

CONTENTS

86	Effect of Pastoralist-Farmers Conflict on Access to Resources in Savanna Area of Oyo State, Nigeria Oladele O.T and Oladele O.I.	616-621
87	Learning Alliances in Sawah Rice Technology Development and Dissemination in Nigeria and Ghana Oladele O. I and Wakatsuki T	622-627
88	The Role of Urban Services` Spatial Dispersion on creation of Ghetto Quarters in Yazd City and Its associated Social Impact MehriHeidariNoshahr NaiierHeidari Noshahr Javad Ebrahimi	628-633
89	A Scatter Search Algorithm for RCPSP with Discounted Weighted Earliness-Tardiness Costs Mohammad Khalilzadeh FereydoonKianfar Mohammad Ranjbar	634-640
90	Effect of Flavonoid Quercetin Supplement on the Progress of Liver Cirrhosis in Rats Gehane M. Hamed, Nehal Mohammad Bahgat, Fayda I. Abdel Mottaleb and Maher M. Emara	641-651
91	Silencing a putative cytosolic NADP-malic enzyme gene compromised tomato resistance to <i>Oidiumneolycopersici</i> Dong-LiPei, Hong-ZhenMa, Yi Zhang, Yuan-Song Ma, Wen-JingWang, Hui-Xia Geng, Jian-YuWu, Cheng-WeiLi	652-657
92	The use of a by-product of paper industry in reclamation of berry-cultivated soils MohammadiTorkashvand, A., Bizhannia, A., Mavajpour, M. and Haghigat, N.	658-661
93	Evaluation of IL18 in acute coronary syndrome patients and its relation to diabetes Ahmed A. Battah, Abeer Ibrahim and Hanan Abdel mawgood	662-666
94	Beneficial Effects of some beverage consumption and Orlist drug on Diet Induced Obesity in Experimental Rate Hala, E.M El- Kewawy, Farida, Abdullah Al-Firdous and Rasha M Nagib	667-675
95	Petroleum Systems in the North Western Desert of Egypt Ahmed Nabil Shahin and Amira Mohamed Al-Awadly	676-685
96	Perinatal Exposure to Sodium Fluoride with Emphasis on Territorial Aggression, Sexual Behaviour and Fertility in Male Rats Mervat M. Kamel, Heba S. El-Iethey, Iman B. Shaheed	686-694
97	Review: Electrical study of pipe – soil – earth system Dr. Ashraf Abdel Raouf Mohamed Fouad Ahmed	695-723
98	Prognostic Value Of Expression Of Survivin And Ki67 In Head And Neck Squamous Cell Carcinoma Treated By Chemoradiotherapy Samy M. A Gizawy, Hoda H. Essa, Abeer M. Refaiy. Gehan M. Elosaily, and H.E.Ahmed	724-733

99	Methods of Distance Education in Agricultural education Hamid Mohammadi, AzamGhaffari	734-738
100	The Wise, Hero Man and His Characteristics from Nietzsche's Viewpoint Muhammad HosseinMardaniNokandeh	739-745
101	Feminism and Power in Islamic Republic of Iran MehrdokhtGhooparanloo	746-762

Effect of Pastoralist-Farmers Conflict on Access to Resources in Savanna Area of Oyo State, Nigeria

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Abstract: This paper examines the effect of pastoralist-farmers conflict on access to resources in savanna area of Oyo state, Nigeria. A snow ball technique was used to obtain a list of agro-pastoralists and their camps in the study area whose conflicts with crop farmers were caused by the nomadic pastoralists' uncontrolled grazing. Fifty percent of the households in each camp were randomly chosen and simple random technique was used to sample male and female household heads. Data was collected through primary source by administering a well-structured interview schedule to the agro-pastoralists. Majority of the agro-pastoralists are married and they are within their active productive age. All male agro-pastoralists made cattle rearing as their primary occupation and their secondary occupations include crop production, goat rearing and sheep rearing, while milk processing and fowl rearing were primary occupation and secondary occupation of female agro-pastoralists respectively. Majority of the agro-pastoralists had no formal education, and not a native of the study area hence adoption of innovation will be difficult. The agro-pastoralists suffered in numerous forms and ways from the conflict ensuing between them and the crop farmers. The aggressiveness of the nomadic pastoralists was the prominent assumed cause of the nomadic pastoralists uncontrolled grazing. The competitive use of various natural resources such as land, water, shelter and air by various rural dwellers is inevitable.

