and BMI z-score-for-age, but there was not a meaningful linear correlation between the Helicobacter pylori stool antigen titer and age of the adolescents.

The demographic findings of adolescents is shown in table 1 ,the mean weight an height in boys was significantly higher than those of girls but there was not significant difference in Age ،Height Percentile-for-age، Height z-score-for-age، Weight Percentile-for-age ، Weight z-score-for-age ، BMI ، BMI Percentile-for-age و BMI z-score-for-age between boys and girls.

The demographic findings of adolescents upon their stool antigen levels is shown in table 2 .this indicates that the demographic parameters of adolescents other than age was significantly lower in adolescents with positive Helicobacter pylori antigen.

History of infection in parents, History of treatment for infection in parents, Abdominal pains, Anorexia and Diarrhea upon age and gender is shown in tables 3 and 4 respectively. These findings indicate that, except Abdominal pains that significantly high in female patients, there is not significant difference in other parameters between two genders of adolescents whereas these parameters are different between Helicobacter pylori antigen positive group and Helicobacter pylori antigen negative group.

The demographic findings are shown in tables 5 and 6 based on parents education levels and based on, History of treatment for infection in parents, Abdominal pains, Anorexia, Diarrhea and History of infection in parents in tables 7 and 8 respectively that indicates that the growth rate of adolescents with positive symptoms are worse than those of adolescents with negative symptoms.

The Helicobacter pylori stool antigen levels is shown in figure 2 based on incomes and socioeconomic level and shows that the Helicobacter pylori stool antigen is higher in patients with lower socioeconomic level.

Table 4. History of infection and treatment for infection in parents, Abdominal pain, Anorexia and Diarrhea based on HP stool antigen titer

	HP stool antigen titer		P
	Positive	Negative	
History of infection in parents	23	13	<0.001
History of treatment for infection in parents	19	12	0.002
Abdominal pains	46	3	<0.001
Anorexia	37	2	<0.001
Diarrhea	7	1	0.002

4. Discussions

Helicobacter pylori infection is probably the most common bacterial infection in the world (Czinn, 2005). Approximately 50% of the world population is infected with Helicobacter pylori, with the highest prevalence rates in developing countries (Czinn, 2005). These are conditions which usually occur in adult life. However, Helicobacter pylori are an infection which is mainly acquired in childhood (Rowland and Drumm, 1998).

Helicobacter pylori was significantly linked to duodenal ulcer and gastric ulcers in the age group of 10-16 years, but not in the age group of 9 years and under (Kato, 2004).

The age at which children are most likely to become infected is still unclear, but findings in a number of cross-sectional studies suggest that infection is acquired before the age of five (Rowland, 1999). Helicobacter pylori infection in pregnant women may affect fetal intrauterine growth (Eslick, 2002).

Helicobacter pylori infection was linked to age, sex and deprived socioeconomic environments, and was more frequent in children with recurrent abdominal pain and in those whose parents suffered from gastro duodenal disease (Leandro, 2005).

Zhang et al showed that, the prevalence of Helicobacter pylori infection varies by geographic locations (Zhang, 2009).

Rowland et al demonstrated that the overall prevalence of Helicobacter pylori in children is 10% in developed countries but can be as high as 30-40% in children from lower socio-economic groups (Rowland and Drumm, 1998).

In our study, positivity rate of helicobacter pylori infection in the adolescents under study was 35.2% which had a significant inverse relationship with economic level of the family.

The prevalence of infection is highest in children in the developing world where up to 75% of children may be infected by the age of 10(Rowland, 1999).

The prevalence of helicobacter pylori infection in our study was similar to the results of the above mentioned studies.

Chong et al indicate that screening for the serum IgG antibody to Helicobacter pylori is a practical method for diagnosing Helicobacter pylori infection in children, and that serial measurements of the Helicobacter pylori IgG antibody are useful for monitoring treatment of Helicobacter pylori because of its high sensitivity and ease of performance (Chong, 1995).

The HpSA is an accurate test for the detection of Helicobacter pylori infection in all age groups of children (Kato, 2003).

Table 5. Demographic finding of patients based on father Education level

	Education level						P
	1	2	3	4	5	6	
Age(*month*)	176.02 ± 4.86	175.39 ± 4.49	175.80 ± 4.44	174.39 ± 4.06	176.44 ± 4.03	171.00 ± 1.41	0.037
Height	166.52 ± 6.25	166.96 ± 6.85	166.36 ± 5.99	166.20 ± 6.78	169.63 ± 6.64	164.75 ± 4.60	0.450
Height Percentile-for-age	59.27 ± 23.11	60.01 ± 24.08	60.50 ± 21.11	58.09 ± 24.84	70.44 ± 16.51	46.23 ± 18.20	0.463
Height z-score-for-age	0.29 ± 0.73	0.34 ± 0.81	0.34 ± 0.69	0.28 ± 0.80	0.66 ± 0.67	-0.10 ± 0.47	0.436
Weight	57.85 ± 10.11	59.66 ±11.15	59.42 ± 8.51	58.65 ± 10.02	61.19 ± 8.93	54.75 ± 6.72	0.282
Weight Percentile-for-age	60.47 ± 26.83	65.42 ± 26.18	67.12 ± 21.14	62.72 ± 26.28	69.69 ± 23.27	57.04 ± 26.09	0.154
Weight z-score-for-age	0.34 ± 0.86	0.51 ± 0.89	0.51 ± 0.68	0.41 ± 0.83	0.62 ± 0.75	0.20 ± 0.70	0.160
BMI	20.76 ± 3.13	21.42 ± 3.34	21.34 ± 2.62	20.95 ± 2.81	21.32 ± 3.29	20.26 ± 3.60	0.176
BMI Percentile-for-age	55.73 ± 28.48	62.01 ± 27.46	63.63 ± 21.98	58.95 ± 26.84	61.13 ± 29.60	54.45 ± 43.65	0.081
BMI z-score-for-age	0.15 ± 0.95	0.35 ± 0.96	0.39 ± 0.71	0.26 ± 0.86	0.27 ± 1.15	0.16 ± 1.25	0.167
Number of family members	4.80 ± 1	4.29 ± 1	4.00 ± 1	4.14 ± 1	4.13 ± 1	4.00 ± 0	<0.001
HP stool antigen titer	0.70 ± 0.49	0.63 ± 0.48	0.59 ± 0.47	0.62 ± 0.48	0.60 ± 0.42	0.95 ± 0.64	0.255

Table 6. Demographic finding of patients based on mother Education level

	Education level						P
	1	2	3	4	5	6	
Age(*month*)	176.12 ± 4.81	175.02 ± 4.37	176.33 ± 4.16	173.84 ± 3.98	177.33 ± 2.52	176.50 ± 6.36	0.003
Height	166.70 ± 6.29	166.28 ± 6.62	166.96 ± 7.49	168.94 ± 7.44	174.00 ± 8.54	168.50 ± .71	0.062
Height Percentile-for-age	59.09 ± 23.28	59.50 ± 23.43	56.35 ± 25.47	67.13 ± 23.63	87.53 ± 15.41	51.18 ± 11.21	0.081
Height z-score-for-age	0.29 ± 0.76	0.31 ± 0.75	0.24 ± 0.89	0.59 ± 0.86	1.41 ± 0.80	0.03 ± 0.28	0.035
Weight	58.02 ± 9.96	58.95 ± 11.03	59.85 ± 9.43	63.63 ± 11.08	65.67 ± 5.51	55.00 ± 7.07	0.017
Weight Percentile-for-age	61.79 ± 26.40	63.48 ± 26.35	65.14 ± 25.80	72.33 ± 22.78	85.23 ± 3.86	50.38 ± 16.67	0.092
Weight z-score-for-age	0.37 ± 0.85	0.44 ± 0.88	0.48 ± 0.80	0.74 ± 0.82	1.06 ± 0.17	0.01 ± 0.42	0.080
BMI	20.92 ± 3.04	21.18 ± 3.28	21.33 ± 2.75	21.95 ± 3.76	21.69 ± 1.10	19.36 ± 2.33	0.339
BMI Percentile-for-age	57.55 ± 27.95	59.72 ± 28.04	64.22 ± 24.06	66.55 ± 23.80	71.22 ± 9.35	44.19 ± 29.15	0.242
BMI z-score-for-age	0.21 ± 0.93	0.28 ± 0.96	0.38 ± 0.84	0.51 ± 0.90	0.57 ± 0.27	-0.17 ± 0.78	0.310
Number of family members	4.78 ± 1	4.14 ± 1	4.04 ± 0	3.98 ± 0	3.67 ± 1	4.00 ± 0	<0.001
HP stool antigen titer	0.69 ± 0.49	0.64 ± 0.49	0.63 ± 0.48	0.50 ± 0.39	0.23 ± 0.12	0.80 ± 0.85	0.078

Table 7. Demographic finding of patients based on Abdominal pains, Anorexia and Diarrhea

	Abdominal pains		P	Anorexia		P	Diarrhea		P
	Yes	No		Yes	No		Yes	No	
Age(*month*)	175.12 ± 4.88	175.61 ± 4.60	0.472	174.33 ± 4.40	175.65 ± 4.62	0.083	175.63 ± 4.63	175.58 ± 4.62	0.979
HP stool antigen titer	1.21 ± 0.29	0.62 ± 0.47	0.009	1.23 ± 0.24	0.63 ± 0.48	<0.001	1.15 ± .39	0.65 ± 0.48	<0.001
Height	161.50 ± 4.93	167.04 ± 6.50	<0.001	162.22 ± 4.54	166.93 ± 6.55	<0.001	163.56 ± 4.32	166.73 ± 6.56	0.173
Height Percentile-for-age	48.14 ± 23.12	60.45 ± 23.31	<0.001	47.16 ± 23.85	60.34 ± 23.28	0.001	52.62 ± 23.06	59.77 ± 23.47	0.931
Height z-score-for-age	-0.07 ± 0.72	0.34 ± 0.77	<0.001	-0.10 ± 0.75	0.33 ± 0.77	0.001	0.11 ± 0.69	0.32 ± 0.77	0.450
Weight	48.81 ± 4.38	59.41 ± 10.44	<0.001	47.63 ± 3.87	59.33 ± 10.40	<0.001	49.63 ± 5.24	58.86 ± 10.48	0.013
Weight Percentile-for-age	46.31 ± 25.89	64.28 ± 25.87	<0.001	38.44 ± 25.14	64.44 ± 25.65	<0.001	49.42 ± 26.91	63.32 ± 26.18	0.136
Weight z-score-for-age	-0.09 ± 0.87	0.46 ± 0.85	<0.001	-0.33 ± 0.84	0.46 ± 0.85	<0.001	0.06 ± 0.97	0.43 ± 0.86	0.228
BMI	19.73 ± 3.07	21.17 ± 3.15	0.002	18.85 ± 2.90	21.20 ± 3.14	<0.001	20.03 ± 3.81	21.10 ± 3.16	0.344
BMI Percentile-for-age	44.35 ± 27.17	60.05 ± 27.45	<0.001	35.45 ± 25.33	60.30 ± 27.25	<0.001	45.83 ± 29.71	59.23 ± 27.64	0.173
BMI z-score-for-age	-0.17 ± 0.91	0.29 ± 0.93	<0.001	-0.49 ± 0.92	0.30 ± 0.92	<0.001	-0.12 ± 1.11	0.26 ± 0.94	0.185

Table 8. Demographic finding of patients based on History of infection and treatment for infection in parents

	History of infection in parents		P	History of treatment for infection in parents		P
	Yes	No		Yes	No	
Age(*month*)	176.39 ± 5.43	175.54 ± 4.57	0.283	176.35 ± 5.25	175.55 ± 4.59	0.342
HP stool antigen titer	0.93 ± 0.47	0.65 ± 0.48	<0.001	0.90 ± 0.49	0.65 ± 0.48	0.005
Height	164.93 ± 5.96	166.79 ± 6.56	0.097	165.47 ± 6.17	166.75 ± 6.56	0.284
Height Percentile-for-age	61.40 ± 21.12	59.62 ± 23.58	0.656	64.09 ± 20.91	59.53 ± 23.56	0.289
Height z-score-for-age	0.37 ± 0.70	0.31 ± 0.77	0.647	0.45 ± 0.70	0.31 ± 0.77	0.300
Weight	55.42 ± 11.79	58.92 ± 10.40	0.050	56.48 ± 12.17	58.86 ± 10.41	0.216
Weight Percentile-for-age	59.96 ± 29.06	63.33 ± 26.08	0.451	60.14 ± 28.55	63.31 ± 26.12	0.510
Weight z-score-for-age	0.38 ± 0.97	0.43 ± 0.86	0.751	0.38 ± 0.95	0.43 ± 0.86	0.787
BMI	21.12 ± 4.68	21.08 ± 3.08	0.941	21.04 ± 4.78	21.09 ± 3.09	0.928
BMI Percentile-for-age	51.63 ± 35.96	59.45 ± 27.20	0.098	50.59 ± 36.03	59.44 ± 27.26	0.081
BMI z-score-for-age	0.07 ± 1.23	0.27 ± 0.92	0.215	0.03 ± 1.24	0.27 ± 0.92	0.166

Konstantopoulos et al demonstrated that, the HpSA performed as well as the 13C-UBT with excellent concordance between the two noninvasive tests. There was no age dependency of the stool test results, and changing the cutoff would not have improved accuracy. Thus, the HpSA test seems suitable to monitor the success of anti- Helicobacter pylori therapy (Konstantopoulos, 2001).

In our study, stool antigen of Helicobacter pylori is studied evaluate the infection rate of Helicobacter pylori in adolescents under study.

Helicobacter pylori infection seems to be the primary event for chronic malnutrition and diarrhea syndrome with failure to thrive (Guisset, 1997).

Hp does not seem to be commonly associated with RAP in our patient population as Hp colonization was detected in only 23% of cases which was not significantly higher than the seroprevalence of anti Hp IgG antibodies in the controls (Bansal, 1998).

In our study, infection rate of Helicobacter pylori was significantly higher in symptomatic patients.

Czinn et al demonstrated that Helicobacter pylori infection is acquired during childhood with those of low socioeconomic means and having infected family members being at highest risk for early childhood acquisition (Czinn, 2005).

Maherzi et al demonstrated that recurrent abdominal pain, anorexia, weight loss and family history of peptic diseases were significantly associated with HP infection ($p<0.05$) (Maherzi, 1996).

In our study, 90% of adolescents with abdominal pain, 95% of adolescents with anorexia and 5/87% of

adolescents with diarrhea were infected with Helicobacter pylori, the rate which was significantly correlated with patients' symptoms.

Helicobacter pylori infection is not associated with specific symptoms in children; however, it is consistently associated with antral gastritis, although its clinical significance is unclear (Torres, 2000).

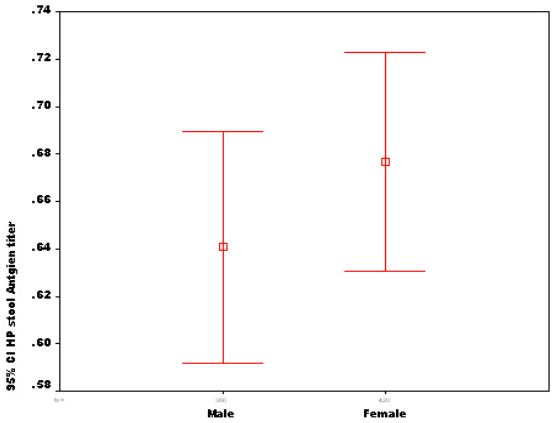

Figure 1. Distribution of Helicobacter pylori antigen levels between two genders

Ertem et al demonstrate that there was no significant association between Helicobacter pylori infection and height and weight percentiles, history of abdominal pain or family history of dyspepsia in the study group (Ertem, 2003).

Malaty et al demonstrated that Helicobacter pylori infection prevalence increased with age ($p < 0.001$) (Malaty, 1996).

In our study, the rate of Helicobacter pylori infection increases with age, but this relationship was not significant.

Bravo et al demonstrate that Helicobacter pylori infection caused significant growth retardation (Bravo 2003).

In our study, the growth rate of adolescents with Helicobacter pylori infection which was significantly slower.

Mera et al demonstrate that Helicobacter pylori infection had a significant and nontransient effect on height and weight (Mera, 2006).

Helicobacter pylori infection is associated with growth delay, growth retardation, or both in affected children(Richter, 2001).

Chronic Helicobacter pylori infection is accompanied by slowed growth in school-age Andean children(Goodman, 2011).

In our study, mean weight, Weight Percentile-for-age, and Weight z-score-for-age in adolescents with Helicobacter pylori infection were significantly lower. As well, other physical growth parameters in adolescents with Helicobacter pylori infection were significantly lower.

The number of children (both boys and girls) falling below the 5th percentile of height-for-age was significantly higher in infected than non-infected children ($P = 0.001$), similarly for Z-scores for height-for-age below -2.0 ($p = 0.003$) (Mohammad, 2008).

Also in our study, Height Percentile-for-age, Height z-score-for-age, Weight Percentile-for-age, and Weight z-score-for-age in infected adolescents was significantly lower than in other adolescents.

In the study of Fialho and et al, 80% patients aged 8-14 years with Helicobacter pylori infection were <25th centile for height as compared to 63% patients aged 8-14 years without Helicobacter pylori infection were <25th centile for height ($p=0.01$)(Fialho, 2007).

Ertem and et al, show that a significant correlation was found between Low socioeconomic status and Helicobacter pylori infection in the children (Ertem, 2003).

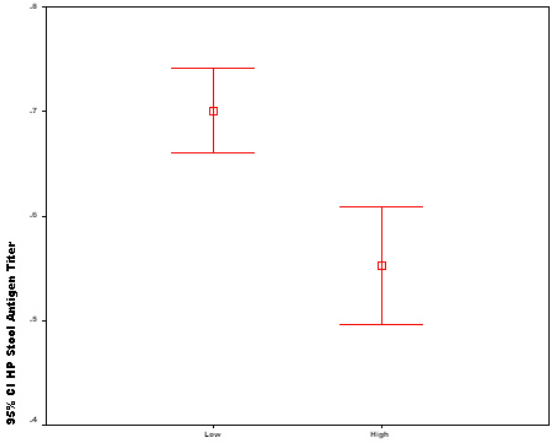

Figure 2. Distribution of Helicobacter pylori antigen levels based on incomes and socioeconomic level

Perri et al demonstrate that Helicobacter pylori infection was associated with growth delay in older children, poor socioeconomic conditions, and household overcrowding (Perri, 1997).

Malaty et al demonstrated that Helicobacter pylori infection prevalence was inversely related to the socioeconomic class of the child's family (Malaty, 1996).

Malaty et al demonstrated that type of housing, whether owned or rented, number of family members living in the same household, water source, and type of community in which a child grew up were not found to be risk factors influencing Helicobacter pylori infection prevalence (Malaty, 1996).

Veldhuyzen van Zanten et al demonstrated that lower socio-economic status and/or a low level of education are associated with an increase in the prevalence of Helicobacter pylori infection (Veldhuyzen van Zanten, 1995).

In our study, Helicobacter pylori stool antigen titers in adolescents from lower socio-economic levels were significantly higher.

Conclusion

The stool Helicobacter pylori antigen was positive in 35.2% of adolescents with a mean level of 0.65±0.48.

There was a negative reverse linear correlation between the Helicobacter pylori stool antigen titers and adolescent's, Height Percentile-for-age, Height z-score-for-age, Weight(*K gr*), Weight Percentile-for-age, Weight z-score-for-age, BMI ،BMI Percentile-for-age and BMI z-score-for-age, but there was not a meaningful linear correlation between the Helicobacter pylori stool antigen titer and age of the adolescents.

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Comparison of serum & pleural levels of NT-ProBNP in patients with acute dyspnea and pleural fluid referred to Emergency Department

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Abstract: Pleural effusion is one of the most common manifestations of cardiac and non cardiac disease all over the world. The first step in the evaluation of patients with pleural effusion is to determine whether the effusion is a transudate or an exudate, that diagnostic Light criteria have been widely used. Although, this criteria are sensitive for identifying exudates, but they misclassify 15% to 25% of transudate as exudates. N-terminal B-type Natriuretic Peptide(NT-proBNP) is a cardiac neurohormone specifically secreted from the ventricles in response to volume expansion and pressure overload. This study aims at Comparison of serum and pleural levels of NT-ProBNP in patients with acute dyspnea and pleural fluid referred to Emergency Department and evaluating diagnostic value of serum and pleural NT-ProBNP in diagnosis of heart failure. In an analytic-descriptive cross-sectional study, 43 patients with acute dyspnea and pleural fluid in two groups (15 patients with CHF and 28 patients with other pathology) were analyzed in a 17 month period in Tabriz Emam Reza hospital. Samples of pleural fluid and serum were obtained from all patients on admission and NT-ProBNP was performed by electrochemiluminiscence immunoassay method. Also other biochemical analysis (albumin, total protein, cholesterol, triglyceride, amylase, LDH) were performed and gradient and ratio of this markers were accounted. The Mean ± SD serum NT-proBNP levels in CHF and non CHF patients were 15423 ± 3351 *pg/ml* and 4751 ± 1616 *pg/ml*, respectively; and plural NT-ProBNP levels in CHF and non CHF patients were 14822 ± 3249 *pg/ml* and 3569 ± 1231 *pg/ml*, respectively. Using a cut-off value of 2350 *pg/mL* for serum and 1750 *pg/ml* for pleural samples, the accuracy of NT-proBNP for identifying pleural effusions from cardiac causes was 76%, the sensitivity and specificity was 93.3% and 76.9%, respectively; The positive and negative likelihood ratio was 3 and 0.10 , respectively. The positive and negative predictive value was 60% and 95%, respectively. In this study Light criteria had 40% sensitivity and 78% specificity in identifying cardiac causes of pleural effusion. NT-proBNP is better than Light's criteria and a useful marker for the diagnosis of pleural effusions from heart failure when measured in either serum or pleural fluid.

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Keywords: B-type Natriuretic Peptide; Congestive Heart Failure; Dyspnea; Pleural Fluid

1. Introduction

Pleural effusion is one the most common presentations of both cardiac non cardiac diseases (Light, 2002). Heart failure, malignancies, pneumonia, tuberculosis and pulmonary embolism are most common causes of pleural effusion in adults(Porcel and Light, 2006). Determining that the pleural fluid is transudative or exudative is the first step in evaluating the patients with pleural effusion and finally making the diagnosis which mainly is made by Light's criterias (Porcel, 2011) but in 15 to 25% of cases this leads to misclassification (Porcel, 2006).

Burgess et al, have used Albumin gradient and Caderia et al have used Protein gradient >3.1 for determining the type of pleural effusion. Despite the use of both gradients, 10% of exudates are still misclassified as exudates. NT-proBNP measurement is one of the proven methods for diagnosis of heart failure in people with acute dyspnea referring to emergency department. NT-proBNP is a cardiac neurohormone secreting from cardiac ventricles in response to increase of volume and overload of cardiac ventricles (Porcel, 2007).

Some studies have stated that a cut off value of serum and pleural fluid NT-proBNP levels is not equal in patients with heart failure in all ages and all races (Raymond, 2003). Considering the importance and emphasizing the differences in cut off values for age, race, sex, diseases and ... It seems that these numbers need to be reviewed for Iranian with considering the other indicators. Our aim of this

study is to evaluate the diagnostic value of serum NT-proBNP in the diagnosis of heart failure in addition to recommend a Cut off number with regard to the number of known cases to take an effective step in quick and easy diagnosis of heart failure and the approach to this disease especially in emergency room.

2. Material and Methods

In a cross sectional descriptive-analytic study on patients with acute dyspnea and pleural effusion in emergency department of Tabriz Imam Reza Hospital the diagnostic value of serum NT-proBNP in the diagnosis of heart failure were studied. 43 patients with acute dyspnea who had pleural effusion on chest radiograph were enrolled to the study,15 of them had a pleural effusion due to heart failure (group A) and 28 of them were classified with pleural effusion with non cardiac causes(group B). Non-cardiac causes were included pulmonary thromboembolism, cancer, parapneumonic effusion, nephrotic syndrome, cirrhosis and had Chronic Myelogenous Leukemia with extramedullary hematopoiesis. After assessing of patients, clinical diagnosis of pleural effusion was established, without the knowledge of the laboratory results. Then with gathering of laboratory, echocardiographic and pathologic findings patients were classified as group A if they had cardiac pleural effusion and otherwise they were classified as group B.

The diagnoses of heart failure in patients were made according to Framingham, echocardiography and American college of cardiology criterias. Other patients were followed up after admission in order to be enrolled upon their diagnosis. Of all patients with pleural effusion and acute dyspnea, and after providing necessary explanations for patients and their families regarding the goals and methods and after obtaining consent, 3 ml venous blood was taken and sent to the laboratory. Serum and pleural fluid samples were centrifuged at 4 ° C and were examined.

Measurement of NT-ProBNP levels in serum was done using the electrochemiluminiscence immunoassay method and results were recorded as Pico gram per Milliliter (*pg/ml*). In this study, NT-proBNP in addition to several other diagnostic markers in pleural fluid and blood were examined simultaneously, including Glucose, albumin, total protein, and lactate dehydrogenase, cholesterol, Triglyceride, WBC count, respectively.

Exclusion criteria included patients with acute coronary syndrome, septic shock, and atrial fibrillation with rapid ventricular response.

Ethical considerations:

Informed consent for thoracentesis and blood sampling were obtained from all patients, regulations of ethical considerations related to the Medical University of Tabriz**,** was observed in all patients. This study has been approved by the Ethical Committee of Tabriz University of Medical Sciences.

Statistical Analysis:

We used descriptive analytical test (Mean ± SD), frequency and percentage for presenting descriptive data to compare qualitative data. Chi-square test or Fisher's exact test was used. We also evaluated the normal distribution of laboratory data for studying their mean difference and due to their lack of normal distribution we used Non parametric u-Mann Whitney test. For studying the Relationship between serum and pleural fluid NT-proBNP Spearman test was used and we used ROC curve (Receiver operating characteristic curve) for determining the Cut off point for NT-ProBNP to diagnosing heart failure. In all cases, P-value less than 0.05 was considered significant.

3. Results

In this study 43 patients with acute dyspnea and pleural effusion assessed. 15 patients in Group A (CHF) and 28 in Group B (Non CHF). Non CHF patients included PTE (Pulmonary Thromboembolism), Cancer, Parapneumonic effusion, Nephrotic syndrome, Cirrhosis and one case with extramedullary hematopoiesis. 28 patients (9 patients in group A, 19 patients in group B) were male and 15 patients (6 patients in group A, and9 patients in group B) were female (P=0.74).

There is no significant difference between 2 groups (A, B) in age, sex variables.

In addition NT-proBNP, other diagnostic markers (Glucose, Albumin, Total protein, lactate dehydrogenase, cholesterol, Triglyceride, amylase, WBC count) in serum and pleural fluid were measured simultaneously and calculated their gradients and ratio (table 1 and 2). U-Mann Whitney test showed that only some variable [Plural Glucose (P=0.017) Plural WBC (P=0.012), Pleural/Serum Albumin (P=0.04), Serum-Pleural Albumin gradient (P=0.003), Serum-Pleural Protein gradient (P=0.003)] had significant deference between two groups. As regards plural Glucose affected with elevated serum glucose in diabetic patients, there is Based on recent recommended criteria 8 (53.3%) cases in Group A and 8 (28.5%) cases in Group B classified as transudate. No significant difference between 10 heart failure patients and 22 patients with non cardiac causes of pleural effusion, after exclusion of diabetic patients.

Table 1. Serum and Pleural Fluid guardian analysis based on pleural effusion type and patients diagnosis

		Transudative (n±16)	Exudative (n±27)	P	Cardiac (n±15)	Non Cardiac (n±28)	P
Serum	Blood glucose	1.02 ± 0.33	0.83 ± 0.33	<0.001	0.98 ± 0.32	0.86 ± 0.35	0.23
	Albumin	0.38 ± 0.12	0.71 ± 0.17	<0.001	0.49 ± 0.15	0.64 ± 0.24	0.04
	Pr	0.37 ± 0.09	0.65 ± 0.18	<0.001	0.45 ± 0.12	0.60 ± 0.22	0.017
	LDH	0.30 ± 0.15	1.06 ± 0.31	<0.001	0.87 ± 0.53	0.73 ± 0.14	0.05
	Chool	0.26 ± 0.18	0.49 ± 0.18	0.94	0.36 ± 0.22	0.43 ± 0.20	0.12
	TG	0.24 ± 0.09	0.20 ± 0.05	0.08	0.27 ± 0.12	0.19 ± 0.04	0.33
	Amylase	0.62 ± 0.27	1.5 ± 0.73	0.001	0.78 ± 0.12	1.4 ± 0.7	0.74
	NT-proBN	0.72 ± 0.10	1.4 ± 0.34	0.12	0.98 ± 0.35	1.2 ± 0.34	0.98
Pleural Fluid	Blood glucose	0.43 ± 8.7	32 ± 13	<0.001	12 ± 14	25 ± 11	0.34
	Albumin	1.8 ± 0.45	0.95 ± 0.59	<0.001	1.7 ± 0.59	1.06 ± 0.64	0.003
	Pr	3.8 ± 0.59	2.1 ± 1.2	0.055	3.5 ± 0.87	2.3 ± 1.3	0.003
	LDH	621 ± 81	246 ± 213	0.063	527 ± 332	310 ± 123	0.18
	Chool	131 ± 84	85 ± 50	0.14	117 ± 65	94 ± 69	0.27
	TG	74 ± 18	100 ± 18	0.27	69 ± 17	102 ± 18	0.56
	Amylase	23 ± 4	13 ± 31	0.01	18 ± 7	9 ± 29	0.42
	NT-proBN	2505 ± 856	75 ± 417	<0.001	600 ± 877	1182 ± 505	0.95

Table 2. Serum and Pleural Fluid analysis based on pleural effusion type and patients diagnosis

		Transudative (n±16)	Exudative (n±27)	P	Cardiac (n±15)	Non Cardiac (n±28)	P
Serum	Blood glucose	118 ± 49	151 ± 72	0.085	164 ± 37	125 ± 50	0.066
	Albumin	3.1 ± 0.8	3.3 ± 0.5	0.33	3.4 ± 0.5	3.2 ± 0.7	0.48
	Pr	6.1 ± 0.9	6.3 ± 0.7	0.61	6.5 ± 0.6	6.1 ± 0.9	0.24
	LDH	876 ± 77	1117 ± 58	0.45	1092 ± 189	993 ± 126	0.89
	Chool	172 ± 76	163 ± 50	0.94	176 ± 48	161 ± 66	0.20
	TG	95 ± 72	126 ± 92	0.11	107 ± 12	119 ± 29	0.71
	Amylase	57 ± 21	68 ± 34	0.48	68 ± 25	61 ± 33	0.13
	NT-proBN	13905 ± 3527	5255 ± 1561	0.017	15423 ± 3351	4751 ± 1616	<0.001
Pleural Fluid	Blood glucose	118 ± 53	119 ± 68	0.75	152 ± 71	100 ± 49	0.017
	Albumin	1.2 ± 0.5	2.4 ± 0.7	<0.001	1.6 ± 0.4	2.1 ± 0.9	0.10
	Pr	2.3 ± 0.7	4.2 ± 1.4	<0.001	2.9 ± 0.8	3.8 ± 1.7	0.0900
	LDH	254 ± 39	871 ± 177	<0.001	565 ± 241	683 ± 137	0.18
	Chool	41 ± 36	77 ± 32	<0.001	58 ± 10	67 ± 7	0.27
	TG	20 ± 12	25 ± 9	0.10	38 ± 20	16 ± 3	0.25
	Amylase	33 ± 28	81 ± 30	0.025	50 ± 7	71 ± 29	0.34
	NT-proBN	11399 ± 3258	5180 ± 1591	0.10	14823 ± 3250	3569 ± 1231	0.066

Table 3. Serum and Pleural Fluid levels of NT-proBNP based on several diagnoses

	Cardiac Failure	PTE	Cancer	Parapunomic Pleural effusion
Serum	15423 ± 3351 (1348-35000)	7118 ± 4384 (60-27544)	1457 ± 951 (27-9832)	7260 ± 3875 (58-35000)
Pleural Fluid	14822 ± 3249 (1482-35000)	6104 ± 3378 (95-19907)	1035 ± 450 (206-4613)	5024 ± 2985 (6-25776)

Table 4. Diagnostic characteristic of Serum and Pleural Fluid levels of NT-proBNP in two different cut of points

	Cut off point (pg/ml)	Sensitivity	Specificity	PPV	NPV	Positive Likelihood Ratio	Negative Likelihood Ratio	Diagnostic Accuracy	Odds Ratio
Serum	2378	93.3%	67.9%	60%	95%	3	0.10	76%	29.5
	6412	80%	78.6%	66%	88%	3.8	0.20	79%	14.6
Pleural Fluid	1759	93.3%	67.9%	60%	95%	3	0.10	76%	29.5
	2452	86.7%	75%	65%	91.3%	3.4	0.17	79%	19.5

In group A (CHF), only 6(40%) cases classified transudate based on Light's criteria and 9 cases (60%) classified as exudative fluids. Thus in our CHF patients, the Light's criteria had a sensitivity of 40% and specificity of 78% in diagnosing transudative pleural fluids due to CHF.

In our study pleural fluid labeled as transudative, if all of 3 following criteria was met:

1) Fluid/Serum Protein level < 0.5
2) Fluid/Serum LDH level < 0.6
3) Fluid and Serum Albumin gradient >1.2

The mean level of NT-proBNP in exudative effusions was 13905.49 ± 3527.86 *pg/ml* and in transudative effusions was 5255.82 ± 1560.44 *pg/ml*(P-value=0.017). The cut off point was determined 3331 *pg/ml* for serum NT-proBNP level to diagnosing transudative pleural fluid with a sensitivity of 75% and a specificity of 63% (Figure1). Mean levels of NT-proBNP in pleural fluids was 11399.92 ± 3185.41 *pg/ml* and in the exudative effusions was 5180.64 ± 1591.29 *pg/ml* (p=0.102).

Table 3 shows Serum and Pleural levels of NT-proBNP upon different diagnosis. There was a meaningful correlation between NT-proBNP serum (P=0.016) and pleural levels (P=0.008) in different diagnosis.

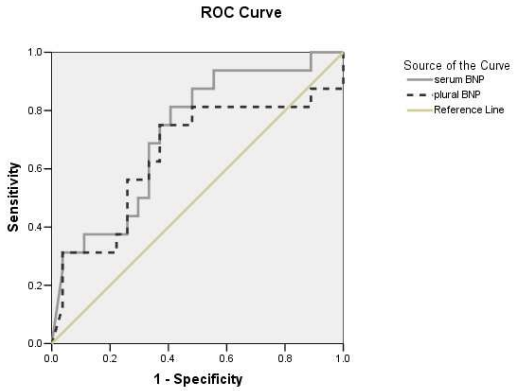

Figure 1. ROC chart of Serum and Pleural Fluid levels of NT-proBNP in diagnosis of transudative pleural effusion

Mean values of serum NT-Pro BNP was 15423.13 ± 3351.68 *pg/ml* in Group A and 4751.72 ± 1616.95 *pg/ml* in Group B(P < 0.001).

Mean values of Pleural NT-Pro BNP was 14822.93 ± 3249.42 *pg/ml* in Group A and 3569.01 ± 1231.78 *pg/ml* in Group B(P-value < 0.001). These values calculated with U-Mann Whitney test, and then cut of values were calculated.

The cut off number for pleural and serum levels for Nt-proBNP was calculated with ROC curve. Area under the curve for serum NT-proBNP with P<0.001 and 95%CI: 0.71-0.95 was 83.6%.

Accuracy, sensitivity, specificity, positive and negative predictive value and positive and negative Likelihood Ratio to diagnose heart failure based on the Cut off point NT-proBNP serum & Pleural Fluid is shown in Table 4 (Figure 2).

9 out of 15 patients with heart failure (60%) who was classified as exudate was diagnosed correctly based on NT-proBNP (2378 serum and 1759 pleura), while only 5 patients (55%) based on albumin gradient, and 4 patients (44%) based on the protein gradient were classified correctly. With significant differences of some of the other variables between the two groups, the Cut off were calculated for each of the variables.

Albumin gradient between serum and pleural fluid with Cut off point =1.2 had a sensitivity of 73% and specificity of 57% and with a cut off point=1.45 had a sensitivity of 66.7% and a specificity of 75% for the diagnosis of heart failure.

Spearman's test showed that, there is a positive statistical correlation in all patients with pleural effusion and serum and pleural fluid NT-proBNP (r=0.92, P<0.001) (Figure 2).

We studied the serum and pleural levels of Nt-proBNP in patients with acute dyspnea and pleural effusion who had the indication of thoracentesis. Serum and pleural fluid Nt-proBNP levels was higher in patients with heart failure in comparison to other patients. In other word with the rise of Nt-proBNP levels in serum the NT-proBNP levels in pleural fluid will also increase. NT-proBNP in serum and pleural fluid can determine the type of pleural effusion more accurately than the Light's criteria and in cases which there is a misclassification of exudate or transudate nature of pleural effusion ,this marker can effectively identify the cause of pleural effusion particularly in cases with pleural effusion due to congestive heart failure.

In our study the lights criteria in diagnosing the pleural effusion due to CHF has a sensitivity of 40% and a specificity of 78% while NT-proBNP had a sensitivity of 93.35 and a specificity of 67.9% in diagnosing the pleural effusion due to cardiac causes with a cutoff point of 1759 *pg/ml* in pleural fluid and 2378 *pg/ml* in serum .In these values serum NT-ProBNP had a positive predictive value(PPV) of 60%, negative predictive value(NPV) of 95%, positive Likelihood ratio(+LR) of 3 and, negative Likelihood ratio(-LR) of 0.1 in identifying of CHF patients(Figure 3).

If we choose serum value of 6412 *pg/ml*, NT-ProBNP have a sensitivity of 80%, specificity of 78.6% , accuracy of 79%, PPV=66%, NPV=88%, (+LR)=3.8, (-LR)=0.2.

For Pleural fluid NT-ProBNP value equal to 1759 *pg/ml* a sensitivity of 93.3%, specificity of 67.9% , accuracy of 76%, PPV=60%, NPV=95%, (+LR)=3, (-LR)=0.1 in identifying CHF patients calculated.

If we choose pleural value of 2452 *pg/ml*, NT-ProBNP have a sensitivity of 86.7%, specificity of 75%, accuracy of 79%, PPV=65%, NPV=91.3%, (+LR) =3.4, (-LR) =0.17. Correlation between Serum and Pleural Fluid levels of NT-proBNP was shown if figure 4.

4. Discussions

In our study the mean serum level for in patients with heart failure was 15423 *pg/ml* and in non cardiac patients was 3569 *pg/ml*. serum NT-proBNP for diagnosing the heart failure has the highest sensitivity in cut off above 2378 *pg/ml* and highest specificity in cut off above 6412 *pg/ml*. Pleural NT-proBNP for diagnosing the heart failure has the highest sensitivity in cut off above 1759 *pg/ml* and highest specificity in cut off above 2452 *pg/ml*.

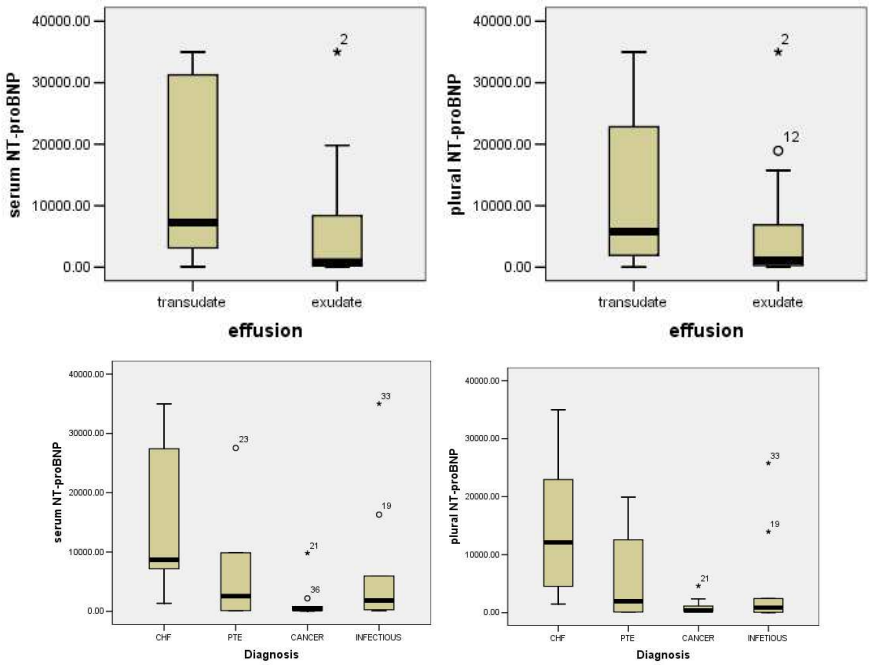

Figure 2. Comparing Serum and Pleural Fluid levels of NT-proBNP distribution in transudative or exudative pleural effusion

Roth BJ et al on their study showed that 28% of the CHF pleural effusions were misclassified using the Light's criteria as exudates (Roth, 1990).
Skouras and colleagues evaluated the diagnostic role of BNP in heart failure and stated that high ratios of pleural effusions in non-cardiac effusions is as an effect of increased permeability of the pleura, local production or reduced removal of pleural cavity as well as that of BNP levels can not differentiate the transudate or exudate of pleural effusion(Skouras, 2008).
In a study by Procel and colleagues on 93 patients (53 patients with heart failure and 40 non-cardiac patients), Cut off point = 1500 *pg/ml* for NT-proBNP in serum and pleural fluid with had an accuracy of 89% and 90% in detecting pleural effusions with cardiac causes. They stated that pleural fluid or serum NT-proBNP with cut off more than 1500 *pg/ml* is helpful in the diagnosing of heart failure (Porcel, 2007).
In a study by Kolditz and colleagues, NT-proBNP at a cut off of more than 4000 *pg/ml* in serum and pleural fluid has a sensitivity of 88% and 92% respectively a 92% and 93% specificity and diagnostic accuracy of 91% and 92%respectively in the diagnosis of heart failure. All patients who incorrectly classified as Light criteria in this study were correctly identified by measuring NT-proBNP (Kolditz, 2006).

Mueller and colleagues stated that most of the diagnostic accuracy of BNP for heart failure is at the cut off = 295 ng/l (*Pg/ml*) (sensitivity 80%, specificity 86%, positive predictive value and negative predictive value 78% with 87% accuracy 83%). The highest Diagnostic Accuracy for NT-proBNP was in cut off = 825 ng/l (*Pg/ml*) (sensitivity 87%, specificity 81%, positive predictive value and negative predictive value 84% with 84% accuracy% 84)they stated that BNP and NT-proBNP in patients with complaints of dyspnea can be very useful in helping to diagnose CHF (Mueller, 2005).
Tomcsanyi and colleagues investigated the role of NT-proBNP in distinguishing exudate or transudate nature of pleural fluid and stated that median level for pleural fluid NT-proBNP levels in patients with heart failure was 6295 *Pg/ml* and in non-cardiac patients 276 *Pg/ml*. it was significantly higher (P =0.0001)in patients with heart failure and found that pleural fluid NT-proBNP levels can distinguish the two groups with high accuracy, while the Light's criteria for transudative pleural fluid has a sensitivity of 93% and specificity of 43%. They suggested that entering the -level assessment of pleural NT-proBNP in routine diagnostic panels can increase the diagnostic power of the different causes of pleural effusions in patients with such disorder. (Tomcsányi, 2004).

Gegenhuber and colleagues stated that the sensitivity, specificity and diagnostic accuracy of BNP levels in the Cut off point = 520 *Pg/ml* for the diagnosis of pleural effusion due to heart disease is 97%, 89% and 93% and at the Cut off point = 2201 *Pg/ml* is 77%, 100% and 88% respectively (Gegenhuber, 2005).

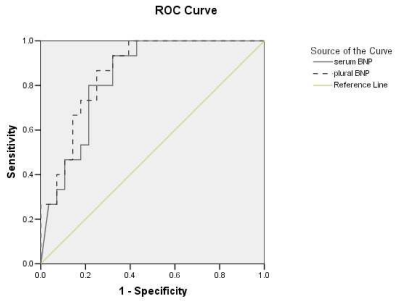

Figure 3. ROC chart of Serum and Pleural Fluid levels of NT-proBNP in diagnosis of heart failure

In systematic review conducted in 2010 by Surinder Janda and John Swiston assessing accuracy (diagnostic accuracy) the mean NT-proBNP levels in pleural fluid in effusion with cardiac origin was 6140 *pg/ml*. The average sensitivity and specificity of pleural fluid NT-proBNP in the total of the studies was % 94 (95%CI: 97-90) and% 94 (995%CI: 97-8) and mean levels of positive Likelihood Ratio was 15.2 (95%CI: 8.1-28.7) and negative Likelihood Ratio was 0.06 (95%CI: 0.03-0.11), respectively. Area under ROC curve was equal to 0.98 (95%CI: 0.98-0.99) and diagnostic odds ratio was equal to 246 (95%CI: 81 -745) respectively. They concluded that NT-proBNP a level of pleural fluid is a very useful biomarker with high diagnostic accuracy distinguishing pleural effusion is of cardiac origin (Janda, 2010).

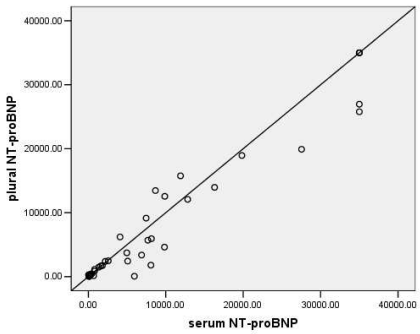

Figure 4. Correlation between Serum and Pleural Fluid levels of NT-proBNP

In the meta-analysis conducted by Zhou Q and colleagues in 2010 in China they stated that NT-proBNP in pleural fluid, had a sensitivity of 95% (95%CI: 97-92), specificity of 94% (95%CI: 96-92) positive Likelihood Ratio 14.12 (51/19-23/1095%CI:10.23-19-51) and negative Likelihood Ratio 0.06 (95%CI:0.04-0.09) and diagnostic odds ratio equal to 213 (95%CI:122-273)in diagnosing pleural effusion with cardiac origin (Zhou, 2010).

Recommendations:

According to the results of this study, NT-proBNP when is measured simultaneously in serum and pleural fluid can help in determining the cause of the effusion more than Light's criteria and it can be a simple and useful marker in detecting the cause of pleural effusion due to heart failure. Thus equipping emergency department's laboratories for the measurement of these markers can be an important and effective step in the diagnosis and determining the patient's illness.

Several cases to consider in future studies are recommended:

1) Conducting comparative studies with other diagnostic modalities in patients with dyspnea and pleural effusion.
2) Evaluating the prognosis of patients who were diagnosed and treated with this method
3) Evaluation of this marker in the diagnosis of pleural effusion with other important causes particularly pulmonary embolism

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10/10/12

Factors influencing beef purchase among consumers in Mafikeng, South Africa

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Abstract: This paper examined Factors influencing beef purchase among consumers in Mafikeng. A descriptive research design was used for this study and from a population of beef consumers in Mafikeng, a sample of 120 respondents were selected for the study. In order to ensure that all the people interviewed for this research are the consumer of beef, ten butcheries were selected from which twelve people from each butchery were interviewed. The results show that majority of consumers are married, and have a high education level with a middle income. The Mafikeng consumers mostly buy meat from butcheries, because they provide for best value for money. They only purchase their beef meat when pressed for time or looking for something extra special. And their main reason for buying beef is for household consumption. The consumers mostly buy fresh and dried beef. The most effecting factors for Mafikeng consumers to buy beef is because of the considerations on beef parts, price, more varieties for cooking, suggestions from known person and the beef colour quality.
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Keywords: beef, consumers, market, demand, supply, taste, prefernces

Introduction

The study of consumer play an important role by helping firms and organizations to improve their marketing strategies, i.e. the consumer is the most important person to the market because the consumer takes into considerations the liking and the disliking of the consumer and produces the goods and services according to them (Becker, 2000). Hence consumer behavior refers to the study of individuals, groups, or organizations and the process they use to secure, use and dispose of a product, services, experience and ideas to satisfy needs and the impact that these process has on the consumer and society (Brester and Wohlgenant, 1991). Consumer behavior involve the psychological process that the consumer goes through in recognizing the needs, finding ways in solving these needs, making purchasing decision(e.g. whether or not to purchase the product, if so which brand and where, interpret information, make plans, and implementing these plans by engaging in compromising shopping or actually purchasing the product).