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Keywords: Pastoralists, farmers, conflict, pasture, land, water resources, transhumance

Introduction

Agriculture plays a leading role in the non-oil sector of Nigeria. It supports 63 percent of the population directly by providing about 28 percent of the gross domestic product (GDP) from the total exports and 70 percent non-oil export production (Oladele and Sakagami 2004). Nigeria as an agrarian country, the production of foods and other raw materials is a necessary ingredient for the take-off of all other sectors of the nation's economy. About 70% of the Nigerian total labour force is employed within the agricultural sector. Ekong 2003 reported 64% of Nigerians live in rural areas and their primary occupation is farming. However most farming households operate land owned through inheritance and acquisition through family ties. More than 50% of farmers own their lands (Okunmadewa, 2002). According to Rahji (2002), "A key feature of the Nigerian Agriculture is the dominance of small holder farms or farm households ...they cultivate less than 5 hectares". The small farmers have limited resources therefore they are dependent on traditional implements; hoes and cutlasses, which in turn limit the output; depend on their efficiency in the utilization of basic production resources available, depend on family and hired labour due to the fact that there is extremely low level of mechanization.

Arable crop and cattle producers have not only intensified the use of their respective lands, they have also been exploring other land frontiers for farming and grazing. Farm lands that are normally allowed to fallow for natural rejuvenation of the soil are fast disappearing, while lands that traditionally provide dry season grazing to pastoralists are becoming shorter in supply (Gefu & Kolawole, 2002). This has heightened the frequency and intensity of competition among various land users. The Fulani herdsmen of lower Sahel and Sudan Savannah are now being found in the south (including the forest belt) in search of greener pasture for their herds (Oyesola, 2000; Ajuwon, 2004). Indeed, Ajuwon (2004) reported farmer herdsmen conflict in Imo State, south east of Nigeria. Competition-driven conflicts between arable crop farmers and cattle herdsmen have become common occurrences in many parts of Nigeria (Ingawa, Ega, & Erhabor, 1999). The competition between these two agricultural land user-groups has often times turned into serious overt and covert hostilities and social friction in many parts of Nigeria. In a newspaper study of crises in Nigeria between 1991 and February 2005, Fasona and Omojola (2005) found that land related conflicts accounted for about 51% of the major clashes reported by the selected newspapers. Specifically, conflicts involving agricultural land use between

farmers and herdsmen accounted for 35% of all reported crises. Politico-religious and ethnic clashes occurred at lower frequencies. Another study of 27 communities in North Central Nigeria showed that over 40% of the households surveyed had experienced agricultural land related conflicts, with respondents recalling conflicts that were as far back as 1965 and as recent as 2005 (Nyong & Fiki, 2005).

Pastoralists may be described as nomadic. Semi-settled (transhumant) or settled (sedentary agro pastoralists) according to the degree of mobility. The semi-settled pastoralists are at times called transhumant agro pastoralist if they also practices cropping (FAO, 1983). Not all pastoralist societies can be accurately described as following a nomadic or transhumance way of life. As conditions change, pastoralists usually adjust. This can result in a traditionally nomadic society or some families within in it becoming more or less transhumance in their migratory patterns if the opportunity arises. Likewise, a society that prefers a transhumance way of life may be forced by circumstances to change to a nomadic pattern for some or all of its livestock (Dennis O'Neil 2007). This makes it difficult for most other rural dwellers to distinguish between the nomadic and the agro-pastoralists. As the livelihoods of pastoralists and agro-pastoralists depend on key resources such as land, water, forests, minerals, wildlife, livestock and pasture, the environment poses particular challenges to their survival. These resources are diminishing from year to year, intensifying competition over resources and causing violent conflict between the pastoralists and other rural land users.

However, most of the crop farmer cannot distinguish between the agro-pastoralist and the nomadic pastoralist's herders but rather referred to agro-pastoralists and nomadic pastoralists as nomads (Ingawa, 2003). Due to the continuous movement pattern of pastoralists, the agro-pastoralists who settled in the area are made mostly to bear the consequences of the uncontrolled grazing and conflicts caused by the nomads. The objectives of this paper were to determine the effect of pastoralist-farmers conflict on access to resources in savanna area of Oyo state, Nigeria.