In dealing with consumer behavior in relation to beef, it is important to know how beef is perceived by different marketing segments, and what the values, needs and expectations of these consumers are. It is also important to know how consumer attitudes are formed and how learning takes place. The consumers' cultural and social backgrounds also have an important influence on the buying behavior. There are other aspects, such as where the target consumers buy their products, how they buy and what they are willing to pay and can afford, and how they decide on specific product, will also influence decision-making by markets. The primary decision that the consumer takes is whether or not to purchase the product, in this case beef, the result of this decision is influenced by many variables which is divided into internal or individual and external or environmental (Steenkamp, 1990)

The factors affecting purchasing pattern of meat and meat products has to be identified in order to comprehend the changes in the purchasing behavior of consumers to make a qualified prognosis for the further development of consumer demand. Shin *et al.* (1997) described that the consumption can only be properly understood through the analysis of multiple factors. A range of economics, cultural, social, religious, marketing and personal factors determines consumer behavior (Northern, 2000). With respect to meat and meat products, factors such as safety, guarantee, quality assurance and trustworthy information, as well as interest in animal welfare and convenience are most relevant consumer considerations (Devine, 2003). Consumers are becoming more demanding about the type of food they buy and the preferred attributes, as well as the expected quality of red meat (beef) they buy and consume. In order for the beef meat to be successfully market it has to meet changing consumer expectation. Consumers are demanding food products that are safe for their families. There are a number of studies that have shown that certain consumer segments are willing to pay for food safety attributes. Even though beef constitutes an important part of many consumers' diets, its consumption has become a quite controversial issue. On the other hand red meet provides essential nutrients, containing high quality protein and essential health life (Hayes et al 1995). Consumers are exposed to beef products with a greater variety on features and

attributes that are preferred, they will be willing to pay more for those character they value (Hoffman, 2000).

Schroeder *and Graff* (1999) found that beef recalls by the Food Safety Inspection Service (FSIS) caused declines in beef demand, especially in years when a relatively large number of recalls occur Several studies have addressed consumer willingness-to pay for food products with safety features or benefits (Shin *et al*., 1992) For example, in an experimental auction, Hayes *et al*. (1995) found that the average undergraduate Iowa State University student would pay approximately R0.70 per meal for safer food (i.e., food screened for pathogenic bacteria).

Consumer preferences have changed dramatically over time. Preference changes have occurred due to numerous demographic factors (Henneberry and Charlet, 1992). Aging population is one factor causing changes in meat consumption. These trends offer the beef industry the opportunity to target leaner cuts of beef to older people because they typically indicate a desire for leaner beef (Capps *et al*., 1988). Female labor force participation is another factor affecting demand for meat. Increased teenage labor provides additional household income and more meals consumed away from home (Kinsey, 1983). Other demographic factors have also contributed to food product demand changes over time, including declining household size and changing ethnic population mix (Henneberry & Charlet, 1992).

Consumer behavior is one of the most stimulating areas in marketing studies. In first place, because understanding how and why consumers behave is a great challenge. Besides it, there are so many variables involved in the consumption process that is not an easy task to establish models to understand it. Human behavior is based not only on personal characteristics, but also on the psychological, environmental, social and cultural environment that they are submitted. Beef has been consumed throughout the years in Mafikeng, it has become a traditional and occupation of the people. The people has been consuming it differently (fried, cooked, e.tc) for different occasions. For example most of the communities buy their beef from their butcheries for household consumption, or they slaughter the cow/cattle during the wedding, parties, cultural ceremonies, funerals and etc. However, in recent years there has been a reduction in the consumption of beef, hence, the decrease in the beef purchasing. Clearly this shows that there must be factors influencing this reduction in beef purchase which needs to be investigated in order to improve or maintain the consumption of beef in the province to improve farmers' income. It has been found that generally, consumers have started to pay more and more attention to information, product quality and safety as main purchase criteria, rather than price.

The main objective of the study is to identify the factors that influence consumers to purchase beef. The specific objectives were to identify personal characteristics, determine consumption behaviour and ascertain purchasing behaviour of beef n consumers. It is hypothesized that beef consumption in Mafikeng is influenced by personal characteristics such sex , age , income , and education, as well as consumption and purchasing behavioural characteristics such as taste, smell, attitude.

MATERIALS AND METHODS

The study was conducted in Mafikeng area in the Dr Ngaka Modiri Molema District, (Central Region) and it is the capital city of the North-West Province. Situated on South Africa's border with Botswana, Mahikeng / Mafikeng is located 1,400 km northeast of Cape Town (Western Cape) and 260 km west of Johannesburg (Gauteng). A descriptive research design was used for this study and from a population of beef consumers in Mafikeng, a sample of 120 respondents were selected for the study. In order to ensure that all the people interviewed for this research are the consumer of beef, ten butcheries were selected from which twelve people from each butchery were interviewed .The names of butcheries used were Totobola butchery, Jof butchery, Joe hyper meat, Top meat butchery, Itireleng butcher, Butshwana and son's butchery, Riviera slaghuis, Sorona butchery, Lebogang Batswana butchery and Central butchery. A structured questionnaire was used to collect data with sections on personal characteristics consumption behavior and purchasing behavior of beef. The results of the survey were coded, and collected of in excel-sheets by the researcher. Also comments are translated and evaluated by the researchers. Probit model is used for explaining discrete choice in home beef consumption. Probit model consists of observable independent variables and unknown parameters, and their values are estimated from a sample of observed choices made by decision makers when they confronted with a choice situation. Binary choice model (Probit) variables indicate whether a consumer wants to buy a product or not.

Assumptions:

1. Variable=1 the consumer wants to buy beef product
2. Variable=0 the consumer does not want to buy beef product
3. Error term ε in the regression of latent dependent variable follows a standard normal distribution.

The probability that a binary choice variable (y1) =1, a consumer is willing to buy

beef is given by: P [consumer i wants to buy beef] = ( ) i φ βX

Where β is a (k×1) vector of regression coefficients;

i X is a (k×1) vector of k regressors for the ith consumer; and

φ denotes the standard normal cumulative distribution function (CDF)

Results

The results shows respondent's personal characteristics in Table 1, frequency of beef purchasing in Table 2, , Beef product preferences among beef consumers in Table 3, reason for purchasing in buttery in Table 4, beef behavior on product preference in Table 5, and parameter estimates of probit regression in Table 6.

Table1 Respondent's personal characteristics (n = 120)

VARIABLES		Frequency	Percentage
Gender	Female	77	64.2
	Male	43	35.8
Marital Status	Married	51	42.5
	Single	40	33.3
	Divorced	14	11.7
		15	12.5
Windowed			
Age	22-29	24	20.8
	30-40	50	41.7
	41-50	31	25.8
	Above	1S	12.5
50			
Size of household			
Male(adult)			
	1.00	114	95
	2.00	6	5.0
Female(adult)	0.00	10	8.3
	1.00	100	83.3
	2-3	10	7.8
Male(children)	0.00	9	7.5
	1-4	102	85.0
	5-8	9	7.5
Female(children)	0.00	21	17.5
	1-4	79	65.3
	5-7	20	16.6
Education	Primary	12	10.0
school			
		34	28.3
Secondary			
	Tertiary	74	61.7
Life Style	Sporty	14	11.7
	Travel	25	20.8
loving			
		23	19.2
Entertainment			
	Relaxing at	58	48.3
home			
Religion	Christian	89	74.2
		28	23.3
Muslim			
		1	0.0
Buddhism			
	Other	2	1.7
Occupation		13	10.8
Student/scholar			
		25	20.8
Officials			
	Own	20	16.7
business			
	Private	53	44.2
company staff			
		9	7.5
Housewife			
Income	<2000	32	26.7
Rand/month			
	2000-	36	56.7
5000 Rand/month			
	6000-	40	90.0
10000 R/month			
		12	10
>10000 Rand/month			

Table 2: Frequency in beef purchasing

Variables	Frequency	percentage
Less than four times per year	4	3.3
At least once per month	17	14.2
At least once per week	82	68.3
Every day	17	14.2
Purchase Location Of Beef		
Supermarket	23	19.2
Local butcher	95	79.2
Farm shop	2	1.6
Other locations		
Looking for something extra special	40	33.3
When pressed for time	53	44.2
When looking for something quick and easy to cook	27	22.5
Purpose For Purchasing		
Household consumption	111	92.5
Gift/souvenir	4	3.3
Other	5	4.1
Brand Acquaintance		
Not acquainted	116	96.6
Acquainted		

Table 3. Beef product preferences among beef consumers

Frequency of beef purchase	Often	Sometimes	Rarely	None
Fresh	95 (79.2)	14 (11.7)	6 (5.0)	5 (4.2)
Pre-cooked	24 (20.0)	42 (35.0)	25 (20.8)	29 (24.2)
Dried	40 (33.3)	27 (22.5)	28 (21.7)	27 (22.5)
Chilled	25 (20.8)	35 (29.2)	30 (25.0)	30 (25.0)
Frozen	27 (22.5)	35 (29.2)	28 (23.3)	30 (25.0)

Table 4 Reason for purchasing in buttery

Reason for purchasing in preferred location	YES	NO
Most convenient	102 (85.0)	18 (15.0)
Best value for money	104 (86.7)	16 (33.3)
Greatest choice	93(77.5)	27 (22.5)
I trust them to make sure the meat is safe for eating	93(77.5)	27 (22.5)
The service is excellent	102(85.0)	18 (15.0)

Table 5 Beef behavior on product preference

Beef type	Mostly buy	Sometimes	Unlikely	Not buy
Meatball	37 (30.8)	43 (35.8)	28 (23.3)	12(10.0)
Deep fried beef	39 (32.5)	53 (44.2)	16 (13.3)	12(10.0)
Ready-to-cook beef steak	48 (40.0)	37 (30.8)	26 (21.7)	9(7.5)
Beef sausage	35 (29.2)	23 (19.2)	40 (33.3)	22(18.8)
Pizza	34 (28.3)	24 (20.0)	36 (30.0)	26(21.7)

Table 6 Parameter estimates of probit regression

Parameter	Estimates	Std error	Z	Sig
Household size	0.76	0.025	3.029	0.002
Attitude	0.213	0.020	10.506	0.000
Perceived characteristics	0.49	0.011	4.690	0.000
Gender	2.578	0.256	10.051	0.000
Marital status	-0.149	0.089	-1.668	0.095
Age	-0.095	0.009	-10.108	0.000
Education	-0.574	0.153	-3.760	0.000
Life style	0.732	0.081	9.048	0.000
Religion	-0.410	0.142	-2.895	0.004
Occupation	-0.046	0.079	-0.585	0.558
Income	0.064	0.097	0.655	0.512
Purchase location	2.020	0.153	13.159	0.000
Purpose of purchasing	1.470	0.180	8.144	0.000
Brand acquaintance	0.006	0.142	0.044	0.965
Regularity of purchase	0.570	0.095	5.969	0.000
Beef type mostly eat	-0.540	0.075	-7.211	0.000
Intercepts	-17.161	1.067	-16.079	0.000
Chi-square	3.18			
df	103			
Sig	0.00			

DISCUSSION

As shown in table1, the findings indicates that 64% of the respondents were female and only 35% of them were male. This may be because the females are recognized of doing the shopping and groceries than males. Forty-two percent of the respondents were married, followed by 33% of those who are single then widowed and divorced respectively. Majority of them were between 30-40 years of age. Almost all of the households had both males (70%) and females (83.3%) adult present, it was rare were only one adult was found in house and of course the majority in the households were children. Most respondents (61.7%) had tertiary qualifications with only 10% of them who had only primary education. The respondents mostly like relaxing at home (48.3), travel loving (20.8) and entertainment respectively (11.7), with only 11.7 of them who are sporty. 89% of the respondents are Christian, followed by Muslim then other religion. Most of respondents are on private companies (44.2), government officials (20.8) and own business respectively (16.7), with an average income ranging from R600.00-R10000 per month (90%).

Table 2 is the frequency in beef purchasing, and the findings indicate that almost all respondents (82%) purchase beef at least once per week and their favorite location for purchasing is local butcher (79.2%). They only purchase from elsewhere when pressed for time (44.2%), looking for something extra special (33.2%) or something that is quick and easy to cook respectively (22.5%). And their main purpose of purchasing is for household consumption (92.5%). Most of the respondents are not brand acquainted (96.6%). Table 3 shows beef product preferences among consumers. It indicates that both in most of the respondents fresh beef ranks highest (79.2%), followed by dried beef (33.3%) by beef consumers. This result is in agreement with the previous literature of Chinese consumers' preference in relation to freshness of meats (Zhang 2002). Pre-cooked beef is the least popular type. Chilled beef (20.8%) is a rather new concept to Mafikeng consumers. It is offered mostly at supermarkets with good refrigerator facilities. The finding from table 4 which is the reason for consumers to purchase beef in preferred location, indicated that the reason for respondents to purchase in preferred location is because it give them best value for their(87.7%), most convenient(85%) and because the service is excellent(85%).

Table 5 is beef behavior on product preference, and it shows that various types of beef parts were popularly purchased especially ready-to-cook beef steak(40%), deep fried beef(32.5%) and meatball30.8%) respectively. The least purchased beef products was pizza and other beef products. Factors influencing consumer behavior in beef purchasing in Mafikeng. The result from the probit model in Table 6 showed that the coefficient/estimates for 8 variables were significant in Mafikeng. These estimates are gender (2,578), purchase location (2.020), purpose for purchasing beef (1.470), (household size), lifestyle (0.732), education (-0.574), regularity in purchasing

beef (0.570) and beef type (-0.540). the sigh for each estimates is consistent with expectation: that is the increase in males or female will increase the beef purchasing, the more the butchery (location) the higher the purchase, less education lead to decrease in beef purchasing, the more people buying every day the higher the beef purchasing and the less the beef type available the lower the beef purchase. Demographic characteristics in Mafikeng indicate that consumers are belonging to lower age group. Generally females are the dominant in households, with more children present in the households. Majority of consumers are married, and have a high education level with a middle income. The Mafikeng consumers mostly buy meat from butcheries, because they provide for best value for money. They only purchase their beef meat when pressed for time or looking for something extra special. And their main reason for buying beef is for household consumption. The consumers mostly buy fresh and dried beef. The most effecting factors for Mafikeng consumers to buy beef is because of the considerations on beef parts, price, more varieties for cooking, suggestions from known person and the beef colour quality.

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Analysis of Support Service Needs and Constraints facing Farmers Under Land Reform Agricultural Projects in North West Province, South Africa

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Abstract: The objective of the research was to analyze support service needs and constraints facing farmers under land reform agricultural projects in the Central district (Ngaka Modiri Molema) of the North West Province. The study covered the five (Ratlou, Tswaing, Mafikeng, Ditsobotla and Ramotshere) local municipalities of Ngaka Modiri Molema district in the North West Province of South Africa. Simple random technique (drawing from the hat method) was used to select 50 LRAD projects. Instrument of data collection was via structured and pre-tested questionnaire, the data was analyzed using the statistical package for social sciences (SPSS), regression analysis frequencies, mean and percentages. The study indicated that size of farms ranges from 6.6 – 1300 hectares. It was also evident that the project beneficiaries are faced with prominent constraints such as; lack of finance, poor building infrastructure, lack of fencing and poor input supply and these constraints have negative impact on the projects. Prominent support services needed by LRAD farmers are funding, building infrastructure, capital funds, farming infrastructure and inputs. The statistical analysis results have indicated that three of the seven variables were positive and one of the three variables was significantly associated with the probability of support services needs and constraints facing farmers under land reform agricultural projects. This is knowledge about extension officer. The regression results indicate that knowledge about extension officer ($t = 2.452$, $p = 0.019$) was highly significant. This variable tended to increase the chances of support services needs and constraints facing farmers under land reform agricultural projects.

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Introduction

Land is a very important scarce economic resource which is cherished by people of all races. It is the most basic need for rural people. The basic importance of land is that it provides people with food, fibre and other materials needed for clothing, housing and for various manufactured goods. Land contains mineral wealth and does not only form the basis of wealth, but also security and pride (Hubacek *et al*., 2002). For this reason, any attempt to dispossess rightful owners of their land can pose serious repercussions in any society. Zimbabwe can be cited as a perfect example where land issues have caused social, economic and political upheavals. In most developing countries the bulk of productive farm land is still owned by minority of land owners. The land suitable for cultivation is getting increasingly scarce because of the growing population pressure. This trend has caused a rise in the number of landless people as well as increasing the inequality of income and wealth distribution. All developing regions (Asia, Africa and Latin America) share impoverishment associated with increasing rural population pressures (Bokermann, 2008). In most countries, the highly unequal structure of land ownership is probably the single most important determinant of existing highly inequitable distribution of rural income and wealth (Todaro, 1994).

The Southern African Development Community region faces a number of land problems that relate to differences in its colonial history, land use policies, population dynamics and heterogeneity in land quality and investment. The issue of unequal access to land and control over benefits from its use and other natural resources has dominated discussions mainly in the former settler colonies such as Zimbabwe, Namibia and South Africa. The other countries that experienced low intensity settler land occupation have mostly encountered issues that are linked to utilization. Land problems have a potential to destabilize social, economic and political development particularly in Southern African Development Community region as a whole if not addressed (SADC, 2009).

The land issue has been of paramount importance in the history of South Africa. For a long time, the dispossession of land from blacks by colonial government was the order of the day. This consequently resulted in the creation of a racially diverse and divided society. The problem was accentuated by the introduction of the apartheid

system of government in 1948. Some of the effects of apartheid policies were the massive removal of blacks from their land to marginal and unproductive land. These massive removals led to the undermining of subsistence farming, which led to wide spread of poverty among black households. In contrast, white farmers were empowered to go into commercial agriculture through financial and technical support (Cousins, 2009).

The dispossession, among other things, resulted in resentment and emotional stress among people. Therefore, the desire to seek redress became of paramount importance. It is against this background that the first democratic government introduced the Land Reform Programme in 1994. As a result of decades of dispossession and racist land laws, land distribution in South Africa is among the most skewed in the world. The result of these racially divisive land laws is that 28% of South Africa's population (a large proportion of whom are farmers as well as farm workers and their dependants) live on 88% of the agricultural land. Thus the remaining 12% of agricultural land supports 72% of the rural population who are most found in former homelands (Department of Agriculture, 1998).

Following the advent of the new democratic dispensation, the South African government has put in place policies and programmes addressing the land issue. Land reform is the transfer of land ownership from existing land owners to new land owners with the aim of addressing the skewed land ownership patterns. Thus encouraging rural development, advancing the land rights and economic of the rural people. Land reform in South Africa is divided into three sub programmes, namely land restitution, land redistribution and land tenure reform. Land restitution is a legal process whereby persons or communities who can prove that they were dispossessed of their property after 19 June 1913, as a result of past racial discriminatory laws and practices can regain their property or receive due financial compensation for it. It is designed to restore property ownership or provide financial compensation to those who were dispossessed of their property under colonialism and apartheid. Therefore promotes equity for victims of dispossession by the state, particularly the landless and rural people. This facilitates development initiates by bringing together all stakeholders relevant to land claims and promotes reconciliation through the restitution process. This sub programme contributes towards an equitable redistribution of land rights (Department of Land Affairs, 2004).

Land redistribution is a process designed to transfer land from people who previously enjoyed favourable access to those who were excluded from land market on the basis of race. Land redistribution main purpose is to address the skewed land ownership patterns of colonial and apartheid past by providing people who were previously excluded from land market with access to land for residential and productive uses, in order to improve their income and quality of life. The programme aims to assist the poor, labour tenants, farm workers, women, as well as emergent farmers. The South African government adopted the principle of market-based approach, without lowering either the rights of those who have historically enjoyed favourable access to the land market. Government will assist in the purchase of land, but in general not be the buyer or owner. Rather it will make land acquisition grants available and will support and finance the required planning process (Department of Land Affairs, 1997).

It is more than seventeen years now since the Land Reform Programme has been operational. However, the debate has continued regarding the efficacy of the land policy and programmes. The concerns regarding the effectiveness of policy and programmes focus mainly on the lack of success of agricultural projects in the country in terms of the intended objectives. Many critics attribute the poor performance of the land reform programme to a number of issues. Anecdotal evidences suggest that farmers who were beneficiaries of land reform policy needed more than land in order to be successful farmers. Thomas and van den Brink (2006) highlighted that much more than land needs to be financed such as, other investments, inputs, resettlement, advice, overhead and land is only 30-40 percent of costs.

Geingob (2005) went further to highlight that the land reform process seems to have more concerned about the quantity of land transferred, the amount spent than the impact on beneficiaries and the beneficiaries' broader needs are not given adequate attention because the land reform process is not situated within integrated development strategies and this lack of post-transfer support keeps beneficiaries from using land productively.

Manenzhe (2007) stated that the provision of land alone is not enough to ensure productive use of that land and to make a positive difference to people livelihoods. Jacobs (2003) also revealed that after land reform beneficiaries have settled on the land, support may be required in the areas of agricultural production, infrastructure, finance and access to markets. The objective of the study is to examine and analyse support services needs and constraints facing farmers under land reform agricultural projects in North West Province, with a view to developing a comprehensive set of recommendations on how to

ensure the successful achievement of the specified set of goals.

Materials And Methods

The study was conducted in the North West Province of South Africa. The provincial land area is 118 797 square kilometers of grassland with scattered trees. Aside from mining, agriculture is the only sector in which the North-West province has a comparative advantage over the other provinces. The agricultural sector produces 13% of provincial GDP and provides jobs for 18% of the labour force in the province. Sunflower seeds, groundnuts, maize, wheat and cattle dominate the agricultural sector. The North-West province has a population of 3.5 million people, who constitute 9.5% of the South Africa's total population. In addition, 65% of this population lives in rural areas (Davis, 2009).

There are 4 districts and 21 local municipalities in North-West Province of South Africa. These districts are Ngaka Modiri Molema, Bojanala, Dr. Kenneth Kaunda and Dr. Ruth Segomotso Mompati. Ngaka Modiri Molema, Bojanala and Dr. Kenneth Kaunda districts comprise 5 local municipalities per district and Dr. Ruth Segomotso Mompati has 6 local municipalities (Department of Cooperative Governance, 2010). The selected study area is Ngaka Modiri Molema district and all 5 local municipalities in Central (Ngaka Modiri Molema) district. The local municipalities are Ratlou, Tswaing, Mafikeng, Ditsobotla and Ramotshere local municipalities. The target population for this study was beneficiaries of Land Reform for Agricultural Development (LRAD) in Ngaka Modiri Molema district. According to Rural Development and Land Reform (RD & LR) district office, the number of farmers under the approved and transferred LRAD projects as at 2011 is 75.

From four districts in North West Province, Ngaka Modiri Molema was selected randomly. From five local municipalities in Ngaka Modiri Molema there are 75 LRAD active projects from which 50 LRAD projects were selected randomly using the drawing from the hat method. A questionnaire was designed as a tool for data collection which consisted of open and closed ended questions. The questionnaire covered demographic and socio-economic variables of LRAD beneficiaries, support services needed by LRAD beneficiaries and constraints facing LRAD beneficiaries. Descriptive statistics such as standard deviation, mean and frequency distribution were employed to summarize the socio-economic data. Regression analysis was done to establish the socio-economic factors that influence support services needs and constraints facing farmers under land reform agricultural projects.

Results

The results of the study are presented in figures and tables. Figures 1, 2 and 3 show the demographics, socio-economic and sources of information of the respondents respectively. Table 1 presents the farming enterprises among respondents, Table 2 shows support services needed, Table 3 highlighted the level of severity of constraints and Table 4 presents the parameter estimates from multiple regression analysis.

Table 1: Farming Enterprises among respondents in the study area

Crop enterprises	Frequency	Percentage
Maize	25	50
Sunflower	22	44
Groundnuts	5	10
Wheat	4	8
Vegetables	12	24
Livestock enterprises		
Beef	35	70
Goats	12	24
Broilers	3	6
Dairy	4	8
Sheep	20	40
Pigs	8	16
Layers	1	2

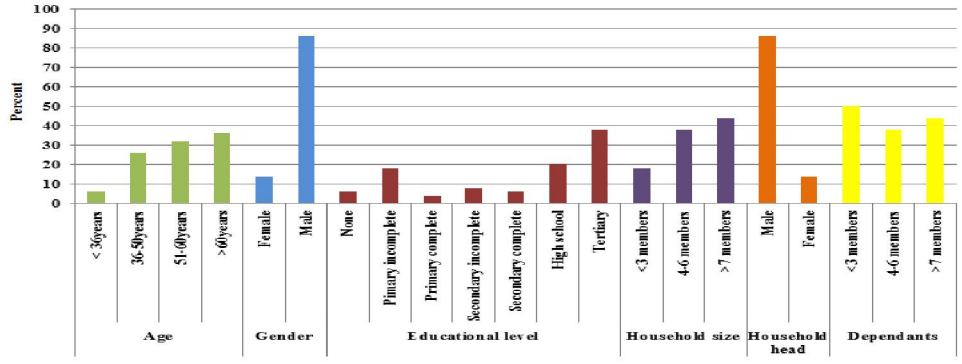

Figure 4.1 : Demographics of the respondents of the study

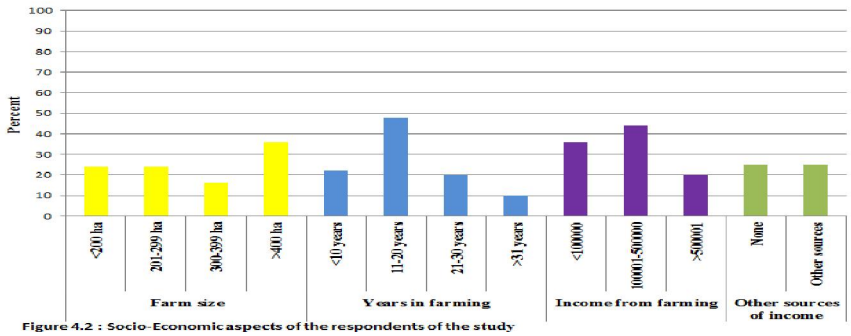

Figure 4.2 : Socio-Economic aspects of the respondents of the study

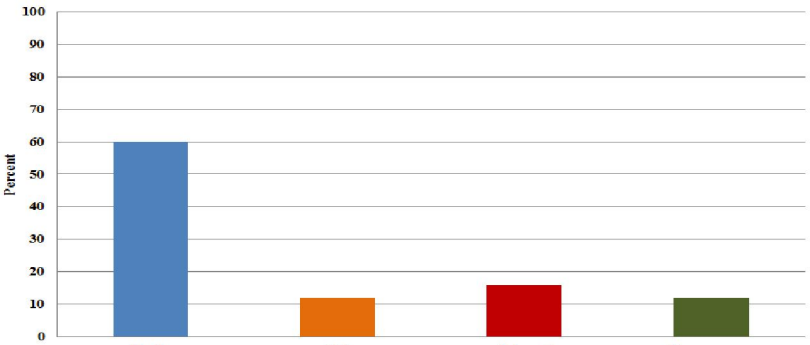

Figure 4.3 : Sources of information

Table 2: Support services needed

Services	Low	Medium	High
Funding	1(2)	3(6)	46(92)
Marketing	7(14)	35(70)	8(16)
Transport	4(8)	30(60)	16(32)
Building infrastructure	3(6)	11(22)	36(72)
Water	13(26)	22(44)	15(30)
Financial advice	7(14)	32(64)	11(22)
Roads	7(14)	25(50)	18(36)
Fencing	7(14)	10(20)	33(66)
Skills	3(6)	40(80)	7(14)
Training	2(4)	40(80)	8(16)
Management	2(4)	40(80)	8(16)
Inputs supply	7(14)	7(14)	36(72)
Support Services	4(8)	28(56)	18(36)
Capital funds	4(8)	2(4)	44(88)
Inputs	4(8)	8(16)	38(76)
Extension support	1(2)	36(72)	13(26)
Farming infrastructure	3(6)	11(22)	36(72)
Skills	2(4)	41(82)	7(14)
Mentorship programmes	4(8)	37(74)	9(18)
Farming advice	2(4)	40(80)	8(16)
Skills development facilities	2(4)	39(78)	9(18)
Access to electricity	21(42)	23(46)	6(12)
Labour force	36(72)	10(20)	4(8)
Machinery and implements	1(1)	28(56)	21(42)

Table 3: Level of severity of constraints

Constraints	Low	Medium	High
Funding / finance	1(2)	2(4)	47(94)
Marketing	7(14)	36(72)	7(14)
Transport	5(10)	25(50)	20(40)
Building infrastructure	3(6)	11(22)	36(72)
Water	13(26)	22(44)	15(30)
Erosion	42(84)	5(10)	3(6)
Roads	4(8)	28(56)	18(36)
Fencing	3(6)	12(24)	35(70)
Skills development facilities	1(2)	39(78)	10(20)
Lack of training	1(2)	40(80)	9(18)
Lack of management skills	1(2)	41(82)	8(16)
Inputs supply	2(4)	8(16)	40(80)
Lack of extension support	1(2)	37(74)	12(24)
Lack of cooperatives	17(34)	30(60)	3(6)
Conflict among members	43(86)	5(10)	2(4)
Linkage with projects	2(4)	47(94)	1(2)
Lack of sense of ownership	39(78)	7(14)	4(8)
Markets	9(18)	40(80)	1(2)
Labour force	36(72)	10(20)	4(8)
Lack of capital funds	1(2)	5(10)	44(88)
Lack of resources	1(2)	33(66)	16(32)
Poor performance	9(18)	36(72)	5(10)
Market price	2(4)	45(90)	3(6)
Lack of access to land	48(96)	1(2)	1(2)
Communications infrastructure	4(8)	44(88)	2(4)
Education	6(12)	37(74)	7(14)
Flows of information and opportunities	2(4)	42(84)	6(12)
Lack of access to credit	9(18)	34(68)	7(14)
Lack of practical Commercial know-how	5(10)	41(82)	4(8)
Lack of capacity building	2(4)	40(80)	8(16)

Table 4: Parameter estimates from multiple regression analysis

Variables	B	Std. Error	Beta	t	p
(Constant)	41.840	15.058		2.779	.008
Age	.110	.124	.151	.887	.380
Educational level	-1.142	.654	-.281	-1.745	.088
Household head	-4.687	3.824	-	-	.227

			.188	1.226	
Farming experience	-.200	.100	-.263	-1.379	2.00
Farming income	-2.615E-6	.000	-.217	-1.587	.120
Farming experience	2.905	4.700	.091	.618	.540
Extension contact	9.204	3.754	.346	2.452	.019
F	2.598				
Sig.	0.026				
R	0.554				
R Square	0.307				
D-Watson	2.035				

Discussion

Demographic and socio-economic characteristics of the 50 LRAD beneficiaries interviewed, such as age, gender, educational level, household size, household head, dependants, farm size, years in farming, income from farming, other sources of income and sources of information at the time of survey are presented in Figure 4.1, 4.2 and 4.3 respectively. The demographics of the respondents are presented in Figure 4.1. The results indicate that (36%) of the respondents were above 60 years of age, (58%) were between the age of 36-60 and only (6%) were 36 years and younger. This shows that there are more adults in the agricultural sector. This may be due to the rural-urban drift of the young. IFAD (2011) stated that the lack of interest by youth in farming poses a threat to agriculture and aggravates urban unemployment and social problems. IFAD further found that one of the difficult issues is that of attracting male and female youth. The study results established that (86%) of the respondents are males and (14%) are females. This shows that there are more men in farming than women. Adams (1995), found that land reform in Kenya favored men against women.

The distribution of respondents according to educational level show that (6%) never attended the school, (18%) primary school incomplete, (4%) primary school complete, (8%) secondary school incomplete, 6% secondary school complete, (20%) high school and (38%) tertiary. Werner (2003) found that most resettled beneficiaries had little or no knowledge of proper farming skills. The utilization of new technologies is critically dependent on workforces that is aware of them and understand how to use them. This also shows that there is a large number of project beneficiaries who are semi literate. Low education will also decrease productivity and income. However, good level of education helps to enhance technology adoption and increase the productivity and agricultural knowledge.

Households with less than three members was (18%), (38%) had between 4-6 members and 48% had more than 7 members. This shows that there are more households with more than 7 members. Aqhajanian (1986) suggested that farmers do adjust their household size to various aspects of the agricultural structure and further stated that considering the high rate of fertility in rural areas, the demographic mechanism of the downward adjustment of household size is the selective migration of young males to work in urban areas. Eighty six percent (86%) of the household heads are males and (14%) are females. This might be due to the fact that more male headed households are involved in farming than females. Kazianga & Wahhaj (2011) revealed that in many instances, gender is an important determinant in the allocation of resources within the household.

Figure 4.1 further shows that (50%) of the respondents have less than three dependants, (38%) had between 4-6 dependants and (44%) had more than 7 dependants. This might be due to the fact that farmers are aware of the importance of family planning. Abdul-Hakim and Che-Mat (2011) found that the dependency ratio, which is the ratio of the farmer to the number of dependants in the household, has a negative relationship with the probability to participate in off-farm employment and further state that the lower the dependency ratio, i.e. the larger the number of dependants, the higher the probability for the farmer to look for off-farm employment and since a farmer with a larger number of dependants requires a higher income to sustain the family and hence, has a higher probability to look for off-farm job.

The socio-economic aspects of the respondents of the study are presented in Figure 4.2. The results revealed that the farm size ranges between 6.6 – 1300 hectares. Thirty six percent (36%) of the respondents had more than 400 hectares, 16% had farm size that ranged between 300-399 hectares, (24%) had a farm size that ranged between 201-299 hectares and only (24%) had less than 200 hectares. This shows that the farms sizes of the majority (36%) of the respondents are more than 400 hectares. Joerger (2012) suggested that the size of a farm should be dependent upon the financial goals of the producer, hence meeting financial goals can be accomplished with a lower gross farm returns when the net farm income percentage is high, however increasing net farm income percentage requires a high level of willingness on the part of the manager to improve his or her farm management skills.

Regarding farming experience, (22%) of the respondents have spent less than10 years in farming while (48%) have 11 – 20 years of farming experience, (20%) have 21 – 30 years of farming experience and (10%) have more than 31 years of farming experience. This shows that the majority (48%) of respondents have 11 – 20 years of farming experience. Chiremba and Masters, (2012) stated that farming experience and skills are strong predictors of good performance and

farming experience is measured by the number of years that the household head has been farming and resettled.

The results indicated that (36%) of respondents had farm income of less than R100 000 per year. Forty four (44%) had a farm income that ranged between R100001 – R500000 per year and only (20%) had more than R500001 as farm income per year. This shows that the majority of the respondents had a farm income that ranged between R100001 – R500000 per year. World Bank (2009) found that the income of resettled households is more than five times as high as that of communal households in similar areas. To a certain degree (25%) gets a portion of their income from other sources like pensions and none farm enterprises.

The sources of information are presented in Figure 4.3. The results revealed that most (60%) of the respondents were receiving information through radio, television (12%), internet (6%) and news papers (12%). This shows that main sources of information remain radio. Access to usable information can have a significant impact on production. These results agree with that of Farm Radio International (2011) that radio is the most widespread medium for mass communications and by broadcasting in local languages, addresses the information and education requirements of farmers in Mali, Ghana, Tanzania and Uganda. This finding is further supported by Sokwanele, (2012) that radio is the main source of information among Zimbabwean farmers.

Farming enterprises are presented in Table 1. The majority (50%) of the respondents were engaged with maize, (44 %) sunflower, (10%) groundnuts, (8%) wheat and (24 %) for vegetables. This might be due to the fact that maize is eaten as a staple food by the majority of people in South Africa. Chianu *et al.*, (2009) highlighted that maize is the largest locally produced field crop and a key staple crop in the farming systems of Western Kenya. From Table 1, majority (70%) of the respondents rear beef cattle, (24%) goats, (6%) broilers, (8%) dairy, (40%) sheep, (16%) pigs and (2%) layers. It is clear from the table that the majority of the respondents' rears beef. Palmer and Ainslie (2012) stated that nationally, beef production is the most important livestock related activity, followed by small stock (sheep and goats) production.

The support services needed by LRAD beneficiaries are presented in Table 2. Most LRAD farmers indicated a high need of financial support. This shows that LRAD beneficiaries are in dire need of funding. With all things being equal, the absence of funding will lead to failure of LRAD projects. Tuta (2008) stated that most of the LRAD farmers reflected a need for more financial support in order for them to buy agricultural equipment. Tuta went further to highlight that the challenges experienced that were reflected by the interviewee when they provide their services amongst others, are insufficient financial resources which results in insufficient support services like vehicles.

It is seen from the table that (72%) of the respondents mentioned that the support services needed (building infrastructure) is high while about (22%) medium and (6%) low. This shows that LRAD farmers are in need of building infrastructure. Building infrastructure plays an important role in farming. Lahiff *et al.* (2008) highlighted that there is a general assumption on the part of the DLA that the provincial Department of Agriculture will provide support to beneficiaries of land redistribution, but there is no system yet in place to check what specific support will be required and whether the department has the resources and appropriate skills to meet the needs. It is also seen that that (88%) of the respondents mentioned that the support services needed (capital funds) is high while about (4%) medium and (8%) low. This shows that there is a lack of capital funds. Geingob (2005) highlighted that the situation is due to lack of efficient and effective post-settlement support services for beneficiaries and no funding for agricultural production has been established for the beneficiaries and the transfer of land is the end of the process for most beneficiaries hence they have to struggle all alone to better their living. Kariuki (2004) went further to highlight that the greatest challenge that faces the success of the land reform project is the lack of production capital to execute goals of business plan.

The majority (76%) of the respondents maintained that the support services needed (inputs) among members is high while about (16%) medium and (8%) low. This shows that LRAD farmers are in need of inputs. It is necessary that LRAD farmers should have access to support services. Kirsten and Machethe (2005) in a review of projects in the North West Province highlighted that there is a general agreement that government and the private sector should take hands in the delivery of land reform and in this joint venture, agribusiness and farmers will be the main partners of government. Kirsten and Machethe went further to highlight that agricultural cooperatives are the input supplier to cattle farmers, followed by rural trading stores and both cooperatives and agribusiness provide only limited additional support to their land reform clients, with the proportion of the (26%) projects that were supported, the highest in categories 1 and 2, which confirms the important role agribusiness needs to play in land reform.

Seventy two percent (72%) of the respondents maintained that the support services needed (farming infrastructure) among members is high while about

(22%) medium and (6%) low. This shows that LRAD farmers are in need of farming infrastructure. If LRAD farmers are to be empowered to play a constructive role in the development of agriculture, it is necessary that they should have access to support services. Manenzhe (2007) stated that recent studies have shown that land reform beneficiaries experiences numerous problems regarding access to complementary services such as infrastructure support, farm credit, agricultural inputs, training extension advice and access to markets for farm outputs and also assistance with productive and sustainable land use.

The level of severity of constraints facing LRAD beneficiaries are presented in Table 3. When the LRAD farmers were asked of what level of severity of constraints they face, most (94%) of them reflected a high level of severity of finance, while about (4%) medium and (2%) low. This shows that LRAD beneficiaries have very limited or no access to financial services, to obtain assistance. With financial support, farmers would be able to better manage scarce economic resources such as land, labour and capital and without it land reform projects can be severely handicapped. Jordaan and Jooste (2003) in a case study of Qwa Qwa emerging commercial farmers found that the lack of production finance and proper extension support experienced by respondents are problems encountered by other land reform beneficiaries.

It is seen that that (72%) of the respondents maintained that the level of severity of constraints (building infrastructure) among members is high while about (22%) medium and (6%) low. This shows that building infrastructure has a high level of severity. If LRAD farmers are to be empowered to play a constructive role in the development of agriculture, it is necessary that they should have access to support services. Kirsten and Machethe (2005) in a review of projects in the North West Province highlighted that of the 43 projects that were selected for in-depth appraisal, 19 had either decreased (10) or zero (9) production due to lack of investment in, and improvements and maintenance of farm infrastructure. It is also seen from the table that (70%) of the respondents mentioned that the level of severity of constraints (fencing) is high while about (24%) medium and (6%) low. This shows that there is a lack of fencing. Manenzhe (2007) in a review of three case studies from Limpopo Province found that smallholders have struggled to expand their production on these farms because of lack of irrigation and fencing to ward off stray livestock and individuals have applied for assistance under the Department of Agriculture's CASP, but have had no response from the extension officer or the Department since.

The majority (80%) of the respondents mentioned that the level of severity (inputs supply) is high while about (16%) medium and (4%) low. This shows that LRAD farmers are in dire need of inputs supply. Inputs supply plays a major role in farming. Manenzhe (2007) highlighted that land reform beneficiaries experience numerous problems regarding access to complementary services such as agricultural inputs, infrastructure support, farm credit, training extension advice and access to markets. Eighty eight percent (88%) of the respondents maintained that the level of severity of constraints (lack of capital funds) among members is high while about (10%) medium and (2%) low. This shows that lack of capital funds. Kirsten and Machethe (2005) in a review of projects in the North West Province highlighted that of the 43 projects that were selected for in-depth appraisal, 19 had either decreased (10) or zero (9) production due to limited access to funds to cover production costs.

The results of the multiple regression analysis showing relationship between socio-economic characteristics and services needed by LRAD farmers are presented in Table 4.9. The independent variables were significantly related to services needed ($F = 2.59$, $p< 0.05$). Also R value of 0.55 showed that there was a strong correlation between independent variable and services needed by LRAD farmers. The results further predicted (31%) of the variation in services needed by LRAD farmers. Significant determinants were educational level ($t = 1.74$, $p = 0.08$), farming experience ($t = -2.00$, $p < 0.05$), and extension contact ($t = -2.45$, $p < 0.05$) It implies that as educational level increases, services needed by LRAD farmers also increase, while as farming experience and extension contact increases, services needed by LRAD farmers decreases. A unit change in educational level leads to (28.1%) decrease in the services needed by LRAD farmers, while a unit change in farming experience will lead to 26.35 decreases in services needed by LRAD farmers.

The regression results show that a unit increase in extension contact will decrease support services needs and constraints facing farmers under land reform agricultural projects. Knowledge about extension officer exerts a positive effect on support services needs and constraints facing farmers' variable. Extension contact has a positive and significant relationship with the probability of support services needs and constraints facing farmers, i.e. the probability of support services needs and constraints facing farmers' decreases with an increase in extension contact. This suggest that a unit change in the extension contact leads to 34.6% change on the support services needs and constraints facing farmers under land reform agricultural projects.

The study has shown clearly that the beneficiaries of LRAD in North West Province are mainly males, between the ages of 36-60 years, had

tertiary education and had more than 7 persons as household size. Also majority had more than 400 hectares as farm size, with 11 – 20 years of farming experience, farm income that ranged between R100001 – R500000 per year, receiving information through radio and produce maize and rear beef cattle. The majority of the respondents received no support from CASP, and rated quality of support from CASP as poor. The most expected support by LRAD beneficiaries was financial and building infrastructure development. Funding and inputs supply were the major constraints with highest level of severity

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Socio-Economic And Job Characteristics Among Farm Workers In Mafikeng Municipality South Africa

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Abstract: The study examined personal and job characteristics and the socio-economic status of farm workers in the Mafikeng area, North West province, South Africa. A simple random sampling technique was used to select 100 farm workers to be interviewed. A structured questionnaire was developed based on the study objectives and related literature to collect data which were analyzed using frequency count, percentages and multiple regression analysis. The results show that the majority of farm workers fall between 20-30 years age group with males dominating and most have gone through primary education. The mean salary of most of the farm workers per month was R1 250.00. Medical aids, sectoral determination and labour unions were non-existent in different farms. In terms of possession of materials, 79% of the farm workers have chickens while 64% have dogs. 92% have radio, 93% have beds, 89% have tables and 59% have electric stoves. Also, 82%have cell phones while 78% have boots and rain coats each. Significant determinants of job characteristics were age (t = 4.66), gender (t = 2.66), Marital status (t = 3.46), educational level (t = 2.95), job category (t = -3.57), types of employment (t = -3.17) and family size (t = -3.32); while significant determinants of socio-economic status were age(t = 3.32), gender(t =3.11) and family size (t = 4.88). The findings have implications for the level of socio-economic status of the farm workers and the need to improve on their livelihoods.

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Introduction

The historical background to the deplorable conditions endured by South African farm workers lies generally in South Africa's history of colonial conquest and dispossession of indigenous people, but more particularly in the 1913 Natives Land Act. This piece of legislation outlawed the ownership of land by blacks in areas which was designated for white ownership. Essentially, it solidified the distribution of land that emerged from the era of colonial wars against indigenous tribes and polities. It further sought to roll back black ownership of land in certain areas. The outcome was that 87 percent of land became white owned, whilst blacks were relegated to the remaining 13 percent (Kassier 2005).

Since the dawn of democracy in 1994, the South African agriculture industry has been characterized by both, profound economic and political changes as well as continuities with its past, rooted in slavery, apartheid and paternalism. In this context Black farm workers, whose labour built the foundation of a prosperous agricultural industry, still belong to the most marginalised groups in post-apartheid society. A number of state and non-state actors, however, attempt to improve the economic and social positions of farm workers in South Africa (Schweitzer, 2008). Schweitzer, (2008) argued that these so called Black Empowerment projects are based on partnerships between White farmers, farm worker communities and complex networks of actors, ranging from state agencies to nongovernmental organisations, international organisations, businesses and private individuals. The mobilisation of these actors and their resources allows farm workers to become land and business owners and in the process to acquire other economic, educational and symbolic benefits. While these projects demonstrate how marginalised Black farm workers become farmers, they also show a series of shortcomings – first and foremost that the 'new Black farmers' do not obtain real autonomy. The same can be said about current living and working conditions of most Black farm workers. The latter still belong to the most marginalised social groups in post-apartheid society, as their income level show that they are even the poorest in the formal economy (SAWB 2003). Those who are permanently employed or whose relatives are permanently employed usually stay on the farm in housing provided by the farmer. The quality of housing largely depends on the attitude of the farmer and ranges from "decent" to "scarcely fit for human habitation" (Ewert and Hamman 1999). Similarly, the educational background of farm workers indicates their marginal position in society. According to (Kassier 2005). almost one-fifth had no access to

formal education and many are illiterate. Moreover, due to their working and living conditions, farm workers are two to three times more likely to get infected by tuberculosis than people living in urban areas (SAWB 2006).

Only half of South Africa's potential labour force is able to find employment in the formal economy. Women, the less skilled and those who live in rural areas are more likely to be poor, and less likely to find formal sector employment. In this regard, the farm labour force sits at the junction between the formal and informal economies. Farm workers earn more than those engaged in informal activities in urban and non-urban areas, yet they earn less than any other workers in the formal economy do. Their duties include inter alia applying pesticides, herbicides, and fertilizer to crops and livestock; plant, maintain, and harvest food crops; and tend livestock and poultry. Repair farm buildings and fences. Duties may include: operating milking machines and other dairy processing equipment; supervising seasonal help; irrigating crops; and hauling livestock products to market.

Most people in the North West are employed on farms, making the agricultural sector the biggest employer in the province. Farm workers are crucial due to their contribution to food production, however, farm workers are the worst-paid labourers and their working conditions are not always favourable. This study will focus on the socio-economic status and job characteristics of farm workers in the Mafikeng and Ramotshere-Moiloa District, Farm workers cited anecdotal experiences of their suffering at the hands of farm owners who they allege to have little or no regard for their well being. The objective of the study is to determine the socio-economic and job characteristics among farm workers in Mafikeng municipality South Africa. The study specifically identified personal characteristics of farm workers, determined job characteristics of farm workers, ascertained their socio-economic status of farm workers and determined relationship between socio-economic status and job characteristics of farm workers. Also, significant relationships between personal characteristics, job characteristics and socio-economic status of farm workers were explored

Materials And Methods

North West is a province of South Africa with capital in Mafikeng. The province is located to the west of the major population centre of Gauteng. North West was created after the end of Apartheid in 1994, and includes parts of the former Transvaal Province and Cape Province, as well as most of the former Bantustan of Bophuthatswana. North West borders Kgatleng and Kgalagadi districts of Botswana and provinces within south Africa such as Limpopo, Gauteng, Free State and Northern Cape. North West Province is traversed by the northwesterly line of equal latitude and longitude The North West province has 4 district municipalities and 21 local municipalities, listed below.