Materials and Methods

The study area is Iseyin Local Government Area of Oyo State, Nigeria. The area is bounded in the North by Itesiwaju Local Government Area, in the east by Oyo West and Afijio Local Government Areas, in the West by Kajola and Iwajowa Local Government Areas and in the South by Ibarapa North and Ibarapa East Local Government Areas, all in Oyo State. The total population is estimated to be 170,589 (NPC1991). Iseyin Local Government has an

estimated land area of 2,952km². The climatic conditions of the area include 1125 - 2600mm of mean annual rainfall and a temperature range of 69^o - 95^of while the relative humidity is high. The vegetation is of the derived guinea savannah type, this is characterized by clumps of deciduous trees reaching between 12-15m and grasses tall (Afolabi, 1977). It has heterogeneous population of Yoruba, Tiv, Agatu, Ibo, Hausa and Fulani (Igbinosa, 1994). The main occupation of majority of the indigenes in the area are farming, trading and weaving. Pastoralism is practiced majorly by the Fulanis and Hausas. Crop farming is ranked highest and this enhanced the designation of the area as the food basket of Oyo State. The agro-pastoralists in Iseyin Local Government Area of Oyo State comprise the population of the study. A snow ball technique was used to obtain a list of agro-pastoralists and their camps in the study area whose conflicts with crop farmers were caused by the nomadic pastoralists' uncontrolled grazing. Fifty percent of the households in each camp were randomly chosen and simple random technique was used to sample male and female household heads. That is one male and one female per household. One hundred and eleven male and female were randomly sampled for the study making a total of two hundred and twenty two respondents.

Data was collected through primary source by administering a well-structured interview schedule to the agro-pastoralists. The instrument for data collection was subjected to pre-existing validation and reliability tests at Oke- Amu and Ipapo in Itesiwaju Local Government Areas. The tests include face validity-to determine the extent to which the instrument measures what was designed to measure, and consistency within the instruments (split half method). The data was analysed by frequency distribution, means and percentage, Chi-square and t-test were used to explore relationship between variables.

Results

The results from the study covered the personal characteristics in Table1, conflicts occurrence and groups involvement in Table 2, access to land before and after conflict in Table 3, restriction to resources after conflict in Table 4 and incidence of relocation after conflict in Table 5. Table 6 presents the Chi-square analysis of relationship between conflict and agropastoralists access to resources while Table 7 covers t-test analysis of difference between male and female agro-pastoralists access to resources.

Table 1: Personal Characteristics of Agro pastoralists

Variables	Frequency	Percent
Gender: Male	111	50.00
Female	111	50.00
Total	222	100.00
Age: 24-30	19	8.56
31-37	74	33.33
38-44	73	32.88
45-51	41	18.47
52-58	11	4.96
59 and above	04	1.80
	222	100.00
Mean Age	39.9	
Education:		
No formal education	216	97.30
Adult Literacy	3	1.35
Koranic School	3	1.35
	222	100.00
Primary Occupation (Male)		
Cattle rearing	111	100.00
Secondary Occupation		
Crop production	111	100
Sheep rearing	43	38.7
Goat rearing	26	23.4
Primary Occupation (Female)		
Milk processing	111	100
Secondary Occupation		
Fowl rearing	111	100
Duration of stay in a community (year)		
1-7	82	36.94
8-14	106	47.74
15-21	16	7.21
22-28	2	0.90
29-35	16	7.2

Table 2 Conflicts occurrence and groups involvement

Variables	Frequency	Percent
Occurrence of conflict		
Yes	217	97.75
No	5	2.25
	222	100.00
Groups involved in conflict		
Crop farmers and agro-pastoralists	173	77.93
Crop farmers and nomadic pastoralists	43	19.37
Agropastoralists and nomadic pastoralists	3	1.35
Agropastoralists and agro-pastoralists	2	0.90
Crop farmers and crop farmers	1	0.45

Table 3: Access to land before and after conflict

Area of land acquire	Before the conflict		After the conflict	
	Frequency	Percent	Frequency	Percent
16-20	3	2.70	03	2.70
11-15	4	3.61	04	3.61
6-10	36	32.43	27	24.32
1-5	68	61.26	77	69.37