The population of study is farm workers in the Mafikeng and Ramotshere Moiloa Municipalities. According to Statistics South Africa (2002), there were 5 349 farming units (farms) in the North West province during the year 2002 and only 29 for Mafikeng. Eight farms consisting of three commercial farms and five communal farms were randomly selected. One Hundred farm workers were randomly selected and interviewed for this study. Data were collected using a structured questionnaire which was made of three sections namely: personal characteristics, socio-economic status and job characteristics. Personal characteristics section consisted of twelve (12) variables such as age, gender, marital status, nationality, educational level, job category, job positions, type of employment, salary grade, religion, source of information and family size. Job characteristics' section consisted of forty-seven (47) items with three scale type of Satisfactory (3), Moderately Satisfied (2) and Not Satisfied (1). The last section was for Socio-economic status with ninety-three (93) items and consists of three scale of Posses (Yes), and Posses (No), and Number of those items posses. Socio-economic status comprised on three sub-sections with one focused on socio-economic status on agricultural possession, the other on household possessions and the other focused on other utilities. This was adapted from Akinbile (2007). Data collected were sorted, coded and subjected to analysis using SPSS. The percentages, mean and standard deviation were used to describe data. The relationship between socio-economic status and personal characteristics were explored with multiple regression analysis.

Results

The results from the data analysisare summarized into six tables. Table 1 presents the percentage distribution of farm workers on the basis of personal characteristics; Table 2 shows the percentage distribution of farm workers on the basis of agricultural possessions, Table 3 depicts the percentage distribution of farm workers on the basis of household possessions. Table 4 shows percentage distribution of farm workers on the basis of other utilities possessions, while Table 5 presents job characteristics with mean and standard deviation and Table 6 shows multiple regression analysis of relationship between, socio-economic status and personal characteristics of farm workers.

Table 1: Percentage distribution of farm workers on the basis of personal characteristics

Variables	Percentage
Age	
Less than 20 Years	2
20-30 years	39
31-40 years	26
41-50 years	23
51-60 years	10
Gender	
Male	74
Female	26
Marital status	
Single	54
Married	19
Cohabiting	27
Nationality	
Republic of South Africa	93
Republic of Zimbabwe	7
Educational level	
Grade 1-6	91
Grade 7-11	9
Job category	
Technical Operators	13
General Labourer	87
Employment types	
Permanent	87
Temporary	13
Salary grade	
R10 000- R15 000 per annum	63
R16 000- R20 000 per annum	37
Information sources	
Radio	91
Television	9
Family size	
1--3	61
4--6	36
Above 6	3

Table 2: Percentage distribution of farm workers on the basis of agricultural possessions

SOCIO-ECONOMIC CHARACTERISTICS (Agric. possession)			
Items	**0**	**1--3**	**Above 3**
Cattle	92	3	5
Horse	100	0	0
Sheep	97	2	1
Goats	84	0	16
Pigs	100	0	0
Dogs	36	63	1
Cats	92	8	0
Donkey	100	0	0
Donkey-Cart	100	0	0
Tractor	99	1	0
Chickens	21	1	78
Turkeys	86	0	14
Peacocks	98	0	2
Land	99	1	0

Table 3: Percentage distribution of farm workers on the basis of household possessions

Household materials	**0**	**1--3**	**Above 3**
Radio	8	92	0
Television Set	52	48	0
DVD Player	75	25	0
Heater	79	21	0
Bed	1	99	0
Wardrobe	50	50	0
Kitchen unit	36	64	0
Table	11	89	0
Chairs	3	57	40
Fridge	91	9	0
Electric stove	41	59	0
Microwave	99	1	0
Kettle	26	74	0
Boiler	100	0	0
Decoder	100	0	0
Satellite dish	100	0	0
Plates	0	4	96
Table spoon	0	39	61
Tea spoon	3	63	34
Knives	0	96	4
Fork	16	77	7
Computer	100	0	0
Air-conditioner	100	0	0
Blankets	0	5	95
Pillows	0	79	21
Curtains	6	64	30
Bath	0	100	0
Mug	0	39	61
Glasses	7	51	42
Window pane	6	69	25
Wooden door	6	94	0
Ironing board	72	28	0
Coffee table	90	10	0
Sofas	96	4	0
Water-buckets	0	95	5
Lawnmower	100	0	0
Drill-machine	99	1	0
Welding-machine	95	5	0
Washing-machine	100	0	0
Sewing-machine	99	1	0
Calendar	4	96	0
Spade	49	51	0
Rake	54	46	0
Spade-fork	78	22	0
Saw	54	46	0

Table 4: Percentage distribution of farm workers on the basis of other utilities possessions

Other Utilities	0	1--3	Above 3
Car	99	1	0
Bicycle	100	0	0
Wheelbarrow	72	28	0
Electricity	21	79	0
Protective clothing	8	74	18
Running portable water	6	94	0
Toilet/ablution facility	11	89	0
Cell phone	18	82	0
Camera	100	0	0
Umbrella	16	77	7
Travelling bag/suitcase	1	80	19
Jackets	0	70	30
Trousers	15	21	64
Blouse	75	7	18
Shirts	24	39	37
T-Shirts	0	37	63
Denim jeans	16	79	5
Gown	75	9	16
Sunglasses	58	42	0
Raincoat	22	78	0
Boots	10	78	12
Shoes	0	86	14
Socks	0	71	29
Hats	0	74	26
Underwear	4	54	42
Tool-box	88	12	0
Yard	96	4	0
Gate	96	4	0
Pens	21	79	0
Notebook	28	72	0
Diary	92	8	0
Watch	39	61	0
Calculator	100	0	0
Washing line	100	0	0

Table 5: Job Characteristics with mean and standard deviation

Job Characteristics Items	Mean	Standard Deviation
Pressure on improved performance	1.92	0.6
Infrastructure for work	2.03	0.69
Working Hours	2.28	0.93
Vote during National, Provincial and Municipal election	2.41	0.75
Relationship with manager/foreman	2.16	0.58
Relationship with subordinates	2.04	0.45
Accommodation provided at the farm	2.48	0.78
Accommodation electricity	2.43	0.89
Accommodation ablution facilities	2.38	0.79
Accommodation running portable water	2.6	0.53
Salary	1.59	0.53
Farm policies	1.62	0.55
Morale within the farm	1.62	0.49
Authority within the farm	1.98	0.51
Job status	1.58	0.49
Promotion	1.52	0.5
Medical Aid	1	0
Loan Schemes	1.13	0.34
Working Conditions	1.86	0.49
Work Equipment (Resources)	2.35	0.74
Leave entitlement	2.01	0.92
Overtime Remunerations	1.66	0.71
Salary advice/Pay slip	1.97	0.98
Labour Union	1	0
Sectoral Determination	1	0
Job Description	1.98	0.45
Response to challenges	1.8	0.4
General operations	2	0.25
Bonuses	1.63	0.52
Documents and Contracts written in vernacular language	1.01	0.1
Night shift allowance	1.45	0.67
Compensation for Sunday and Public Holiday work	1.66	0.63
Pay/salary in South African Currency	3	0
Salary on every month-end	2.77	0.55
Pay-day on the agreed date between employer and employee	2.74	0.58
Foul language within the farm	1.95	0.43
Conflicting orders	2	0.35
Qualification for job	1.94	0.44
Job specialization	2.07	0.38
Job security	1.98	0.81
In-Job training	2.36	0.69
Deductions on your salary	1.9	0.57
Flexibility and initiative	1.74	0.44
Meal intervals during working hours	2.61	0.75
Provision of food within the farm	2.55	2.04
Does employer know your physical address of your next of kin in case of unforeseen circumstances	2.48	0.87
Burial rites within the farm	1.2	0.4

Table 6: Multiple regression analysis of relationship between, socio-economic status and personal characteristics of farm workers

	Job characteristics					Socio-economic status				
	B	Std. Error	Beta	t	Sig	B	Std. Error	Beta	t	Sig
(Constant)	76.31	25.37		3.00	.003	138.29	44.9		3.08	.003
Age	6.75	1.45	.48	4.66	.000	8.53	2.56	.289	3.32	.001
Gender	8.48	3.18	.25	2.66	.009	17.54	5.63	.249	3.11	.002
Marital status	5.62	1.62	.33	3.46	.001	-1.66	2.87	-.046	-.57	.56
Nationality	-1.90	9.13	-.03	-.20	.835	-10.62	16.16	-.088	-.65	.51
Educational level	13.12	4.44	.25	2.95	.004	-5.61	7.86	-.052	-.71	.47
Job category	-12.54	3.50	-.28	-3.57	.001	.18	6.21	.002	.03	.97
Type of employment	-10.68	3.36	-.24	-3.17	.002	-26.03	5.95	-.283	-4.37	.00
Information sources	4.19	8.03	.08	.52	.602	-1.03	14.21	-.010	-.07	.94
Family size	-3.46	1.04	-.34	-3.32	.001	8.99	1.84	.424	4.88	.00
F	10.53					19.3				
p	0.00					0.00				
R	0.72					0.81				
R square	0.51					0.65				

Discussion

In Table 1, the majority of farm workers fell between 20-30 years age group, this may be as a result of high unemployment rate that the country is currently experiencing. Kruger et al., (2006), concluded that employment is usually linked to men, while most women have access to casual jobs only. The male dominates the farming sector as farm workers as a result of the type of work associated with 'hard labour'. Males are known to take care of the families, as women are regarded as those who care for the house. About 70% of all agricultural workers are male. Farm workers are also relatively young, their average household size is relatively small, and the overwhelming majority is South African citizens and female farm workers are paid less than male. This gender disparity exists despite the fact that the female are better educated than male. Female are paid less because the tasks typically performed by female are viewed as less skilled, and because employers often choose to view male workers as 'permanent' while female are viewed as 'casual' workers whose employment is contracted via a male partner. Most of the respondents are not married, the figure of singles stands at 54%, and this may be of a fact that most farm workers fell on 20-30 years age group while 27% of them are cohabiting as a result of testing each other's compatibility or saving money for lobola; with only 19% being married.

Seven percent of farm workers are from the Republic of Zimbabwe, this may result from the collapse of agriculture in Zimbabwe has resulted in an influx of skilled farm workers to South Africa and 93% of farm workers are South African Citizen as a result of high rate of unemployment, most of South African citizen has no other option but to look for job elsewhere and working on the farm is no exception. Most farm workers (91%) had primary school level of education. This may emanates from the fact that the type of work concern does not require any formal qualification. Only 9% of farm workers have surpassed the grade 6 and above. Vorster et al., (2000) concluded that farm workers have the lowest literacy rate in South Africa and the immense backlog in education services still persists on farms. About 87% of farm workers were permanent and mostly classified as general labourers, the interaction was that honesty can lead to one being registered as a permanent worker; and only 13% of them were temporary workers. Temporary workers present a heterogeneous assemblage of casual, seasonal and contract workers who have far less legal rights than their permanently employed counterparts (Schweitzer, 2008). The results on income show that 63% of farm workers earn R10 000—R15 000 per annum and the mere 37% were earning R16 000—R20 000, this may be as a result of compensation from public holidays and Sundays work. Kruger et al., (2006) found out that those women who were permanently employed in a farm had a mean cash income of R500.00 per month; the mean income of male workers on farms in the Ventersdorp district was R544.00 per month. Most farm workers in addition to their income received benefits from farm owners such as free access to accommodation and water, with the conditions of accommodation and also the type of sanitation varying greatly between farms.

According to Statistics South Africa (2007) ownership of a radio, television, computer, refrigerator and cell phone has increased considerably between 2001 and 2007, this concurred well as 91% of farm workers rely on radio as a source of information, this may be a result of the price tag on radio compared to other audio-visual equipments and only 9% utilize television. Farm workers had varying family size ranging from 1-3 was observed to be 61% and 4-6 with 36% and above 6 family size ought to be only 3%, this might resembles the outcome of cost of living; as more and more families tried in vain to reduce the size of the

family due to high costs of food prices, school fees, clothing, toiletries, transport. Husy and Samson, (2001) observed that as opposed to those employed on farms, consideration has to be given to the dependents of these workers who are resident on farms. In general, dependents constitute additional 4-5 members of the family unit, reflecting an approximate national number of employees and dependents permanently residing on farms.

From Table 2, prominent agricultural possessions among respondents in the study area were chicken (78%), goats (16%) and turkey (14%) as well as cattle (8%). The indicators of socio-economic status change with time in every community because of the dynamics of human existence. With the agrarian-based community made up of some disguisedly poor ruralite and a generally poverty ridden farming population (Olawoye, 2002). In terms of the possession of household materials by the farm workers prominent items include radio, bed, blankets, pillows, table, water-buckets, bath, calendar, window panes, wooden door and eating utensils are the most objects that almost every farmworker possess. These materials are the basic necessity for the farmer workers in order to enhance their existence due to the vagaries of weather and sustaining their work-life (Table 3). Ovwigho (2009) found similar results among farmers in Nigeria.

Table 4 shows that on other utilities, there are findings that only one farm worker from the rest owns a motor vehicle, and most household have electricity. A substantial portion of the farm-worker community in South Africa is comprised of the descendants of people who may have occupied and farmed white-owned land in a relatively independent manner. Those who are permanently employed or whose relatives are permanently employed usually stay on the farm in housing provided by the farmer. The quality of housing largely depends on the attitude of the farmer and ranges from “decent” to “scarcely fit for human habitation” (Ewert and Hamman 1999). Protective clothing and cell phones seemed to be the most common item they possess. There seems to be no interest on calculator, camera, toolbox and diaries. Ovwigho (2011) found similar results among farmers in Nigeria.

Table 5 shows a list of 47 indicators of job characteristics of farm workers. The respondents were asked to rate the statements using 3 point Likert-type scale as follows; 3 satisfactory, 2 moderately satisfied and 1 not satisfied. The actual mean is 2 due to the rating scale and a mean of greater than 2 denoted a satisfaction while a mean less than 2 denoted non-satisfaction with their job characteristics. Out of the 47 indicators 18 items had mean score higher than 2, which implies that farm workers were only satisfied with 18 indicators. The 18 indicators are work related such that the farm workers were able to carry out their duties without interruption. The mean scores for non-work related indicators were less than 2, which is an indication of non-satisfaction. Prominent indicators farm workers were satisfied with include: Salary on every month-end (2.77); Pay-day on the agreed date between employer and employee (2.74); Meal intervals during working hours (2.61); Provision of food within the farm (2.55); Accommodation provided at the farm (2.48) and employer knowledge of workers’ physical address of your next of kin in case of unforeseen circumstances(2.48). According to SAWB (2003) farm workers were the most marginalized social groups in post-apartheid society, as their income level show that they are even the poorest in the formal economy. Those who are permanently employed or whose relatives are permanently employed usually stay on the farm in housing provided by the farmer. The quality of housing largely depends on the attitude of the farmer and ranges from “decent” to “scarcely fit for human habitation” (Ewert and Hamman 1999). Moreover, due to their working and living conditions, farm workers are two to three times more likely to get infected by tuberculosis than people living in urban areas (SAWB 2006). Most farm workers in addition to their income received benefits from farm owners such as free access to accommodation and water, with the conditions of accommodation and also the type of sanitation varying greatly between farms. On some farms, however, farm workers had to pay for accommodation. On most of the farms, farm workers were able to buy subsidised food such as fresh milk, meat, maize meal, eggs, poultry or vegetables from the farm owner, depending on the type of farming (Kruger et al., 2006).

Farm workers indicated that they were not satisfied with pressure on improved performance; Salary; Farm policies; Morale within the farm Authority within the farm; Job status; Promotion; Medical Aid; Loan Schemes; Working Conditions; Overtime Remunerations; Salary advice/Pay slip; Labour Union; Sectoral Determination; Job Description; Response to challenges; Bonuses; Documents and Contracts written in vernacular language; Night shift allowance; Compensation for Sunday and Public Holiday work; Foul language within the farm; Qualification for job; Job security; Deductions on your salary; Flexibility and initiative, and Burial rites within the farm.

The result of multiple regression analysis of relationships between farm workers’ personal characteristics and job characteristics were presented in Table 6. The independent variables were significantly related to job characteristics with F value of 10.53, $p < 0.05$. Also, R value of 0.72 showed that there was a strong correlation between independent

variables and job characteristics. The result further predicted 51 percent of the variation in job characteristics by farmer workers. Significant determinants were age (t = 4.66), gender (t = 2.66), Marital status (t = 3.46), educational level (t = 2.95), job category (t = -3.57), types of employment (t = -3.17) and family size (t = -3.32). It implies that as farmers age, gender, marital status, and educational level increases, the more satisfactory they become with job characteristics. In terms of farm workers' socio-economic status, independent variables were significantly related to socio-economic status with F value of 19.3, $p < 0.05$. Also the R value of 0.81 shows that there was a strong correlation between independent variables and socio-economic status. Table 6 further revealed that 65 percent of the variation in socio-economic status of farm workers were predicted by independent variables. Significant determinants were age(t = 3.32), gender(t =3.11) and family size (t = 4.88). The results imply that as age and gender and family size increases, socio-economic status would increase.

The following conclusion can be drawn based on the findings that majority of farm workers are males. Most of the farm workers are illiterate with very few above primary education level. The majority earn between R10 000—R15 000 per annum. None of the farm workers possess medical aid. Agricultural possession can be observed in only few of farm workers. Significant determinants of job characteristics were age, gender, Marital status, educational level, job category, types of employment and family size, while Significant determinants of socio-economic status were age, gender and family size.

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CFD analysis of the ball valve performance in presence of cavitation

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Abstract: In this paper, the ball valve performance was numerically simulated using an unstructured CFD code based on finite volume method. Navier-Stokes equations in addition to a transport equation for the vapor volume fraction were coupled in the RANS solver. Separation was modeled very well with a modification of turbulent viscosity. In this paper, the results of CFD calculations of flow through a ball valve based on the concept of Chern & Wang [8] experimental data are described and analyzed. Comparison of flow pattern at several opening angles was investigated. Pressure drop behind of the ball valve and formation of vortex flow after the valve section have been discussed. As the opening of the valve decreases, these vortices grow and may cause more pressure drop. In other words, more energy is lost due to these growing vortices. In general, the valve opening plays very important roles to the performance of a ball valve.

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Keywords: Ball Valve, CFD Code, Finite Volume, RANS, Cavitation, Performance

Introduction

The ball valves are rotary valves can be utilized as control valves or block valves in a system or a process. They generally rotate 90 degree to block the flow. Ball valves have low-pressure drop, good flow capabilities, and good temperature and pressure ratings. The ball valve has low cost, compact, and easy to fix. So it is the best instrument for on-off service and can be used for throttling service. The selection of their size, design and material plays an important role in reliability and performance of any system. Advanced technology is required to manufacture ball valve. Therefore, it is vital to know the characteristics of fluid flows inside a ball valve.

Cavitation is a destructive phenomenon in hydraulic components and systems. It not only destroys the flow continuity and changes the physical performance, but also in many cases, it results undesirable effects such as intensive noise, vibration and erosion of the solid surfaces. Severe cavitation damage can limit the life expectancy of the valve. So it is very important to know in which conditions the severe cavitation may appear.

More experimental researches about the cavitation phenomenon were performed in ball valves Work .Hutchison [1], Kirik and Driskell [2] and Pearson [3] supplied useful information on the design of ball valves. Ota and Itasaka [4] investigated the surface pressure distribution behind a blunt body to understand the structure of the recirculation behind the blunt body. In addition, Kelso et al. [5] also measured the surface pressure distribution and investigated the balance between the pressure distribution and Reynolds shear stress along the separation streamline and the surface behind a surface-mounted blunt plate. Mertai et al. [6] constituted a water tunnel system to survey the performance test of a V-sector ball valve. They used an LDV measuring system to explore the flow filed in ball valves. Davis and Stewart [7] employed a closed piping system to test and behold a global control valve flow. Chern & Wang [8] utilized particles and a laser sheet to visualize flow patterns through a ball valve. Cavitation phenomena were observed at some valve openings. If the flow structure in a ball valve is available, it would help engineers to improve the performance of ball valves. It is now possible to observe the Structures of vortices especially the cavitation phenomenon inside a ball valve by computational analysis. Computational fluid dynamics (CFD) has become an important instrument for design of fluid machinery. It has also been applied to valve research. Therefore the designing valves can be done much faster. CFD analysis can show the complex flow structure at the valve. Mertai et al. [9] used a commercial package, FLUENT, to survey the flow at a V-sector ball valve. Van Lookeren Campagne et al. [10] also adopted a commercial package, AVL-Fire TM, to simulate flows containing bubbles in ball valves. In this study,

CFD analysis of flow field and flow patterns inside the ball valve has been carried out to understand its performance and safeties. Various patterns of flows in and downstream the ball valves in different valve openings and inlet velocities are investigated. Finally, cavitation phenomena are observed under certain conditions. Further more, Good agreements were obtained between the experimental and the numerical results.

Governing equation

Fluids have to conserve mass and momentum, so the continuity equation and the Navier-Stokes equations are used as governing equations**.** For the multi-phase flow solutions, the single-fluid mixture model is applied**.** The vapor-liquid flow defined by a single-fluid model is treated as a homogeneous bubble-liquid mixture. Thus, one set of equations is needed to simulate cavitating flows. To deal with turbulent flows, the Reynolds averaged approach is utilized to decompose mean quantities and fluctuations for all of the physical variables. In this work, only the case of two phase flow is considered to investigate the cavitation phenomenon in the ball valve, and there is no relative or slip velocity between the two phases, so the flow is homogeneous**.** Therefore, 3-D governing equations can be denoted as:

$$\frac{\partial}{\partial t}\left(\rho_m\right)+\nabla.\left(\rho_m\overrightarrow{V_m}\right)=m^{\bullet}$$

$$\frac{\partial}{\partial t}\left(\rho_m\overrightarrow{V_m}\right)+\nabla.\left(\rho_m\overrightarrow{V_m}\overrightarrow{V_m}\right)=-\nabla P+\nabla.\left[\mu_m\left(\nabla\overrightarrow{V_m}+\nabla\overrightarrow{V_m}^{T}\right)\right]+\rho_m\vec{g}+\vec{F}+\nabla.\left(\sum_{k=1}^{n}\alpha_k\rho_k\vec{V}_{dr,k}\vec{V}_{dr,k}\right)$$

The Equation (1) is continuity and the Equation (2) are momentum equation for the mixture, respectively**.** $m^{\bullet}$ Represents mass transfer due to cavitation. Where F is the body force. V_m is the mass-averaged velocity, refers to Reynolds averaged components in three directions. ρ_m is the mixed density, μ_m is the mixed viscosity and μ_{mt} is the mixed eddy viscosity. Homogenous mixture properties that controlled by vapor volume fraction of the phase *k* are defied as following:

$$\rho_m=\sum_{k=1}^{n}\alpha_k.\rho_k$$

$$\mu_m=\sum_{k=1}^{n}\alpha_k\mu_k$$

$$\mu_{mt}=\frac{\rho_m C_\mu k^2}{\varepsilon}$$

α_k is the vapor volume fraction of the phase k *and* n is the number of phases.

$$\sum_{k=1}^{n}\alpha_k=1$$

and $\vec{V}_{dr,k}$ is the drift velocity for secondary phase *k*

$$\vec{V}_{dr,k}=\vec{V}_k-\vec{V}_m$$

Additionally, a transport equation for the volume fraction for the secondary phase *p* is required. In this case α_p means actually vapor volume fraction. From the continuity equation can be obtained:

$$\frac{\partial}{\partial t}\left(\alpha_p\rho_p\right)+\nabla.\left(\alpha_p\rho_p\overrightarrow{V_m}\right)=-\nabla.\left(\alpha_p\rho_p\vec{V}_{dr,p}\right)$$

Turbulence Modeling

Reynolds stress due to velocity fluctuations. Because of the unknown Reynolds stress, more equations are required to close the RANS equations. Hence, a turbulence model is required to simulate the Reynolds stress in turbulent flows. So, the author choose , the standard k-ε turbulence model with wall function, because the k-ε model does not involve the complex nonlinear damping functions required for the other models and is therefore more accurate and more robust [11]. The transport equations of k and ε are as follows:

$$\frac{\partial\left(\rho_m k\right)}{\partial t}+\frac{\partial\left(\rho_m\vec{u}_j k\right)}{\partial x_j}=p_t-\rho_m\varepsilon+\frac{\partial}{\partial x_j}\left[\left(\mu_m+\frac{\mu_{mt}}{\sigma_k}\right)\frac{\partial k}{\partial x_j}\right]$$

$$\frac{\partial\left(\rho_m\varepsilon\right)}{\partial t}+\frac{\partial\left(\rho_m\vec{u}_j\varepsilon\right)}{\partial x_j}=C_{\varepsilon 1}\frac{\varepsilon}{k}p_t-C_{\varepsilon 2}\rho_m\frac{\varepsilon^2}{k}+\frac{\partial}{\partial x_j}\left[\left(\mu_m+\frac{\mu_{mt}}{\sigma_k}\right)\frac{\partial\varepsilon}{\partial x_j}\right]$$

The turbulence production, Reynolds stress tensor terms, and the Boussinesq eddy viscosity concept are defined as:

$$p_t = \tau_{ij} \frac{\partial \overline{u_i}}{\partial x_j}$$

$$\tau_{ij} = -\overline{\rho u_i' u_j'}$$

$$\overline{u_i' u_j'} = \frac{2k\,\delta_{ij}}{3} - \nu_t \left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right)$$

The empirical coefficients originally proposed by Launder and Spalding [12] assuming local equilibrium between production and dissipation of turbulent kinetic energy are as follows:

$$C_{\varepsilon 1} = 1.44; C_{\varepsilon 2} = 1.92; \sigma_\varepsilon = 1.3; \sigma_k = 1$$

Numerical Method

An unstructured CFD code based on finite volume method is used for three-dimensional calculations. Velocity-pressure coupling and the overall solution procedure are based on a SIMPLE type segregated algorithm adapted to unstructured grids. The diffusive flux is discretized using the second order central difference scheme, for the convective flux the first order upwind scheme is considered. The discrete equations are solved using point wise Gauss-Seidel iterations, and algebraic multi-grid method accelerates the solution convergence. The transport equation based on cavitation models, which was described earlier, is implemented into the solver, and related modifications regarding the convection schemes and the pressure-based algorithm have been made.

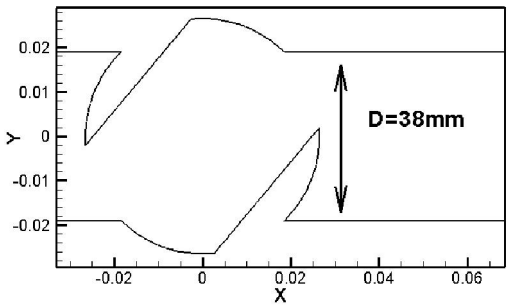

Fig.1 . ball valve geometry

Geometry

Figure 3 demonstrates the 3-D computational mesh utilized in the numerical simulation. The entrance length from the upstream boundary to the valve is 20D. The downstream length from the valve to the outlet boundary is 60D. The diameter of the pipe, *D*, is 38 mm and is used as the characteristic length of Reynolds number. The test section, as shown in Fig. 3, includes a ball valve of nominal diameter 50.8 mm (2 in.).

Unstructured grids are applied to the ball valve. Structured grids are used for the rest of domain including the pipe. Tetrahedron elements are generated for ball valve and the region close to the valve. Other part of the domain is meshed with hexahedron elements. There are more cells close to the behind of valve to capture the important characteristics of flow. For each case, the calculations were performed with three different meshes; the sizes of grids were 109770, 303722 and 801986. Number of control volumes varies from 8019860 to 871986 due to different valve openings. A general overview of the mesh surface is presented in Fig. 2.

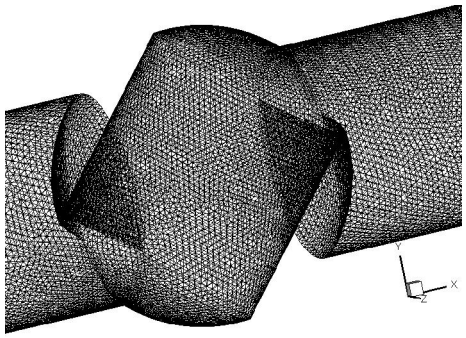

Fig.2 . Unstructured mesh for a valve angle of 50 degree

Boundary Condition

A uniform inlet velocity profile is specified at the entrance to the pipe. Length of the pipe is designed to be long enough for the fluid to be fully developed. On the downstream outflow face, a zero-gradient pressure outlet was applied. On the wall, the boundary conditions are the impermeability and no-slip for the velocity, and the normal gradient of pressure is assumed to be zero. Wall functions based on the law of the wall are used as boundary conditions for the turbulence modeling. The turbulence intensity at the entrance to the channel was set to 10%. No heat transfer is considered in simulation.

Results

Figure 3. Illustrates the velocity contours and the path-line flow pattern on the middle surface at six different opening degrees. It can be found that as the valve opening decrease, the number and the region of vortex increase . Three vortices can be observed in the flow field when the valve is not fully open. Two vortices are inside the ball valve, the other one is behind the exit of the ball valve. The one that is outside is larger than the two inside the valve. The

size of each vortex can be estimated**.** These vortices grow as the valve angle increases.

Also Fig. 3. Shows the locations of reattached points of the recirculation behind the ball valve. The recirculation zone behind the ball valve dominates the pressure drop. Energy is dissipated in this region. Hence, the larger the recirculation length is, the more the pressure drop. So the recirculation length or the energy dissipation is affected by the valve position. It is clear that the recirculation length gets increased as the valve opening gets decreased. In other words, the system has to pay more energy to maintain the same volumetric flow rate or the same inlet velocity at small valve opening.

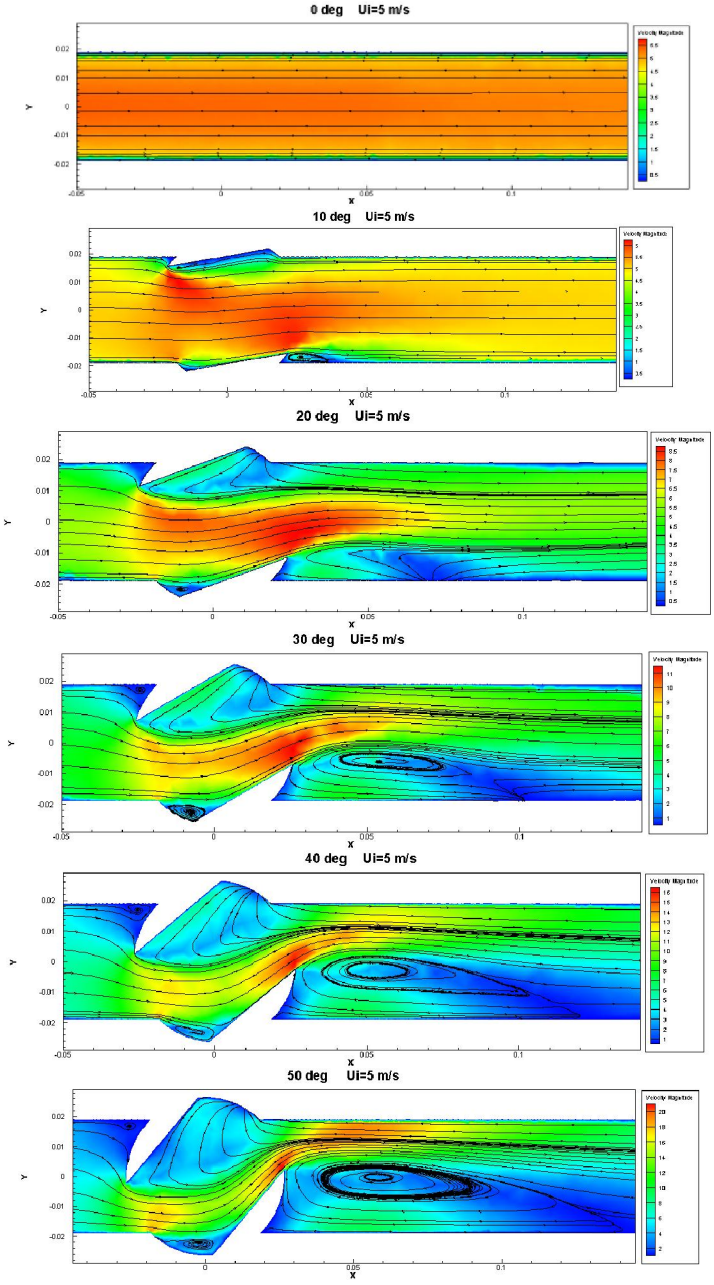

Fig.3. Velocity contours and streamlines at Ui=5 at different opening angle (0, 10, 20, 30, 40 and 50).

Fig. 4. Shows the static pressure distribution in plan (z=0) of the ball valve. In these plots, the area of reduced pressure and its extent have been clearly illustrated. It can be seen that there is a so-called "cavitation region" where the static pressure is smaller than the vaporization pressure of the water (In this study, the vaporization pressure is presumed as 2339 Pa). Extreme low-pressure regions are predicted within the flow domain. The predicted pressures are far below the water vapor pressure

when the ball valve opening gets decreased. With the decrease in pressure at higher degrees than 40 &50, water may reach its boiling point even at normal temperature (20'C), causing severe vaporization, resulting in cavitation and formation of bubbles.

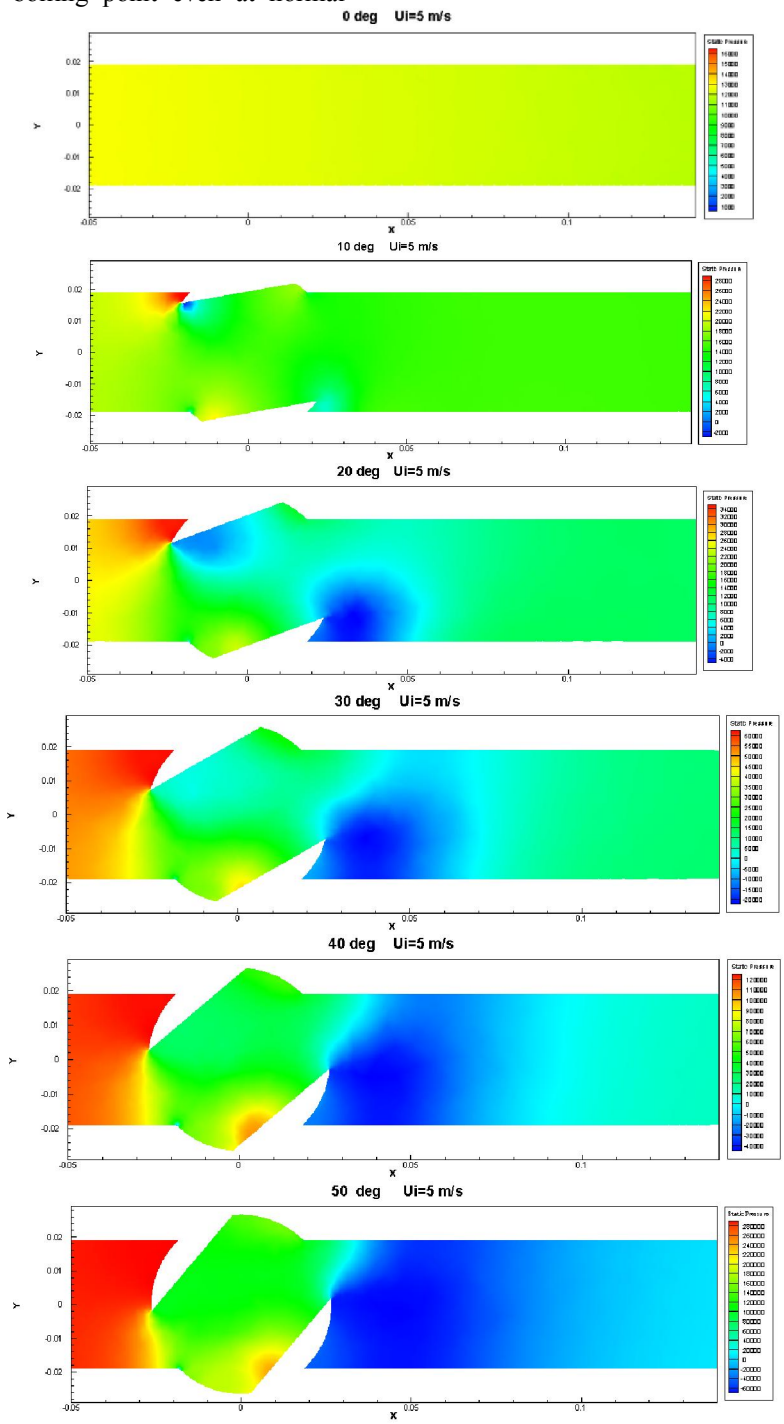

Fig.4. Static pressure (gage) distribution in plane Z=0, Ui=5 at different opening angle (0, 10, 20, 30, 40 and 50)

Volume fraction

Figure. 5. Presents the distribution of the vapor volume fraction during the closing process of ball valve. From these figures, it can be found that the value of vapor volume fraction gets higher and the cavitation region enlarges behind of valve with the closing ball valve from 40 deg to 50 deg. So the cavitation region extends.

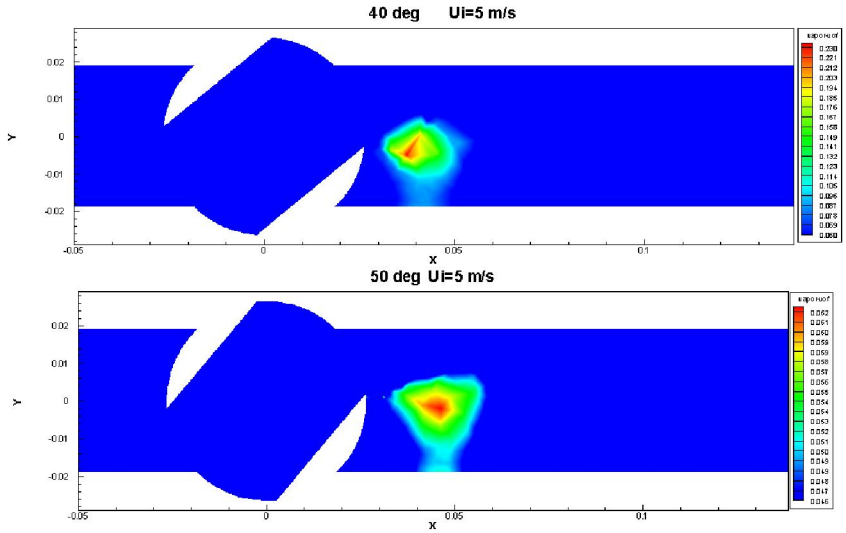

Fig.5. the contour of vapor volume fraction

3.4.2. The loss coefficient

The loss coefficient represents the energy loss due to a ball valve. Therefore, the pressure drop is non-dimensionalized as the loss coefficient, K, in Eq. (1).
It can be denoted as:

$$K = \frac{\Delta P}{\frac{1}{2}\rho U_i^2}$$

Where Ui is the mean inlet velocity. Δ P is the pressure drop measured between 2D in front of the valve and 6D behind the valve.

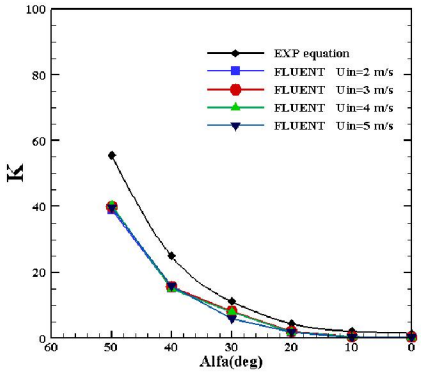

Fig.6 . Variation of loss coefficient at various opening degrees

Figure .6. Shows that the loss coefficient is inversely proportional to the valve opening and provides the comparison result of the loss coefficient, K, between numerical and experimental results. Experimental data are fitted by an equation,

$$K = 385.3 - 12.67\phi + 0.141\phi^2 - 0.000522\phi^3 .$$

There is an agreement between numerical and experimental results. The variation of inlet velocity or the corresponding Reynolds number does not affect the loss coefficient in terms of Fig. 15. As the percent opening of the ball valve decreases, the loss coefficient increases. In terms of Fig.15, the loss coefficients estimated by the numerical model are less than the experimental results.

3.4.3. The flow coefficient

The flow coefficient refers to the capability of flow in a ball valve, defined as:

$$C_v = \frac{q}{0.865F_p}\sqrt{\frac{G}{\Delta P}}$$

Where q is the volume flow rate, G is the specific gravity relative to water at 4°C and Fp is the geometric factor. G and Fp are set to unity in this study.

Figure 7. Compares the experimental results and the simulation results of the Cv. The fitted equation for experimental data is $C_v = 2.23 + \exp(0.0034\phi)$. C_v decrease as the valve opening becomes low (alpha becomes large). However, the relationship between C_v and the valve open is not linear in terms of Fig. 16. As we see, C_v is not affected by the Reynolds number as well. Also, the numerical results are lower than the experimental results.

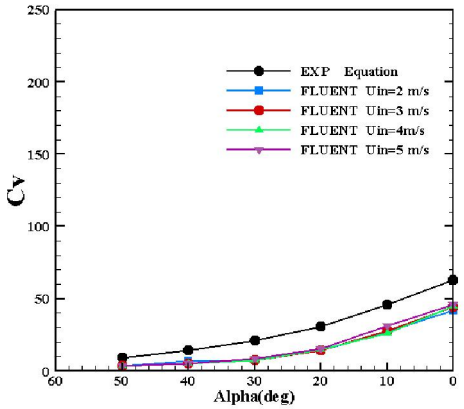

Fig. 7. Variation of flow coefficient at various opening degrees

3.4.4. Cavitation in ball valve

One of the important effects in a ball valve operation is cavitation. Cavitation is a phase transformation phenomenon which occurs in fluid systems under certain conditions. It is well known that the cavitating rise up the vibration, the noise and the erosion. Theoretically, the cavitation appears at the critical condition that the local pressure is lower than the saturated vapor pressure.

To predict the conditions where cavitation happens, the cavitation index is used and is denoted as:

$$C_{cs} = \frac{\Delta P}{P_{in} - P_v}$$

P_v refers to the saturated vapor pressure 2339 Pa at 20°C.

Figure .8. Demonstrates the variation of cavitation index, Ccs, with respect to the valve opening in the fluid flow.

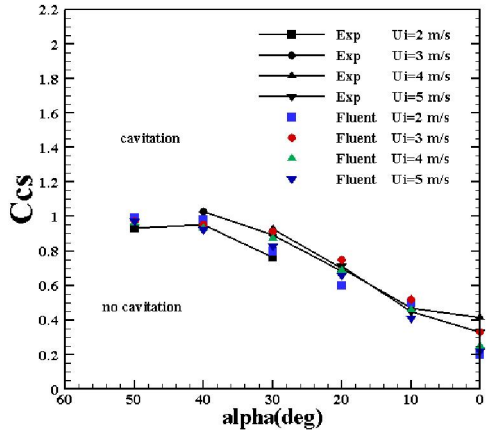

Fig.8 . Variation of cavitation index at various opening degrees

There is a good agreement between numerical and experimental results. Large pressure drop is caused in the small opening ball valve region. It is clear that the critical cavitation indexes vary with the inlet velocity and the valve position. Above the curves, the severe cavitation is observed. For a constant inlet velocity, Ccs increases with the decreases of valve openings. The curve of cavitation index with respect to the valve opening indicates the lowest value for which cavitation occurs. Severe cavitation is possible above the cavitation index curve. No cavitation is expected below the curve. Low cavitation is near the Csc=1.

Calculation

Flow regime in the conventional ball valve was analysed. The comparison of computational and experimental results is given. The current numerical calculations of flow through the ball valve get results that agree well with the experimental results, implies that the computations can predict well flow characteristics of other types of valves with different geometries. The code offers large possibilities of 3D modelling of incompressible viscous flows through valve channels of complex geometry.

According to the pressure and velocity distribution plots, cavitation region with high mass fractions is in recirculation area of low pressure region of valve. The recirculation zone behind the ball valve dominates the pressure drop. Energy is dissipated in this region. Hence, the larger the recirculation length is, the more the pressure drop. It is clear that the recirculation length gets increased as the valve opening gets decreased.

The inception of cavitation can be predicted using the cavitation index, Ccs, which is also determined by the pressure data. Cavitation can create excessive leakage, distort flow characteristics, or cause the eventual failure of the valve body and piping. In some severe high-pressure drop applications, cavitation can destroy valve parts within minutes. The critical conditions of inception of cavitation can be found in the figures. Modify the system is one of basic actions can control or eliminate cavitation. A designer of valve can find the critical values of inception of cavitation at various Re_D and valve openings in the figures. The region above curves in the figure refers to the appearance of severe cavitation and should be avoided. The same numerical approach can be applied to other control valves to determine their performance and to observe cavitation phenomena.

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Effects of Nitrogen Fertilizer and Tropical Legume Residues on Nitrogen Utilization of Rice-Legumes Rotation

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Abstract: Nitrogen (N) is the major nutrient limiting yield of rice (*Oryza sativa*) and adequate quantity of nitrogenous fertilizer is one of the important strategies for increasing yield. In this study two tropical legumes such as long bean and mung bean were used as precedence crops of rice. Nitrogen fertilizer was applied in both legumes at rates of 0, 2, 4 and 6 g m^{-2}. No chemical fertilizer was applied in 2nd year for both legumes and rice crop. First crop cycle of rice was also fertilized with different levels of N fertilizer (0, 4, 8 and 12 g m^{-2}) to assess the ability of long bean and mung bean to supply nitrogen to wetland rice and to determine the amount of fertilizer N required to optimize rice yield when long bean and mung bean were grown in the rice crop rotation. Mung bean added 4.7-5.7 g N m^{-2} of which 0.3 to 1.1 g fixed N m^{-2} while long bean added 4.6-5.5 g N m^{-2} of which 0.2 to 1.0 g fixed N m^{-2} to the soil when legumes residue was incorporated in 2010. In the 2nd cycle of cropping mung bean added 4.6-5.4 g N m^{-2} of which 0.5 to 1.2 g fixed N m^{-2} while long bean added 4.4-5.3 g N m^{-2} of which 0.5 to 1.1 g fixed N m^{-2} to the soil when both legume plant residue was incorporated in 2011. Rice after long bean and rice after mung bean with N at rates of 8 and 12 g N m^{-2} produced higher yield of rice in both years although no N fertilizer was applied in 2nd year rice crop. This superior performance of rice after long bean or mung bean is likely linked to higher N uptake along with N fixation of mung bean and long bean which can be a possible supplement N source to boost soil fertility. Such tropical legumes that improve productivity of rice might be attractive to farmers who are generally resource-poor farmers. The results reveal that mung bean and long bean can supply >50% of N required for rice and can be a feasible alternative organic N source to enhance soil fertility.
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Keywords: Rice yield; Legume residues; Nitrogen fertilizer

1. Introduction

Nitrogen (N) is an essential macronutrient for plants and constituent of amino acids, proteins, chlorophyll, several plant hormones and improving grain yields of cereal crops (Ladha and Reddy, 2003; Zhang et al., 2004). However, excessive amounts and inappropriate application methods lead to low N efficiency and high fertilizer losses through runoff, leaching, denitrification, and volatilization (Richter and Roelcke, 2000; Zhu et al., 2000), resulting in a series of environmental problems. Low N efficiency also increases production costs, leading to lower net returns for farmers (Wang et al., 2001). Thus, efficient N utilization should be realized in agriculture for environmental and economic reasons (Stevens et al., 2005; Delin et al., 2008). Rational N application is an important measure to improve nitrogen use efficiency, while the coordination between soil N supply and crop N demand is the one of the key to rational N application (Fageria and Baligar, 2005). Soil N and biological nitrogen fixation (BNF) by associated organisms are major sources of N for lowland rice (George et al., 1992). More than 50% of the N used by flooded rice receiving fertilizer N is derived from the combination of soil organic N (Bouldin, 1986; Broadbent, 1984) and BNF by free-living and rice plant-associated bacteria (Roger and Ladha, 1992). The remaining N requirement is normally met with fertilizer. Soil organic N is continually lost through plant removal, leaching, denitrification and ammonia volatilization (Kirda et al., 2001). The additional concern is that the capacity of soil to supply N may decline with continuous intensive rice cropping under wetland conditions, unless it is replenished by biological N fixation (Kundu and Ladha, 1995). Reducing fertilizer N use in lowland rice systems while maintaining the native soil N resource and enhancing crop N output is desirable from both environmental and economic perspectives. This may be possible by increasing BNF by using legume crops, minimizing soil N losses, and by improved recycling of N through plant residues (Buresh and De Datta, 1991). Thus the management of indigenous soil N and N derived in situ through legume BNF has the potential to enhance the N nutrition and N use efficiency of crops and total N output from a lowland rice-based cropping system (Ladha and Reddy, 2003). The ability of legumes to fix N and their residual impact on soil N status has long been recognized, but many farmers also realize that the accrued N benefits will vary between different legume systems (Rochester and Peoples, 2005). To date the fate of N in green manure and productivity of dual-purpose legumes and their effects on soil N dynamics and their contributions to the yield and N uptake (Ladha et al., 1996) of the following rice crop has been studied only a few instances (George et al., 1998).

Leguminous green manures played a role in conserving NO_3 in addition to fixing atmospheric N_2. Grain and forage legumes and their residues could supplement available N for succeeding rice (Ladha et al., 1996). Nitrogen production from legumes is a key benefit of growing cover crops and green manures (Schmid and Klay, 1984).

Fertilizers are an important component to sustain high yields under mono cropping systems in Malaysia and the government spent RM 1.14 billion to import mineral fertilizers in 2001 (DOA, 2003). To minimize the dependence on mineral fertilizers, the government has focused towards natural and healthier methods of food production (Faridah, 2001). The department of agriculture has also been encouraging farmers to employ an integrated approach of rice cultivation with vegetables, intercropping practices of sweet corn, maize, crop rotation and organic farming (Wan, 2003). The optimal use of fertilizer, fuel and pesticides, through improved management practices can help increase the profitability of agricultural production while helping to meet society's environmental goals. Inclusion of annual or perennial legumes or cover crops in rotation with cereals will improve soil N fertility levels (Derksen et al., 2001), improve soil structure, water holding capacity (Russell et al., 2006), soil organic C and N (Campbell and Zentner, 1993), mineralizable C and N (Biederbeck et al., 1994), higher grain yield, economic returns, while reducing production risk and increasing long-term sustainability as well as to achieve agronomic and environmental benefits (Peterson et al., 1993; Anderson et al., 1999).

Productivity is slowly declining as well as environmental quality is deteriorating by injudicious applications of chemical fertilizer under intensive monoculture system such as paddy rice in Malaysia. Healthy and pleasant ecosystems are inevitable in order to make an environment safe crop production system (Khairuddin, 2002). Grain legumes or cover crops can play a significant role to add mineralize N to the soil by decomposing legume residue to the principal crops (Motior et al., 2009); and improve nutrient status of soil as well as to protect bare soil against erosion losses in the warm tropical climate. However grain legumes are produced on a small scale and crop rotation practices are not well practiced especially in rice producing areas in Malaysia, where double cropping per year or sometimes five crops in a two year period (Khairuddin, 2002) causes an alarming soil degradation and great threatens the environment through intensive use of chemical fertilizers. Undoubtedly, the use of legumes as grain or cover crops is desirable in terms of the environment and economy. Both long bean and mung bean are widely used in Malaysia as popular vegetables and practiced as mono crop but there is an ample opportunity to fit these crops in upland rice crop rotation system. However in recent years, sustainability or use of natural resources rather than increase in the food production has attracted the attention of many people and there has been a trend towards use of legumes to improve the soil N fertility for the following rice crop. The use of long bean and mung bean alone or with inorganic N fertilizers offer promising opportunities to evaluate N contribution to rice crop rotation systems in Malaysia. Therefore the present study was undertaken with the following objectives: (i) to quantify N fixed by long bean and mung bean using the total N difference method (ii) to assess the ability of long bean and mung bean to supply N to rice and (iii) to determine the amount of fertilizer N required to optimize rice yield when long bean and mung bean are included in the system

2. Material and Methods

Experimental Site and Plan

The experiment was conducted in a glass house at the University of Malaya, Kuala Lumpur, Malaysia during 2010-2011. Soil was collected from rice field in Selangor (1° 28' 0" N, 103° 45' 0" E), Malaysia. The top 30-cm soil layer had an air dried pH (1:5 w/v water) of 6.55±0.20, cation-exchange capacity of 15 ($cmol_c$ kg^{-1} soil), and contained 1.75±0.48 % organic carbon, 0.18±0.04 % total N, NH_4-N 6.37±1.25 (mg 100^{-1} g soil), exchangeable CaO 171.0±20.15 (mg 100^{-1} g soil), exchangeable MgO 10.8±2.75 (mg 100^{-1} g soil) and exchangeable K_2O 14.9±9.06 (mg 100^{-1} g soil). The soil texture of experimental pot was clay loam. Soils were air-dried before being used in the experimental pots. Polyethylene pots (height 46 cm x diameter 54 cm = surface area 1 m^2) were filled with soil up to about 40 cm height of each pot and kept 30 days to settle soil depth. The seeds of mung bean, long bean and corn were sown in soil maintaining saturated moisture until germination. The experiment was conducted under completely randomized design with four replications.

Cultivation and sampling of legume, corn and rice crops

In the 2010, mung bean, long bean and corn were randomly assigned to pots. In the first cycle of the experiment, N fertilizer at rates of 2, 4 and 6 gm^{-2} was applied in mung bean and long bean while 4, 8 and 12 g m^{-2} was applied in corn and rice crop. N fertilizer was applied in soil before sowing of mung bean, long bean and corn. In addition, 16 pots filled with soil were placed as the requirement to fulfill of rice after fallow crop rotation to compare mono cropping. In rice crops four rates of fertilizer (0, 4, 8 and 12 g N m^{-2}) were superimposed onto the fallow 16 pots and each crop pots. After harvesting of corn and or incorporation of legume residues, rice was planted as 2nd crop. Zero-N checks were also included in all crops for the first

cycle. After harvesting of rice again mung bean, long bean and corn was grown in the same pot as third crop in 2nd cycle but no chemical fertilizer was applied to see the residual effect of legume residue for the subsequent crop. Nitrogen fertilizer (urea) was used only in first year rice crop and no fertilizer N and other chemical fertilizer was applied in second year rice crop. Simultaneously fallow pot was also used for rice crop cycle. In early May of 2010 and 2011, mung bean, long bean and corn was planted in pots. After 70 days of crop age, all crops were harvested. Mung bean and long bean plant residues were cut and manually chopped into 10-to 12-cm pieces and uniformly spread onto the pots and incorporated to a depth of about 10 cm into soil with hand mulching following flooding of the pot and kept for 30 days in preparation for rice planting. About 100 g fresh plant samples were taken and kept in oven at 72^0C for 48 hours then dry weight into whole plants of dry samples were converted. Out of 12 plants per pot, four plant samples were taken from each pot for above ground dry matter and N determination for each crop at final harvest.

Two-week-old seedlings of rice were transplanted at pots on July 15 in 2010 and July 16 in 2011. In 2010, first year rice crop was fertilized with urea and applied in three splits: one third at transplanting, one third at tillering and one third at panicle primordial initiation stages, respectively. In both years rice was harvested during the second week of December. Total biomass and grain yield were determined from experimental pot. Rice grain, culm and leaf were dried to constant weight at 70^0C and analyzed for total N by the micro-Kjeldahl method (Bremner and Mulvaney, 1982; Ladha et al., 1996).

Estimation of Biological Nitrogen Fixation

The contributions of biological nitrogen fixation (BNF) to total N accumulation in legume were estimated by the N difference method (Peoples and Herridge, 1990; Peoples et al., 2002). Plant materials were dried at 70^0C for at least 48 h, weighed; milled and total N concentration was determined by Kjeldahl digestion. Sources of N for non-fixing and fixing crops are different and corn was used as non-fixing control or reference crop. It is assumed that sources of N for non-fixing crops are soil and fertilizer. For non-fixing crops, the proportions of N from all available sources can be expressed (IAEA, 2001):

$$\% \text{ Ndff}_{NF} + \% \text{ Ndfs}_{NF} = 100 \%$$

Where, Ndff_{NF} stands for nitrogen derived from fertilizer for non-fixing crops, Ndfs_{NF} stands for nitrogen derived from soil for non-fixing crops. On the contrary, sources of N for fixing crops (F) are soil, fertilizer and atmosphere and it can be expressed:

$$\% \text{ Ndff}_{F} + \% \text{ Ndfs}_{F} + \% \text{ Ndfa}_{F} = 100 \%$$

$$\% \text{ Ndfa} = 100 - (\% \text{ Ndff}_{F} + \% \text{ Ndfs}_{F})$$

Where, Ndff_{F} stands for nitrogen derived from fertilizer for fixing crops, Ndfs_{F} stands for nitrogen derived from soil for fixing crops and Ndfa_{F} stands for nitrogen derived from atmosphere for fixing crops.

Estimates of the proportion of legume N derived from N_2 fixation (% Ndfa) with the total N difference procedure were calculated by comparing N accumulated in the legume with N accumulated in the non-legume reference as follows: % Ndfa= 100[(Legume N – Reference N)]/(Legume N).

Statistical analysis

Statistical analysis was carried out by one-way ANOVA using general linear model to evaluate significant differences between means at 95% level of confidence (SAS, 2003). Further statistical validity of the differences among treatment means was estimated using the least significant differences (LSD) comparison method.

3. Results and Discussion

Biomass production and nitrogen accumulation of legume crops

In 2010, aboveground biomass yield at harvest was 138-162 g m^{-2} for mung bean and 135-158 g m^{-2} for long bean with corresponding N uptake of 4.7-5.7 g m^{-2} for mung bean and 4.6-5.5 g m^{-2} for long bean, respectively. In 2011, aboveground biomass yield at harvest was 137-156 g m^{-2} for mung bean and 132-158 g m^{-2} for long bean (Table 1) with corresponding N uptake of 4.6-5.4 g m^{-2} for mung bean and 4.4-5.3 g m^{-2} for long bean, respectively (Table 2). In both years, long bean and mung bean produced consistently similar biomass with N accumulation. The amount of nitrogen available from legumes depends on the species of legumes grown, the total biomass production and the

Table 1. Biomass accumulation of mung bean, long bean, and corn as affected by nitrogen fertilizer

Fertilizer N ($g\ m^{-2}$)		Biomass accumulation ($g\ m^{-2}$)					
		Mung bean		Long bean		corn	
corn		2010	2011	2010	2011	2010	2011
0	0	138 c	137 b	135 c	132 c	463 d	450 d
2	4	145 b	141 b	145 b	142 b	538 c	515 c
4	8	156 a	149 a	152 ab	148 ab	580 a	560 b
6	12	162 a	156 a	158 a	158 a	635 a	603 a

Means followed by the same letters are not significantly different at the 5% level

percentage of N in the plant tissue. Motior et al., (2011) observed that broad bean produced >10 kg dry matter m^{-2} at physiological maturity which produced >35 g N m^{-2}. Nitrogen production from legumes is a key benefit of growing cover crops and green manures. Nitrogen accumulations by leguminous cover crops ranged from 4.5 to 22.5 g of nitrogen per m^{-2} (Evans et al., 2001).

Rochester and Peoples (2005) reported that total N inputs from faba bean crop residues (11.6 to 19.9 g m^{-2}) which were lower than those achieved by green manure vetch (16.4 to 26.4 g m^{-2}). In our study, total N inputs from dwarf long bean residues were similar to mung bean residues because of similar growth nature.

Legume crops effect on nitrogen fixation

In this study the plant N derived from N_2 fixation (% Ndfa) in mung bean was 7-23% and long bean was 4-22% in 2010 as calculated by the total N difference method. Regardless of N fertilizer applied in rice crops in 2010 plant N derived from N_2 fixation (% Ndfa) in mung bean was 9-26% and long bean was 8-23% of total plant N in 2011 as calculated by the total N difference method (Table 2). Maximum N_2 fixation was derived from mung bean (23-26%) and long bean (22-23) when both legume was grown with zero N fertilizer. Estimates of % Ndfa for other forage legumes and *Cajanus cajan* were with in the range of 44 to 95 % (Peoples and Herridge, 1990). Nitrogen fixation by broad bean and hairy vetch was 41 and 78% of total plant nitrogen (Motior et al., 2009).

Table 2. Nitrogen uptake and N recovery efficiency (NCE) of long bean and mung bean as affected by fertilizer N and estimates of the proportion of plant N derived from N_2 fixation of long bean and mung bean determined by N-difference method

Crops & N g m^{-2}	N uptake		Legume N[a]		N fixation (%) [b]		NCE (%)	
	2010	2011	2010	2011	2010	2011	2010	2011
Mung bean								
0	4.7 c	4.6 c	1.1 a	1.2 a	23 a	26 a	0	0
2	5.0 b	4.8 c	0.7 b	0.8 b	14 b	17 b	20 a	20 a
4	5.4 ab	5.1 b	0.6 b	0.6 b	11 c	12 c	17 b	16 b
6	5.7 a	5.4 a	0.3 c	0.5 b	7 d	9 c	16 b	15 b
Long bean								
0	4.6 c	4.4 c	1.0 a	1.1 a	22 a	23 a	0	0
2	5.0 b	4.8 b	0.7 b	0.9 a	14 b	17 b	16 b	10 b
4	5.2 b	5.1 a	0.5 b	0.6 b	8 c	12 c	17 a	14 a
6	5.5 a	5.3 a	0.2 c	0.5 b	4 d	8 d	16 b	14 a
Corn								
0	3.6 c	3.4 c	-	-	-	-	-	-
4	4.3 b	4.0 b	-	-	-	-	-	-
8	4.8 a	4.5 a	-	-	-	-	-	-
12	5.3 a	4.9 a	-	-	-	-	-	-

Means followed by the same letters are not significantly different at the 5% level

[a]Data collected from average percentage of total N derived from N_2 fixation (%Ndfa) values derived from columns 2nd and 6th; 3rd and 7th columns of table 2 as N fixed = 1/100 (% Ndfa X total N).

[b]N fixed by legumes was calculated based on N-difference method. Corn used as reference plants for estimation of N_2 fixation by N-difference method.

Nitrogen recovery efficiency (NRE) was significantly higher (20%) when mung bean was grown with 2 g N m^{-2} in 2010 and similar trend was also observed in 2011 (Table 2). Application of a lower rate of N fertilizer was associated with the highest N_2 fixation NRE in both long bean and mung bean. Nitrogen recovery efficiency was appreciably higher in long bean when grown with 4 g N m^{-2} in 2010 while in 2011 NRE was higher when it was grown with 4 or 6 g N m^{-2}.

Long bean provided BNF input of 0.2-1.0 g N m^{-2} in 2010 and 0.5-1.1 g N m^{-2} in 2011. Regardless of the N fertilizer levels applied in rice crops, removal of N in long bean was 3.6-5.3 g N m^{-2} in 2010 and 3.3-4.8 g N m^{-2} in 2011 (Table 2). Mung bean provided BNF input of 0.3-1.1 g N m^{-2} in 2010 and 0.5-1.2 g N m^{-2} in 2011. Regardless of the N fertilizer levels applied in rice crops, removal of N in mung bean was 3.6-5.4 g N m^{-2} in 2010 and 3.4-4.9 g N m^{-2} in 2011 (Table 2). Nitrogen fixed from both mung bean and long bean was appreciably higher when fertilizer was not applied. Legume contributions from BNF were lowest in treatments with the highest level of N fertilizer applied to the preceding rice crop. Our observations suggest that legumes incorporated into rice cropping sequence contribute not only to increased productivity but also to the maintenance and improvement of soil fertility by virtue of their capacity to fix substantial amounts of atmospheric N. Legumes can play a positive role in boosting soil N fertility (Sullivan, 2003). However, they must leave behind more N from N_2 fixation than the amount of soil N they remove (Ladha et al., 1996). A large number of plant characteristics contribute to BNF, including biomass yield, legume N demand, capacity to fix N_2, and adaptability to specific environments (Ladha et al., 1996).

Biomass, grain yield and harvest indices of rice

Higher biomass accumulation was credited by higher levels (8 or 12 g N m^{-2}) of N application in all cases. Lower biomass was recorded when rice was grown with zero N fertilizer. Both years, the incorporation of legume residue and N fertilizer amended soil significantly increased grain yield of rice (Table 3). In 2010 and 2011, rice after long bean with 8 and 12 g N m^{-2}, produced significantly higher rice grain yields (538-570 gm^{-2}). The minimum yield was obtained in rice after corn (293-349 g m^{-2}) and rice after fallow (319-371 g m^{-2}) and when no N fertilizer was applied in rice crops. Rice after mung bean with 8 g N m^{-2} and 12 g N m^{-2} gave similar yields (489-521 g m^{-2}) corresponds to rice after long bean in 2010. In 2011, slightly lower yield was obtained in rice after long bean but similar trend was observed. Rice after corn with 8 g N m^{-2} and 12 g N m^{-2} showed similar and comparatively poor yield than other counterparts. No appreciable difference was observed on rice after fallow with 8 g N m^{-2} and 12 g N m^{-2} (Table 3). In both years, rice yield showed that mung bean and long bean

was effective even in 2011 when no fertilizer was applied in rice crop. In the second year of the experiment, incorporation of legume residues slightly decreased grain yield of rice in the zero-N control but higher than rice after fallow with 4 g N $m^{-2}$and very close with 8 g N m^{-2}. There was an insignificant increase or even a decrease in grain yield associated with residue incorporation, especially without application of fertilizer N (Thuy et al., 2008). A multi-location research project on the management of crop residue for sustainable production concluded that residue incorporation did not lead to higher grain yields (IAEA, 2003). Bijay et al., (2008) summarized 51 data sets from rice-rice-cropping system experiments and reported that statistically significant increases in grain yield associated with residue incorporation were found in seven experiments. In most cases, legume residue retention does not reduce rice yield in N-fertilized plots. In some cases, it may increase or decrease yield but in general has positive effect on yield. Where N fertilizer is not applied, legume residues often increase both yield and N uptake. Clearly, the effect of residues on grain yield depends on soil characteristics, incorporation method, amount of residue returned to soil (Motior et al., 2011), and timing and rate of N-fertilizer application (Ponnamperuma, 1984).

Table 3. Biomass accumulation, grain yield and harvest index (HI) of rice as affected by N fertilizer and legume residue

N fert. (g m^{-2})	Biomass (g m^{-2})		Grain yield (g m^{-2})		Harvest index	
	2010	2011	2010	2011	2010	2011
Rice after mung bean						
0	953 c	912 c	407 c	396 c	43 c	43 c
4	1066 b	987 b	495 b	449 b	46 b	46 b
8	1129 a	1072 a	540 a	489 a	48 a	46 b
12	1132 a	1079 a	565 a	521 a	49 a	48 a
Rice after long bean						
0	949 b	929 c	417 c	404 c	43 c	43 b
4	1069 a	1038 b	502 b	472 b	47 b	46 a
8	1136 a	1083 a	538 a	495 ab	47 b	46 a
12	1138 a	1103 a	570 a	538 a	50 a	49 a
Rice after corn						
0	906 b	873 b	349 d	293 c	38 c	34 c
4	932 b	906 b	407 c	358 b	44 b	40 b
8	1026 a	961 a	472 a	407 a	46 ab	42 ab
12	1059 a	1007 a	508 a	440 a	48 a	44 a
Rice after fallow						
0	941 c	906 c	371 c	319 c	35 c	35 c
4	1065 b	994 b	428 b	375 b	38 b	38 b
8	1137 a	1042 a	521 a	440 a	42 a	42 a
12	1127 a	1059 a	554 a	456 a	43 a	43 a

Means followed by the same letters are not significantly different at the 5% level

Harvest indices were also affected significantly by incorporation of legume residue and N fertilizer application for both years (Table 3). In 2010 and 2011, rice after long bean with 4, 8 g N m^{-2}, obtained identical HI while 12 g N m^{-2} obtained slightly HI. The lowest HI was recorded in rice after fallow and rice after corn when no N fertilizer was applied in rice crops. Rice after mung bean with 8 or 12 g N m^{-2} in 2010 and 4, 8 or 12 g N m^{-2} gave superior HI, respectively. Rice after corn with 8 g N m^{-2} and 12 g N m^{-2} showed similar HI for both years. No appreciable difference was observed on rice after fallow with 8 or 12 g N m^{-2} (Table 3).

Conclusions

The N difference methods employed in this study could show that N derived from long bean and mung bean is readily available and can be used efficiently by rice crop. Long bean and mung bean is capable of producing a large quantity of dry matter and accumulating significant quantities of nitrogen and can fix substantial amount of N for rice crop. The combined application of mung bean or long bean along with N fertilizer at the rate of 4 g m^{-2} can be an alternative N fertilizer management method to reduce N losses from N fertilizer applied to rice crop. Mung bean and long bean residues incorporated into the soil supplied N to rice crop and produced benefits comparable with that of 4 g fertilizer N m^{-2}. Such kinds of tropical legumes that improve annual productivity of rice might be attractive to farmers who are generally resource-poor farmers. Thus, long bean and mung bean has the potential to substitute or supplement for chemical/inorganic N fertilizer.

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An Exploration into Spatial - Temporal Variations Trend Focusing on Forest Classification and Adoption of Classified Error Matrix (Case Study: Central Zagros)

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Abstract: In order to study on the rate of variations in Zagros central region, LANDSAT satellite data from years 1976-2008 were used to prepare a map comprising five classes (of land use) including agriculture, urban, forest, rocks and ranch. Accordingly, the satellite imageries relating to the given period were prepared, interpreted and mapped and variations trend was quantitatively computed, and obtained data were compared to each other while this task was done at three levels i.e. Macro-level (Central Zagros), Meso-level (Dena Protected Area) and Micro-level (Western Dena). On the other hand, measurement of canopy has been introduced as an appropriate factor in forest management and classification at micro level (11). To prepare the given map, distribution of canopy was classified by means of arithmetic interpretation of aerial photographs so that scanned aerial photos 1:20000 (1968) and 1:40000 (2001) were prepared by application of PCI Geometrica orthographically at first step and mosaic pattern was arranged from them. In the next step, the arithmetic orthophotomosaic was classified in three classes (dense canopy, semi-open canopy and open canopy forests) and the resulting map from this classification was prepared using ArcGIS System. To calculate canopy, dotted network with 0.5mm intervals was used as arithmetic layer. Statistical analyses have been adopted for a 30-year period by means of Maximum Likelihood Supervised Technique and in order to determine variation in contrast method after classification as well as Maximum Likelihood Algorithm. The obtained results indicated the rates of total accuracy in images classification for 1976 and 2008 as 90.22% and 94.09% respectively. The computations suggest that areas for farming lands, residential use and open canopy forest have increased, while the dense, semi-open and open canopy forest areas as well as ranches and rocks have been reduced.

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Introduction

With respect to today's importance of ecosystems survey, preparation of applied maps for lands and evaluation and study on variation trend of eco-systemic structure have turned into a crucial approach in the field of resources management (31, 34). In this sense, remote sensing together with aerial photographs and ground control systems are employed as powerful tools to determine and analyze land use planning and land coverage (28, 30). Assessment of land coverage variations is a process that may lead to a proper concept from way of interaction between humans and the environment, and is of greater importance for mountainous-forestial regions (46).

Central Zagros and Dena Protected Zone are one of the biospheric deposits in Iran that are also registered in UNESCO, and solely possess several endemic plant varieties as much as 46 countries throughout of the world. The investigation may show that there are 2000 plant varieties and several medicinal types of plants throughout Kohkilouyeh and Boyer-Ahmad Province in Iran, out of which one thousand plant varieties grow in Dena Protected Zone and these numbers are related the indigenous and unique varieties in the Dena region (8). However, for some period of time, this region has been exposed to many threats; as a result, in order to manage and protect green areas and tree coverage, it requires depiction of these variations and planning and

decision making by taking more wide and informative vision for this purpose through acquiring information from past times and the contingent condition in the future and making efforts in the course of their protection. One of the foremost factors exerting land use planning changes is the Urban Development phenomenon.

In 2003, spatial-temporal variations in Millennium National Park that is situated in Sydney, Australia were investigated. To conduct this study, Kate Hughes used satellite images that were taken in 1980, 1998 and 2000 and finally decided to restore the appropriate ecology for this area. In 1996, Humbush (31) and Cropper (24) explored the coverage of Thailand forests by adoption of satellite images that had been taken from 1976 to 1989 where the results signified 28% reduced coverage in the given forests. In 1993, Lieu (34) examined forests coverage in the Philippines. He accomplished this task by using the previously mentioned images taken from 1934 through 1988. In 2003, Roanoke region in Virginia State (USA) was classified by satellite images that were taken in 1985 and 1998 for restoring the ecology in this area (39, 45).

Exploration in the previous study indicates that several researches have been conducted so far in the field of surveying and displaying environmental variations by remote sensing systems. However, due to some reasons including preparation of variations matrix, there was less sensitivity to the changes caused by atmospheric and environmental errors because of wide application and ease of use; hence, variations determination technique that is called "Post-Classification Comparison" is one of the best methods in identifying land coverage variations, which have also been used in this case study.

The present study aims at quantitatively and qualitatively showing rate of variations in forest coverage as well as other applications in spatial-temporal dimensions by canopy parameter via use of accuracy test.

Materials and Methods

Materials

The Studied Region

Zagros region is situated in the West of Iran with approximately 1500km length and 400km width at widest area and it covers a total of 400,000 square kilometers and/or one fourth of the area of Iran. The Zagros range includes 70% of Zagros region and it is spread from Northwestern to Southeastern direction; and Central Zagros is located in an area with 2,500,000 hectares and with an area of over 93,821 hectares, Dena Protected Zone is situated in 51° 9' 36"N to 31° 14' 36"E in the Central Zagros region. According to classifications in the in Iranian Comprehensive Water Plan, this area is located in the water basin of rivers including Karoon, Maroon-Jarahi and Bakhtegan-Maharloo lakes (second degree) and sub-basin 3-4-1-2 (fourth degree). With 4'413m height, Dena peak is the highest point in this region and its lowest point is located at northwestern side of Kolahgaleh city with an altitude of 1,359.2 meters. The Eastern boundary of Dena is limited to Bijan ramp and Northern, Western and Southern sides of this region are restricted to Marbar and Bashar rivers. In terms of frequency of gradient classes, 42.62% of land this region comprise of greater than 60% slope and some parallel watercourses with types of groove and ditch-like erosions and at higher than 30% of gradient in all units, signify the mountainous nature of this area with high sensitivity to erosion (3).

From a vegetation perspective, 29 types of ranch and one ranching subtype have been recognized in the studied area. Forestial types in the studied region comprise of about 43,613 hectares that are situated in hydrologic lots of Ab-e-Malakh, Banestan, Dasht-e-Rose, Dashtak-e-Sisakht, Khafar, Meymand, Pataveh, Sisakht, Sivar, and Rigan Bay. The widest forestial area belongs to hydrologic division of Banestan with an area of 13,619 hectares, and the minimum area of this type belongs to Sivar area with 452 hectares (9).

In terms of forestial coverage, Persian Oak (Quercus Brantii var. Persica) is the dominant variety of trees in this forest (7). Rather than the above variety, some other varieties may be observed in this region such as Montpellier Maple (Acer Monspessulanum), Common Hawthorn (Crataegus Aronia) and Pistachio Tree (Pistacia Atlantica) (16).

Satellite Images and Other Data

In this study, some MSS and IRS satellite images were used related to periods 1976-2008 (33 years) and their specifications are given in Table 1. It should be noted that due to prevention of possible errors, biennial images were taken within closer time intervals in order to reduce impacts caused by seasonal conditions and variation factors during investigations (29).

Similarly, in order to enhance operational accuracy the following auxiliary data were used:

· Aerial photos relating to June 2005;

· Basic topographical maps prepared by the Geographical Organization of Armed Forces in 1998 with the scale of 1:50000;

· Online images from Google Earth

- Stages of work execution:

1- Interpretation of satellites images (36 & 39)

· Geometric correction

➢ Preparation of base map;

➢ Reading of ground control points;

➢Selection of adaptation equation;
➢Omission of inappropriate control points;
➢Correction of image coordinates system;
➢Assessment of accuracy in the produced maps;

Fig1: Regional situation of Dena to Central Zagros

Fig2: Regional situation of Dena In 2nd degree water basin

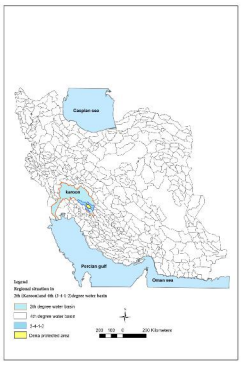


Fig3: Regional situation of Dena In4nd degree water basin

Table 1: Specification of satellite images used in this study

Generator	Magnitude (m)	Number of the used bands	Title of satellite	Used image
USA	**79**	**4**	**Lansat**	**MSS**
India	**24**	**4**	**IRS**	**LISS**

2- *Selection of Interpretation Method*

Classified methods are categorized based on whether these non0imagery data are helpful in analyzing the images, or simply categorize images based on their data using supervised and unsupervised methods, and result evaluation is one of the important stages after classification. Presentation of classification results may reduce their value without any feature that expresses quality and precision of these results (4). To determine the accuracy of classified images in 1976, those satellite images were used that had been taken from control points in the same year, and each of main effects of this region that had been taken via Global Positioning System (GPS) were employed from actual ground points for year 2008.

3- *Preparation of Land Use Map*

In this part, Normalized Difference Vegetation Index (NDVI) was prepared and by adoption of unsupervised classification technique, land use map was prepared for three coverage levels i.e. Central Zagros, Dena Protected Zone, and Western Dena including forest coverage, ranching and urban lands, rocks and farming, and residential lands.

Vegetation Index (NDVI) that is based on spectral values is widely utilized to identify growth conditions for vegetation and it is considered the most practical indices for survey of vegetation variations. Often a certain ratio of close infrared and red bands is used for vegetation coverage maps and study on their conditions, since both these bands are severely adsorbed and reflected by plants. The presence of a high ratio may show sound vegetation while a low ratio signifies unsound vegetation or non-vegetation that is calculated from the following formula (37).

$$NDVI=(NIR-RED)/(NIR+RED) \qquad \text{NDVI computation Eq1}$$

Where *NIR* is reflector of the radiated ray at wavelength close to infrared band and *RED* is the reflection of radiated beam at visible red wavelength. NDVI range value [+1, -1] may display the fact well that higher value of NDVI denotes greater vegetation (37).

Results

1- *Macro level*: (Central Zagros): According to the results obtained from the amount of lands area with forestial vegetation,, the area of this region was reduced from 360,000 hectares in 1976 to 263,000 hectares in 2007. This area is approximately 96,000 hectares and with respect to Tables 2 and 3, maximum rate of conversion of forestial and ranching lands into urban lands has occurred in an area of 250 hectares.

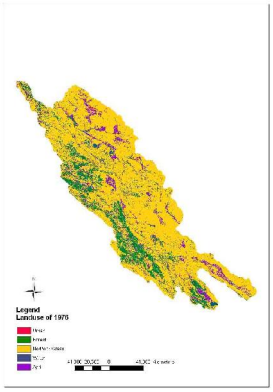


Fig 4: Image of Central zagros classification in 1976

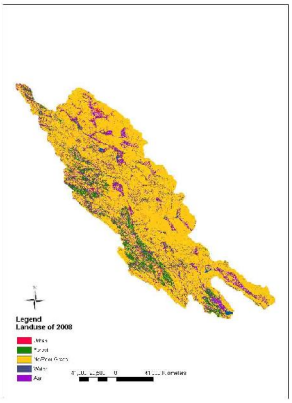


Fig 5: Image of Central zagros classification in 1976

Table 2: Specification of satellite images used in this study

Area of land use classes during several years (in hectares)		
Land Use	**MSS 1975**	**IRS 2008**
Residential and constructed lands	6250.4	17343.5
Lands with forest vegetation	360241.5	263478
Arid lands without vegetation or with low coverage	1746927	1858699
Hydrologic coverage	26844	27062.2
Farming lands	237920.3	311601

Table 3: Exerted changes in land uses during several years

Conversion rate of several uses into each other (in hectares)	
Land Use	
Forest to Residential	424.17
Forest to ranch and arid lands	26074.25
Forest to hydrologic area	494.61
Forest to farming lands	85859.31
Ranching and arid lands to residential	3218.17
Ranching and arid lands to hydrologic area	561.08

2: *The Meso-Level*: (Dena Protected Zone)

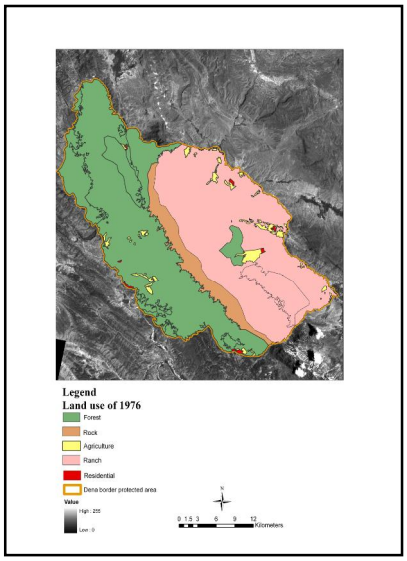


Fig 6:
Classified image of Dena protected Areas in 1976

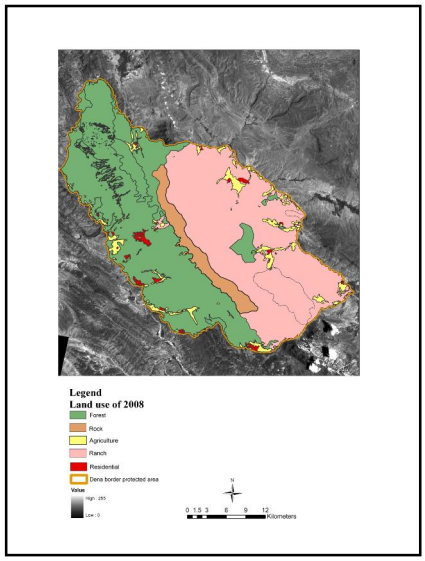


Fig 7:
Classified image of Dena protected Areas in 2008

Accuracy Assessment: Conducting of accuracy assessment for mapping from satellite images is crucially important, particularly if using these maps for management of natural resources. By arranging Error Matrix, accuracy assessment is carried out for the maps prepared from satellite images based on comparison among ground truths and result of maps interpretation (13).

To assess accuracy for the maps prepared from ground truth, the ground truth and random points, which had been derived by GPS system in this region, were utilized and accuracy of producer and user as well as Kappa statistics were extracted from related matrices.

One of the characteristics for accuracy is Kappa coefficient that is extracted from the given matrix. The values of Kappa statistics is used to calculate accuracy of classification to a fully randomized classification. Namely, Kappa value may indicate accuracy of classification to the mode when a fully randomized image (unsupervised) is classified. This action may be denoted by this point that correspondence value will be computed by ground truth after deletion of chance in classification (13).

This value is derived from the following expression:

$$K=\frac{N\sum_{i=1}^{r}X_{ii}-\sum_{i}^{r}X_{i+}X_{+i}}{N_2-\sum_{i}^{r}X_{i+}X_{+i}} \qquad \textit{Calculation of kappa coefficient} \quad \textit{Eq.2}$$

Where N denotes total number of ground truth pixels, $Xi+$ is the sum of arrays in i^{th} row and X+I is sum of arrays in i^{th} column. As a result, when Kappa coefficient is set to 75% this means results of classification is 75% better than in a mode when pixels are labeled randomly. Value of one means a fully correct classification is based on the derived samples, and negative values of Kappa denote classification weakness and extremely bad results of interpretation.

Error Matrix

Usually, error assessment and estimation of classification accuracy are conducted based on statistical parameters extracted from an error matrix. Error matrix, which is also called "Confusion Matrix", is the product of comparison of pixel with known pixels (in ground truth) and correspondent pixels in classification results. The label of any known pixel is compared with the label of correspondent pixels, and identical results are added together, and labels that are not complied with each other will be calculated. In this table, ground data are displayed as columns and relevant data to results of classification in rows.

Figures that are placed on the main diameter of the matrix characterize the number of pixels, which their labels are complied, with two series of data. In other words, pixels, which have been properly classified, are placed on the main diameter and non-diagonal arrays are error sets. Total accuracy is the average value of classification accuracy that indicates ratio of properly classified pixels to sum of known pixels as defined in Eq. 3. This does not require complex operation, because it is the mean value of classification accuracy and only calculated based on diagonal arrays in the error matrix. Consequently, no useful information may be employed from non-diagonal arrays in this matrix, therefore this is considered as one of its defects in comparison with the Kappa coefficient (13).

Matrix Results: In the present study, error matrix has been utilized for accuracy assessment of images classification in years 1976 and 2008 (Tables 3, 4). Accuracy of user and producer are two parameters, which are separately defined in order to assess the accuracy of classification for different classes. In this table, the number of points taken as sample for any coverage type, rate of mixing samples with others, and eventually accuracy of producer and user are derived from this classification. Producer's accuracy denotes the accuracy of pixels related to a certain class in ground truth map. User's accuracy also expresses possibility of classification in a certain class according to the same class in ground truth map (43).

$$O.A=\frac{\sum_{i=1}^{c}E_{ii}}{N}$$

Computation of overall accuracy

Computation of total overall (*Eq.*3)

where c denotes number of classes, N is total number of known pixels, and Eii expresses diagonal members of error matrix.

Values of Overall Accuracy are computed as 90.22% and 94.09% for years 1976 and 2008 respectively.

Table 4: Classification accuracy in 1976

Coverage Classes	Dense canopy forest	Semi-open canopy forest	Open canopy forest	Palatable Ranch	Ranch	Farming	Residential	Rock	Total	User's accuracy
Dense canopy forest	59	7	0	5	0	0	8		79	74.68
Semi- open canopy forest	2	68	0	00	4	0	0	8	82	82.92
Open canopy forest	0	0	64	0	0	0	0	0	64	100
Palatable Ranch	0	0	0	51	0	0	0	0	51	100
Ranch	0	2	0	0	47	0	5	0	54	87.03
Farming	0	0	4	0	0	71	0	0	75	94.66
Residential	7	0	0	3	0	0	47	0	57	82.45
Rock	0	0	0	0	1	0	0	55	56	98.21
Total	68	77	68	59	52	71	60	63	491	-
User's accuracy	86.76	88.31	94.11	86.44	90.38	100	78.33	87.30	-	-

Table 5: Classification accuracy in 2008

Coverage Classes	Dense canopy forest	Semi-open canopy forest	Open canopy forest	Palatable Ranch	Ranch	Farming	Residential	Rock	Total	User's accuracy
Dense canopy forest	49	2	0	0	0	0	4	0	55	89.09
Semi- open canopy forest	0	37	0	2	1	0	0	0	40	92.5
Open canopy forest	0	1	28	0	0	3	0	1	33	84.84
Palatable Ranch	0	1	0	33	0	0	0	0	34	97.05
Ranch	0	0	2	0	54	0	4	0	60	90
Farming	0	1	0	2	0	18	0	0	21	85.71
Residential	0	0	0	0	3	0	45	0	48	93.75
Rock	0	2	0	0	0	1	0	13	16	81.25
Total	49	44	30	37	58	22	53	14	307	-
User's accuracy	100	84.09	93.33	89.18	93.1	81.81	84.9	92.85	-	-

Discussion and Findings

The results for both images in years 1967 and 2008 indicated that Supervised Parallel piped Classification has the maximum level of accuracy. The criterion for their preference was control points and their adjustment with the produced maps by various techniques. Similarly, for higher accuracy, Normalized Difference Vegetation Index (NDVI) was utilized for ranches and forest (35).

Change of Land Use in Dena Protected Zone

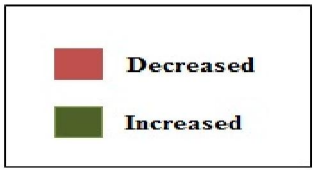
After carrying out classification operation, raster maps derived from classification of satellite images, transferred into IDRISI medium and vector maps were prepared from the given maps. Area of any land uses may be calculated several times, and one can easily determine the value of variations in each of uses within time intervals from 1976 to 2008. The rate of these changes in the period of 1976 to 2008 is given in Tables 6-8.

Table 8: Area of land uses and the exerted changes on them in 1976

Land Use Planning related to year 1976			
Land Use Planning	**Area (hectare)**	**Area (m²)**	**Area (Percentage)**
Forest	45313.94	453139441.98	48.3
Agriculture	2207.35	22073531.41	2.35
Residential	233.04	2330412.016	0.25
Ranch	39910.06	399100680.12	42.63
Rock	6306.79	6307903.29	6.72
Total	93821.53	938215313	100.00

Table 9: Area of land uses and the exerted changes on them in 2008

Land Use Planning related to year 1976			
Land Use Planning	**Area (hectare)**	**Area (m²)**	**Area (Percentage)**
Forest	436136636.29	43613.66	46.49
Agriculture	45306068.32	4530.61	4.83
Residential	8105880.7	810.59	0.86
Ranch	396916386.89	39691.6386	42.3
Rock	49453783.4	4945.38	5.27
Total	938215411	93821.54	100.00



3- *Micro level*: (Dena Western Protected Areas):

Dena Protected Areas is almost bisected from the middle into Eastern and Western parts due to passing through Dena Range where both parts are completely different from each other in terms of climate and vegetation. Since it is intended to examine variation in forest vegetation, and the fact that the Eastern part of Dena Areas lacks forestial vegetation, therefore this part was left, and Western Dena was selected instead.

Structure of Forestial Mass and its Specifications

To identify, study and plan forestial mass accurately, its specifications and properties were analyzed in terms of horizontal structure where this means the surficial distribution of forestial mass on the ground in the forest where the forestial masses were separated by recognizing this factor and canopy index (the surface that is occupied by forestial mass via trees' canopy) was used to carry out this task.

1- Utilized Software and Data

✓ Aerial Photographs
➢1968 with scale 1:20000 (16 plots)
➢2002 with scale 1:40000 (20 plots)
✓ Map's arithmetic files in scale 1:25000
✓ Basic topographical paper map with scale 1:50000 taken from the given area under Nos. 6252I, 6252II, 6252III, 6252IV, 6352III, 6251IV, 6351IV
✓ Satellite imagery taken in 1976 and 2008
✓ PCI- Geometrica software version 9.1

2- Estimation of Canopy Area: Employing data that were obtained from remote sensing may enable decision-makers to be aware of green space area and its development and variation trend within certain times

While due to financial and time-limitation problems achieving these data from the ground is not possible, however this point should be accurately taken into consideration that there is a significant relationship between regression coefficients of aerial photographs taken from canopies, and ground control points (25). In a study that was carried out on Parama forests in Kermanshah City, (8) and Andarz Urban Forests (2), this point was proved and higher regression coefficients and significant relationships were indicated among canopies. Therefore, these relations may be applied to other similar regions. Similarly, those results showed that in order to achieve canopy and classification of urban forests, one might use aerial photographs instead of application of ground vector statistics that are totally incurred considerable time and money.

3- Execution Phases of Canopy Density Level Estimation

✓ *Preparation of Aerial Photographs*

As one of the foremost and most available types of remote sensing data, aerial photographs are considered appropriate information sources for application in forest sustainability management (27). Aerial photographs may be utilized to study on forests, and this may result in very favorable outcomes in forests with wide areas and simple structure of canopy {one-story} and limited plant varieties (27). Such conditions are highly similar to characteristics of Zagros forests, since these forests are distributed within a very vast area {about five million hectares, 15} where varietal frequency is relatively low. With respect to the previously mentioned statements, aerial photographs may be deemed as efficient and useful tools in Zagros forests and of course, results that came from several studies conducted until now may confirm this point (1, 14, 5, and 10). With respect to the structure of Zagros forests, and due to (diagonal and height) and very slow growth as well as climatic conditions and lack of important industrial varieties, on the one hand; and through study on factors like: diameter breast height, average height, number of branches, canopy volume and tree crown; on the other hand, characteristics of canopies were selected as appropriate factors to study on these forests (12, 17). One may utilize these factors as one of the important variables in forestry,

forest sciences and eco-forestry (13) in order to examine variations and survey these forests (11).

Map Preparation is one of the foremost applications of aerial photographs (27). Canopy is one of the forestial features that can be studied on aerial photographs and this action may be followed by higher accuracy from aerial photographs in comparison with ground operation since trees' canopy are observed from top view in aerial photographs and as a result, measurements will be more accurate (21, 32). To prepare map of canopy mass, several studies have been conducted on using aerial photographs in forests, and in many of them, canopy map has been adopted instead of canopy mass (density) map (Ahmadi Sani 1, 11, 18, 22, 46, 23, 47). In other studies on aerial photographs, canopy mass (density) map has been prepared. The point which has been considered in the previously mentioned studies is that "canopy" and "density of canopy" differ from each other (12). Canopy is the level that is covered by vertical image of tree crown on the ground; and to calculate the rate of canopy of two trees that are overlapped, the joint coverage resulting from overlapping of trees crown should be omitted; while in order to compute density of canopy that is expressed by percent, the amount of canopy in trees gird is estimated within certain limits (like a typical part or area unit) (26, 38).

➢ First series of photographs: Aerial photographs in 1968 with scale 1:20000 - (16 plots) (The sole available series of photographs in Iranian National Cartographic Center NCC)

➢ Second series of photographs: The latest series of aerial photographs with scale 1:40000 920 plots) (The series of photographs that was available from NCC organization in year 2001)

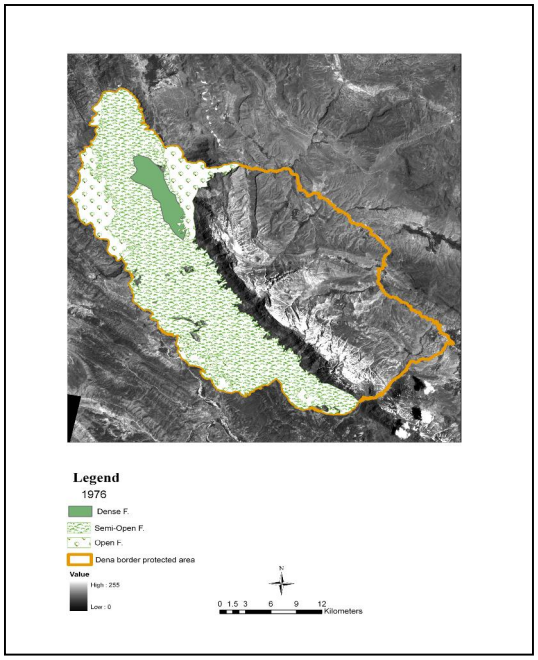
(Photographs were prepared as dispositive and coordinated scans)

✓ *Mosaicking of aerial photographs*

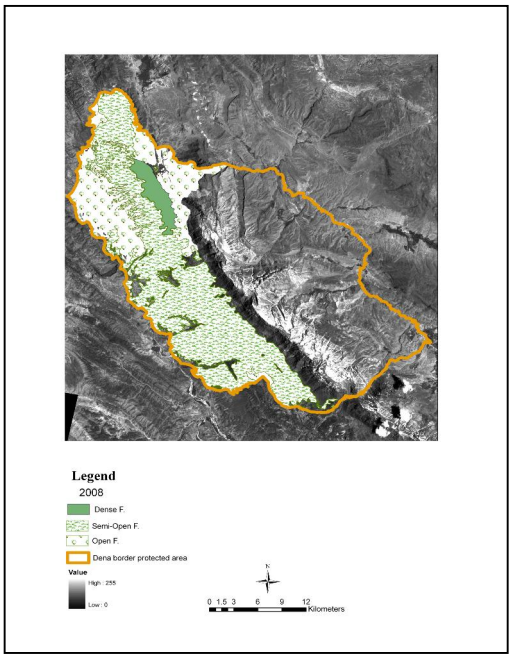
At this stage, the regional photographs prepared from two different scales were integrated into the same scale and juxtaposed, and arithmetic orthophotomosaic was prepared.

✓ *Design of dotted network*: Dotted network was prepared in medium of ArcGIS software so that a dotted network was utilized with 5×5 dimensions and 25 points within 0.5mm identical intervals (16). The same network was adopted for aerial photographs in both periods because of their identical scale, and this network was located on orthophotomosaics and the points on canopy were counted and separated in three classes in such a way that in class I canopy exhibited less than 35% coverage, and class II canopy coverage was 35-70%, and finally in class III canopy had a coverage of more than 70% (16). There is another classification of course:

Class I: Less than 50% coverage; Class II: 50-90%; and Class III: Greater than 90% coverage



Classified image of Dena Forest in 1976



Classified image of Dena Forest in 2008

4- Results:

Table 10: Forest classification in 1976

Forest classification 1976			
Land Uses	**Area (m²)**	**Hectare (m²)**	**Area Percent**
Dense Canopy Forest	24699056.23	2469.91	2.63
Semi- Open Canopy Forest	340079638.5	34007.96	36.25
Open- Canopy Forest	88360747.25	8836.07	9.42

Table 11: Forest classification in 2008

Forest classification 2008			
Land Uses	**Area (m²)**	**Hectare (m²)**	**Area Percent**
Dense Canopy Forest	19998020.29	1999.80	2.13
Semi- Open Canopy Forest	284727297.5	28472.73	30.35
Open- Canopy Forest	131411318.5	13141.13	14.01

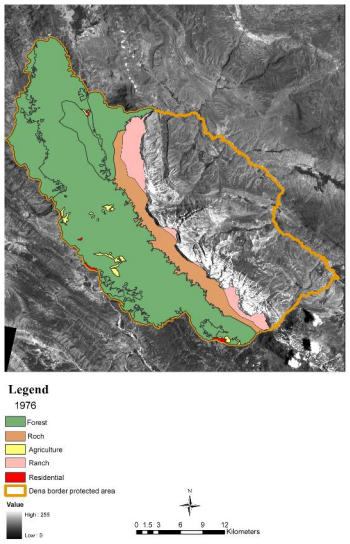


Fig 10: Classified image of Western Dena protected Areas in 1976

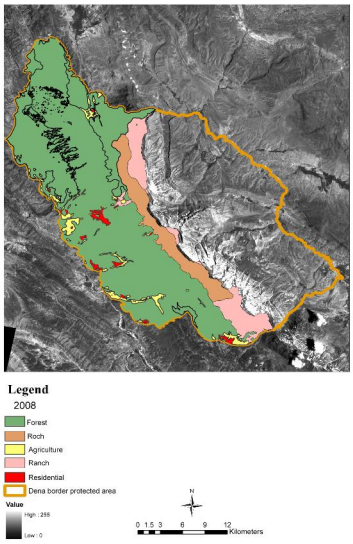


Fig 11: Classified image of Western Dena protected Areas in 2008

Results suggest that such variations have been directed toward reduction of (dense and semi-dense) forest lands and ranches and increase in farming and urban lands and open-canopy forests throughout this region within a 30-year period, that may be considered as population growth and intervention caused by human activities in Dena Protected Zone, so one may refer to this point as follows:

1- *Land Use Plan with positive growth*:

2- *Land Use Plan with negative growth*:

✓ Agriculture: From 2.35 to 4.83%

✓ **Forest:**

✓ Residential: From 0.25 to 0.86%

➢ Dense: From 2.63 to 2.13%

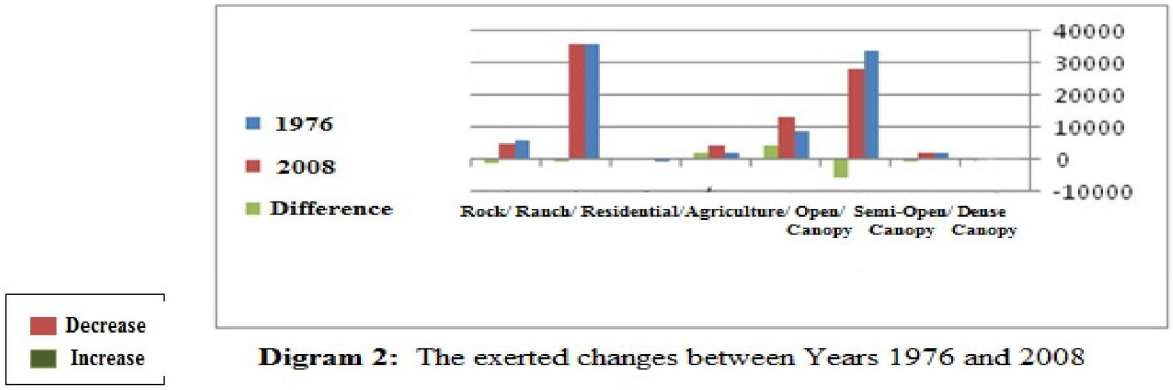
✓ Open- canopy forest: From 9.42 to 14.01%

➢ Semi- open canopy: From 36.25 to 30.35%

✓ Rocks: From 5.27 to 6.7%

Table 12: The exerted changes during years 1976 and 2008

Comparison of Land Uses	1976	2008	Difference
Dense Canopy Forest	2469.91	1999.80	-470.10
Semi- Open Canopy Forest	34007.96	28472.73	-5535.23
Open- Canopy Forest	8836.07	13141.13	4305.06
Agriculture	2207.35	4530.61	2323.25
Residential	233.4	810.59	577.55
Ranch	39910.06	39691	-218.43
Rock	6306.79	4945.38	-1361.41



Digram 2: The exerted changes between Years 1976 and 2008

Discussion and Conclusion

In response to economic and social factors etc., land use and coverage models may be changed. In order to acquire information about the rate, spatial distribution, and type of variations that occurred in sources over time, the first step in recognition of reason and place of incidence of such variations in natural resources is the process of revealing these changes, while by means of this information, managers, policy-makers, and users may make more knowledgeable decisions concerning possession, protection and sustainable use of natural resources.

Overall, the total area of 85,800 hectares at macro-level and 1700.28 hectares at Meso and micro-levels from Central Zagros have been converted from natural vegetation into farming and residential areas from 1976 to 2008. While the rate of open canopy forest has increased up to 4.56%, this may refer to conversion of semi-open canopy into open canopy forests. At the same time, farming and residential lands and ranches have increased 2.48%, 0.61% and 0.33% correspondingly and this point totally signifies the variations in land use of semi-open canopy forests into such uses. Farming land use varies by development in former points while there has been no residential use planning in water basin of Dash-e-Rose and Pataveh Plains during past years, therefore settlement activities have been executed within recent years. The other point is reduction of rock use up to 1.43% (Dena Range) that has been converted into farming, residential and often ranching-use planning.
In a general conclusion, it can be said:

15.84% of the existing lands in 1976 and 2008 were affected by changes (irrespective of possible errors in the available tools).

The impetus for forestial vegetation changes has been the increase in farming, urban, and constructed lands (passing gas pipeline V) in the Western Dena region.

This trend denotes the point that during events of the Islamic Revolution and the Iraqi Imposed War, and due to lack of management plan for these regions in the one hand, and inappropriate increase of industrial development throughout this country after the war on the other hand, as well as paying no attention to Iranian natural resources, the central region of Zagros Range and Dena Protected Zone have been degenerated. Thus, in order to decrease stress and losses caused by these variations, and to improve prevalent models for lands management toward realization of comprehensive sustainable development and stable planning in this region, the trend of these variations should be adequately taken into consideration; and it is recommended to execute Land Survey Plans for all points in Central Zagros and Regions Management Plan for the Dena Protected Area.

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The Role of e-Commerce Awareness on Increasing Electronic Trust

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Abstract: It is not long ago that e-commerce service has turned to be one of the most important applications of the Internet and www. In all aspects of human life, especially in business activity, the application of ICT is so strong that in near future, the world will witness inevitability of this technology in most of the daily issues. Regardless of its technological advantages in the areas of increasing speed, accuracy, ease and dramatic reduction of transaction or processing costs, many challenges and application barriers are continuously faced by its users. Concerns such as users' privacy breaches, ensuring the accuracy, original identification of the buyers and sellers, confidentiality provision cause discomfort and distress an individual during cyberspace transaction or deal. And the achievement of the desired level of confidence in the abilities and capabilities of the other side and performance endanger the system. The increased level of awareness and the security culture of the cyberspace application enhance relative peace of an individual while being in the virtual space or in the process of e-commerce. The resulting comfort helps a person to identify and belief in the capabilities of the opposite side or system and their adherence to the commercial, behavioral, legal and technical principles connected to right deals. In cyberspace under discussion, this identification or situation is corresponding with electronic trust. E-Trust is the pillar of E-commerce. This article will discuss the role of e-commerce awareness in increasing the electronic trust.
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Keywords: Trust, E-commerce Awareness, Privacy, Security, Risk, e-Trust

1. Introduction

Digitally enabled commercial transactions between and among organizations and individuals, also known as e-commerce, involve the exchange of value across organizational or individual boundaries in return for products and/or services. Due to this, IT usage in present times has become a common practice. B2C transactions, B2B transactions, C2B and B2B2C are commonly used in the market. Chen and Dhillon have defined ecommerce as "the transaction of goods and services over the internet". It is also described as the "sharing, transferring and exchanging of information". In order to survive in the highly competitive global economy, businesses must leverage technologies such as data warehousing and data mining to collect customer information, analyze their characteristics and behaviors, build relationships with existing customers, and draw potential ones. As such, gathering information about customers is a necessary task for managers to gain a better understanding of consumer preferences. Despite its exponential growth, e-commerce is faced with the predicament of an increasing number of users and their corresponding apprehension. The purpose of e-commerce is to perform B2B as well as B2C online transactions, and to exchange goods and services from a distance by any electronic and networked device that can use the Internet. E-commerce entails the exchange of information by EDI. The success of e-Commerce will continue to be an important part of business growth if it can overcome the concerns businesses and consumers have with stolen identity, secure banking, payments, and transactions. One way to overcome these concerns (and secure e-Commerce) is to use cryptography. The Internet is not known for its secure environment. In fact, the Internet is not safe for e-Commerce unless it involves using cryptography and making users aware of the concerns with e-Commerce. PC users need to know how to improve e-Commerce security. Both PGP and SSL encryption provide cryptography; they can form the basis of a secure e-Commerce infrastructure. Another aspect of confidence and trust is linked to the capability to evaluate and assess the security levels/features of components, systems, services, etc.

2. E-Business and Internet Marketing

Customer and Merchant trust is really important because without that there is no business. E-commerce leans to trust. Internet is good way how to make money and also good way how to spend them, but this is also quite insecure place! Every day peoples suffer from identity thief and lost money, identity and reputation. Because it is so important make a place, where people-customer can feel safe and be sure that information which he hand over here, will never be use to make damage him! The trust is really hard to get and if you lose it once then it is big possibility that you

lose it forever! E-commerce application includes the use of many different types of online facilities to do business: order registration, electronic advertising, electronic billing system, electronic marketing, online delivery status and tracking and customer services support. E-business applications also include the use of many different types of online facilities to communicate and coordinate: production planning, JIT management, scheduling, outsourcing and other business operation process. In the Internet, Make the most of your online presence by ensuring that your website is working effectively for your business. Everything you do to promote your business online is Internet marketing. For example, Internet marketing strategies include (but are not limited to) website design and content, search engine optimization, directory submissions, reciprocal linking strategies, online advertising, and email marketing. Internet marketing is a fast-changing industry that readily adapts to improvements in technology. There are always new marketing tools available to small businesses. Some of these tools are listed below (Website development & search engine optimization / Online advertising models / Publishing on third-party websites / Permission marketing using email / Corporate blogs / Affiliate/referral programs. It is not so hard, make webpage, and find something what to sell and starting make e-commerce! In these days it is really easy, but much harder is find customers and get trust from them, because any business plan, even the most perfect, can totally fail without trust. How to get this trust? How make webpage safe? How to known, that this webpage is dependable? When a merchant or companies want to setup and use the new e-commerce website, before all of them, they should find the correct answer for above questions. In the e-commerce models (main categories: B2C, C2C, B2B,...) enhancing online presence Items is one of the important factors. This is some considerable factors for enhancing online presence involves: The basics of developing your website (Learn how to create a website so you can attract more customers to your business) / Internet search tools (Find out how you can improve the chances of having your business found on the Web)/ Domain names(e-shop or E-commerce Portals names on the Internet) /Website visibility(Find tips to help you improve the way your website is found and displayed by search engines)/Getting hits(Find out how to attract customers to your website and keep them coming back). By offering products and services on the Web, businesses can gain unique benefits: (New customers, Cost-effective delivery channel, Stream lined enrollment, Better marketing through better customer knowledge.

3. Trust, Risk, Privacy and Security

The concepts, Trust, Risk, Privacy and Security, are widely used in various studies done by multiple disciplines, and they are often incorrectly referred to almost as synonyms. The aim is to clarify the concepts from the consumer viewpoint in e-commerce. E-business has issues that you are less likely to find with more traditional means of doing business. Entire relationships are built in e-business without any kind of face-to-face communication. However, e-business does expose you and your customers to risks, such as theft of your customer lists and customer credit card information, fraudulent purchases, misunderstanding with suppliers and customers due to lack of personal communications, and loss of customer or Consumer trust. For consumers to trust a transaction partner, they must have a degree of knowledge about them. This knowledge can be gained through previous experiences or by gaining information from a third party. Needham (1998) agrees that one way vendors can win the trust of potential customers is to secure recommendations and referrals from credible third parties. This is particularly important in online environments. Since time and experience are needed to deepen trust and the Internet is still relatively new, online transactions require very explicit guarantees up front. Clearly, the degree to which a consumer's opinions and purchasing behavior is influenced by a referee is directly dependent on the consumer-perceived reliability and trust of that referee. We classify four types of referees (word-of-mouth; watchdogs; certificate authorities; seals-of-approval) (Head, et al).

Consumer trust may be even more important in electronic, "cyber" transactions than it is in traditional, "real world" transactions. This is because of some of the characteristics of Internet cyber transactions they are blind, borderless, can occur 24x7,and are non-instantaneous (payment may occur days or weeks before delivery is completed) can cause consumers to be concerned that the seller won't adhere to its transactional obligations. In the electronic transactions, the key to success in Internet business is the establishment of trusted transaction processes where e-sellers create an environment in which a prospective consumer can be relaxed and confident about any prospective transactions. In other words, parties to a transaction in the online environment, should be on safe and secure environment, with minimal risk, maximal trust attempt to deal do so. After its transactions, its remain previous level of risk and trust in good status. If in the Cyber space, there are good policy and privacy, suitable trust and confidence, the risks will be negligible. Electronic transaction or e-commerce, the parties to the transaction, would be satisfactory and profitable. Since trust is likely to play an essential role in online transactions, it is important

to identify the antecedents of a consumer's trust in the context of an Internet transaction. In e-commerce development security is a critical and key factor. It is one of the pivotal success factors of e-commerce. Security is defined as "The protection of data against accidental or intentional disclosure to unauthorized persons, or unauthorized modifications or destruction". It usually refers to the provision of access control, privacy, confidentiality, integrity, authentication, non-repudiation, availability and effectiveness. Surveys conducted and compiled recently shows increasing concerns on security risks and have become a global issue. When customers lose Trust in a systems ability to protect sensitive and confidential data such as credit card information its feasibility will be compromised.

Since personal computers and web servers possess the ability to gather and process large amounts of data and the ability of the internet to provide and make available such on a global scale the need and concern for better security has also arisen. In turn consumers, legislators and even privacy advocates have pressed for broader and improved privacy protocols on the internet. Grandinetti 1996 and Martin 1973 define Privacy as "The rights of individuals and organizations to determine for themselves when, how and to what extent information about them is to be transmitted to others". Privacy can be understood as a legal concept and as the right to be let alone. Privacy can also mean "the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others". There is wide acceptance that trust is an important factor in nurturing or constraining the growth of e-commerce. The concept of trust has been heterogeneously defined by many authors in the fields of economics, social psychology, sociology, management, marketing, and information systems. One of the most accepted definitions of trust is stated as follows: "the willingness of a party to be vulnerable to the actions of another party, based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party. For online consumer's, Trust is defined as "a consumer's subjective belief that the selling party or entity will fulfill its transactional obligations as the consumer understands them". From a privacy standpoint, trust can be viewed as the customer's expectation that an online business will treat the customer's information fairly. The aim of building consumer trust in e-commerce is twofold: to encourage potential buyers to purchase for the first time and to encourage those who have already bought once to continue to do so. But, risk is defined as a consumer's subjective experience of uncertain consequences regarding an action the consumer took. A consumers' perceived risk is an important barrier for online consumers who are considering whether to make an online purchase. The perceived risk (RISK) means as a consumer's belief about the potential uncertain negative outcomes from the online transaction. There are strategies and methods that can help you reduce the risks to yourself and your customers. Be aware of the risks and take steps to deal with them before they become problems. Since the concept of perceived risk appeared in the marketing literature, various types of risk have been identified. For example, Jacoby and Kaplan identified seven types of risks: financial, performance, physical, psychological, social, time, and opportunity cost risk. In the case of Web shopping, three types of risk are said to be predominant: financial risk, product risk, and information risk (security and privacy). Product risk is associated with the product itself; for example the product may turn out to be defective. Financial risk, including opportunity cost and time, is related not to the product but to the marketing channel (the Internet); for example the online transaction may be duplicated because of technological error or unintended double-click the purchase button. Information risk is associated with transaction security and privacy; for example, the requirement that a consumer submits credit card information through the Internet can evoke apprehension due to the possibility of credit card fraud.

4. Trust and E-commerce

E-commerce and the Internet are usually defined as equivalent to each other. In fact, E-commerce is an integrated part of the Internet. They are commonly but mistakenly utilised as synonyms. While e-commerce is the utilisation of electronic means in making business transactions, the Internet is what has given e-commerce a greater outreach by providing a faster transmission media. E-commerce was used long before the Internet. E. Boyd and I. C. Bilegan shows electronic data usage to engage in purchasing and selling behavior is not new. They argue that the travel and hospitality business were pioneers in the sharing of information through electronic media for more than three decades. An example of this is the booking of reservations by airlines. As part of the airline Revenue Management System, transmission of data by electronic means was established to enable sales through a central reservation system in the early 60's. E-Commerce covers a wide variety of perspectives. The technological enabler is the Web, including the globally connected networks, the universal networking interface and transmitting standard (based on TCP/IP), and the WWW infrastructure that facilitates information storage, browsing, and retrieval. The Internet is the tool which makes e-commerce grows at a geometrical rate. As a

global system of connected computer networks, the Internet gives the opportunity to reach global markets with a broad audience and rapid transmission of information. According to the World Bank's World Development Indicators, in a very recent report (September, 2011), 27 percent of the world's population are internet users. E-commerce has created very specific benefits and some that were even unimaginable during the pre-internet era. It has become a basic instrument for successful commerce and more than a strategic issue, it has transformed into a tactical essential for effective business transactions. The Internet has developed as a media for transmitting information to everyone, but e-commerce needs to limit the distribution of information. This leads to several failures when it comes to transactions and information sharing. In the e-commerce literature, researchers have encountered many areas of concern. However, from the customer's perspective, trust and security are the two biggest concerns, and repeatedly studied by researchers.

The basic definition of trust is the reliance on the integrity, ability, etc. of a person or thing. The concept of trust has been widely analysed in different areas of study. Psychologists, sociologists and economists among others define trust from different perspectives. Trust is viewed as a personal characteristic by psychologists, as a social framework by sociologists, and as an economic mechanism for selection by economists. There are diverse definitions of trust, but all point in the same direction. In addition trust is a very complex construct, which has many definitions. For example, there seems to be a distinction between interpersonal trust and organizational trust. Interpersonal trust is trust in which the trustee is another individual. The target of trust is the person, which is not based on their position, title, or because they represent an organization. Organizational trust is when the trustee is an organization. Example includes that an employee trusts his or her company. Another aspect of organizational trust is that the trustee could be the representative of an organization. Key characteristic of trust include that, without it, it is hard to transfer knowledge, since the risk and uncertainty is high for the exchange of intellectual capital. There seems general agreement that risk is essential in understanding trust, whether it is interpersonal or organizational. For instance, Boon and Holmes define trust as "positive expectations about another's motives with respect to oneself in situations entailing risk ". Trust is a method of dealing with uncertainty; when dealing with independent agents, institutions or providers of resources (including knowledge), one trusts them if one accepts their characterization of what they will do. Trust can be a moral notion (X trusts Y to act in X's interests), or not (X trusts Y to perform some task T). Adopting the attitude of trust towards others means that one can plan and cooperate more efficiently, at the cost of greater risk of wasting resources when trust is misplaced.

To succeed in the fiercely competitive e-commerce marketplace, businesses must become fully aware of Internet security threats, take advantage of the technology that overcomes them, and win customers' trust. The process of addressing these general security questions (about customer concerns) determine the fundamental goals of establishing an e-commerce trust infrastructure: (Authentication, Confidentiality, Data integrity, Nonrepudiation).

The cyber world of e-commerce, there are always concerns. The solution for meeting the goal status less concerns includes two essential components:

- Digital certificates for Web servers, to provide authentication, privacy and data integrity through encryption
- A secure online payment management system, to allow e-commerce Web sites to securely and automatically accept, process, and manage payments online.

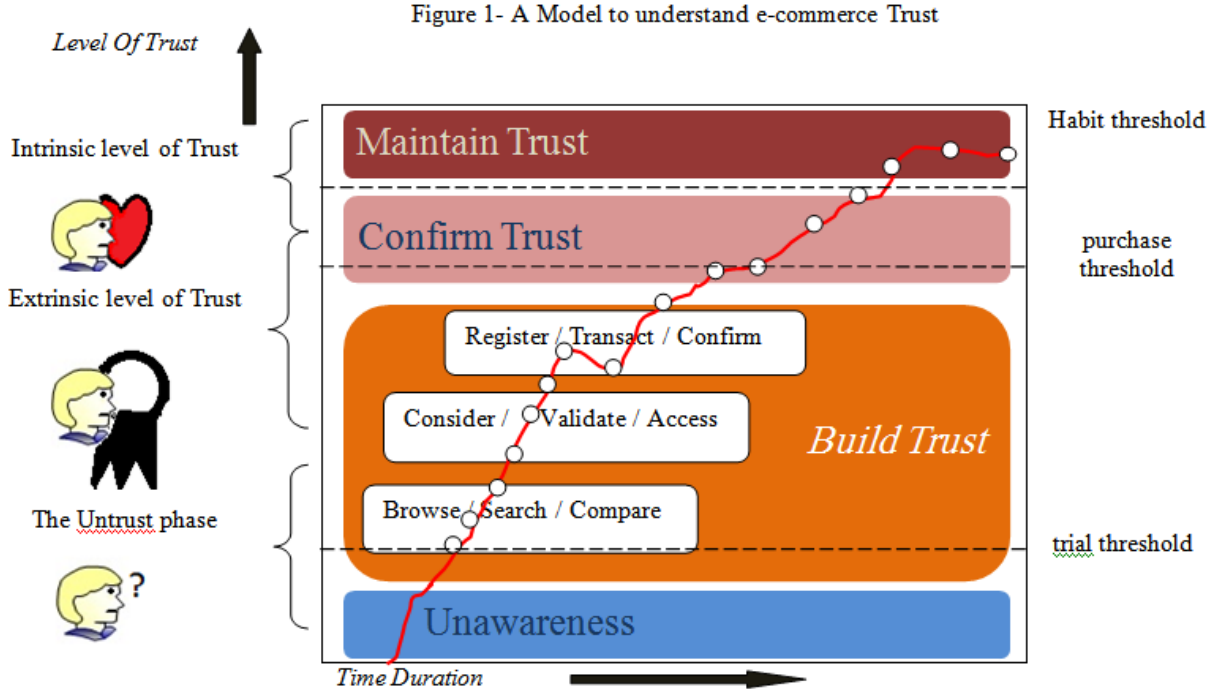
Together, these technologies form the essential trust infrastructure for any business that wants to take full advantage of the Internet. There is background technical information on cryptographic systems, including Public Key Cryptography, the system underlying SSL the basis for every e-commerce trust infrastructure. Encryption is the process of transforming information before communicating it to make it unintelligible to all but the intended recipient. Encryption employs mathematical formulas called cryptographic algorithms, or ciphers, and numbers called keys, to encrypt or decrypt information. There are some of secure solutions for reduce concerns on using e-commerce include : Symmetric Cryptography, Public-Key Cryptography, Modern Cryptography Systems (A Hybrid Approach), The Key Management Problem, Digital Signatures, Digital Certificates. A secure awareness of the packages listed in the e-commerce consumer confidence helps.

Web design is the process of developing a Web site, consisting of five main phases. Web design is 1-dimensional and N-dimensional as opposed to the 2-dimensionality of print design. Trust is one of the most important issues e-commerce Web sites have to consider. The issue of trust is of major importance for e-commerce Web sites. Visitors new to e-commerce are usually very reluctant and careful. The Web is often considered as a medium where information is vulnerable to hackers, where technology is unreliable, and where good intentions may lead to unpredictable results. These uncertain perceptions lead to a desire of control, protecting one's personal information. For current e-commerce users, control is still a

fundamental concern, but does not result in an non-buying attitude anymore. These users feel sufficiently assured, to their satisfaction, that they retain some control over their own personal information.

A model to understand e-commerce trust is provided below (model developed by Cheskin and Archetype Studio). Four phases can be distinguished: unawareness, building trust, confirming trust, and maintaining trust. Obviously, the aim of every e-commerce Web site is to arrive at the latest phase, which will be called lock-in in this thesis. Although the last phase is the most interesting one to an e-commerce Web site, the second phase, building trust, is the most important one. By completion of this phase, one travels from the trial threshold to the purchase threshold. As the figure shows, building trust is a long process of several Web site specific activities: browsing, searching, comparing, considering, validating, assessing, registering, transacting, and confirming. As will be discussed and investigated, building trust in e-commerce Web sites is primarily achieved by pursuing several good Web design strategies. Building trust in a Web site is not only a matter of using an appropriate Web design strategy. There are some factors, which we call extraneous factors that have a great impact on trust but cannot be influenced by the developer of an e-commerce Web site. Lack of consumer trust in e-commerce merchants, e-commerce technology, and the social, financial and legal infrastructures of the e-commerce environment, poses a major challenge to the large-scale uptake of business to consumer e-commerce.

Figure 1- A Model to understand e-commerce Trust



Four extraneous factors can be distinguished that have an impact on trustworthiness in an e-commerce Web site: increased experience with using the Internet, higher numbers of hours online at home, use of the Web for financial services, and a significant reliance on e-mail. Note that these factors not only increase trustworthiness, but also result in an increase of online spending. Trust is built on a foundation with a multitude of influential elements. If the e-commerce website cannot attractive the consumer or visitor, the greater the likelihood the visitor will go elsewhere, like a competitor's site. By following the above recommendations, you are all but guaranteeing an increase in trust and online sales. Trust plays an important role in customers' willingness to proceed with a transaction. The major concern of many users not buying goods and services on the Internet involves security reasons. It is clear that users who use the Web for financial services are not preoccupied with security concerns, and hence put a high degree of trust in e-commerce Web sites.

5. E-Trust

Trust is often understood as a relation between an agent (the trustor) and another agent or

object (the trustee) and this is a complex concept that has been studied from varying views and disciplines. The relation is supposed to be grounded on the trustor's beliefs about the trustee's capabilities and about the context in which the relation occurs. This is a generalization of the definition of trust provided by (Gambetta, 1998). Trust is a catalyst for human cooperation. It allows people to interact spontaneously and helps the economy to operate smoothly. Lack of trust on the other hand is like sand in the social machinery. It makes us waste time and resources on protecting ourselves against possible harm and thereby clogs up the economy. From a business perspective, trust has been defined as the willingness to depend on an exchanging partner in whom one has confidence, the willingness to be vulnerable to the actions of another party, and the expectation of ethically justifiable behavior, among others. Geyskens et al. provide a concise and meaningful view, where trust is described as the belief or expectation that the vendor's word or promise can be relied upon and the vendor will not take advantage of the consumer's vulnerability. The establishment of consumer trust is highly desirable for vendors, as it facilitates long-term relationships and encourages repeat interactions/purchases. In order to identify the antecedents of on-line trust needed to develop a model, we first have to define on-line trust. While this may appear to be a relatively straightforward task, defining on-line trust is inherently difficult. The on-line trust can emerge in numerous trustor / trustee relationships. However, it is not obvious that all forms of on-line trust relationships can be understood through one definition. For exploration of online trust can be start by discussing the several combinations of trustor / trustee relationships occurring both offline and online. Psychologists, sociologists and others have discussed several forms of trustor / trustee relationships as they occur in the offline world. Trustors and trustees, that is, objects of trust, can be individual people or groups. Groups may be families, neighbors, organizations or even societies. In the online world, there are two approaches to defining relationships between trustors and objects of trust. Computer-mediated communication researchers study individual-to-individual trust relationships mediated through technology. In contrast, other researchers focus on technology as the object of trust. E-trust occurs in environments where direct and physical contacts do not take place, where moral and social pressures can be differently perceived, and where interactions are mediated by digital devices. All these differences from the traditional form of trust give rise to a major problem that any theory of e-trust must solve: whether trust is affected by environmental features in such a way that it can only occur in non-digital environments, or it is mainly affected by features of the agents and their abilities, so that trust is viable even in digital contexts.

6. E-Commerce awareness and Trust

The survey and studying about e-commerce awareness and readiness users and companies is very important, because the e-commerce awareness can be reducing the all online consumers and customers concern. This study also identifies the enabling factors, the bottlenecks and, forecasts the future growth of e-commerce in scope of using e-commerce. Now, Awareness of e-commerce among the companies is very high but investment to develop an e-commerce application is very poor according to the survey. Awareness is the state or ability to perceive, to feel, or to be conscious of events, objects, or sensory patterns. In this level of consciousness, sense data can be confirmed by an observer without necessarily implying understanding. More broadly, it is the state or quality of being aware of something. In biological psychology, awareness is defined as a human's or an animal's perception and cognitive reaction to a condition or event. Awareness is a relative concept. Awareness is also a concept used in CSCW. Its definition has not yet reached a consensus in the scientific community in this general expression. However, context awareness and location awareness are concepts of large importance especially for AAA applications. The term "Customer Awareness" has found many uses in commerce. The understanding by an individual of their rights as a consumer concerning available products and services being marketed and sold. The concept involves four categories including safety, choice, information, and the right to be heard. The process of development along with the expanding globalization and liberalization process has increased the number of consumer related issues. Consumer protection has earned an important place in the political, economic and social agendas of many nations. Consumer education is an important part of this process and is a basic consumer right that must be introduced at the school level. Consumers by definition include all citizens who are, by and large the biggest group, who are affected by almost all government, public or private decisions. The most important step in consumer education is awareness of consumer rights.

Consumer awareness, which refers to a buyer's knowledge of a particular product or company, allows the buyer to get the most from what he buys. Consumers know more about their choices when they have product information and benefit from knowing their rights, hearing about alerts and warnings and finding out about safety issues.

On the one hand, the Awareness word is connected to the Security. On the other hand, security

and trust are the foundation of e-commerce and customer awareness on e-business is a necessity. In other words, awareness and security in e-commerce are related to each other. Therefore, in the e-commerce ISMS play a role. Security awareness is one of the main activities in design and implementation of information security management system in any organization.

Information security (IS) has always been looked upon as a necessary evil by business people and management. One of the biggest challenges for IS professionals has been to sell security to management. IS is a process and not a product. The process is intended to identify and minimize risk to acceptable levels. It should be iterative and should be managed. An ISMS is a set of policies concerned with IS management or IT related risks. The governing principle behind an ISMS is that an organization should design, implement and maintain a coherent set of policies, processes and systems to manage risks to its information assets, thus ensuring acceptable levels of IS risk. As with all management processes, an ISMS must remain effective and efficient in the long term, adapting to changes in the internal organization and external environment. ISMS is a proactive approach to continuously and effectively manage, at a high level, IS including people, infrastructure and businesses. The goal is to reduce risks to manageable level, while taking into perspective both business goals and customer expectations.

7. Security Awareness and Trust

These concepts of trust, risk, privacy, and security are used for many purposes and with many meanings. It is important to understand that these concepts serve different purposes: trust and risk are human-related concepts, while security is mainly used in a technical way. Security in that sense is the means to achieve and support consumer privacy. Security could also mean a consumer's feeling of being secure, safe. Studies concerning consumer trust, privacy, and security are often theoretical in nature. Two phrase "insecurity of financial transactions" and "loss of privacy" are among the major impediments to e-commerce. But in fact most users have only ague ideas about the threats and risks (lack awareness), and a very limited understanding of the technical and legal options for minimizing their risk. For instance, the cardholder's risk in sending his or her credit card number over the Internet is typically over estimated. At least as of this writing payments over the Internet are treated like mail-order / telephone-order transactions, which means that the cardholder is not liable at all. All risk is with the merchant. Strategies, products and services to enhance trust can be evaluated along five dimensions, each having different implications on trust and privacy: (participation, depth, publication, payer and price). Understanding each is important in developing guidelines and policies for evaluating, monitoring, comparing and developing different approaches and products to deal with specific trust-enhancement goals. When examining barriers to the adoption of e-commerce, numerous studies have singled out consumers' lack of trust as a major factor. Some people reduce the trust problem to one of security, arguing that, if security issues are resolved, people will be happy to transact online. However, when the trust problem is broken down into its constituents, privacy, ease-of-use or the credibility of information on the web are revealed to be as important to consumers as security. In other words, in all cases to achieve proper awareness of the consequences of any decision to reduce the risks of e-commerce. Lack of awareness of e-commerce system performance (privacy, security, risk), Technical items, required skills, Laws, regulations, legal considerations will be in creating is understandings. The mutual confidence and trust in the system or is reduced. The mismatch between consumer risk on online activities perception and the real risks has already been pointed out. (One of the illustrations the auction market) This lack of consumer awareness of the actual level of risks, of risk reduction measures and of available protection mechanisms is a major target of consumer protection. The security awareness goal is twofold: first, to provide information on trust and risk to businesses that are developing e-commerce systems; and second, to help consumers understand the risks in using the Internet for purchases and show them how to protect themselves.

8. Conclusion

Since the commercial events in cyberspace or virtual reality, unlike the traditional trade, are done online, thus every attempt of an individual: be it the buyer or the seller, may cause and bear damaging consequences for one of the parties or both of them, or their supporters such as the intermediaries, insurance agencies and banks. The decision for approving the electronic transaction is one the challenging steps in the e-commerce environment. These challenges can be discussed in relation to the security, validity and credibility of measures. For a safe business in cyberspace, the desirable level of trust and confidence is necessary for the actual beneficiaries of the e-commerce application. Even though for detection of unusual events in the electronic process, the contemporary electronic trading systems have advanced and intelligent mechanisms, but still in these systems most of the transactions are done under the impact of human factor. Among the key and influential issues in establishing a level of trust in e-commerce, the following are of importance:

Knowledge, skills, expertise and experience of an individual in making decision to acquire the necessary information regarding the deal, choosing a product or service, purchase decision and post purchase behavior, or

A deal together with the certain feeling of reliability toward system performance at the application layer and other layers of infrastructure under use, as well as

The integrity of the identities of the parties, accuracy of the product or service, assurance of a proper time for shipping and delivery.

Elimination or alleviation of security concerns requires the basics knowledge of security in e-commerce. One of the key factors affecting implementation and stability of the security solutions is knowledge: the awareness and scientific level of the users of e-commerce. Security awareness means training and cultural enhancement to achieve the desired level of security and mitigate the risks and threats against users in cyberspace. Since the users of cyberspace are concerned about issues like breach of privacy, confidentiality of information, dissemination of personal information, or responses to the inquiries and spam messages and the professional methods used by cyberspace robbers to steal, he increases in the e-commerce awareness level cause the enhanced level of e-trust.

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Electrical and thermal transport properties of binary chalcogenide indium polytelluride crystals

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Abstract: In the present work, single crystals of In_2Te_5 were grown by the modified Bridge man technique. An investigation has been carried out on the influence of temperature on the electrical conductivity, Hall effect and thermoelectric power. The energy gap calculated to be 0.88 ev, the ionization energy of acceptor was determined to be 0.14 ev. The conductivity throughout the entire temperature range was found to be of P-type. The electrical conductivity, Hall coefficient, carrier concentration ration at room temperature were estimated to be 1.47 x10 $^{-2}$ (Ω^{-1} cm^{-1}), 4.6 x10^4 cm^3/C and 1.3 x10^{14} cm^{-5} respectively, the electron and hole mobility are found to be 8.53 x10^3 cm^2/v.sec and 6.78x10^3 cm^2/v.sec respectively. The effective masses of charge carriers are 1.59 x10^{-39} kg and 2.42 x10 $^{-38}$ Kg for electrons and holes respectively. The diffusion coefficient for both majority and minority carriers was estimated to be 177.6 cm^2/sec and 221.3 cm^2/sec respectively. The diffusion length as well as the relaxation times of holes and electrons are found to be Lp= 4.29x10^{-7} cm, L_n= 1.368x10^{-7} cm, τ_p = 1.63 x 10^{-15} sec and τ_n = 8.4 x10^{-17} sec respectively. In addition to these pronounced parameters, the efficiency of the thermoelectric element (figure of merit) was checked, which leads to better application in many fields keywords; crystal growth, In_2Te_5, electrical conductivity, Hall effect, thermoelectric power.

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Key words: In_2Te_5, Hall effect, TEP, electrical conductivity

1. Introduction

Research on binary semiconducting compound formed by the elements from groups (III) and (VI) of the periodic table as a collective group of materials have been and are still the subject of much intensive investigation. In the last few years widespread attention has been paid to the semiconductors of the ($A^{III}B^{VI}$) group. This interest has been driven by their possible device application.(1) Great attention has been paid(2) to Ga, In and Te chalcogenides. In particular the study of the $A_2^{III}B_3^{VI}$, $A_2^{III}B_5^{VI}$ and $A_4^{III}B_3^{VI}$ compounds is quite attractive during the last few decades(3).

Indium tellurides are useful as materials for electronics and for optical recording. The phase diagram of the In Te system studied by many authors(4-7), and according to the last study it is obvious that four compounds in the In-Te system, InTe, In_2Te_3, $IaTe_5$ and In_4T_5 are stable. In_2Te_5 is a member of this family, has interesting properties. Among $A^{III}B^{VI}$ compounds not much attention has been paid to investigations of indium telluride, there are some works devoted to InTe and In_2Te_3, (8-19), but only very few works devoted to structure and some physical properties of In_2Te_5(20-25). The search for new semiconducting materials has led us to the present investigation on In_2Te_5, As far as we know from the published literature up to now, there is still insufficient data to throw a clear light upon the actual behavior of this compound, also some of the results given in the literatures show some discrepancies. In view of this, the present work aims to prepare In_2Te_5 in single crystal form and investigate the main transport properties of this compound. This study is a timely one in view of the recent interest in this compound.

2- Experimental

2.1. Preparation of sample

In_2Te_5 samples were prepared using a modified Bridgman technique for growing crystal from melt. Indium polytelluride monocrystals was prepared from high purity indium (6N) representing 26.4672% and tellurium (5N) representing 73.5328%, stoichiometeric of the elements was used as starting material in the growth experiments. At the beginning of the growth run, the ampoule with its charge was held in the hot zone of the furnace at 783k for 10 h for melt homogenization the charge was shaken during heating several times to accelerate the diffusion of contaminates through each other. Then the ampoule was moved into the middle zone of the furnace with a temperature of 740k corresponding to the crystallization temperature according to the phase diagram(4), Afterwards, the ampoule was cooled down slowly in the third zone of the furnace, then the furnace was switched. Details of the experimental equipment for crystal growth and preparation procedures are

described elsewhere[27]. The resulting ingots had a plate-like habit with metallic bright color. The producing ingot showed good agreement with the obtained data reported early[21]. The single crystallinity of the compound was checked using X-ray diffraction technique. From the X-ray studies it was evident that the crystal has a high degree of crystallinity with the required phase without any secondary phase.

2.2. Experimental arrangement

Measurements of the electrical conductivity and Hall effect were done with the help of a Pyrex glass cryostat, which was designed[28] for this purpose. The cryostat is used as a holder evacuated container for liquid nitrogen (for low-temperature measurement) and support to the electric heater (for high-temperature measurements. Copper-constantan thermocouple was used for measuring the temperature of the sample. Silver paste was used for the ohmic contact. Typical dimension for rectangular sample were (8.5×2.7×1) mm^3. The Hall measurements were made in a magnetic field of 0.5 tesla and were performed using the conventional DC potentiometer method. For thermoelectric power (TEP) measurements, an evacuated working chamber was used to protect the sample from oxidation and water vapor condensation at high and low temperature respectively. The outer heater discharge its heat slowly to the specimen environment. The inner heater was attached to lower end of the crystal in order to control the temperature and its gradient along the specimen. More details about the apparatus and technique of measuring have been published.[29,30]

3- Results and discussion:

3.1.Temperature dependence of electrical conductivity and Hall effect for In_2Te_5

Fig.1 shows the variation of electrical conductivity σ versus inverse temperature for In_2Te_5 single crystal. The electrical conductivity and Hall coefficient measurements were performed in the temperature rang extend from 198 up to 558K. The complete temperature range can be subdivided into three regions, below the transition, the transition region and above the transition. These regions are quite clearly shown in fig.1. With increase of temperature the electrical conductivity at first increases gradually, then it reaches the transition region at 373k, then the lnσ vs 1/ T curve passed through an intermediate region (373-473k) in which the carrier concentration is not actually constant, and in the third region, σ rises rapidly. This pattern of changes in the electrical conductivity is due to the appeance of impurity and intrinsic conductivity, respectively, and to the variation of the carrier mobility and concentration with temperature. In the intermediate region where the carrier density (N_A-N_D) = constant, until the intrinsic region is reached. The decrease of the value of σ in this region may be due to the increase of intensity of lattice vibration which leads to decrease in the carrier mobility. This discussion is acceptable, since the conductivity decrease in this region and this extended to full ionization of impurity at the end of impurity at the end of exhaustion region. At temperatures above the transition point the conductivity increases rapidly (473-558K). The temperature dependence exhibits a transition from a region of lower slope to one of higher slope. The slopes of the curve increase with increasing temperature, and are higher at higher temperature because of the carriers being excited from the extended state of the valance band into the conduction band. The width of the forbidden gap as calculated from the slope of the curve in the high- temperature region is found to be ΔE_g =0.88 ev. Also the ionization energy as deduced in the impurity region was evaluated to be ΔE_a = 0.14 ev.

The room temperature conductivity of In_2Te_5 single crystal equal to $1.47x10^2$ $(\Omega\ cm)^{-1}$. The Hall coefficient (R_H) variation with temperature and a positive sign of (R_H) indicated the major contribution to the conductivity by holes.

Fig.2. Shows the temperature dependence of ($R_H T^{3/2}$), it is the usual type for semiconductors.

Assessment of the forbidden band width from this graph and found have a value close to that determined from electrical conductivity and that reported early.[26]. It was found also the depth of the acceptor centre is 0.14 ev. The variation of the Hall mobility with temperature is shown in fig 3.

It was found that the exponent(n) in the relation $\mu \sim T^n$ below 373k is equal to 1.112, while in the high temperature range (T>373) the mobility decreases according to the low $\mu \sim T^{-1.92}$ from this relation, it seems that the value of n close to impurity and lattice scattering mechanism, in the low and high temperature respectively. The room temperature mobility was found to be 6.866 $xl0^3$ cm^2/V.sec. The variation of carrier concentration with temperature is shown in fig 4.

As the, In_2Te_5 sample exhibiting intrinsic behavior above 473K the expected value for the intrinsic concentration will be given as

$$n_i = 2\left(\frac{2\pi k}{h^2}\right)^{3/2}\left(m_n^* m_p^*\right)^{3/4} T^{3/2} \exp\left(\frac{-\Delta Eg}{2kT}\right)$$

One can see that the carrier concentration varies sharply with increasing temperature. The room temperature concentration is $1.3x10^{14}$ cm^{-3}

3.2. Temperature dependence of TEP for In_2Te_5 single crystal.

The thermoelectric power (TEP) measurements were performed in a wide, temperature range (153-450k).

Fig5 illustrates the general mode of variation of TEP with temperature. This was done by plotting the relation between α and ln T in the low temperature range. Fig (5) shows a straight line relation in this region of temperature.

In the impurity region the following formula could be applied[31].

$$\alpha = \frac{K}{e}\left[2 - \frac{\ln Ph^{3}}{2(2\pi m_{p}^{*} KT)^{3/2}}\right]$$

Thus the effective mass of holes is evaluated to be$2.42\text{x}10^{-38}$ kg.

Some features of these results may be pointed out

(1) Our sample shows P-type conductivity within the temperature range of investigation, which is in quantitative agreement our previous data of the Hall coefficient and another published data[26].

(2) The room temperature thermoelectric power value for In_2Te_5 mounted to be 7.47 μv/K.

(3) The figure shows that the value of α decreases as the temperature rises. This may be due to the presence of some crystal defects or trapping centers in the direction of the carrier flow.

(4) With further rise of temperature α decreases i.e in the whole extrinsic range of temperature α decreases with T.

As follows from the expression for TEP of a semiconductor in the intrinsic region [32] .

$$\alpha = \frac{-k}{e}\left[\frac{b-1}{b+1}\left(\frac{\Delta Eg}{2KT}+2\right)\right]+\frac{1}{2}\ln\left[\frac{m_n^*}{m_p^*}\right]^{3/2}$$ Where

k is the Boltzmann constant, b is the ratio of the electron to hole motilities, ΔE_g is the gap width and $\left(m_n^*, m_p^*\right)$ are the effective masses of electrons and holes respectively.

Fig 6 shows the relation between the thermoelectric power and the inverse of temperature. This relation show that a plot of α in the intrinsic range, as a function of reciprocal of absolute temperature is a straight line.

The measured thermoelectric power in conjunction with the previously obtained Hall effect data are used to calculate electron to hole mobility ratio and also the ratio of effective masses of both electrons and holes. The slopes of the curve are used to estimate the ratio of the electron and hole mobilities. Taking ΔE_g =0.88 ev, the ratio $b=\mu_n/\mu_p$ is found to be 1.245, since μ_p =$6.86\text{x}10^{3}$ cm^2/v.sec, then we can evaluate μ_n =$8.53\text{x}10^{3}$ cm^2/v.sec.

Another important parameter can be deduced with the aid of the obtained values of μ_n and μ_p using Einstein relation, that is the diffusion coefficient for both majority and minority carriers at room temperature can be evaluated to be 177.6 and 221.3 cm^2/sec respectively.

The ratio between the effective masses of both electrons and holes can be estimated from the intersection of the curve. We evaluate this ratio as $(m_n^*/m_p^* = 0.065)$

Combining the value of affective mass of holes with that obtained for the ratio m_n^*/m_p^* , one obtains an effective mass of minority carriers of the value m_n^* = $1.57\text{x}10^{-39}$ kg. By using the effective mass values of electrons and holes, the relaxation time for both current carriers can be determined. Its value for holes comes to be $1.038\ \text{x}10^{-15}$ sec, while for electrons it is equal to $8.4\text{x}10^{17}$ sec. Using the values of diffusion coefficient and relaxation time, the diffusion length for both charge carriers can be determined. The values of the diffusion length for electrons and holes are found to be $L_n=1.36\text{x}10^{-7}$ cm and $L_p= 4.29\text{x}10^{-7}$ cm,

respectively. Our results are in good agreement with each other, since the mobility 0f holes is smaller compared with that of electrons,and its effective mass is larger than that of electrons. Its relaxation time will be larger than that of electrons. Fig.7 represent the dependence of α on carrier concentration for a given In_2Te_5 sample, as we have seen α increases sharply and linearly with the decrease of carrier density.

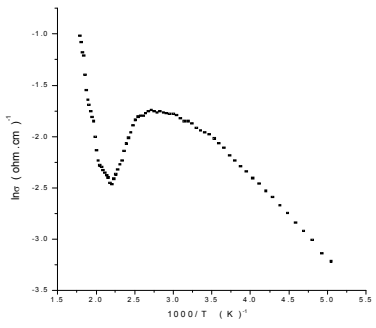

Fig.1:The temperature dependence of electrical conductivity for In_2Te_5 single crystal.

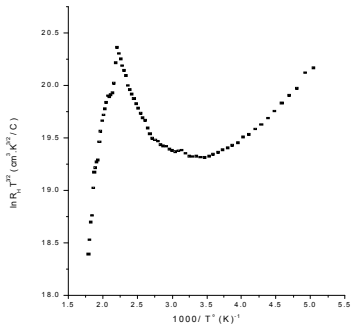

Fig.2:The dependence of ($R_H T^{3/2}$) against the temperature for In_2Te_5 single crystal.

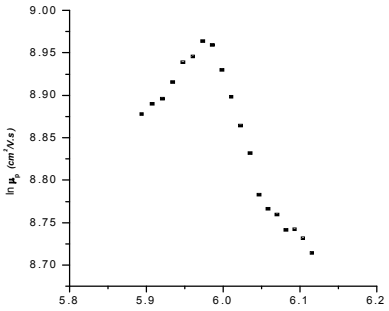

Fig3: behavior of the Hall mobility with temperature.

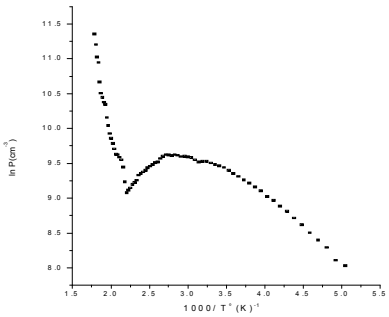

Fig4: Variation of carrier concentration with temperature

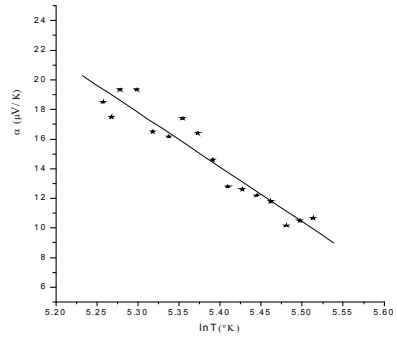

Fig5: Relation between TEP for In_2Te_5 and ln T.

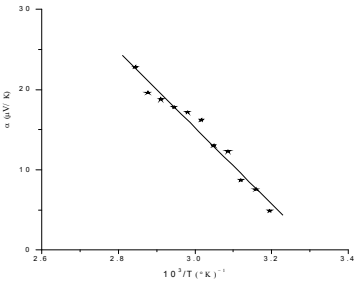

Fig 6: Plot of α against 10^3 /T for In_2Te_5 crystal.

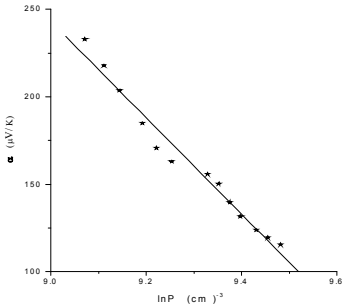

Fig.7 Represent the dependence of TEP on carrier density

From this behavior we realize the effect of the charge carriers is a strong factor governing the variation of α.The same behavior was observed when we plotted α vs Ln σ for In_2Te_5 sample as in Fig.8

This figure shows the dependence of thermoelectric power coefficient α on the natural logarithm of electrical conductivity according to the published formula (33)

$$\alpha = \frac{K}{e}\left[A + \frac{ln2\left(2\Pi m_p^* KT\right)^{3/2} eM}{\left(2\Pi h^2\right)}\right] - \frac{K}{e} ln\sigma$$

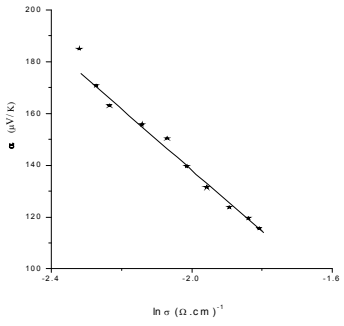

Fig. 8 The dependence of TEP on the natural logarithm of σ for In_2Te_5

It is seen from the curve that the thermoelectric power decrease rapidly as the electrical conductivity increased. From figures 7 and 8, we can deduced that

the variation of α with the environmental temperature is not a mobility effect, but is dependent on the variation of concentration. The choice of material for thermoelectric generators and refrigerators is based on the efficiency parameter Z defined by the relation;

$$Z = \frac{\alpha^2 \sigma}{K}$$

where K is the thermal conductivity of semiconductor and σ is the electrical conductivity. K value of In_2Te_5 was determined previously [34]. This parameter was deduced and its value was found to be 6.2×10^{-10} K^{-1}.

The proposed treatment of the experimental data sheds newlight on the main physical parameters in In_2Te_5 single crystal.However those pronounced parameters are found to be sufficient to give complete information about the physical behavior of our best compound. This gives the chance of practical application in different fields.

4-Conclusion

Measurement of electrical conductivity, Hall coefficient and TEP of as grown In_2Te_5 single crystals are performed over wide range of temperature. The conductivity was found to be P-type. The energy gap was calculated to be 0.88 eV, while the depth of the acceptor level is 0.14 eV. The experimental data gives us the chance to determine the following pronounced parameters, carrier mobility, effective masses, diffusive coefficient, diffusive length as well as the relaxation time of both types of charge carriers.Also the efficiency of the material as thermo-element was checked. This mode of investigation (crystal growth, electrical conductivity, Hall effect and thermoelectric properties study) is an ideal was for finding out the possibility of making application for this semiconductor compound especially in the field of energy conversion, semiconductor devices and electronic engineering.

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Global analysis of a virus infection model with multitarget cells and distributed intracellular delays

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Abstract: In this paper, we investigate the global analysis of a virus infection model with multitarget cells and multiple distributed intracellular delays. The model is a $(2n+1)$-dimensional nonlinear delay differential equations that describes the dynamics of the virus, n classes of uninfected target cells and n classes of infected cells. The incidence rate of infection is given by saturation functional response. The model has two types of distributed time delays describing the time needed for infection of target cell and virus replication. This model can be seen as a generalization of several models given in the literature describing the interaction of the virus with one class of target cells. Lyapunov functionals are constructed to establish the global asymptotic stability of the uninfected and infected steady states of the model. We have proven that if the basic reproduction number is less than unity then the uninfected steady state is globally asymptotically stable, and if the infected steady state exists then it is globally asymptotically stable.
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Key words: Global stability; viral infection; intracellular delays; multitarget cells; Lyapunov functionals.

1 Introduction

In the last decades, there has been much interest in developing mathematical models of virus infection dynamics of many diseases [1]. This is because their importance to explore possible mechanisms and dynamical behaviors of the viral infection process, to estimate key parameter values, and to guide development efficient anti-viral drug therapies. Some of these models are given by ODEs under an assumption that, the infection could occur and the viruses are produced from infected target cells instantaneously, once the uninfected target cells are contacted by the virus particles (see e.g. [2], [3], [4], [5], [6] and [7]). Other accurate models incorporate the delay between the time the viral entry into the target cell and the time the production of new virus particles, modeled with discrete time delay or distributed time delay using functional differential equations (see e.g. [9], [10], [11], [26] and [28]). The basic virus dynamics model with distributed intracellular time delay has been proposed in [28] and given by

$$\dot{x}(t) = \lambda - dx(t) - (1-u_{rt})\bar{\beta}x(t)v(t) \qquad (1)$$

$$\dot{y}(t) = (1-u_{rt})\bar{\beta}\int_0^\infty f(\tau)e^{-m\tau}x(t-\tau)v(t-\tau)d\tau - ay(t), \qquad (2)$$

$$\dot{v}(t) = (1-u_p)\bar{p}\int_0^\infty g(\tau)y(t-\tau)d - cv(t), \qquad (3)$$

where $x(t), y(t)$ and $v(t)$ represent the populations of uninfected target cells, infected cells and free virus particles at time t, respectively. Here λ, represents the rate of which new target cells are generated from sources within the body, d is the death rate constant, and $\bar{\beta}$ is the constant rate at which a target cell becomes infected via contacting with virus. Equation (2) describes the population dynamics of the infected cells and shows that they die with rate constant a. The virus particles are produced by the infected cells with rate constant $\bar{p}$ and are removed from the system with rate constant c. The model includes two kinds of antiretroviral drugs, reverse transcriptase inhibitors (RTI) to prevent the virus from infecting cells and protease inhibitors (PI) to prevent already infected host cells from producing infectious virus particles. The parameters $u_{rt}\epsilon[0,1]$ and $u_p\epsilon[0,1]$ are the efficacies of RTI and PI, respectively. To account for the time lag between viral contacting a target cell and the production of new virus particles, two distributed intracellular delays are introduced. It is assumed that the target cells are contacted by the virus particles at time $t-\tau$ become infected cells at time t, where τ is a random variable with a probability distribution $f(\tau)$. The factor $e^{-m\tau}$ accounts for the loss of target cells during time period $[t-\tau, t]$. On the other hand, it is assumed that, a cell infected at time $t-\tau$ starts to yield new infectious virus at time t where τ is distributed according to a probability distribution $g(\tau)$.

Many authors have devoted their effort in developing various mathematical models of viral infections with discrete or distributed delays and studying their qualitative behaviors (see [9], [11], [26], [10], [28], [22], [23], [21], [27], [24], [31] and [33]). These works addressed the virus dynamics models

under the assumption that the virus attack one class of target cells (e.g. $CD4^+$ T cells in case of HIV or hepatic cells in case of HCV and HBV). In case of HIV infection, the HIV has two classes of target cells, $CD4^+$T cells and macrophages [29]. In ([8], [30], [12], [13], [14], [17], [15], [19]), a class of HIV infection models with two classes of target cells has been proposed. The global stability of these models has been investigated in ([12], [13], [14], [15] and [19]). Since the interactions of some types of viruses inside the human body is not very clear and complicated, therefore the virus may attack more than two classes of target cells. In very recent works, Elaiw [18] and [16], has proposed some virus dynamics models with multitarget cells and investigated the global asymptotic stability of its steady states. In [16], multiple discrete-time delays have been incorporated into the model.

The purpose of this paper is to propose a delayed virus dynamics model with multi-target cells and establish the global stability of its steady states. We incorporate two types of distributed delays into this model to account the time delay between the time the target cells are contacted by the virus particle and the time the emission of infectious (matures) virus articles. We assume that the infection rate is given by saturation functional response. The global stability of these models is established using Lyapunov functionals, which are similar in nature to those used in [25]. We prove that if the basic reproduction number is less than unity, then the uninfected steady state is globally asymptotically stable (GAS) and if the infected steady state exists, then it is GAS.

2 Virus infection model with multitarget cells and distributed delays

In this section we propose a virus dynamics model which describes the interaction of the virus with n classes of target cells taking into account the saturation infection rate and multiple distributed intracellular delays.

$$\dot{x}_i(t) = r_i(x_i) - \frac{\beta_i x_i(t) v(t)}{1+\alpha_i v(t)}, \qquad i = 1, \cdots, n \quad (4)$$

$$\dot{y}_i(t) = \beta_i \int_0^\infty f_i(\tau)\, e^{-m_i\tau} \frac{x_i(t-\tau)v(t-\tau)}{1+\alpha_i v(t-\tau)} d\tau - a_i y_i(t), \qquad i = 1, \cdots, n \quad (5)$$

$$\dot{v}(t) = \sum_{i=1}^{n} p_i \int_0^\infty g_i(\tau) e^{-\delta_i\tau} y_i(t-\tau) d\tau - cv(t), (6)$$

where x_i and y_i represent the populations of the uninfected target cells and infected cells of class i, respectively, and v is the population of the virus particles. Here $\alpha_i, i = 1, \cdots, n$ are positive constants, $\beta_i = (1-u_{rt})\bar{\beta}_i$ and $p_i = (1-u_p)\bar{p}_i, i = 1, \cdots n$. The factors $e^{\delta_i\tau}, i = 1, \cdots, n$ account for the cells loss during the delay period. All the other parameters of the model have the same meanings as given in (1)-(3). The growth rate of the uninfected target cells of class i is given by the function $\tilde{r}_i(x_i)$. The following particular forms of function $\tilde{r}_i(x_i)$ have widely been used in the literature of virus dynamics:

$$\bar{r}_i(x_i) = \lambda_i - dx_i,$$
$$\tilde{r}_i(x_i) = \lambda_i - dx_i + b_i x_i \left(1 - \frac{x_i}{x_{i,max}}\right),$$

where b_i is the maximum proliferation rate of the target cells of class i, and $x_{i,max}$ is the maximum level of target cells population in the body. We mention that, if $n = 1, \alpha_1 = 0$ and $r_1 = \bar{r}_1$, then model (4)-(6) leads to the model presented in [33] and [31].

The probability distribution functions $f_i(\tau)$ and $g_i(\tau)$ are assumed to satisfy $f_i(\tau) > 0$ and $g_1(\tau) > 0$ and

$$\int_0^\infty f_i(\tau)d\tau = \int_0^\infty g_i(\tau)d\tau = 1, \int_0^\infty f_i(u)e^{su}du < \infty$$
$$\int_0^\infty g_i(u)e^{su}du < \infty \quad i = 1, \cdots, n,$$

where s is a positive number. Let $F_i = \int_0^\infty f_i(\tau)e^{-m_i\tau}d\tau$ and $G_i = \int_0^\infty g_i(\tau)e^{-\delta_i\tau}d\tau$, $m_i \geq 0$, $\delta_i \geq 0$, then $0 < F_i \leq 1$ and $0 < G_i \leq 1$, $i = 1, \cdots, n$. The initial conditions for system (4)-(6) take the form

$$x_j(\theta) = \varphi_j(\theta), \qquad y_j(\theta) = \varphi_{j+n}(\theta).\ j = 1, \cdots, n,$$
$$v(\theta) = \varphi_{2n+1}(\theta), \varphi_j(\theta) \geq 0, \qquad j = 1, \cdots, 2n+1,$$
$$\theta \in (-\infty, 0), \qquad (7)$$

$\varphi_j(0) > 0, j = 1, \cdots, 2n+1,$

where $(\varphi_1(\theta), \varphi_2(\theta), \cdots, \varphi_{2n+1}(\theta) \in UC\big((-\infty, 0], \mathbb{R}_+^{2n+1}\big)$, and UC is the Banach space of fading memory type defined as [32]:

$$UC\big((-\infty, 0), \mathbb{R}_+^{2n+1}\big) = \{\phi \in C((-\infty, 0], \mathbb{R}_+^{2n+1}): \phi(u)e^{su} \text{is uniformly continuous}$$

on $(-\infty, 0]$ and $\|\phi\| = \sup_{u \le 0} \phi(u)e^{su} < \infty\}$

where $C((-\infty, 0], \mathbb{R}_+^{2n+1})$ is the Banach space of continuous functions mapping the interval $(-\infty, 0]$ into $\mathbb{R}_+^{2n+1}$. By the fundamental theory of functional differential equations [20], system (4)-(6) has a unique solution satisfying the initial conditions (7).

Assumption A1 For $i = 1, \cdots, n$, function $\tau_i: [0, \infty) \to \mathbb{R}$ satisfies:

(i) $r_i(x_i)$ is continuous, differentiable and $r_i(0) > 0$,

(ii) there exits an $x_i^0 > 0$ such that

$$r_i(x_i^0) = 0, \quad r_i'(x_i^0) < 0$$
$$(x_i - x_i^0) r_i(x_i) \le 0, \quad x_i \ne x_i^0$$

2.1 Non-negativity and boundedness of solutions

In the following, we establish the non-negativity and boundedness of solutions of (4)-(6) with initial conditions (7). Let $\mathbf{x} = (x_1, x_2, \cdots, x_n)^T$ and $\mathbf{y} = (y_1, y_2, \cdots, y_n)^T$.

Proposition 1. Suppose that Assumptions A1 holds true and $(\mathbf{x}(t), \mathbf{y}(t), v(t))$ be any solution of (4)-(6) satisfying the initial conditions (7), then $\mathbf{x}(t)$, $\mathbf{y}(t)$ and $v(t)$ are all non-negative for $t \ge 0$ and ultimately bounded.

Proof. First, we prove that $x_i(t) > 0$ for all $t \ge 0$. Assume that $x_i(t)$ lose its non-negativity on some local existence interval $[0, \sigma]$ for some constant σ and let t^* be such that $x_i(t^*) = 0$. From Eq. (4) we have $\dot{x}_i(t^*) = r_i(0) > 0$, $i = 1, \cdots, n$. Hence $x_i(t) < 0$ for some $t \in (t^* - \varepsilon, t^*)$, where $\varepsilon > 0$ is sufficiently small. This leads to a contradiction and hence $x_i(t) > 0$, for all $t \ge 0$. Further, from Eqs. (5) and (6) we have

$$y_i(t) = y_i(0)e^{-a_i t} + \beta_i \int_0^t e^{-a_i(t-\eta)} \int_0^\infty f_i(\tau) e^{-m_i \tau} \frac{x_i(\eta - \tau) v(\eta - \tau)}{1 + \alpha_i v(\eta - \tau)} d\tau d\eta$$
$$i = 1, \cdots, n,$$

$$v(t) = v(0)e^{-ct} + \sum_{i=1}^n p_i \int_0^t e^{-c(t-\eta)} \int_0^\infty g_i(\tau) e^{-\delta_i \tau} y_i(\eta - \tau) d\tau d\eta.$$

Then similar arguments can easily be used to show that $y_i(t) \ge 0$ and $v(t) \ge 0$ for all $t \ge 0$.

Next we show the boundedness of the solutions. Assumption A1 and Eqs. (4) imply that $\lim sup_{t \to \infty} x_i(t) \le x_i^0$. If follows that $\int_0^\infty f_i(\tau) e^{-m_i \tau} x_i(t - \tau) d\tau \le F_i x_i^0$.

Let $X_i(t) = \int_0^\infty f_i(\tau) e^{-m_i \tau} x_i(t - \tau) d\tau + y_i(t)$,

$i = 1, \cdots, n, S_i = sup_{x_i \in [0, x_i^0]} r_i(x_i)$ and $\bar{a}_i \le \min\left\{a_i, \frac{S_i}{x_i^0}\right\}$, then

$$\dot{X}_i(t) = \int_0^\infty f_i(\tau) e^{-m_i \tau} \left(r_i\big(x_i(t - \tau)\big) - \frac{\beta_i x_i(t - \tau) v(t - \tau)}{1 + \alpha_i v(t - \tau)}\right) d\tau + \int_0^\infty f_i(\tau) e^{-m_i \tau} \frac{\beta_i x_i(t - \tau) v(t - \tau)}{1 + \alpha_i v(t - \tau)} d\tau - a_i y_i(t),$$

$$\le F_i S_i - a_i y_i(t) \le F_i S_i - a_i y_i(t) + F_i S_i - \bar{a}_i \int_0^\infty f_i(\tau) e^{-m_i \tau} x_i(t - \tau) d\tau$$
$$\le 2F_i S_i - \bar{a}_i X_i(t).$$

Hence $\lim sup_{t \to \infty} X_i(t) \le L_i$, where $L_i = 2F_i S_i / \bar{a}_i$. Since $\int_0^\infty f_i(\tau) e^{-m_i \tau} x_i(t - \tau) d\tau > 0$, we get $\lim sup_{t \to \infty} y_i(t) \le L_i$. On the other hand,

$$v(t) \le \sum_{\iota=1}^n p_\iota L_\iota \int_0^\infty g_\iota(\tau) e^{-\delta_\iota \tau} d\tau - cv = \sum_{\iota=1}^n p_\iota L_\iota G_\iota - cv,$$

then $lim\, sup_{t \to \infty} v(t) \le L^*$, where $L^* = \sum_{i=1}^n \frac{p_i L_i G_i}{c}$. Therefore, $\boldsymbol{x}(t), \boldsymbol{y}(t)$ and $v(t)$ are ultimately bounded.

2.2 Steady states

Assumption A1 ensures that system (4)-(6) has an uninfected steady state $E_0 = (\boldsymbol{x}^0, \boldsymbol{y}^0, v^0)$, where x_i^0 is the solution of $r_i(x_i^0) = 0$, $y_i^0 = 0$ and $v^0 = 0$. In addition to E_0, the system can has a positive infected steady state $E_1(\boldsymbol{x}^*, \boldsymbol{y}^*, v^*)$. The coordinates of the infected steady state, if they exist, satisfy the equalities:

$r_i(x_i^*) = \frac{\beta_i x_i^* v^*}{1+\alpha_i v^*}$, $a_i y_i^* = F_i \frac{\beta_i x_i^* v^*}{1+\alpha_i v^*}$, $i = 1, \cdots, n$ (8)

$cv^* = \sum_{i=1}^{n} G_i p_i y_i^*$. (9)

The basic reproduction number of system (4)-(6) is given by

$$R_0 = \sum_{i=1}^{n} R_i = \sum_{i=1}^{n} \frac{F_i G_i \beta_i p_i x_i^0}{\alpha_i c}, \qquad (10)$$

where R_i is the basic reproduction number for the dynamics of the interaction of the virus only with the target cells of class i.

2.3 Global stability analysis

In this section, we prove the global stability of the uninfected and infected steady states of system (4)-(6) employing the method of Lyapunov functional which is used in [25] for SIR epidemic model with distributed delay. Next we shall use the following notation: $z = z(t)$, for any $z \in \{x_i, y_i, v, i = 1, \cdots, n\}$. We also define a function $H: (0, \infty) \to [0, \infty)$ as

$$H(z) = z - 1 - \ln z.$$

It is clear that $H(z) \geq 0$ for any $z > 0$ and H has the global minimum $H(1) = 0$.

Theorem 1. If $R_0 \leq 1$ and Assumption A1 holds true, then E_0 is GAS.

Proof. Define a Lyapunov functional W_1 as:

$$W_1 = \sum_{i=1}^{n} \gamma_i \left[x_i^0 H\left(\frac{x_i}{x_1^0}\right) + \frac{1}{F_i} y_i + \frac{\beta_i}{F_i} \int_0^{\infty} f_i(\tau) e^{-m_i \tau} \int_0^{\tau} \frac{x_i(t-\theta) v(t-\theta)}{1+\alpha_i v(t-\theta)} d\theta d\tau + \frac{a_i}{F_i G_i} \int_0^{\infty} g_i(\tau) e^{-\delta_i \tau} \int_0^{\tau} y_i(t-\theta) d\theta d\tau \right] + v,$$

where $\gamma_i = \frac{p_i F_i G_i}{\alpha_i}$

The time derivative of W_1 along the trajectories of (4)-(6) satisfies

$$\begin{aligned} \frac{dW_1}{dt} = \sum_{i=1}^{n} \gamma_i \Bigg[& \left(1 - \frac{x_i^0}{x_i}\right) \left(r_i(x_i) - \frac{\beta_i x_i v}{1+\alpha_i v}\right) \\ & + \frac{\beta_i}{F_i} \int_0^{\infty} f_i(\tau) e^{-m_i \tau} \frac{x_i(t-\tau) v(t-\tau)}{1+\alpha_i v(t-\tau)} d\tau - \frac{a_i}{F_i} y_i \\ & + \frac{\beta_i}{F_i} \int_0^{\infty} f_i(\tau) e^{-m_i \tau} \left(\frac{x_i v}{1+\alpha_i v} - \frac{x_i(t-\tau) v(t-\tau)}{1+\alpha_i v(t-\tau)} \right) d\tau + \frac{a_i}{F_i G_i} \int_0^{\infty} g_i(\tau) e^{-\delta_i \tau} \left(y_i - y_i(t-\tau) \right) d\tau \Bigg] \\ & + \sum_{i=1}^{n} p_i \int_0^{\infty} g_i(\tau) e^{-\delta_i \tau} y_i(t-\tau) d\tau - cv. \end{aligned}$$

Collecting terms we get

$$\begin{aligned} \frac{dW_1}{dt} &= \sum_{i=1}^{n} \gamma_i \left(\left(1 - \frac{x_i^0}{x_i}\right) r_i(x_i) + \frac{\beta_i x_i^0 v}{1+\alpha_i v} \right) - cv \\ &= \sum_{i=1}^{n} \gamma_i \left(1 - \frac{x_i^0}{x_i}\right) r_i(x_i) - cv + cv \sum_{i=1}^{n} \frac{F_i G_i p_i \beta_i x_i^0}{a_i c (1+\alpha_i v)} \\ &= \sum_{i=1}^{n} \gamma_i \left(1 - \frac{x_i^0}{x_i}\right) r_i(x_i) - cv + cv \sum_{i=1}^{n} \frac{R_i}{1+\alpha_i v} \\ &= \sum_{i=1}^{n} \frac{\gamma_i}{x_i} \left(x_i - x_i^0\right) r_i(x_i) - \sum_{i=1}^{n} \frac{R_i \alpha_i c v^2}{1+\alpha_i v} + (R_0 - 1) cv \end{aligned}$$

If $R_0 \le 1$ and Assumption A1 is satisfied, then $\frac{dW_1}{dt} \le 0$ for all $x, y > 0$. By Theorem 5.3.1 in [20], the solutions of system (4)-(6) limit to M.the largest invariant subset of $\left\{\frac{dW_1}{dt} = 0\right\}$. Clearly, it follows from (11) that $\frac{dW_1}{dt} = 0$ if and only if $\boldsymbol{x} = \boldsymbol{x}^0$ $v = 0$. Noting that M is invariant, for each element of M we have $\square\square v = 0$, then $\square\dot{v} = 0$. From Eq. (6) we drive that

$$0 = \dot{v} = \sum_{i=1}^{n} \int_0^{\infty} g_i(\tau)\, e^{-\delta_i \tau}\, p_i y_i(t-\tau) d\tau$$

This yields $y_i = 0$. Hence $\frac{dW_1}{dt} = 0$

if and only if $x = x^0$ $y_i = 0$ and $v = 0$. From LaSalle.s invariance principle, $\square E_0$ is GAS.

Assumption A2. For $\square\square = 1, \cdots, \square\square\square\square\square\square\square\square\square$, function $\square_{\square}\square\square$ satisfies:

$$\left(1 - \frac{\square_{\square}^*}{\square_{\square}}\right)(\square_{\square}(\square_{\square}) - \square_{\square}(\square_{\square}^*)) \le 0 \text{ for all } \square_{\square} > 0\square$$

Theorem 2. If $\square_1$exists and Assumptions A1-A2 hold true, then $\square\square_1$ is GAS.

Proof. We construct the following Lyapunov functional

$$\square_2 = \sum_{\square=1}^{\square} \square_{\square}[\, \square_{\square}^* \square\left(\frac{\square_{\square}}{\square_{\square}^*}\right) + \frac{1}{\square_{\square}} \square_{\square}^* \square\left(\frac{\square_{\square}}{\square_{\square}^*}\right) +$$

$$\frac{1}{\square_{\square}} \frac{\square_{\square}\square_{\square}^*\square^*}{1 + \square_{\square}\square^*} \int_0^{\infty} \square_{\square}(\square)\square^{-\square_{\square}\square}$$

$$\int_0^{\square} \square\left(\frac{\square_{\square}(\square - \square)\square(\square - \square)(1 + \square_{\square}\square^*)}{\square_{\square}^*\square^*(1 + \square_{\square}\square(\square - \square))}\right)\square\square\square\square$$

$$+ \frac{\square_{\square}\square_{\square}^*}{\square_{\square}\square_{\square}} \int_0^{\infty} \square_{\square}(\square)\square^{-\square_{\square}\square} \int_0^{\square} \square\left(\frac{\square_{\square}(\square - \square)}{\square_{\square}^*}\right)\square\square\square\square\,]$$

$$+ \square^*\square\left(\frac{\square}{\square^*}\right).$$

Differentiating with respect to time yields

$$\frac{\square\square_2}{\square\square} = \sum_{\square=1}^{\square} \square_{\square}\,[\left(1 - \frac{\square_{\square}^*}{\square_{\square}}\right)\left(\square_{\square}(\square_{\square}) - \frac{\square_{\square}\square_{\square}\square}{1 + \square_{\square}\square}\right)$$

$$+ \frac{1}{\square_{\square}}\left(1 - \frac{\square_{\square}^*}{\square_{\square}}\right)\left(\square_{\square} \int_0^{\infty} \square_{\square}(\square)\square^{-\square_{\square}\square} \frac{\square_{\square}(\square - \square)\square(\square - \square)}{11 + \square_{\square}\square(\square - \square)}\square\square - \square_{\square}\square_{\square}\right)$$

$$+ \frac{\square_{\square}}{\square_{\square}} \int_0^{\infty} \square_{\square}(\square)\square^{-\square_{\square}\square}\left(\frac{\square_{\square}\square}{1 + \square_{\square}\square} - \frac{\square_{\square}(\square - \square)\square(\square - \square)}{1 + \square_{\square}\square(\square - \square)}\right.$$

$$\left. + \frac{\square_{\square}^*\square^*}{1 + \square_{\square}\square^*} \ln\left(\frac{\square_{\square}(\square - \square)\square(\square - \square)(1 + \square_{\square}\square)}{\square_{\square}\square(1 + \square_{\square}\square(\square - \square))}\right)\right) d\square$$

$$+ \frac{\square_{\square}}{\square_{\square}\square_{\square}} \int_0^{\infty} \square_{\square}(\square)\square^{-\square_{\square}\square}(\square_{\square} - \square_{\square}(\square - \square)$$

$$+ y_i^* \ln\left(\frac{\square_{\square}(\square - \square)}{\square_{\square}}\right))\square\square] + \left(1 - \frac{\square^*}{\square}\right) \times$$

$$\left(\sum_{i=1}^{n} \beta_i \int_0^{\infty} \lambda_i(a) e^{-\lambda_i a} \lambda_i(a-a) da - \mu\right).$$

Collecting terms we obtain

$$\frac{dI_2}{dt} = \sum_{i=1}^{n} \beta_i \left[\left(1 - \frac{I_i^*}{N_i}\right) \lambda_i(I_i) + \frac{\beta_i \lambda_i^* I}{1 + \beta_i I} - \frac{\beta_i}{N_i} \int_0^{\infty} \lambda_i(a) e^{-\lambda_i a} \frac{\beta_i \lambda_i^* (a-a) \lambda(a-a) I_i^*}{1 + \beta_i I (a-a) \lambda_i} da + \frac{\beta_i}{N_i} \lambda_i^* + \frac{1}{N_i} \frac{\beta_i \lambda_i^* \lambda^*}{1 + \beta_i \lambda^*} \int_0^{\infty} \lambda_i(a) e^{-\lambda_i a} \ln\left(\frac{\beta_i \lambda_i (a-a) \lambda(a-a)(1 + \beta_i I)}{\beta_i I (1 + \beta_i I (a-a))}\right) da + \frac{\beta_i \lambda_i^*}{N_i \beta_i} \int_0^{\infty} \lambda_i(a) e^{-\lambda_i a} \ln\left(\frac{\beta_i \lambda_i (a-a)}{N_i}\right) da \right] - \mu I - \frac{\lambda^*}{N} \sum_{i=1}^{n} \beta_i \int_0^{\infty} \lambda_i(a) e^{-\lambda_i a} \lambda_i(a-a) da + \mu \lambda^*.$$

Using the infected steady state conditions (8)-(9), and the following equality

$$\mu I = \mu \lambda^* \frac{N}{\lambda^*} = \frac{N}{\lambda^*} \sum_{i=1}^{n} \beta_i \lambda_i \lambda_i^* = \frac{N}{\lambda^*} \sum_{i=1}^{n} \frac{\beta_i \lambda_i}{N_i} \lambda_i^*$$

we obtain

$$\frac{dI_2}{dt} = \sum_{i=1}^{n} \beta_i \left[\left(1 - \frac{I_i^*}{N_i}\right)(\lambda_i(I_i) - \lambda_i(I_i^*)) + \frac{\beta_i}{N_i} \lambda_i^* \left(1 - \frac{I_i^*}{N_i}\right) + \frac{\beta_i}{N_i} \lambda_i^* \frac{I(1 + \beta_i I \lambda^*)}{\lambda^*(1 + \beta_i I)} - \frac{\beta_i}{I_i^2} \lambda_i^* \int_0^{\infty} \lambda_i(a) e^{-\lambda_i a} \frac{I_i^* \beta_i (a-a) \lambda(a-a)(1 + \beta_i I \lambda^*)}{\beta_i N_i \lambda^* (1 + \beta_i I (a-a))} da + \frac{\beta_i}{N_i} \lambda_i^* + \frac{\beta_i}{I_i^2} \lambda_i^* \int_0^{\infty} \lambda_i(a) e^{-\lambda_i a} \ln\left(\frac{\beta_i \lambda_i (a-a) \lambda(a-a)(1 + \beta_i I)}{\beta_i I (1 + \beta_i I (a-a))}\right) da + \frac{\beta_i}{N_i \beta_i} \lambda_i^* \int_0^{\infty} \lambda_i(a) e^{-\lambda_i a} \ln\left(\frac{\beta_i \lambda_i (a-a)}{N_i}\right) da - \frac{\beta_i}{N_i} \lambda_i^* \frac{I}{\lambda^*} - \frac{\beta_i}{N_i \beta_i} \lambda_i^* \int_0^{\infty} \lambda_i(a) e^{-\lambda_i a} \frac{\lambda^* \beta_i (a-a) \lambda(a-a)}{I I_i^*} da + \frac{\beta_i}{N_i} \lambda_i^* \right]. \quad (12)$$

Then collecting terms of (12) and using the following equalities

$$\ln\left(\frac{\beta_i \lambda_i (a-a) \lambda(a-a)(1 + \beta_i I)}{\beta_i I (1 + \beta_i I (a-a))}\right) = \ln\left(\frac{I_i^* \beta_i \lambda_i (a-a) \lambda(a-a)(1 + \beta_i I \lambda^*)}{\beta_i N_i \lambda^* (1 + \beta_i I (a-a))}\right) + \ln\left(\frac{I_i^*}{N_i}\right) + \ln\left(\frac{\lambda^* \beta_i}{I I_i^*}\right) + \ln\left(\frac{1 + \beta_i I}{1 + \beta_i I \lambda^*}\right),$$

$$\ln\left(\frac{\beta_i \lambda_i (a-a)}{N_i}\right) = \ln\left(\frac{I I_i^*}{\lambda^* \beta_i}\right) + \ln\left(\frac{\lambda^* \beta_i \lambda_i (a-a)}{I I_i^*}\right),$$

$$\ln\left(\frac{\square^{*}\square_{\square}}{\square\square^{*}_{\square}}\right)+\ln\left(\frac{\square\square^{*}_{\square}}{\square^{*}\square_{\square}}\right)=\ln(1)=0.$$

We obtain

$$\frac{\square\square_{2}}{\square\square}=\sum_{\square=1}^{\square}\square_{\square}\left[\left(1-\frac{\square^{*}_{\square}}{\square_{\square}}\right)(\square\ (\square_{\square})-\square_{\square}(\square^{*}_{\square}))\right.$$
$$+\frac{\square_{\square}}{\square_{\square}}\square^{*}_{\square}\left(1-\frac{\square^{*}_{\square}}{\square_{\square}}\right)+\frac{2\square_{\square}}{\square_{\square}}\square^{*}_{\square}$$
$$+\frac{\square_{\square}}{\square_{\square}}\square^{*}_{\square}\left(\frac{\square(1+\square_{\square}\square^{*})}{\square^{*}(1+\square_{\square}\square)}-\frac{\square}{\square^{*}}\right)-\frac{\square_{\square}}{\square^{2}_{\square}}\square^{*}_{\square}$$
$$\int_{0}^{\infty}\square_{\square}(\square)\square^{-\square_{\square}\square}\frac{\square^{*}_{\square}\square_{\square}(\square-\square)\square(\square-\square)(1+\square_{\square}\square^{*})}{\square_{\square}\square^{*}_{\square}\square^{*}(1+\square_{\square}\square(\square-\square))}\square\square$$
$$+\frac{\square_{\square}}{\square^{2}_{\square}}\square^{*}_{\square}\int_{0}^{\infty}\square_{\square}(\square)\square^{-\square_{\square}\square}\times$$
$$\left(\ln\left(\frac{\square^{*}_{\square}\square_{\square}(\square-\square)\square(\square-\square)(1+\square_{\square}\square^{*})}{\square_{\square}\square^{*}_{\square}\square^{*}(1+\square_{\square}\square(\square-\square))}\right)+\ln\left(\frac{\square^{*}_{\square}}{\square_{\square}}\right)\right.$$
$$\left.+\ln\left(\frac{\square^{*}\square_{\square}}{\square\square^{*}_{\square}}\right)+\ln\left(\frac{1+\square_{\square}\square}{1+\square_{\square}\square^{*}}\right)\right)\square\square+\frac{\square_{\square}}{\square_{\square}\square_{\square}}\square^{*}_{\square}\times$$
$$\int_{0}^{\infty}\square_{\square}(\square)\square^{-\square_{\square}\square}\left(\ln\left(\frac{\square\square^{*}_{\square}}{\square^{*}\square_{\square}}\right)+\ln\left(\frac{\square^{*}\square_{\square}(\square-\square)}{\square\square^{*}_{\square}}\right)\right)\square\square$$
$$\left.-\frac{\square_{\square}}{\square_{\square}\square_{\square}}\square^{*}_{\square}\int_{0}^{\infty}\square_{\square}(\square)\square^{-\square_{\square}\square}\frac{\square^{*}\square_{\square}}{\square\square^{*}_{\square}}\square\square\right]\qquad(13)$$

Eq.(13) can be rewritten as

$$\frac{\square\square_{2}}{\square\square}=\sum_{\square=1}^{\square}\square_{\square}\left[\left(1-\frac{\square^{*}_{\square}}{\square_{\square}}\right)(\square_{\square}(\square_{\square})-\square_{\square}(\square^{*}_{\square}))\right.$$
$$+\frac{\square_{\square}}{\square_{\square}}\square^{*}_{\square}\left(\frac{\square^{*}_{\square}}{\square_{\square}}-1-\ln\left(\frac{\square^{*}_{\square}}{\square_{\square}}\right)\right)+\frac{\square_{\square}}{\square_{\square}}\square^{*}_{\square}\times$$
$$\left(-1+\frac{\square(1+\square_{\square}\square^{*})}{\square^{*}(1+\square_{\square}\square)}-\frac{\square}{\square^{*}}+\frac{1+\square_{\square}\square}{1+\square_{\square}\square^{*}}\right)$$
$$-\frac{\square_{\square}}{\square_{\square}}\square^{*}_{\square}\left(\frac{1+\square_{\square}\square}{1+\square_{\square}\square^{*}}-1-\ln\left(\frac{1+\square_{\square}\square}{1+\square_{\square}\square^{*}}\right)\right)$$
$$-\frac{\square_{\square}}{\square_{\square}}\square^{*}_{\square}\int_{0}^{\infty}\square_{\square}(\square)\square^{-\square_{\square}\square}\times$$
$$\left(\frac{\square^{*}_{\square}\square_{\square}(\square-\square)\square(\square-\square)(1+\square_{\square}\square^{*})}{\square_{\square}\square^{*}_{\square}\square^{*}(1+\square_{\square}\square(\square-\square))}-1\right.$$
$$\left.-\ln\left(\frac{\square^{*}_{\square}\square_{\square}(\square-\square)\square(\square-\square)(1+\square_{\square}\square^{*})}{\square_{\square}\square^{*}_{\square}\square^{*}(1+\square_{\square}\square(\square-\square))}\right)\right)\square\square$$
$$-\frac{\square_{\square}}{\square_{\square}\square_{\square}}\square^{*}_{\square}\int_{0}^{\infty}\square_{\square}(\square)\square^{-\square_{\square}\square}\times$$
$$\left.\left(\frac{\square^{*}\square_{\square}(\square-\square)}{\square\square^{*}_{\square}}-1-\ln\left(\frac{\square^{*}\square_{\square}(\square-\square)}{\square\square^{*}_{\square}}\right)\right)\square\square\right].$$

Using the following equality

$$-1+\frac{\square(1+\square_{\square}\square^{*})}{\square^{*}(1+\square_{\square}\square)}-\frac{\square}{\square^{*}}+\frac{1+\square_{\square}\square}{1+\square_{\square}\square^{*}}=$$

$$\frac{-\square_{\square}(\square-\square^{*})^{2}}{\square^{*}(1+\square_{\square}\square^{*})(1+\square_{\square}\square)},$$

we can rewrite $\frac{\square\square_{2}}{\square\square}$ as:

$$\begin{aligned}\frac{\square\square_{2}}{\square\square}=\sum_{\square=1}^{\square}\square_{\square}\Bigg[&\left(1-\frac{\square_{\square}^{*}}{\square_{\square}}\right)(\square_{\square}(\square_{\square})-\square_{\square}(\square_{\square}^{*}))\\&+\frac{\square_{\square}}{\square_{\square}}\square_{\square}^{*}\frac{-\square_{\square}(\square-\square^{*})^{2}}{\square^{*}(1+\square_{\square}\square^{*})(1+\square_{\square}\square)}\\&+\frac{\square_{\square}}{\square_{\square}}\square_{\square}^{*}\square\left(\frac{\square_{\square}^{*}}{\square_{\square}}\right)+\frac{\square_{\square}}{\square_{\square}}\square_{\square}^{*}\square\left(\frac{1+\square_{\square}\square}{1+\square_{\square}\square^{*}}\right)\\&+\frac{\square_{\square}\square_{\square}^{*}}{\square_{\square}^{2}}\int_{0}^{\infty}\square_{\square}(\square)\square^{-\square_{\square}\square}\times\\&\square\left(\frac{\square_{\square}^{*}\square_{\square}(\square-\square)\square(\square-\square)(1+\square_{\square}\square^{*})}{\square_{\square}\square_{\square}^{*}\square^{*}(1+\square_{\square}\square(\square-\square))}\right)\square\square\\&+\frac{\square_{\square}\square_{\square}^{*}}{\square_{\square}\square_{\square}}\int_{0}^{\infty}\square_{\square}(\square)\square^{-\square_{\square}\square}\square\left(\frac{\square^{*}\square_{\square}(\square-\square)}{\square\square_{\square}^{*}}\right)\square\square\Bigg].\end{aligned}$$

It is easy to see that if Assumption A2 is satisfied and

$\square\square\square\square_{\square}^{*},\square_{\square}^{*},\square^{*}>0,\ \square=1,\cdots,\square$, then $\frac{\square\square_{2}}{\square\square}\leq 0$. By Theorem 5.3.1 in [20], the solutions of system (4)-(6) limit to $\square$, the largest invariant subset of $\left\{\frac{\square\square_{2}}{\square\square}=0\right\}$. It can be seen that $\frac{\square\square_{2}}{\square\square}=0$ if and only if $\square_{\square}=\square_{\square}^{*},\square=\square^{*}$, and $\square=0$ i.e.,

$$\frac{\square_{\square}^{*}\square_{\square}(\square-\square)\square(\square-\square)(1+\square_{\square}\square^{*})}{\square_{\square}\square_{\square}^{*}\square^{*}(1+\square_{\square}\square(\square-\square))}=\frac{\square^{*}\square_{\square}(\square-\square)}{\square\square_{\square}^{*}}=1$$

For almost all $\square\in[0,\infty)$. (14)

If $\square=\square^{*}$ then from (14) we have $\square_{\square}=\square_{\square}^{*}$, and hence $\frac{\square\square_{2}}{\square\square}$ equal to zero at $\square_{1}$. LaSalle's invariance principle implies global stability of $\square_{1}$.

3 Conclusion

In this paper, we have proposed a virus dynamics model describing the interaction of the virus with *n* classes of target cells taking into account the saturation infection rate. Two types of distributed time delays describing time needed for infection of target cell and virus replication have been incorporated into the model. The global stability of the uninfected and infected steady states of the model have been established by using suitable Lyapunov functionals and LaSalle invariant principle. We have proven that, if the basic reproduction number is less than unity, then the uninfected steady state is GAS and if the infected steady state exists then it is GAS.

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Physiological and root profile studies of four legume tree species

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Abstract: It is a great challenge for researchers to select plant species in terms of their physiological and root properties for vegetation on slope. Therefore, this study was aimed to investigate the physiology and root profile of four selected tropical plants namely *Leucaena leucocephala* (LL), *Adenanthera pavonina* (AP), *Peltophorum pterocarpum* (PP) and *Pterocarpus indicus* (PI). The species studied were grown in three different types of soil; slope, clay and sandy, under greenhouse conditions. Outstanding physiological performance, as measured by chlorophyll fluorescence, the photosynthetic rate, the biomass production and growth rate were observed to be the highest in LL, followed by PP, AP and PI. In terms of the root profiles, LL exhibited a higher root length (450%), volume (500%), and root biomass (600%) than PI. The root biomass values of the species studied was highly correlated with the soil moisture content (R^2=0.83). Overall results suggested that *L. leucocephala* exhibited outstanding physiological performance and root profiles and can be a potential plant for soil reinforcement.
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Keywords: Chlorophyll fluorescence, Photosynthetic rate, Cumulative ranking, Root profiles, and Root tensile strength

1. Introduction

Vegetation has been widely used as a tool to improve slope stability and protect riverbanks. The relationship between vegetation and soil reinforcement are complex and involve such factors as the combination of soil type, plant coverage and soil moisture content (Normaniza *et al.*, 2008; Nordin *et al.*, 2011). In addition, each species has its own physiological mechanism, including root-soil interaction, for the capacity to survive under different conditions and level of soil nutrients (Stokes *et al.*, 2009). Each plant can perform many functional roles and contribute to slope but certain types of plants are better than others depending on the desired functions including soil reinforcement, water uptake and surface protection (Normaniza *et al.*, 2008). Accordingly, native species are often better adapted to weather conditions within their native range than exotics species (Schnitzlera *et al.*, 2007; Normaniza and Barakabah, 2011). Therefore, the screening of native plant species in observing their potential characteristics as a slope plant e.g., higher growth rate and highly branched root systems for soil reinforcement is crucial.

Several researchers have formulated a set of criteria which are more related to plant physiology and root biomass production for the selection of best plant species (Stokes *et al.*, 2009). For example, based on previous species selection, slope plants should possess a high growth rate, photosynthetic rate, leaf area index (LAI) value, fine roots length and an extensive root system, which leads to enhanced water uptake, reinforced soil, and increased shear strength by binding soil particles (Stokes *et al.*, 2009; Normaniza *et al.*, 2008; Normaniza and Barakabah, 2011). Mafian *et al.* (2009) showed that the reinforcement of soil by vegetation is a highly promising solution and that this approach would be more beneficial if the species displayed the appropriate mechanical (through the reinforcement of the soils by plant roots), hydrological (through the reduction in runoff and by keeping the slope relatively dry) and environmental properties through the increase in carbon sequestration to reduce the rising carbon dioxide levels in the atmosphere (Syed and Iqbal, 2007). Eschenbach *et al.* (1998) and Marron *et al.* (2007) explained that the leaf chlorophyll, nitrogen, and carbon contents were the vital parameters in evaluating high-yielding species. Poorter and Bongers (2006) compared the leaf traits and plant performance of 53 co-occurring tree species in a semi-evergreen tropical moist forest community and demonstrated that leaf traits are good indicators of plant physiological performance. However, other parameters (leaf chlorophyll fluorescence, leaf potassium content, root length, root volume, and root tensile strength) and factors (correlation among root biomass, soil moisture content and leaf area index) have to be considered to understand the actual function of the plant as slope colonizer (Jiang *et al.*, 2006), as plant physiological and root behaviors are interrelated. In relation to this, the development of shoots and roots can also be considered to be influenced by the soil type. It is also reported that the soil density, hydraulic

conductivity and soil water relation affect the growth of roots (Laboski *et al.,* 1998). Thus, the root profiles and soil water relation are referred as vital parameters to predict the slope stability and soil erosion rate (Normaniza and Barakabah, 2006). It is well documented that when a plant experiences stress conditions (e.g., water stress and light stress), the performance can be either increased or decreased (Niinemets, 2010; Araus *et al.,* 2002). Hence, a higher physiological performance with root profiles of the plant can indicate a healthy species (an individual) and help to select a potential species.

Therefore, this study was performed to assess the plant physiological and root properties of four selected species in different soil types, to deduce some correlations among the parameters studied and to determine the two best potential species.

2. Material and Methods

Experimental site, soil and plant materials: Three types of soil (clay, sand and slope soil) and four native legume tree species, LL, AP, PP and PI, were selected for this experiment. Seeds were collected from the Forest Research Institute of Malaysia (FRIM) and grown in an open-ended 30 cm PVC pipe. Individually, each type of soil (Table 1) was used to fill the PVC pipe (2356 cm^3), with ten replications; 120 seedlings [3 (three types of soil) ×10 (replication) ×4 (species)] were grown. The experiment was conducted for six months under glasshouse conditions (temperature of 21-32°C, average 12-h photoperiod, maximum PAR of 2100 µE m^{-2} s^{-1} and relative humidity of 60-90%) at the Plant Physiology Garden, University of Malaya. The plants were arranged in a completely randomized design (CRD), with 30 cm row to row distances and 30 cm plant to plant distances. The plants were irrigated once every two days to avoid water stress.

Plant height and biomass: The plant height and stem diameter were measured at six months of growth using a measuring tape and Vernier calipers, respectively. The shoot and root dry biomass (oven-dried at 80°C for 48 hours) were determined using a balance (Model-Mettle PJ3000, Japan) after six months of growth.

Measurements of photosynthesis, transpiration rate, stomatal conductance and chlorophyll content: The photosynthetic rate, transpiration rate and stomatal conductance of the plants were measured using the Portable Photosynthesis System (Model *LI-6400XT,* USA) at six month of growth. The chlorophyll content was measured using a portable chlorophyll meter (SPAD-502, Minolta, Japan).

Table 1: Properties of the soils used in this present study.

Soil properties	Slope soil	Clay soil	Sand soil
Specific gravity	2.62	2.68	2.0
Dry unit weight (kN/m^3)	13.1	13.3	10.5
Soil Field Capacity	20.3 %	32.7 %	29.9 %
pH	4.45	3.94	5.51
Color	6/8/Hue 10 [Bright yellowish brown]	5/3/Hue 2.5 Y [Yellowish brown]	5/4/Hue 7.5 YR [Dull brown]
Type	Size distribution	Size distribution	Size distribution
500 to1.0 mm	12.165 %	0 %	65.36 %
250 to 500 mic	29.45 %	32.12 %	17.02 %
100 to 250 mic	38.58 %	21.4 %	11.42 %
50 to100 mic	13.14 %	27.53 %	4.5 %
<2 to 50 mic	6.64 %	18.93 %	1.67 %

Measurements of chlorophyll fluorescence: The chlorophyll fluorescence was measured at 2-month intervals using a Plant Efficiency Analyser (Model LH36/2R, Hansatech Instrument Ltd., England). A leaf clip was attached to one of the leaves and kept in the dark for 30-45 minutes for dark adaptation; the leaf clip was then oriented with the shutter plate. When light was applied to the leaf, the fluorescence signal was counted for 3 seconds and the quantum yield or photosynthetic yield (temperature = 28ºC, time range = 10 μs^{-3} sec) was measured. The maximal fluorescence (Fm) and minimal fluorescence (Fo) values were obtained. The yield of variable fluorescence (Fv) was calculated as Fm-Fo, and the calculation of chlorophyll fluorescence was determined according to the equation for Fv/Fm.

Leaf area index (LAI) and soil moisture content: The leaf area index and soil moisture content were measured using a leaf area instrument (AccuPAR-LP80, UK) and portable Delta-T soil moisture meter (HH2 Moisture Meter, England), respectively, at 2-month interval.

Potassium estimations: The most recent fully expanded leaves of the same age and relative position were collected from each treatment. One gram of fresh leaf tissue was ground with 5 ml distilled water in a mortar and then centrifuged at

3,500 rpm for 20 min. A sampling paper was placed on the sensor, and 3 to 5 drops of the supernatant liquid were added to the calibrated sensor pad (Cardy Potassium Meter, Model-2400, USA) until the sampling paper was saturated. After stabilizing (30 to 45 seconds), the measurements (ppm) were recorded.

Root profiles: The root lengths of all the different species were determined by scanning and using the WinRHIZO Pro Software after three and six months. This software was also used to assess the nodulation frequency, total root length, fine roots and average volume of the root.

Root tensile strength: The laboratory root tensile test was conducted by using Universal Testing Machine (Instron, Model 5582, United Kingdom) to determine the root tensile strength. The roots were cut into 10 cm in length and two ends of root were clamped with sand paper to avoid slippage during the testing. The roots were pulled up vertically at 500 mm/min in the testing machine. During the test, the result data of Force and Extension at failure had been obtained and automatically generated by the software that connected to the Universal Testing Machine.

Statistical analysis: The data was analysed using SPSS 11.5 statistical software. ANOVA was applied to evaluate significant differences in the studied treatments. The LSD ($p < 0.05$) was calculated using the error mean squares of the analysis of variance. The correlation test among parameters (root biomass, soil moisture content and leaf area index) studied was analyzed using Microsoft Excel.

3. Results

Biomass production: The influence of different soil types on the biomass production was measured at the 6th month (Table 2). The biomass production of LL was observed to be the highest amongst the species evaluated, followed by PP, AP and PI. In the sandy soil, the reductions in the root weights of AP and PP might be attributable to lower shoot growth. PP demonstrated the second highest shoot-root biomass in the slope soil.

Table 2: Shoot dry weight (SDW) and root dry weight (RDW) was measured in 6th months.

Species	SDW			RDW		
	Clay	Sand	Slope	Clay	Sand	Slope
LL	15ay	19ax	17ax	5aby	7ax	5by
AP	10bx	5byz	10cx	4cx	2cz	4cy
PP	10by	4bz	14bx	5ax	3by	6ax
PI	2cy	5bx	3dx	0.9dy	1dx	1dxy

The values of plant height and stem diameter were significantly ($p < 0.05$) higher for LL, followed by PP, AP and PI (Fig. 1 and Fig. 2). A higher plant height (13%) for LL was observed in the sandy soil than those in clay soils, whereas AP and PP species showed lower values in the sandy soil than clay. Thus, the plant growth or shoot biomass was presumably associated with the root growth and biomass production.

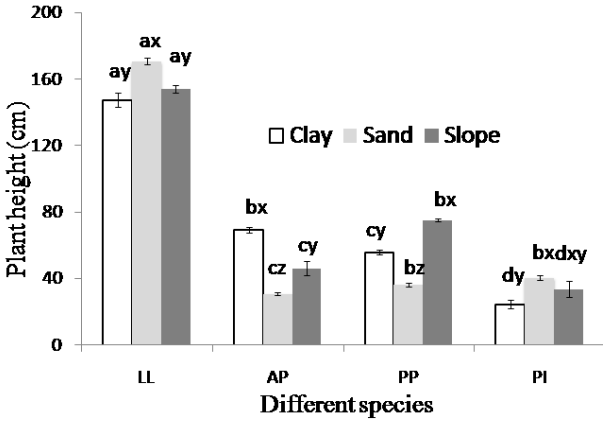

Fig. 1. Plant height of four species was affected by different types of soils. [*Leucaena leucocephala* (LL), *Adenanthera pavonina* (AP), *Peltophorum pterocarpum* (PP), and *Pterocarpus indicus* (PI)]. For the same types of soil with the different species, different letters (a-d) showed significantly different ($p < 0.05$, ANOVA). For the same species with the different soil types, different letters (x-z) showed significantly different ($p < 0.05$, ANOVA).

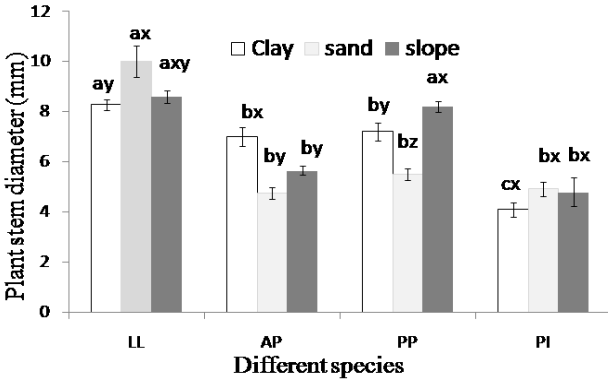

Fig. 2. The effects of different soils on the plant stem diameter. Different letters were significantly different ($p < 0.05$, ANOVA).

Leaf chlorophyll content and chlorophyll fluorescence: The leaf chlorophyll content is one of the most important parameters in determining the photosynthetic rate (Rong-hua *et al.*, 2006). The high chlorophyll content was observed in LL in all soil types and attributed to a enhanced capacity of the plant to utilize the existing soil nutrients (Fig.

3). Low chlorophyll content was observed for AP grown in sandy soil. Consequently, the plant height was the smallest in the sandy soil versus the clay and slope soils. Additionally, in sandy soil, LL showed a higher chlorophyll fluorescence by 19, 17 and 9 % than AP, PP and PI, respectively. This was due to the higher capability of LL to transport electrons through PSII (Fig. 4). In the sandy soil, AP and PP showed lower chlorophyll fluorescence values (0.7 and 0.71, respectively) due to their inability to metabolize normally. Therefore, the plant shoot and root biomass values were also lower in the sandy soil than in the slope and clay soils. Furthermore, the lower chlorophyll fluorescence and smallest plant sizes in the sandy soil indicated that the leaves were less efficient in utilizing light energy, which ultimately led to a decline in the growth of the plants. LL showed an excellent chlorophyll fluorescence (0.83) value in the sandy soil, reflecting its outstanding photosynthesis capability, which could result in a faster growth of this species. Therefore, the chlorophyll fluorescence represents a parameter to recognize better performance species.

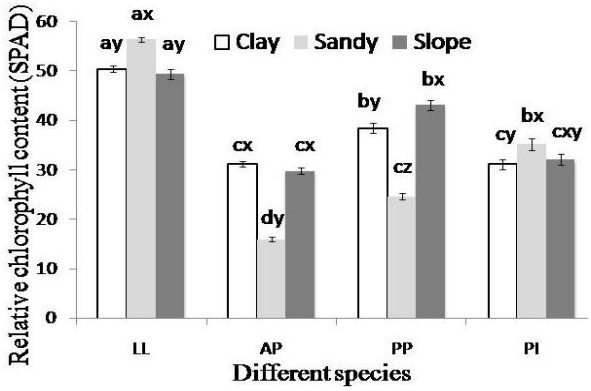

Fig. 3. Relative chlorophyll content (SPAD) was recorded during the 6th month of four different species.

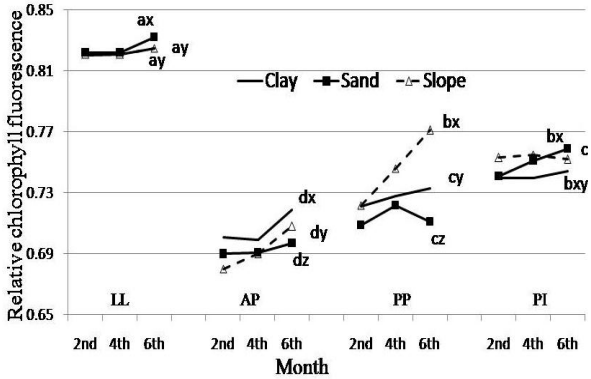

Fig. 4. Relative chlorophyll fluorescence of different species was measured at two-month interval. Different letters were significantly different ($p < 0.05$, ANOVA).

Photosynthesis, transpiration and stomatal conductance: In the sandy soil, the photosynthetic rate of LL was remarkably high, with a value that was twice those of AP and PP (Fig. 5); LL also grew very well in both clay and slope soils. Although PP grew well, displaying a high physiological performance in the slope soil, it did not grow well in the sandy soil. This finding is due to the lower rate of photosynthesis, which have affected its normal physiological activities, such as plant growth. The total photosynthesis and transpiration rates were significantly ($p < 0.05$) higher for LL in all soil types, whereas photosynthesis and transpiration were significantly lower in the sandy soil for both AP and PP (Fig. 6). This result was due to the highly reduced chlorophyll content of the leaves or species-specific variations in photosynthesis, transpiration and stomatal conductance (Fig. 7).

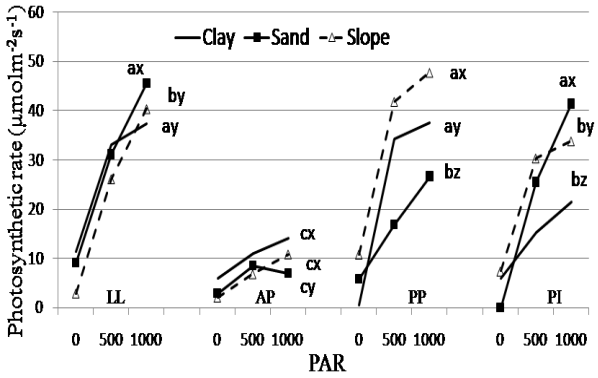

Fig. 5. Photosynthetic rate in different species. Different letters were significantly different ($p < 0.05$, ANOVA).

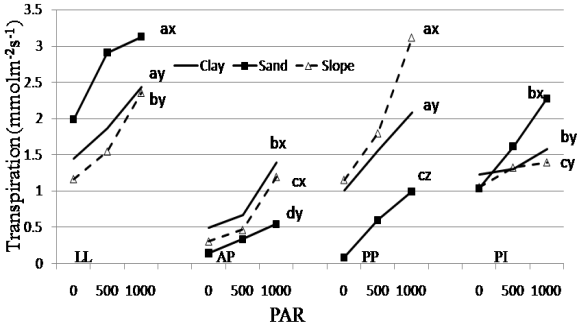

Fig. 6. Transpiration rate of different species. Different letters were significantly different ($p < 0.05$, ANOVA).

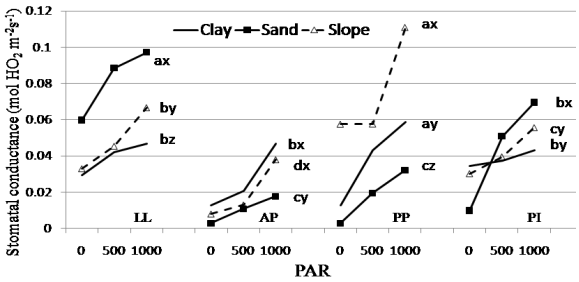

Fig. 7. Stomatal conductance of different species.

Leaf area index (LAI): LAI is considered to be a value of the leaf area per unit area of land. The results showed that there were significant ($p < 0.05$) differences among the soil types and species. The LAI values for LL and PP were increased by 20% and 15%, respectively, compared to PI (Fig. 8); PI displayed the lowest LAI values in all of the soil types, which was due to the lower growth rate. LL showed a higher (163%) LAI than PI in sandy soil, which is due to the better physiological performance (especially with regard to photosynthesis and chlorophyll fluorescence). PP also showed a high LAI value in the slope soil that was almost similar to that for LL. The higher LAI of PP was possibly attributable to the high photosynthetic activity and growth. AP, PP and PI showed lower LAI values than LL in the sandy soil, a result that was due to their lower growth rates and photosynthetic activities.

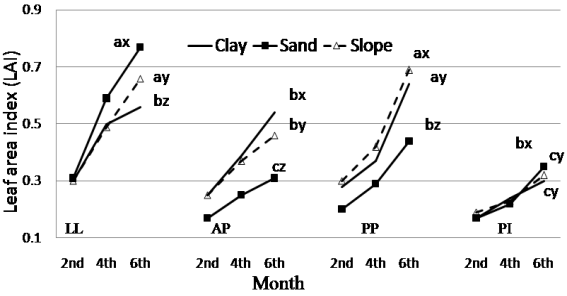

Fig. 8. Evaluation of the leaf area index (LAI) of different species in the 2nd, 4th and 6th months.

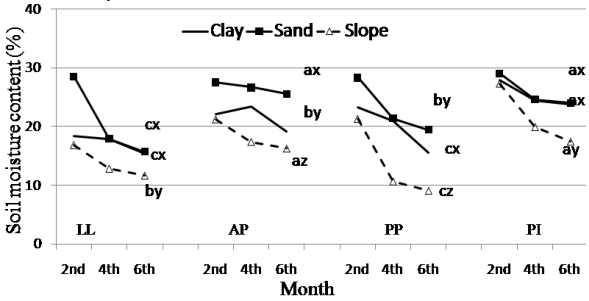

Fig. 9. Measurement of soil moisture content (%) of different species at the 2nd, 4th and 6th months.

Soil moisture content (%): The initial moisture content of three different soils is referred to as the water-holding capacity (Tripathi *et al.*, 2009). With the progression of time, the soil moisture content was more related to the presence of the plant species, plant height and root biomass. The three types of soil showed a similar downward trend for this parameter. A Comparatively lower moisture content (47%) was found for PP than PI in the slope soil (Fig. 9). The sandy soil contained a high moisture, even though it does not have the capacity to hold water like clay does, and this was due to the low plant growth and root-shoot biomass, especially for AP and PI, the conservative water-use strategies by the plants or the regular irrigation.

Potassium contents: The potassium content was higher (75%) in LL than AP in sand soil. For AP and PP, the potassium content was significantly ($p < 0.05$) lower in the sandy soil than the slope and clay soils. The high level of potassium allowed increased photosynthesis. Therefore, the high potassium contents were observed in LL leaves (Table 3).

Table 3: The leaf potassium content (ppm). Different letters were significantly different ($p < 0.05$, ANOVA).

Species	Potassium		
	Clay	Sand	Slope
LL	53.6±0.8ax	56±1.15ax	54.33±3.2ax
AP	44.3±1.8bx	32.66±2.9by	43.66±0.8bx
PP	45.6±1.2bx	34.33±2.6by	48±3abx
PI	45.6±0.88bx	52±2.3ax	47±2.5abx

Potassium deficiency in AP and PP were observed in the sandy soil and resulted in low plant canopy (LAI). Concerning the effect of potassium on the leaf, it has been shown by Maria *et al.* (2008) that potassium stress leads to reduce stomatal opening, which also reduces plant productivity. It is well documented that the key role of potassium is to act as a catalyst for many enzymatic processes and regulate the water use of the plant. A lack of potassium in the leaf can reduce the net CO_2 assimilation rate, increase the leaf respiration and control the photosynthetic rate in many woody ornamental plants and crops (Egilla and Davies, 1995; Basile *et al.*, 2003).

Table 4: Nodule frequency of the studied species in different soils. Different letters were significantly different ($p < 0.05$, ANOVA).

Species	Nodule		
	Clay	Sand	Slope
LL	63±7.8z	182±8.9x	102±9y
AP	No	No	No
PP	No	No	No
PI	7.3±1.8z	82±2.9x	21±2y

Root nodulation: After six months of growth, nodules were found only in LL and PI. The number of nodules of these legume species was the highest in sand soil (Table 4). This was due to the symbiotic relationships between sand soil microbes and these leguminous species.

Root profiles: LL had a higher root length (450%) and volume (500%) than PI in sand soil (Fig. 10 and Fig. 11). Consequently, LL also had a higher root biomass than PI in sand soil (Table 2). High root lengths and volumes maximize the soil-root interface and water uptake rate. Therefore, LL showed a lower moisture content than PI. Whereas, the root tensile strength of four different tree species were exhibited in Table 5. The results showed that there was a significant difference ($p < 0.05$) of root tensile strength amongst the species studied. The root tensile strength of species studied provide information that LL roots will be able to supply better ductility to the root-soil composite with a higher ability to reinforce soil (Nordin *et al.*, 2011). Stokes *et al.* (2009) documented that high tensile strength of roots will be able to show more resistant in tension during slope failure. Thus, this property of LL roots would ultimately increase in share strength of the root-soil composite in the natural slope condition.

4. Discussion

Relationship of plant biomass and physiological characteristics: The differences in the plant biomass production and nodule formation among the different soil types are shown in Figure 12 and Table 4, respectively. Higher shoot dry weights (SDW) were observed for LL and PP, presumably due to their higher root dry weight (RDW). In contrast, the plant height and root biomass were significantly ($p < 0.05$) lower for PI grown in all types of soil. PP showed low photosynthesis (43%) and chlorophyll florescence (7%) in the sandy soil, which was due to the low shoot biomass that contain low levels of chlorophyll content per unit leaf area for the interception of sunlight for photosynthesis (Jordan and Smith, 1993). Jordan and Smith (1993) also reported that low canopy may less effectively capture CO_2 molecules. Moreover, AP had also low photosynthetic rates and LAI values, despite growing in a high soil moisture (Fig. 9) in the sandy soil, a result that could be due to low root biomass. It was found that LL and PI contain more roots and produce more nitrogen-fixing nodules in the sandy soil than the clay and slope soils, which is due to more internal metabolism.

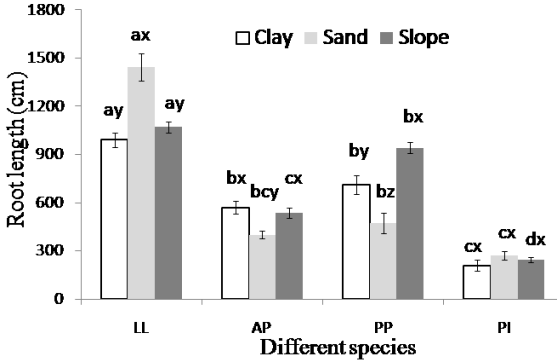

Fig. 10. Effect of different soils on the total root length of different species.

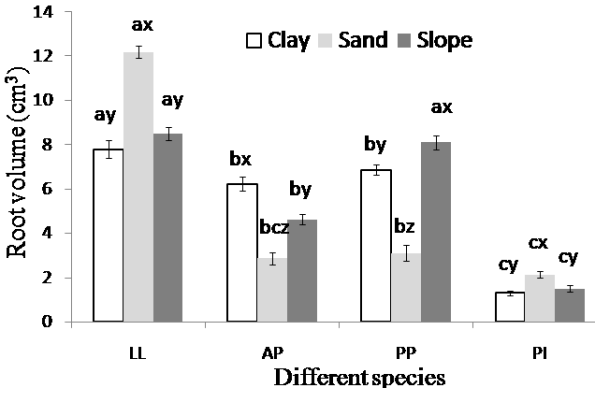

Fig. 11. Total root volume of different species was affected by different soil type. Different letters were significantly different ($p < 0.05$, ANOVA).

The production of nodules resulted in more nitrogen fixation, leading to better physiological performance (Antolin *et al.*, 2010). Nitrogen-related symbiosis with plants generally function effectively in the presence of nodules and fine roots, with microorganisms fixing atmospheric nitrogen. However, McKey (1994) reported that nitrogen fixation developed in legumes to maintain their internal nitrogen demand and not because of a low nitrogen content in the soil. Therefore, nodulation formation increased with the increasing

of plant age and biomass to support metabolism (Table 4). It can be assumed LL and PI had strong symbiotic relationships that allowed these species to produce more nodules as the plant grew. A higher number of nodules were observed for LL and PI growing in the sandy soil. Consequently, higher shoot and root biomass values were observed in the sandy soil than in the clay and slope soils. We suggest that nodulation also supported the higher photosynthetic rates of LL and PI in the sandy soil, whereas the sandy soil was less beneficial for AP and PP. Therefore, this finding provided a well idea of root-shoot relationship. It seemed that root growth promoted the shoot growth or LAI (Fig. 8). Therefore, the presence of more root biomass for LL was arguably associated with a higher water uptake and concomitantly high rates of photosynthesis and transpiration. Additionally, Kumar et al. (2010) described that high values of root length and biomass are the most promising characteristics for better physiological performance. Whereas, Tognetti et al. (2009) described that a high root biomass would be beneficial for water absorption and to increase water movement from the soil to plant tissue. Root biomass is also an important criterion for root influence on soil reinforcement for example soil anchorage. In the presence of a large plant size and LAI, the effects will be more beneficial in reducing the soil moisture content via transpiration. Similar results were reported by Cairns *et al.* (1997) who described that a reduction of the soil moisture content was due to the presence of more root and shoot biomass. Shaozhong *et al.* (2002) also showed that more root biomass most likely leads to a higher water uptake by roots.

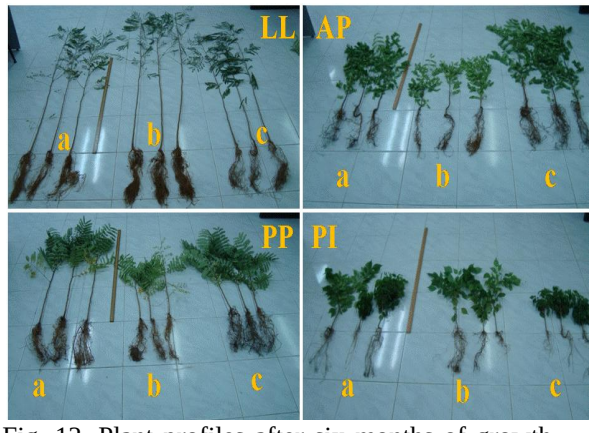

Fig. 12. Plant profiles after six months of growth. Slope Soil=a, Sand Soil=b, and Clay Soil=c

Root profiles and correlation between root biomass and soil moisture: In terms of root profiles, LL exhibited the highest (176%) root tensile strength. This study suggested that LL has added value as a good potential plant for soil reinforcement works as it exhibited outstanding root mechanical (tensile strength) properties. Root tensile strength also contributes to tree anchorage. It is well documented that high root tensile strength possessed tree showed more resistance to overturning (Stokes *et al.*, 2009; Nordin *et al.*, 2011). This property of roots would eventually increase soil shear strength by producing a composite material, soil and roots. Thus, root tensile strength gives an idea to predict the species contribution to soil reinforcement. Therefore, root tensile strength is a useful tool in selecting potential tree species. In the present study, LL and PP possessed a higher quantity of fine roots in the range of 0.5-1.5 mm (Fig. 13). It is well documented that fine roots increased the efficiency of soil binding between the soil particles and improved cohesion (Stokes *et al.*, 2009; Nordin *et al.*, 2011). It is also suggested that fine roots increased the hydrological properties via their capability to absorb sufficient water, thus lowering the risk of landslides and erosion (Shaozhong *et al.*, 2002).

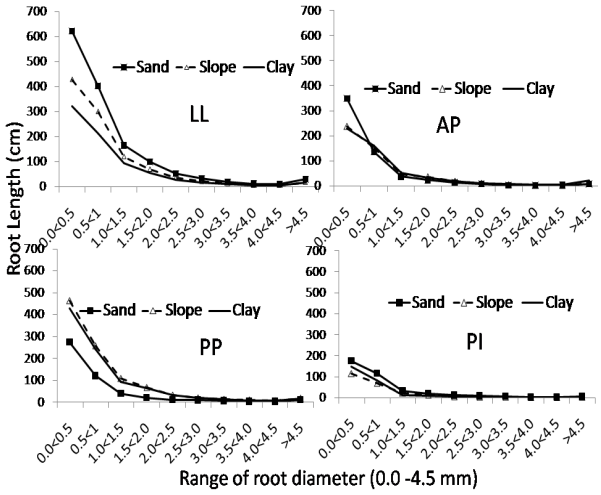

Fig. 13. The effect of different soils on the total fine root length of different species and fine root length according to various diameter classes; fine roots (>0.0–2.0 mm) and thin roots (>2.0–10.0 mm).

Table 5: Root tensile strength (RTS) of four tree species (Different letters showed significantly different at $p < 0.05$, ANOVA).

Species	RTS (MPa) Slope soil
LL	92.6±7a
AP	44.5±8c
PP	63.3±7b
PI	35.5±2d

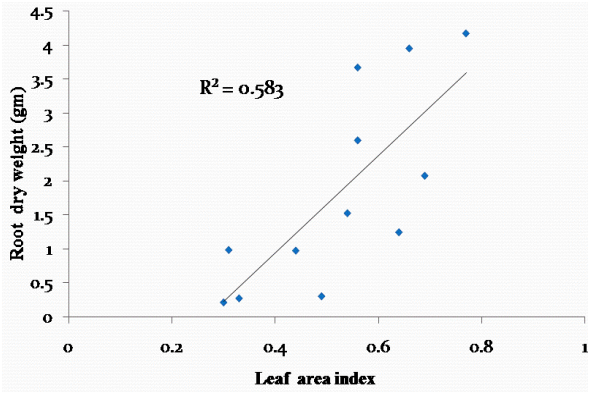

Fig. 14. Positive correlation between leaf area index and root dry weight.

There is a positive correlation (R^2=0.58) between the plant LAI and root biomass (Fig. 14), implying that the belowground biomass would be higher if the aboveground biomass was higher. Conversely, the soil moisture content (%) and root biomass are negatively correlated (Clay: R^2=0.89; Sandy: R^2=0.45; Slope: R^2=0.83) (Fig. 15), implying that a higher belowground biomass is associated with a lower soil moisture content (%). Therefore, increased root biomass, e.g., fine roots (0 to 2 mm), is greatly beneficial in absorbing excess soil water and moving water to the atmosphere via transpiration (Rosado *et al.*, 2011). The removal of excessive water would lead to drying of the soil and a greater stability of the soil.

Screening the potential species using their physiological and root properties: Chlorophyll fluorescence is the light that can be re-emitted after being absorbed by the chlorophyll molecules of leaves. Light energy, which is absorbed by photosystem II (PSII), can be converted to chemical energy to drive photosynthesis. The chlorophyll fluorescence might reflect whether the plant has suffered stress, such as extreme temperature, light and water availability or lack of nutrients. Stress conditions can reduce the ability of a plant to metabolize normally and, consequently, reduce the chlorophyll fluorescence value. Therefore, the assessment of plant physiology by measuring the chlorophyll fluorescence is well documented. Moreover, the chlorophyll fluorescence can also indicate an imbalance between the assimilation of light energy by the leaves and the use of energy during photosynthesis (Rong-hua *et al.*, 2006).

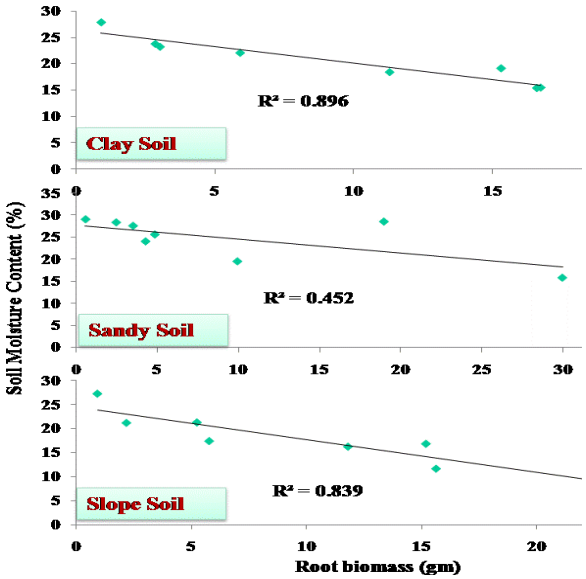

Fig. 15. Negative correlation between soil moisture content and root biomass.

In many plant species, an optimal chlorophyll fluorescence value is approximately 0.8, and this value indicates healthy plants (Calatayud *et al.*, 2002). Values of approximately 0.81-0.83 for LL in each soil type suggested that this species had a better photosynthetic or light reaction ability than the other species. High photosynthesis implies that the plant is more efficient in utilizing light for enhancing growth. Therefore, the plant is also more likely to grow faster. This is essential for slope soil colonizer (Normaniza and Barakabah, 2006). Additionally, root biomass, length volume, and tensile strength are also an important criterion for soil reinforcement for example root-soil interaction. In addition, the LAI, chlorophyll content, and growth rate were the most important parameters for assimilation (Normaniza *et al.*, 2009). The leaf potassium content is related to the ability of the plant to fix carbon, the carbon sink potential and the conversion of CO_2 into photosynthate. Furthermore, the shoot biomass and LAI of the plant influenced the level of chlorophyll pigments. A high chlorophyll content resulted in high photosynthesis and plant biomass production. Fast-growing species, such as LL, had high potassium

contents in their leaves (Table 3), resulting in better physiological activities. Hence, overall higher value (studied physiological and root parameters) of a species can indicate a comparatively healthy species among the present plants. According to the observations, LL showed the highest performance in the sandy soil, and PP showed the second highest performance in the slope soil. The higher plant growth and root profiles of LL and PP demonstrated remarkable characteristics that are essential for soil reinforcing plants.

5. Conclusion

The species studied were evaluated on their physiological characteristics such as the photosynthetic rate, transpiration rate, chlorophyll florescence, chlorophyll content and growth rate and root profiles, such as root tensile strength, fine roots, root biomass, root volume and root length. This screening process will assist to select a plant species which showed comparatively better physiological and root profiles or reinforcement (root length, volume and tensile strength) characteristics. A higher physiological performance such as plant growth, photosynthetic rate and chlorophyll florescence and root profiles such as number of fine roots, root length, and root tensile strength were observed in LL which leaded to this species in selecting as potential plants. In conclusion, based on our screenings, *L. leucocephala* grown in sandy soil exhibited the best performance, followed by *P. pterocarpum* in the slope soil. The root biomass is negatively correlated with the soil moisture content and positively correlated to the LAI. However, more stringent screening will be conducted using *L. leucocephala*, and *P. pterocarpum* in microenvironmental slope conditions to examine further their potential as soil reinforcing plants.

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Sensitivity analysis of Super-efficiency DEA Models for Iranian banks

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Abstract: Banks as the economy monetary sectors and also due to the speed of the reflection of the policies of these sectors have an effective role for making economic steady growth in the whole society. Due to the variety of services, the assessment of bank units is complicated. The current assessment methods and the evaluation of bank units are empirical methods and since they are not standardized, their results in different banks are not comparable with each other. In addition, these methods do not consider the efficiency of the units and only consider the output of the units. The methodology of the data envelopment analysis (DEA) is a scientific and nonparametric approach for evaluating efficiency or none efficiency of decision making units (DMU) which has many scientific applications in banks, hospitals, power stations, insurance, and also universities. In this paper, variation of input and output of an efficient bank with considering its efficient is verified. In this regard, strong bank efficiency is defined and the sensitive variations in input and output of the bank are studied in contrast with efficient banks.
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KEYWORD: Data Envelopment Analysis, Super efficiency, Sensitive Analysis, Bank System.

1- Introduction:

One of the main issues of the economics which is in relation to the economic growth, price stability, and unemployment rate adjustment and obtain a main part of economic scientists attempt is to achieve efficiency and productivity. Achieving efficiency needs to consider optimum resources and factors of production. To consider the development of the world, particularly, and the rapid growth of the production, the revision and improvement of the methods for the optimum scarce resources such as raw materials, skilled labor, and time are the factors for units of enterprises to the whole economy of a country.

Banks as the administrators of economy monetary sectors with providing possible investment and making the capital for trade activities play an important role in the development of the economy of the country. Regarding the rapid reflection of the policies of this unit in the whole economy of the country, the control of its fulfillment can be significant. Without the assessment and improving the methods and avoid destroying the resources in banks, these institutes cannot be successful in fulfillment of their dynamic role in the economic development process. The available banks assessment and evaluation methods are frequently empirical and do not have any scientific background.

In this paper, in section 2, we study a method for the assessment of the banks fulfillment on the basis of DEA that has about two decade's antecedent. Then, in section 3 the sensitivity analysis of efficient units with considering simultaneous variations in inputs and outputs with efficiency are discussed. At the end, in section 4 the mentioned methodology is used with real data of 113 branches of one bank in Tehran-Iran.

2- Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a mathematical planning method for evaluating decision making units (DMU). This method has been found by Charnes, Cooper and Rhodes (CCR) in 1978[3]. They developed Farrell nonparametric method that has been designed for evaluating (DMU) with two inputs and one output. They added mathematical planning and removed some limitations which Farrell's method caused. Then, in 1984, Banker, Charnes, and Cooper (BCC)[2] considered very important concept of return to scale and developed the applied domain of DEA. In this way, DEA subject started and during the two last decades developed both in applying and theoretical point of view. Today, the managers use DEA as an effective tool for assessment of DMU revenue. DEA different models with input view and the output oriented model of DMU assess them. This systematic view occurred with the aid of DEA model that they, in turn, are basically the planning problem. Suppose that there are n DMU that j^{th} unit of s dimensional outputs vector y_{ij} produce component x_{ij} from m dimensional input. The CCR and BCC models with input oriented are as follow, respectively:

The Input Oriented CCR

$$Min\,\theta - \varepsilon(1s^- + 1s^+)$$

$$\sum_{j=1}^{n} x_j \lambda_j + s^- = x_r \theta$$

$$\sum_{j=1}^{n} y_j \lambda_j - s^+ = y_r$$

$$\lambda_j \geq 0, j = 1,2,\ldots,n$$

$$s^+ \geq 0\ ,\ s^- \geq 0$$

The Input Oriented BCC

$$Min\,\theta - \varepsilon(1s^- + 1s^+)$$

$$\sum_{j=1}^{n} x_j \lambda_j + s^- = x_r \theta$$

$$\sum_{j=1}^{n} y_j \lambda_j - s^+ = y_r$$

$$\lambda_j \geq 0, j = 1,2,\ldots,n$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$s^+ \geq 0\ ,\ s^- \geq 0$$

In the above models, ε is a very small none Archimedean . s^+ and s^- are s and m dimensional slack variables corresponding to output and input constraints, respectively. θ and λ_i are the other variables.

During the recent years, the issue of sensitivity and stability of data envelopment analysis (DEA) result has been extensively studied. Some studies, Ali and Seiford (1993) and Smith (1997), focus on the sensitivity of DEA results to the variable and model selection. Most of the DEA sensitivity analysis studies focus on the misspecification of efficiency classification of a test decision making unit. However, we shall note that DEA is an external method in the sense that all extreme points are characterized as efficient. If data entry errors occur for various DMUs, the resulting may vary substantially (see, e.g., Sexton et al., 1986). In the current proposal, as in many other DEA sensitivity studies, we say that the calculated frontiers of DEA models are stable if the frontier DMUs that determine the DEA frontier remain on the frontier after the particular data perturbations are made for all DMUs.

By updating the inverse of the basis matrix associated with a specific efficient DMU in a DEA linear programming problem, Charnes **et al. (**1995) study the sensitivity of DEA model to single output change. This is followed by a series of sensitivity analysis articles by Charnes and Neralic (1990)[5] in which sufficient conditions preserving efficiency are determined.

Another type of DEA sensitivity analysis is based on super–efficiency DEA approach in which a test DMU is not included in reference set (Andersen and Petersen, 1993; Seiford and Zhu, 1999[12]). Charnes **et al.** (1992), Rousseau and Semple (1995) and Charnes **et al. (**1996) develop a super-efficiency DEA sensitivity analysis technique for the situation where simultaneous proportional change is assumed in all inputs and outputs for a specific DMU under the consideration. This data variation condition reduced by Zhu (1996), Seiford and Zhu (1998)[10],[11] to a situation where small inputs or outputs variations can be changed. In addition, this necessary condition for preserving the efficiency of the considered DMU was proved

The DEA sensitivity analysis methods are all developed for the situation where data variations are only applied to the test efficient DMU and the data for the remaining DMUs are assumed fixed. Obviously, this assumption may not be realistic, since possible data errors may occur in each DMU. Seiford and Zhu (1998) generalize the technique in Zhu (1996) and Seiford and Zhu (1998) to the worst-case scenario where the efficiency of the test DMU is deteriorating while the efficiencies of the other DMUs are improving. In their method, same maximum percentage data change of a test DMU and the remaining DMUs is assumed and sufficient conditions for preserving an extreme-efficient DMUs efficiency are determined. Note that Thompson **et al.** (1994) use the SCSC (strong complementary slackness condition) multipliers to analyze the stability of CCR model when the data for all efficient and all inefficient DMU are simultaneously changed in opposite directions and in same percentages. Although the data variation condition is more restrictive in Seiford and Zhu (1998) than that in Thompson et al. (1994), the super-efficiency based approach may generate a larger stability than the SCSC method does. Also the SCSC method is dependent upon a particular SCSC solution, among other and, therefore, the resulting analysis may vary.

For the DEA sensitivity analysis based upon the inverse of basis matrix, is referred to Neralic (1994). It is well-known that certain super-efficiency DEA models may be infeasible for some extreme-efficient DMUs. Seiford and Zhu (1999) develop the necessary and sufficient conditions for infeasibility of various super-efficiency DEA models. Although the super-efficiency DEA models employed in Charnes et al.

(1992) and Charnes et al. (1996) and did not encounter the infeasibility problem, the models used in Seiford and Zhu (1998a). Seiford and Zhu (1998a)[10] discovered the relationship between infeasibility and stability of efficiency classification. That is, infeasibility means that the CCR efficiency of the test DMU remains stable to data changes in the test DMU. Furthermore, Seiford and Zhu (1998b) [11]showed that this relationship is also true and the simultaneous data change case and other DEA models, such as BCC model of Banker et al. (1984) and additive model of Charnes et al. (1985b). This finding is critical since super-efficiency DEA models in Seiford and Zhu (1998b) are frequently infeasible for real-world data sets, indicating efficiency stability with respective to data variations in inputs/outputs associated with infeasibility. As a result, DEA sensitivity analysis can be easily applied if we employ various super-efficiency DEA models. By using super-efficiency DEA models, the sensitivity analysis of DEA efficiency classification can be easily achieved. Since the approach uses optimal values to various super-efficiency DEA models, our approach provides "what-if" tool to the standard DEA analysis kit. We are able to know what may happen to DMUs efficiency, if data variation occurs in all DMUs as a result of new strategic planning. The new sensitivity analysis technique can well be applied to inefficient DMUs if we are interested in preserving the inefficiency of inefficient DMUs. (see Liang, L., Zha, Y., Cook, W.D. and Zhu, Joe, A. in press).

Suppose that there are n DMU such that j^{th} unit of s dimensional outputs vector y_{ij} produce component x_{ij} from m dimensional input. The CCR and BCC models with input oriented as follows, respectively:

The Input Oriented CCR

$$Min\ \theta - \varepsilon(1s^- + 1s^+)$$

$$\sum_{j=1}^{n} x_j \lambda_j + s^- = x_r \theta$$

$$\sum_{j=1}^{n} y_j \lambda_j - s^+ = y_r$$

$$\lambda_j \geq 0, j = 1,2,\ldots,n$$

$$s^+ \geq 0\ ,\ s^- \geq 0$$

The Input Oriented BCC

$$Min\,\theta - \varepsilon(1s^- + 1s^+)$$

$$\sum_{j=1}^{n} x_j \lambda_j + s^- = x_r \theta$$

$$\sum_{j=1}^{n} y_j \lambda_j - s^+ = y_r$$

$$\lambda_j \geq 0, j = 1,2,\ldots,n$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$s^+ \geq 0\ ,\ s^- \geq 0$$

Where ε very small non-Archimedean is number, s^+ and s^- are s dimensional slack variables corresponding to output and input constraints, respectively, θ and λ are the other variables. Suppose I is a set of inputs data that are variable and O is a set of outputs that are also variable. In this case, we have:

$$DMU_O$$

1 – *Input Oriented Case*

$$\begin{cases} y_{ro}^{\wedge} = \tau y_{ro}, 0 \leq \tau \leq 1, & r \in O \\ y_{ro}^{\wedge} = y_{ro} & r \notin O \end{cases}$$

$$\begin{cases} y_{ro}^{\wedge} = y_{ro} - (1-\tau) y_{ro}, & r \in O \\ y_{ro}^{\wedge} = y_{ro} & r \notin O \end{cases}$$

2 – *Output Oriented Case*

$$\begin{cases} x_{xo}^{\wedge} = \delta x_{io}\ ,\ \delta \geq 1, & i \in I \\ x_{xo}^{\wedge} = x_{io} & i \notin I \end{cases}$$

$$\begin{cases} x_{io}^{\wedge} = x_{io} + (\delta - 1) x_{io}, & i \in I \\ x_{io}^{\wedge} = x_{io} & i \notin I \end{cases}$$

$$DMU_J, J \neq O$$

1 – *Input Variable Case*

$$\begin{cases} y_{rj}^{\wedge} = y_{rj}/\tau \,, 0 \prec \tau \le 1, & r \in O \\ y_{rj}^{\wedge} = y_{ro} & r \notin O \end{cases}$$

$$\begin{cases} y_{rj}^{\wedge} = y_{rj} + \dfrac{1-\tau}{\tau} y_{rj}, & r \in O \\ y_{rj}^{\wedge} = y_{rj} & r \notin O \end{cases}$$

2 – *Output Variable Case*

$$\begin{cases} x_{xj}^{\wedge} = x_{ij}/\delta \,, \delta \ge 1, & i \in I \\ x_{xj}^{\wedge} = x_{ij} & i \notin I \end{cases}$$

$$\begin{cases} x_{ij}^{\wedge} = x_{ij} - \dfrac{(1-\delta)}{\delta} x_{ij}, & i \in I \\ x_{ij}^{\wedge} = x_{ij} & i \notin I \end{cases}$$

Now for these two cases we have:

Theorem 1: If $1 \le \delta \le \sqrt{\beta^*}$ then the DMU remain efficient, where $\sqrt{\beta^*}$ is an upper bound of variations of inputs and by the above modified the follow efficiency model is obtained:

$$\beta^* = Min\ \beta$$

$$\sum_{\substack{j=1 \\ j \ne o}}^{n} x_{ij}\lambda_j \le \beta x_{io}, \quad i \in I$$

$$\sum_{\substack{j=1 \\ j \ne o}}^{n} x_{ij}\lambda_j \le x_{io}, \quad i \notin I$$

$$\sum_{\substack{j=1 \\ j \ne o}}^{n} y_{rj}\lambda_j \ge y_{ro}, \quad r = 1,2,\ldots,s$$

$$\beta \ge 0, \quad \lambda_j \ge 0$$

Theorem 2: If $\sqrt{\alpha^*} \le \tau \le 1$, then the DMU remain efficient, where $\sqrt{\alpha^*}$ is a lower bound of variations of outputs, and by the above modified model follow efficiency models obtained as:

$$\alpha^* = Max\ \alpha$$

$$\sum_{\substack{j=1 \\ j \ne o}}^{n} x_{ij}\lambda_j \le x_{io}, \quad i = 1,2,\ldots,m$$

$$\sum_{\substack{j=1 \\ j \ne o}}^{n} y_{rj}\lambda_j \ge \alpha x_{ro}, \quad r \in O$$

$$\sum_{\substack{j=1 \\ j \ne o}}^{n} y_{rj}\lambda_j \ge y_{ro}, \quad r \notin O$$

$$\alpha \ge 0, \quad \lambda_j \ge 0$$

Assessment of efficiency and the analysis of sensitive bank system

In this study 113 branches of an Iranian trading bank are considered. In the interior classification of the bank, the branches are consisted in a region in Tehran and, therefore, all the branches are selected from that region and they are compared in trading and economic positions. In the following, the inputs and outputs which have been employed with the help of bank specialists are introduced.

Introducing Inputs

The following inputs have been achieved on the basis of research and bank specialists (table 3):

1- The number of personnel of each unit with considering a particular weight for each of them:
   1-1 Personnel with high education
   1-2 Personnel with high experience
2- Regional position of the considered unit (branch) from the trade and economical view
3- Congestion of the branches of the other banks close to the under study unit
4- Infrastructure of the considered unit
5- Cost of the considered unit:
   5-1 Personnel costs
   5-2 Administrative costs
   5-3 Operational costs

6- The number of computer terminals used in the considered unit

In this study, the selected inputs with considering limited information are as follows:

1- Personnel costs
2- Number of terminals
3- Rate of renting

The Personnel costs are the function of the number of staffs and a combination of branch staffs. For this reason, this input has been used in place of the number of staffs. The number of branch computer terminals is the second input that is used in the same way as received. The cost of renting is another input which is a function of regional trade position and infrastructure of the branch. Particularly, regional trade position has an effect on the rate of renting cost of branch. This input has been used as an indicator for comparing economical position of regions that the branches have been established there. Rent costs are considered up to date. Concerned information to input has been achieved from the related centers in bank and then without any changes has been used.

Introducing Outputs

Considering the main duties of the trade banks, branch outputs are studied in the following 3 sections:

1- Outputs concerned to the branch activities in the equipment of sources section
2- Outputs concerned to the branch activities in the allocation of sources section Outputs concerned to the branch activities in the services section.

Finally, regarding informational limitations and the bank specialists' point of view, the following outputs are considered (table 6);

1- Sources
2- Consumptions
3- Services
4- Account numbers

Considering Computing results and Conclusion

In this section the results are discussed. In order to solve linear programming, the GAMS software is used. According to the results, the following branches of banks in the sample obtained efficient (Table4).The branches are numbers 7, 8, 21, 22, 25, 26, 29, 32, 34, 37, 41, 49, 50, 57, 62, 71, 78, 80, 83, 84, 85, 92, 111, 112, and 113. These make assessment standard of efficient frontier for the other branches. Different combinations of efficiency branches provide possibility for the presentation revenue improvement approaches of inefficiency branches. Beside efficiency result of the models with input oriented, the effectiveness references presentation and the concerned computational provide revenue improvement possibility approaches in such a way that it can be reduced of the inefficiency branches so as to approach to frontier. As an example, the branch 1 with 95 percent of efficiency is inefficient and its assessment references are the branches 26, 29, 62 and 85 with corresponding weight .586, .235, .160 and .018, respectively.

Revenue improvement approaches with input oriented

For considering branches operating situation with the rate of efficiency and their references, the revenue improvement approaches with input oriented are computed and also presented. Table 1 shows the operating situation of the branch of 64. Particularly with allocating the corresponding weights to reference branches, the assessment reference branches show that they correspond with a point on efficient frontier.

Table (1): the revenue of branch number 64

Branch 64 Efficiency rate %86		**inputs**			**Outputs**
Branch current situation		25000000	12	17675020	2836 6737 253183 19190151
References	weights				
37	.361	1000000	6	9580191	1077 5822 1359328 13855106
84	.639	7000000	11	18276182	3798 11862 6024026 29902424
Branch desirable situation		8083000	9.1	15136929	2816 9681 4340070 24109342
Reducing inputs so as to Transform the current situation To desirable one		16917000	2.8	2538091	

In fact, the desired situation suggests the best one for the branch. It produces the current outputs with unknown rate. In order to revenue improvement, the branch number 64 reduction rate of inputs is recommended.

We embark to improve the revenue with input oriented and the branches are leads to frontiers reality that has been described by them. The following are the results:

Table (2): summery result

Inputs Situation	**current situation**	**desired**
Branches personality cost	804698493	711433241
Branches computer terminal	360	291
Branches rental costs	276936516	40030000

With this improvement we should obtain the current available outputs with reduction %11.59 in branches personnel costs and %10.16 in branches computer terminal and %30.81 in branches rental structural costs. In table 4 the efficiency is presented with using BCC model. In this table, the efficiency of DMUs and their indicator units are specified. As an example, the DMU number 14 has 70% efficiency and its indicator units are the DMU numbers 32, 34, 62, 83, and 85. Obviously, this says the linear combination of the indicator units where all of them are effective. There are at most 70% inputs of the DMU and number 14 produce at least the same outputs. The coefficient of this linear combination is the same value λ that obtained from solving the model. The coefficient λ for the DMU numbers 32,34,62,83, and 85 are .148, .117, .156, .455, and .123, respectively. As an example, the unit 14 has personnel cost 8864374 Rials (Iranian money unit), whereas the linear combination of the personnel cost of the indicator units of number 14 with cited coefficient is 735200 Rials. It shows that this unit is effective and the money saving in the personnel cost will be 1512373 Rials. In summary, if all inefficient units with the reduction of their inputs get efficiency and the corresponding outputs have no any changes, then the monthly money saving in personnel cost will be 93265252 Rials. That is, there is a possibility that the reduction of about %19 is due to the reduction in personnel cost by reducing the number of personnel. In addition, there are 69 computer terminals out of total number of 360. Also, there is possible reduction in rate rental units, as we said before, the upper bounds $g_o(\delta-1)$ and $g(=\frac{\delta-1}{\delta})$ for the input variations and $h_o(=1-\tau)$, $h(=\frac{1-\tau}{\tau})$ for the outputs are obtained, where the upper bounds g_o and g_1 with considering theorem and the upper bounds h_o and h_1 by using theorem will be computed. There are three inputs and four outputs for the 113 bank units. Therefore, there are 20 cases for the only variations and the only output variations and the simultaneous inputs and outputs variation. For example, we consider variations in three inputs and four outputs, simultaneously. Table 5 is an example. It shows:

$(g_o, g) = (\%31.114, \%32.75)$, $(h_o h) = (\%47.08, \%88.98)$.

That is, three inputs of the DMU 34 can simultaneously be increased as %23.75. Also four outputs of DMU 34 can be decreased as %47.08 and four outputs of the other units can be increased %88.98; while, unit 34 remained efficient.

Table (3): trade banks input

DMU	P.C	T.N	R.R	DMU	P.C	T.N	R.R	DMU	P.C	T.N	R.R	DMU	P.C	T.N	R.R
1	1048247	4	3500000	29	5059262	3	1000000	57	4833471	3	3000000	85	16488749	5	1500000
2	11091919	7	1500000	30	6538932	4	4000000	58	5675406	5	6000000	86	543265	5	5000000
3	6006368	7	9000000	31	7743787	4	4500000	59	6845551	4	4000000	87	5677375	4	1000000
4	4983049	6	10000000	32	4728702	6	6500000	60	4648552	5	9000000	88	6041356	5	1000000
5	595421	4	3000000	33	5710969	4	3600000	61	8067707	5	3000000	89	13551643	7	1000000
6	12361292	8	12000000	34	5376670	6	8000000	62	6897099	4	2500000	90	7201054	8	5000000
7	5667654	3	7000000	35	5853293	4	5000000	63	5104826	4	6000000	91	5920688	4	500000
8	4576087	4	5000000	36	5413185	4	1000000	64	17675020	12	25000000	92	19213993	11	3000000
9	8758295	6	1200000	37	9580191	4	8000000	65	4643428	4	8000000	93	5324270	4	3000000
10	6556536	4	7000000	38	15788314	7	4000000	66	7069601	4	8000000	94	10724288	6	5000000
11	4247944	4	2000000	39	4319690	5	2500000	67	7798662	5	5000000	95	8682941	6	8000000
12	9186560	5	5000000	40	9169764	7	6000000	68	24765351	11	5000000	96	5754220	4	3500000
13	14483093	6	3500000	41	4271776	3	5000000	69	7513519	6	8000000	97	7458563	5	5000000
14	8864374	6	7000000	42	8248442	4	7000000	70	8352050	6	6000000	98	6368766	4	1000000
15	4509167	5	3500000	43	6898955	5	6000000	71	6631905	3	8000000	99	6313385	5	7000000
16	5843595	4	45000000	44	6389470	4	2500000	72	5864453	5	5000000	100	4142405	4	1500000
17	6811667	4	6000000	45	7733840	4	5600000	73	4075674	4	3000000	101	5567881	4	3000000
18	5166614	5	1800000	46	5178158	5	6000000	74	5587501	5	1500000	102	4635193	4	3000000
19	5696379	4	2500000	47	8411440	4	5000000	75	8538411	4	6000000	103	4521143	4	6000000
20	8663787	5	1000000	48	6951224	4	4000000	76	10649418	8	10000000	104	7483051	5	10000000
21	6187368	4	1500000	49	3350041	3	2000000	77	8548086	4	4000000	105	8144612	6	7000000
22	4795112	3	5000000	50	13232901	8	4500000	78	5483076	3	600000	106	4410235	4	5000000
23	5856757	5	2000000	51	4456491	4	3000000	79	6968171	5	5000000	107	4422029	5	4000000
24	4950695	6	3500000	52	6291246	4	1500000	80	2846195	4	1700000	108	8577974	4	1200000
25	5223122	3	1000000	53	5424185	5	1500000	81	6662196	5	10000000	109	5468282	4	1000000
26	6491851	4	80000	54	6094183	5	9000000	82	6830834	6	1000000	110	5764381	5	2000000
27	4611285	4	800000	55	5175868	5	3000000	83	3875326	3	1500000	111	2692566	3	1500000
28	4736197	4	5000000	56	8487390	5	4000000	84	18276182	1	70000	112	4892159	3	3000000
												113	1868551	6	8000000

Table (4): Branches efficiency assessment with using BBC model

DM	eff	ref	wei	ref	wei	ref	wei	ref	wei	ref	wei	ref	wei
1	95%	26	.586	29	.235	62	.160	85	.018				
2	66%	8	.253	21	.185	26	.128	78	.303	92	.131		
3	67%	32	.463	34	.093	83	.102	111	.343				
4	78%	32	.429	34	.124	85	.000	111	.438	113	.009		
5	75%	7	.003	25	.285	71	.073	83	.639				
6	59%	8	.253	21	.185	26	.128	78	.303	92	.131		
7*	100%	7	1.000										
8*	100%	8	1.000										
9	58%	26	.264	29	.222	34	.072	83	.427	85	.015		
10	80%	25	.427	29	.442	34	.055	83	.063	85	.014		
11	77%	26	.036	32	.011	62	.006	83	.310	85	.002	111	.635
12	61%	25	.778	29	.201	34	.008	85	.013				
13	97%	21	.291	78	.298	85	.128	92	.282				
14	70%	32	.148	34	.117	62	.156	83	.455	85	.123		
15	82%	26	.078	32	.130	34	.098	80	.322	85	.010	111	.362
16	85%	32	.011	34	.044	62	.145	83	.754	85	.046		
17	75%	26	.264	29	.222	34	.072	83	.427	85	.015		
18	84%	26	.370	32	.102	85	.002	111	.526				
19	75%	57	.342	78	.163	83	.326	85	.001	111	.169		
20	71%	25	.094	26	.191	29	.582	34	.112	85	.121		
21*	100%	21	1.000										
22*	100%	22	1.000										
23	75%	21	.049	26	.347	34	.072	80	.142	111	.390		
24	73%	26	.105	32	.204	34	.011	80	.659	111	.021		
25*	100%	25	1.000										
26*	100%	26	1.000										
27	94%	1	.445	26	.213	111	.324						
28	90%	32	.171	62	.077	83	.736	85	.001	111	.015		
29*	100%	29	1.000										
30	76%	25	.550	29	.196	34	.005	83	.241	85	.008		
31	88%	25	.641	29	.167	34	.163	85	.024				
32*	100%	32	1.000										
33	83%	26	.091	34	.008	62	.182	83	.715	85	.003		
34*	100%	34	1.000										
35	82%	26	.212	29	.146	62	.049	83	.591	85	.002		
36	88%	8	.112	21	.122	26	.275	78	.134	111	.357		
37*	100%	37	1.000										
38	99%	26	.507	84	.355	85	.086	92	.053				
39	85%	26	.152	32	.131	34	.007	80	.667	111	.043		
40	66%	26	.342	34	.244	80	.313	85	.098	92	.003		
41*	100%	41	1.000										
42	85%	25	.459	29	.396	34	.095	85	.049				
43	90%	32	.231	34	.101	62	.394	83	.210	85	.065		
44	91%	25	.686	26	.136	34	.156	85	.210	85	.065		
45	76%	7	.257	25	.565	29	.154	85	.024				
46	97%	32	.180	34	.204	80	.197	85	.106	111	.218	113	.096
47	82%	32	.058	34	.040	83	.883	111	.018				
48	77%	25	.764	29	.205	34	.027	85	.004				
49*	100%	49	1.000										
50*	100%	50	1.000										
51	85%	32	.080	34	.054	83	.667	111	.200				
52	78%	21	.004	26	.085	78	.377	83	.524	85	.009		
53	82%	21	.132	26	.315	34	.011	80	.542				
54	69%	32	.102	62	.127	83	.617	85	.002	111	.152		
55	72%	26	.131	32	.092	34	.058	83	.147	111	.573		
56	65%	25	.636	29	.050	34	.047	83	.217	85	.051		
57*	100%	57	1.000										
58	82%	32	.272	34	.044	62	.151	83	.530	85	.002		
59	85%	25	.710	29	.148	34	.130	85	.012				
60	76%	32	.226	34	.046	83	.230	111	.498				
61	68%	25	.410	26	.160	34	.055	83	.329	85	.046		
62*	100%	62	1.000										
63	76%	34	.016	83	.973	85	.000	111	.011				
64	86%	37	.361	84	.639								
65	87%	32	.065	62	.286	85	.001	85	.012				
66	76%	25	.426	29	.543	62	.018	85	.012				
67	73%	25	.389	26	.241	29	.197	34	.117	83	.039	85	.017
68	77%	26	.326	84	.336	85	.039	92	.300				
69	71%	32	.195	34	.101	62	.381	83	.130				
70	73%	32	.120	34	.121	62	.629	83	.130				
71*	100%	71	1.000										
72	70%	32	.136	62	.088	83	.642	111	.134				
73	84%	34	.118	83	.319	85	.003	111	.560				
74	76%	21	.050	26	.344	34	.008	80	.391	111	.206		
75	79%	25	.570	29	.370	34	.058	85	.005				
76	54%	32	.105	34	.185	62	.427	83	.264	85	.019		
77	86%	25	.329	26	.098	29	.220	62	.351	85	.003		
78*	100%	78	1.000										
79	79%	32	.085	34	.076	62	.485	83	.355				
80*	100%	80	1.000										
81	75%	32	.000	34	.158	62	.252	83	.580	85	.009		
82	64%	32	.236	34	.023	62	.089	83	.650	85	.002		
83*	100%	83	1.000										
84*	100%	84	1.000										
85*	100%	85	1.000										
86	72%	32	.174	34	.019	62	.687	111	.120				
87	84%	21	.021	26	.337	78	.202	83	.131	111	.309		
88	83%	32	.142	34	.172	62	.141	83	.521	85	.025		
89	78%	26	.282	34	.032	37	.686						
90	70%	32	.649	34	.184	62	.116	83	.051				
91	79%	26	.056	29	.281	62	.106	83	.557	85	.001		
92*	100%	92	1.000										
93	97%	32	.154	34	.016	62	.364	83	.646	85	.005		
94	71%	26	.635	37	.116	62	.231	85	.018				
95	69%	26	.032	34	.190	62	.459	83	.293	85	.025		
96	78%	25	.056	26	.100	29	.158	62	.021	83	.662	85	.003
97	85%	32	.039	34	.135	62	.722	83	.101	85	.004		
98	88%	25	.273	26	.464	34	.008	83	.246	85	.009		
99	68%	29	.062	34	.121	83	.805	85	.011				
100	91%	26	.262	32	.048	111	.690						
101	79%	25	.234	29	.077	34	.046	83	.641	85	.002		
102	85%	32	.083	62	.159	83	.354	111	.403				
103	96%	32	.231	34	.022	62	.075	83	.672				
104	76%	26	.372	34	.070	62	.184	83	.361				
105	81%	32	.182	34	.134	37	.121	62	.563				
106	83%	32	.096	34	.012	83	.630	111	.262				
107	89%	26	.092	32	.438	111	.470						
108	95%	25	.311	26	.615	34	.048	85	.027				
109	85%	21	.034	25	.072	26	.376	78	.086	111	.432		
110	76%	21	.154	26	.254	34	.051	80	.226	111	.315		
111*	100%	111	1.000										
112*	100%	112	1.000										
113*	100%	113	1.000										

Table (5):sensitive analytical results regarding to three inputs and four outputs

Effi. DMU	In.inpout DMU_0	De.input DMU_J	De.output DMU_0	In.output DMU_J
26	infeasible			
32	%3.44	%3.32	%14.24	%16.60
34	%31.14	%23.75	%47.07	%88.98
37	infeasible			
62	infeasible			
84	%11.35	%10.19	%12.82	%14.70
85	Without any change			
92	infeasible			

Table (6): Outputs of 113 trade bank

DMU	SOU	COM	S.N	A.N	DMU	SOU	COM	S.N	A.N	DMU	SOU	COM	S.N	A.N	DMU	SOU	COM	S.N	A.N
1	8072802	1137288	3553	1027	29	3369191	73004	2572	745	57	1537353	547768	1386	1661	85	1207845	30613605	1816	1377
2	3796848	8802238	1771	1111	30	2810359	441499	1887	1267	58	4507971	551102	2238	762	86	2805270	108529	1718	986
3	4388834	328775	3650	3473	31	3832076	1120866	3576	1112	59	3886103	741356	3249	919	87	1997840	293928	2070	926
4	3275816	723422	2873	1237	32	6183678	1299979	2553	2163	60	2255696	134776	1569	1044	88	4856578	1160545	3306	1292
5	2144232	130902	1497	1043	33	3029892	340393	2068	1003	61	3792390	2779127	2342	1085	89	12465404	906861	4585	2160
6	558342	1669955	4685	2848	34	6742874	428067	12680	1458	62	10235516	178267	2249	983	90	5957086	597212	4102	1370
7	2379602	978280	1569	1666	35	3850715	227202	2173	1001	63	1327064	127459	1976	861	91	2924174	134378	2163	648
8	1847615	369477	1341	762	36	2814899	841857	1363	669	64	19190101	2531283	6737	2836	92	14981686	43515415	4755	1888
9	3866057	1132261	2907	1372	37	13855106	1359328	5822	1071	65	2901544	195778	844	512	93	3972444	448796	1964	1104
10	2629585	737234	2660	881	38	25500395	8219533	5822	1365	66	6149032	566435	1863	1917	94	12923013	1140798	2623	1683
11	1364925	158713	793	707	39	2481749	217056	1542	1055	67	5454577	1139455	3768	1027	95	7802798	1495416	3782	1064
12	3085390	899475	1828	1438	40	6353515	3229342	4745	1215	68	18779101	13973829	6074	2483	96	2756073	241804	1845	1046
13	5944605	20520010	2161	944	41	2404629	326794	1163	739	69	6470746	230553	3220	1296	97	5585589	498031	3278	1285
14	5509590	7677767	2718	452	42	3922389	2641086	2778	2003	70	6470746	230553	3220	1643	98	2279105	500717	3247	895
15	2761161	5721165	2239	1074	43	5363843	4651810	3206	1106	71	2131713	481673	2043	762	99	3460702	648227	3020	922
16	3482386	2739362	2056	933	44	4939518	1038649	3753	903	72	2772727	184187	1606	773	100	2114675	567999	1266	761
17	3137177	578727	1783	841	45	2856027	1947496	1445	894	73	1578610	287373	2211	3557	101	3413493	211528	1932	1083
18	2979151	277762	1681	995	46	3361165	7527834	3632	1013	74	3061077	291655	1981	885	102	2528746	41547	1167	675
19	1642125	257041	1211	666	47	2767980	128683	2138	701	75	3373373	185792	2663	792	103	3476094	205468	2098	813
20	4858125	764296	3475	1557	48	2282079	254094	2253	816	76	6827827	1402650	3147	2063	104	6239642	933676	3445	1271
21	2636044	4588414	1777	706	49	1087799	165857	723	483	77	4633627	293017	2174	1089	105	7836688	300411	3721	1641
22	2449765	318999	1601	918	50	16553107	15447880	8038	1181	78	1647497	241576	1561	659	106	2090219	78817	1424	733
23	2606134	456496	2475	1163	51	3097595	71839	1893	1027	79	5400530	135597	2471	1327	107	3302432	417763	1665	980
24	2832667	230500	1522	1245	52	3026974	485292	1837	1111	80	990122	49881	897	750	108	3244055	1640191	4021	881
25	4144835	53852	896	578	53	2904981	1123450	1949	3473	81	4963290	612598	3394	899	109	2732872	373473	1996	890
26	5707467	7861	4549	1240	54	2801642	356528	1152	1237	82	3643806	537143	2033	1280	110	3361719	1517184	2100	707
27	1931856	156395	1121	680	55	2372087	74417	1761	1043	83	1913860	100350	1550	832	111	582473	21207	270	348
28	3148362	347568	1707	1092	56	3494077	3153101	2076	2848	84	29902424	6024026	11862	3798	112	23672613	232131	792	334
															113	162874	232131	435	42

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Some approximation theorems via σ-convergence

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Abstract: The concept of σ-convergence was introduced in [P. Schaefer, Proc. Amer. Math. Soc. 36(1972)104-110] by using invariant mean.In this paper we apply this method to prove some Korovkin type approximation theorems.
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1. Introduction and preliminaries

Let c and ℓ_∞ denote the spaces of all convergent and bounded sequences, respectively, and note that $c \subset \ell_\infty$. In the theory of sequence spaces, a beautiful application of the well known Hahn-Banach Extension Theorem gave rise to the concept of the Banach limit. That is, the lim functional defined on c can be extended to the whole of ℓ_∞ and this extended functional is known as the Banach limit [2]. In 1948, Lorentz [8] used this notion of a weak limit to define a new type of convergence, known as the almost convergence. Later on, Raimi [17] gave a slight generalization of almost convergence and named it the σ-convergence. Before proceeding further, we should recall some notations and basic definitions used in this paper.

Let σ be a mapping of the set of positive integers $\mathbb{N}$ into itself. A continuous linear functional φ defined on the space ℓ_∞ of all bounded sequences is called an invariant mean (or a σ-mean; cf. [17]) if it is non-negative, normal and $\varphi(x) = \varphi\left(\left(x_{\sigma(n)}\right)\right)$.

A sequence $x = x_k$ is said to be σ-*convergent* to the number L if and only if all of its σ-means coincide with L, i.e. $\varphi(x) = L$ for all φ. A bounded sequence $x = x_k$ is σ-convergent (cf. [18]) to the number L if and only if $\lim_{p\to\infty} t_{pm} = L$ uniformly in m, where

$$t_{pm} = \frac{x_m + x_{\sigma(m)} + x_{\sigma^2(m)} + \cdots + x_{\sigma^p(m)}}{p+1}$$

We denote the set of all σ-convergent sequences by V_σ and in this case we write $x_k \to L(V_\sigma)$ and L is called the σ-limit of x. Note that a σ-mean extends the limit functional on c in the sense that $\varphi = \lim x$ for all $x \in c$ if and only if σ has no finite orbits (cf. [11, 12]) and $c \subset V_\sigma \subset \ell_\infty$.

If σ is a translation then the σ-mean is called a Banach limit and σ-convergence is reduced to the concept of almost convergence introduced by Lorentz [8].

For σ-convergence of double sequences, we refer the reader to [3, 12, 13, 14].

If $m = 1$ then we get $(C,1)$; convergence, and in this case we write $x_k \to \ell(C,1)$; where $\ell = (C,1)$-lim x.

Remark 1.1. Note that:
(a) a convergent sequence is also σ-convergent;
(b) a σ-convergent sequence implies $(C,1)$ convergent.

Example 1.2. The sequence $z = (z_n)$ defined as

$$z_n = \begin{cases} 1 & \text{if } n \text{ is odd,} \\ 0 & \text{if } n \text{ is even} \end{cases}$$

is σ-convergent to 1/2(for $\sigma(n) = n+1$) but not convergent.

Let $C[a,b]$ be the space of all functions f continuous on $[a,b]$. We know that $C[a,b]$ is a Banach space with norm $||f||_\infty := \sup_{a\le x\le b} |f(x)|, f \epsilon C[a,b]$. Suppose that $T_n : C[a,b] \to C[a,b]$. We write $T_n f(x)$ for $T_n(f(t),x)$ and we say that T is a positive operator if $T(f,x) \ge 0$ for all $f(x) \ge 0$.

The classical Korovkin approximation theorem states as follows [6, 7]:

Let T_n be a sequence of positive linear operators from $C[a,b]$ into $C[a,b]$ and $\lim_n \|T_n(f_i, x - f_i(x)\|_\infty = 0$, for $i = 0,1,2$, where $f_0(x) = 1, f_1(x) = x$ and $f_2(x) = x^2$. Then $\lim_n \|T_n f(x) - f(x)\|_\infty = 0$, for all $f \in C[a,b]$.

Quite recently, such type of approximation theorems for functions of single variables were proved in [5, 9, 10, 15, 16] and for functions of two variables in [1, 4] by using statistical convergence and almost convergence. In this paper, we use the notion of σ-convergence to prove Korovkin type approximation theorems.

2. Korovkin type approximation theorem

The following is the V_σ-version of the classical Korovkin approximation theorem followed by an example to show its importance.\newline

Theorem 2.1. Let $(T)_k$ be a sequence of positive linear operators from $C[a,b]$ into $C[a,b]$ and $D_{n,p}(f,x) = \frac{1}{p}\sum_{k=}^{p=1} T_{\sigma^k(n)}f(x)$ satisfying the following conditions

$$\lim_{p\to\infty}\left\|D_{n,p}(1,x)-1\right\|_\infty = 0 \quad \text{uniformly in } n, \qquad (2.1.1)$$

$$\lim_{p\to\infty}\left\|D_{n,p}(t,x)-x\right\|_\infty = 0 \quad \text{uniformly in } n, \qquad (2.1.2)$$

$$\lim_{p\to\infty}\left\|D_{n,p}(t^2,x)-x^2\right\|_\infty = 0 \quad \text{uniformly in } n, \qquad (2.1.3)$$

Then for any function $f\epsilon\, C[a,b]$ bounded on the whole real line, we have

$$\sigma\text{-}\lim_{k\to\infty}\|T_k(f,x)-f(x)\|_\infty = 0 \text{ i.e.,}$$
$$\lim_{p\to\infty}\left\|D_{n,p}(f,x)-f(x)\right\|_\infty = 0 \quad \text{uniformly in } n,$$

Proof. Since $f\epsilon\, C[a,b]$ and f is bounded on the real line, we have

$$|f(x)| \le M, \qquad -\infty < x < \infty.$$

Therefore,

$$|f(t)-f(x)| \le 2M, -\infty < t,x < \infty \qquad (2.1.4)$$

Also we have that f is continuous on $[a,b]$, i.e.,

$$|f(t)-f(x)| < c, \qquad \forall\, |t-x| < \delta \qquad (2.1.5)$$

Using (2.1.4), (2.1.5) and putting $\psi\,(t) = (t-x)^2$, we get

$$|f(t)-f(x)| < \epsilon + \frac{2M}{\delta^2}\psi, \forall |t-x| < \delta,$$

This means

$$-\epsilon - \frac{2M}{\delta^2}\psi < f(t)-f(x) < \epsilon + \frac{2M}{\delta^2}\psi.$$

Now, we operating $T_{\sigma^k(n)}(1,x)$ for all n to this inequality since $T_{\sigma^k(n)}(f,x)$ is monotone and linear. Hence

$$\begin{aligned} T_{\sigma^k(n)}(1,x)\left(-\epsilon - \frac{2M}{\delta^2}\psi\right) &< T_{\sigma^k(n)}(1,x)\big(f(t)-f(x)\big) \\ &< T_{\sigma^k(n)}(1,x)\left(\epsilon + \frac{2M}{\delta^2}\psi.\right) \end{aligned}$$

Note that x is fixed and so $f(x)$ is constant number. Therefore

$$\begin{aligned} -\epsilon T_{\sigma^k(n)}(1,x) - \frac{2M}{\delta^2}T_{\sigma^k(n)}(\psi,x) &< T_{\sigma^k(n)}(f,x) - f(x)T_{\sigma^k(n)}(1,x) \\ &< \epsilon T_{\sigma^k(n)}(1,x) + \frac{2M}{\delta^2}T_{\sigma^k(n)}(\psi,x) \quad (2.1.6) \end{aligned}$$

But

$$\begin{aligned} T_{\sigma^k(n)}(f,x) - f(x) &= T_{\sigma^k(n)}(f,x) \\ -f(x)T_{\sigma^k(n)}(1,x) &+ f(x)T_{\sigma^k(n)}(1,x) - f(x) \\ &= \left[T_{\sigma^k(n)}(f,x) - f(x)T_{\sigma^k(n)}(1,x)\right] \\ &+ f(x)\left[T_{\sigma^k(n)}(1,x) - 1\right] \qquad (2.1.7) \end{aligned}$$

Using (2.1.6) and (2.1.7), we have

$$\begin{aligned} T_{\sigma^k(n)}(f,x) - f(x) &< \epsilon T_{\sigma^k(n)}(1,x) \\ &+ \tfrac{2M}{\delta^2}T_{\sigma^k(n)}(\psi,x) + f(x)(T_{\sigma^k(n)}(1,x)-1) \quad (2.1.8) \end{aligned}$$

Let us estimate $T_{\sigma^k(n)}(\psi,x)$

$$\begin{aligned} T_{\sigma^k(n)}(\psi,x) &= T_{\sigma^k(n)}((t-x)^2,x) \\ &= T_{\sigma^k(n)}(t^2-2tx+x^2,x) \\ &= T_{\sigma^k(n)}(t^2,x) + 2xT_{\sigma^k(n)}(t,x) + x^2T_{\sigma^k(n)}(1,x) \\ &= [T_{\sigma^k(n)}(t^2,x)-x] - 2x[T_{\sigma^k(n)}(t,x)-x] \\ &\quad + x^2\left[T_{\sigma^k(n)}(1,x)-1\right]. \end{aligned}$$

Using (2.1.8), we obtain

$$\begin{aligned} T_{\sigma^k(n)}(f,x) - f(x) &< \epsilon T_{\sigma^k(n)}(1,x) \\ &+ \frac{2M}{\delta^2}\left\{\left[T_{\sigma^k(n)}(t^2,x)-x^2\right] + 2x\left[T_{\sigma^k(n)}(t,x)-x\right]\right. \\ &\quad \left. + x^2\left[T_{\sigma^k(n)}(1,x)-1\right]\right\} \\ &\quad + f(x)\left(T_{\sigma^k(n)}(1,x)-1\right) \\ &= \epsilon\left[T_{\sigma^k(n)}(1,x)-1\right] + \epsilon \\ &+ \frac{2M}{\delta^2}\left\{\left[T_{\sigma^k(n)}(t^2,x)-x^2\right] + 2x\left[T_{\sigma^k(n)}(t,x)-x\right]\right. \\ &\quad \left. + x^2\left[T_{\sigma^k(n)}(1,x)-1\right]\right\} \\ &\quad + f(x)\left(T_{\sigma^k(n)}(1,x)-1\right). \end{aligned}$$

Since ϵ is arbitrary, we can write

$$\begin{aligned} T_{\sigma^k(n)}(f,x) - f(x) &\le \epsilon\left[T_{\sigma^k(n)}(1,x)-1\right] \\ &+ \frac{2M}{\delta^2}\left\{\left[T_{\sigma^k(n)}(t^2,x)x^2\right]\right. \\ &+ 2x\left[T_{\sigma^k(n)}(t,x)-x\right] \\ &\left. + x^2\left[T_{\sigma^k(n)}(1,x)-1\right]\right\} \\ &+ f(x)\left(T_{\sigma^k(n)}(1,x)-1\right). \end{aligned}$$

Similarly

$$\begin{aligned} D_{n,p}(f,x) - f(x) &\le \epsilon\left[D_{n,p}(1,x)-1\right] \\ &+ \frac{2M}{\delta^2}\left\{\left[D_{n,p}(t^2,x)-x^2\right]\right. \\ &+ 2x\left[T_{\sigma^k(n)}(t,x)-x\right] \\ &\left. + x^2\left[D_{n,p}(1,x)-1\right]\right\} \\ &+ f(x)\left(D_{n,p}(1,x)-x\right), \end{aligned}$$

and therefore

$$\begin{aligned} \left\|D_{n,p}(f,x)-f(x)\right\|_\infty &\le \left(\epsilon + \frac{2Mb^2}{\delta^2} + M\right) \\ \left\|D_{n,p}(1,x)-1\right\|_\infty &+ \frac{4Mb}{\delta^2}\left\|D_{n,p}(t,x)-x\right\|_\infty \\ &+ \frac{2M}{\delta^2}\left\|D_{n,p}(t^2,x)-x^2\right\|_\infty. \end{aligned}$$

Letting $p \to \infty$ and using (2.1.1), (2.1.2), (2.1.3), we get

$$\lim_{p\to\infty}\left\|D_{n,p}(f,x)-f(x)\right\|_\infty = 0 \text{ uniformly in } n$$

This completes the proof of the theorem.

In the following we give an example of a sequence of positive linear operators satisfying the conditions of Theorem 2.1 but does not satisfy the conditions of the Korovkin theorem.

Example 2.2.. Consider the sequence of classical Bernstein polynomials

$$b_n(f,x) := \sum_{k=0}^{\infty} f\left(\frac{k}{n}\right)\binom{n}{k}x^k(1-x)^{n-k},$$
$$0 \le x \le 1.$$

Let the sequence (P_n) be defined by $P_n: C[0,1] \to C[0,1]$ with $P_n(f(,x) = (1+z_nB_n(f,x)$, where z_n is defined as in Example 1.2. Then

$$B_n(1,x)=1, B_n(t,x)=x, B_n(t^2,x)=x^2+\frac{x-x^2}{n},$$

and the sequence (P_n) satisfies the conditions (2.1.1)-(2.1.3). Hence we have

$$\sigma\text{-lim}\,\|P_n(f,x)-f(x)-f(x)\|_\infty = 0.$$

On the other hand, we get $\$P_n(f,0) = (1+z_n)f(0)$, since $B_n(f,0)=f(0)$, and hence

$$\|P_n(f,x)-f(x)\|_\infty \ge |P_n(f,0)| = z_n|f(0)|$$

We see that (P_n) does not satisfy the classical Korovkin theorem, since $\lim \sup_{n\to\infty} z_n$ does not exists.

Now we present a slight general results.

Theorem 2.3. Let T_n be a sequence of positive linear operators on $C[a,b]$ such that

$$\lim_n\|T_{n+1}-T_n\|_\infty = 0 \qquad (2.3.1)$$

If

$$\sigma\text{-}\lim_n\|T_n(t^\nu-x)-x^\nu\|_\infty = 0 \quad (\nu=0,1,2). \qquad (2.3.2)$$

Then for any function $f \in C[a,b]$ bounded on the real line, we have

$$\lim_n\|T_n(f,x)-f(x)\|_\infty = 0 \qquad (2.3.3)$$

Proof. From Theorem 2.1, we have that if (2.3.2) holds then

$$\lim_p\left\|D_{n,p}(f,x)-f(x)\right\|_\infty = 0, \text{ uniformly in } n \qquad (2.3.4)$$

We have the following inequality

$$\|T_n(f,x)-f(x)\|_\infty \le \left\|D_{n,p}(f,x)-f(x)\right\|_\infty + \frac{1}{p}\sum_{k=n+1}^{n+p-1}\left(\sum_{l=n+1}^{k}\|T_l-T_{l-1}\|_\infty\right)$$

$$\le \left\|D_{n,p}(f,x)-f(x)\right\|_\infty + \frac{p-1}{2}\left\{\sup_{k\ge n}\|T_k - T_{k-1}\|_\infty\right\} \qquad (2.3.5)$$

\

Hence using (2.3.1) and (2.3.4), we get (2.3.3).

This completes the proof of the theorem.

Remark 2.4. We know that σ-convergence implies $(C,1)$ convergence. This motivates us to further generalize our main result by weakening the hypothesis or to add some condition to get more general result.

Theorem 2.5. Let $(T_n$ be a sequence of positive linear operators on $C[a,b]$ such that

$$(C,1)-\lim_{n\ge p}\|T_n(t^\nu,x)-x^\nu\|_\infty = 0 \ (\nu=0,1,2) \qquad (2.5.1)$$

and

$$\lim_p\left\{\sup_{n\ge p}\frac{n}{p}\left\|\xi_{n+p-1}(f,x)-\xi_{n-1}(f,x)\right\|_\infty\right\} = 0 \qquad (2.5.2)$$

where

$$\xi_n(f,x)=\frac{1}{n+1}\sum_{k=0}^{n}T_k(f,x).$$

Then for any function $f \in C[a,b]$ bounded on the real line, we have

$$\sigma\lim_{n\to\infty}\|T_n(f,x)-f(x)\|_\infty = 0,$$

Proof. For $n \ge p \ge 1$, it is easy to show that

$$D_{n,p}(f,x) = \xi_{n+p-1}(f,x) + \frac{n}{p}\left(\xi_{n+p-1}(f,x)-\xi_{n-1}(f,x)\right),$$

which implies

$$\sup_{n\ge p}\left\|D_{n,p}(f,x)-\xi_{n+p-1}(f,x)\right\|_\infty = \sup_{n\ge p}\frac{n}{p}\left\|\xi_{n+p-1}(f,x) - \xi_{n-1}(f,x))\right\|_\infty \qquad (2.5.3)$$

Also by Theorem 2.1, Condition (2.5.1) implies that

$$(C,1)\text{-}\lim_{n\to\infty}\|T_n(f,x)-f(x)\|_\infty = 0 \qquad (2.5.4)$$

Using (2.5.1)-(2.5.4) and the fact that σ-convergence implies $(C,1)$ convergence, we get the desired result.

This completes the proof of the theorem.

Theorem 2.6. Let $(T_n$ be a sequence of positive linear operators on $C[a,b]$ such that

$$\lim_n\sup_m\frac{1}{n}\sum_{k=0}^{n-1}\left\|T_n - T_{\sigma^k(m)}\right\| = 0$$

If

$$\sigma\text{-}\lim_n\|T_n(t^\nu,x-x^\nu\|_\infty = 0 \ (\nu=0,1,2) \ (2.6.1)$$

Then for any function $f \in C[a,b]$ bounded on the real line, we have

$$\lim_n \|T_n(f,x) - f(x)\|_\infty = 0. \qquad (2.6.2)$$

Proof. From Theorem 2.1, we have that if (2.6.1) holds then

$$\sigma\text{-}\lim_n \|T_n(f,x) - f(x)\|_\infty = 0,$$

which is equivalent to

$$\lim_n \left\| \sup_m D_{m,n} = (f,x) - f(x) \right\|_\infty = 0$$

Now

$$T_n - D_{m,n} = T_n - \frac{1}{n}\sum_{k=0}^{n-1} T_{\sigma^k(m)}$$

$$= \frac{1}{n}\sum_{k=0}^{n-1} (T_n - T_{\sigma^k(m)}).$$

Therefore

$$T_n - \sup_m D_{m,n} = \sup_m \frac{1}{n}\sum_{k=0}^{n-1} \left(T_n - T_{\sigma^k(m)}\right).$$

Hence using the hypothesis we get

$$\lim_n \|T_n(f,x) - f(x)\|_\infty$$

$$= \lim_n \left\| \sup_m D_{m,n}(f,x) - f(x) \right\|_\infty$$

$$= 0,$$

that is (2.6.2) holds.

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Investigation of the Electrical Transport Properties of $TlBiTe_2$ Single Crystals

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Abstract: The preparation and electrical properties of a Thallium Bismuth ditelluride single crystals are reported in the present work. Measurements of the electrical conductivity and Hall coefficient were performed over a temperature range from 178-568 K. The study was carried out under vacuum. The crystals obtained had p-type conductivity with a hole concentration of 1.4×10^{10} cm^{-3} at room temperature. The conductivity and Hall mobility at 300K were 5.06×10^{-6} $\Omega^{-1}cm^{-1}$ and 2257.53 $cm^2V^{-1}s^{-1}$ respectively. The calculated energy gap width and the ionisation energy were 0.43 eV and 0.15 eV, respectively. The variation in the charge carrier concentration versus temperature is discussed. The scattering mechanism was evaluated over the entire range of temperature. Additionally, other important parameters were estimated, such as the diffusion coefficient, the mean free time and the diffusion length of holes. These properties have not been reported to date.
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Key words: Chalcogenides, Thallium Bismuth ditelluride – crystal growth.

1. Introduction

In the past three decades, there have been significant research interest in chalcogenide materials because of the interesting physical properties of these materials and their wide technological applications[(1)]. There is increasing interest in ternary compound semiconductors with the general formula III-III-VI_2 because of their attractive physical properties, anisotropic, quasi-two-dimensional structure and unusual optical and photoelectric characteristics[(2)]. Ternary semiconductor compounds with the formula $TlAB_2$ (A: As, Sb, Bi and B: Te, Se, S) have been proposed for various application such as a coustoptic detectors, infrared detectors, thermoelectrics, and switching and memory elements[(3)]. Narrow-gap semiconductors have attracted considerable interest due to their wide application in infrared optoelectronics [(4)]. $TlBiTe_2$ is a narrow gap semiconductor [(5)], belonging to the family of III-V-VI ternary compounds of the general type $TlBiX_2$ (X = Te, Se, S) often referred to as pseudo-lead chalcogenides because of their close chemical relation to the PbTe, PbSe and PbS. $TlBiTe_2$ has been the subject of several studies because of their interesting features, but its use has been limited because TI and its compounds have to carefully handled[(6)]. Nevertheless, there are few studies on some of the transport properties of $TlBiTe_2$. In particular, no detailed study of the electrical conductivity and Hall coefficient over a wide range of temperature has been performed. The objective of this work was to grow $TlBiTe_2$ single crystals and to study the conductivity and Hall coefficient in these crystals. The properties of this compound have not been reported to date.

2- Experimental arrangement:

2-1- Growth technique.

Ingots of $TlBiTe_2$ were synthesized by direct fusion of stoichiometric amounts of spectroscopically standardised elements (Aldrich mart) with a purity of 99.999%. The samples were prepared by direct melting of the starting materials placed in quartz ampoules sealed under vacuum at approximately 10^{-6} Torr. The silica ampoule and its load was placed on a tray made from a heat-resistant alloy to minimise the effect of heat loss, for homogeneous distribution of heat and to protect the muffle furnace from the explosion hazard of the silica tube. The entire assembly was then placed in a controlled muffle furnace and the temperature raised gradually in 20ºC/h steps until the reaction occurred, as determined from previous studies [(7)]. At this point, the temperature was held constant for 10 hours, after which it was raised by 40ºC its rise is then continued to some 40°C above the melting point (520ºC) of the compound and held constant at this last stage for several hours. The sample was shaken several times to ensure complete mixing of the components. During this stage, any strain present in the matrix was relieved. To obtain a uniform composition of stoichiometric material, it was necessary to cool the mixture very slowly at a rate of 5ºC /h until it reached 150ºC, followed by rapid cooling to room temperature. These procedures take a long time to complete. The ingot obtained contained silvery, dark metallic crystals. X-ray diffraction of the synthesised crystals was performed using monochromatic Cu-Kα radiation.

The prepared material was highly crystalline, as determined by diffraction, and the diffraction data did not show the presence of any secondary phases.

2-2- Measurement technique:

To study the electrical conductivity and Hall effect, a rectangular sample was prepared. After polishing, the sample dimensions were 7.5 x 2 x 1 mm^3. The sample had a length three times its width. This aspect ratio is useful to avoid a Hall voltage drop. The electrical conductivity and Hall effect measurements were measured using a DC four probe method. The sample was placed in an evacuated pyrex cryostat[8]. The cryostat works as a liquid nitrogen container and is supported with electric heaters for low- and high-temperature measurements, respectively. The magnetic field value in the experiment was 0.5 T using a GMW electromagnet model 5403. The electrical conductivity and Hall coefficient were measured by a DC compensation method. Ohmic contact was made with the aid of silver paste. These contacts were ohmic in the range of the applied voltage. The ohmic nature of the contact was checked by recording the current-voltage characteristics. Details of the experimental procedures and apparatus have been published [9].

3- Results and Discussion:

Fig.1 shows the temperature dependence of the electrical conductivity σ for a $TlBiTe_2$ single crystal in a temperature range from 178 K to 568 K. The curve can be subdivided into three regions. The first region represents the extrinsic range. In this region, σ increases slowly with temperature, and the number of ionised acceptors mainly determines the carrier concentration. This effect occurs naturally as a result of the transition of carriers from the impurity level to the conduction band. The depth of the acceptor centre was determined from the region in which the conductivity is predominantly due to the impurity atoms and was found to be 0.16 eV. The second region represents the transition region (248 - 443 K), in which the behaviour of σ is governed by the behaviour of both the charge carrier concentration and their mobility. In this region, the increase in the electrical conductivity is due to the increase in mobility. The carrier density in this temperature regime remains practically constant until the intrinsic region is reached. Above 443 K, intrinsic conduction begins, and σ increases sharply. This finding reveals that both electrons and holes contribute to conduction at this high-temperature range. The dependence of this temperature follows the relation:

$$\sigma = \sigma_o \exp\left(-\frac{\Delta E_g}{2KT}\right) \qquad (1)$$

where σ_o is the pre – exponential factor and ΔEg is the width of the energy gap. Using this formula, the energy gap ΔEg is 0.43 eV. The value of σ at 300K is equal to 5.06 x 10^{-6} Ω^{-1} cm^{-1}.

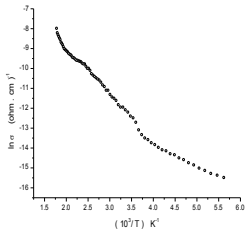

Fig. 1. Temperature dependence of the electrical conductivity

From the measurements of the Hall coefficient, it is evident that the sign of the Hall coefficient of $TlBiTe_2$ is positive over the entire range of investigation, indicating that the compound is a p-type semiconductor. The Hall coefficient at room temperature was 4.46 x 10^8 cm^3/C. The temperature dependence of the Hall coefficient for $TlBiTe_2$ specimen is shown in Fig. 2.

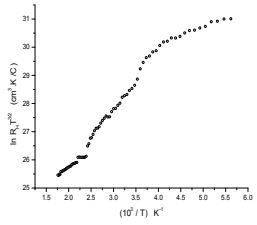

Fig.2. Temperature dependence of the Hall effect

Determination of the energy gap and ionisation energy from the Hall data is possible by plotting the relationship between Ln R_H $T^{3/2}$ and $10^3/T$ as shown in Fig. 3.

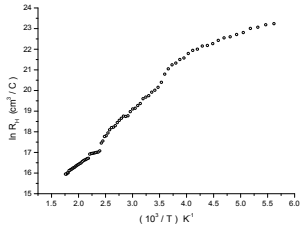

Fig. 3. Relationship between R_H $T^{3/2}$ and $10^3/T$

From this figure, three regions of the curve are also observed. This result agrees with that observed in Fig. 1. From the intrinsic region, ΔEg was found to be 0.43 eV, whereas in the extrinsic region, the value of ΔEa was estimated to be 0.15 eV. These data are approximately in good agreement with those obtained from the electrical conductivity data. A combination of the Hall measurements and electrical conductivity data were used to study the temperature dependence of the mobility of the charge carriers. Fig. 4 shows the variation of μ as a function of temperature. The variation of μ with temperature can be divided into two regions. At low temperature, μ increases with

increasing temperature with the following relation: $\mu \alpha T^{1.66}$. Such behaviour is characteristic of a scattering mechanism of charge carriers with ionisation impurities. In the high-temperature range, which is the intrinsic conduction region, the hole mobility decreases with increasing temperature according to the relation $\mu \alpha T^{-2}$, which indicates that the scattering mechanism in this temperature range is caused by acoustic lattice vibrations. The hole mobility at room temperature 2257.53 cm^2/ V sec. The charge carrier concentration was calculated from the Hall coefficient data using the relation:

$p = 1/R_H e$, where p is the hole concentration and e is the electron charge.

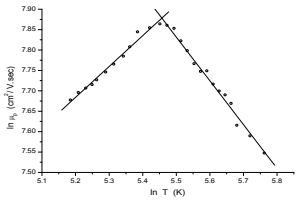

Fig. 4. Behaviour of the Hall Mobility as a function of temperature

The variation of the number of majority carriers versus reciprocal temperature is shown in Fig. 5. At room temperature, the concentration reaches a value of 1.4 x 10^{10} cm^{-3}. At low temperature (178 - 248 K) in $TlBiTe_2$, the carrier concentration is determined by the number of ionised acceptors. The variation of the carrier concentration is quite slow. Because the $TlBiTe_2$ sample exhibits intrinsic behaviour at temperatures above 443 K, the value for the intrinsic concentration will be given by:

$$P_i = 2\left(\frac{2\pi K}{h^2}\right)^{\frac{3}{2}} (m_n^* m_p^*)^{3/4} T^{3/2} \exp\left(-\frac{\Delta E_g}{2KT}\right) \quad (2)$$

where symbol have their usual meaning, and the energy gap width determined from this relation is 0.43 eV.

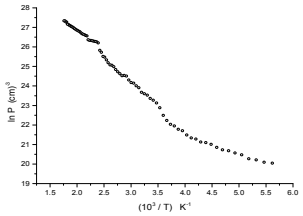

Fig. 5. Variation of carrier concentration with temperature

Calculating the diffusion coefficient for holes yielded a value of 58.47 cm^2/sec. Assuming the effective mass for holes is equal to the rest mass, and using the value for the hole mobility at room temperature, the mean free time could be determined and was equal to 1.393 x 10^{-12} sec. Additionally, the diffusion length of holes in the $TlBiTe_2$ specimen was 9.024 x 10^{-6} cm.

4- Conclusion:

The preparation and electrical properties of Thallium Bismuth ditelluride single crystals is reported in the present work. Measurements of the electrical conductivity and Hall coefficient were performed over a temperature range from 178 - 568 K. All measurements were performed under vacuum in a special cryostat designed for this purpose. The measured Hall coefficient indicates p-type conductivity for our sample with a hole concentration of 1.4 x 10^{10} cm^{-3} at room temperature. The conductivity and Hall mobility at 300 K were 5.06 x 10^{-6} Ω^{-1} cm^{-1} and 2257.53 cm^2/V.sec, respectively. The scattering mechanism was evaluated over the whole temperature range and was found to be due to charge carriers with ionised impurities at low temperature and to lattice scattering in the high temperature regime. The width of the band gap was estimated to be 0.43 eV. The position of the acceptor level was determined to be at 0.15 eV. The diffusion coefficient, mean free time and the diffusion length of holes were also evaluated.

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