Table 4: Restriction to resources after conflict

Restriction to resources after conflict	Frequently	Rarely	Never
Restriction to land	11(5.0)	22(9.9)	189(85.1)
Restriction to water	20(9.0)	96(43.2)	106(47.7)
Restriction to fodder crops	11(5.0)	36(43.3)	175(78.8)
Restriction to shelter	10(4.5)	22(9.9)	190(85.6)

Table 5. Incidence of relocation after conflict

Variable	Frequency	Percent
Occurrence of re- location		
Yes	5	2.3
No	217	97.7
Total	222	100.00

Table 6 Chi-square analysis of relationship between conflict and agropastoralists access to resources

Variable	Access to resources
Chi-square (X^2) value	0.002
df	1
P	0.961
Decision	Not significant

Table 7 t-test analysis of difference between male and female agro-pastoralists access to resources

Variable	N	Mean	Standard Deviation	t-value	P	Decision
Male	111	18.595	1.598	10.248	.000	S
Female	111	17.027	17.027			

Discussion

As stated in Table 1, about fifty percent of the respondents were male while the remaining was female. This agrees with Quisumbing (1994) and Gladwin (1996) that when individual characteristics, other than sex, and input levels are controlled, male and female farmers are equally efficient farm managers. Similarly, it agrees with Ibrahim (1998) that agro-pastoralists migrate from one place to another with their wives and children. The mean age of the agro-pastoralists is 39.9 years. About sixty six percent of the agro-pastoralists were between the age of 31 and 44. This age bracket, as asserted by Oladele (1998) is highly ambitious and can engage in more than one livelihood activities. One hundred percent of the respondents were married. This suggests that the agro-pastoralists marry early (on or before the age of 24). This is in agreement with Oladele (1998) that marriage provides additional farm labour for the farmers.

Majority (97.30%) of the agro-pastoralists have no formal education. This justifies the inclusion of nomadic education in the National Policy of Education to take care of majority of the pastoralists that do not have the advantage of formal education (National Policy on Education, 1998). The primary occupation of the male agro-pastoralists is predominantly cattle rearing. The secondary occupations of the agro-pastoralists are crop production (100%), Sheep rearing

(38.7%) and goat rearing (23.4%). This agrees with Dylan et al (1998) assertion that herders pursue a complex range of conflict avoidance strategies to minimize vulnerability and to avoid confrontations with other resource users by diversification of livelihood strategies. This sheep-goat rearing ratio (2: 1) is contrary to rearing ratio of (3: 5) in Kastina State (Hamisu, 1999). The primary occupation and secondary occupation of female agro-pastoralists are milk processing and fowl rearing respectively. This agrees with Sean (2003) that the pastoralists have a high degree of gender and age stratification. He added that female agro-pastoralists role is confined to the home. The mean length (duration) of stay (year) in the community is 8.75. The mode (47.74%) of the duration year bracket is 8-14 years. This agrees with Roger and Ingawa (2003) that agro-pastoralists considerably live longer in, and more committed to their communities unlike the mobile people (nomads) who simply are not committed to committees.

Table 2 shows that about 98% of the agro-pastoralists indicated the incidence of conflicts between crop farmers or nomadic pastoralists in their respective communities. This agrees with Ogunsanya and Popoola (1999) that nomadic pastoralists uncontrolled grazing is rampant in Iseyin Local Government Area. Majority (77.93%) of the conflicts were between the crop farmers and agro-pastoralists, followed by crop farmers

and nomadic pastoralists (19%), agro-pastoralists and nomadic pastoralists (1.35%), agro-pastoralists and agro-pastoralists (0.90%) and crop farmers and crop farmers (0.45%). The multiple resource systems common to dry land areas are characterized by the utilization of natural resources for multiple purposes or by more than one user (Cousins, 1996). Because groups have different objectives and interests in the use of resources, competition are often accentuated through violent conflict is not necessarily inevitable (Sean 2003). Hussein (1996) added that local-level conflicts over natural resources are endemic in Africa's pastoral and agro-pastoral system. However, Daniel and Gerett (1999) were of the opinion that misunderstanding or confusion regarding rights to natural resources and management responsibility can escalate into more intense conflicts as the number of people involved and the problems multiply.

As stated in the table 3, majority (93.69%) of the agro-pastoralists acquired less than eleven acres of land for crop production before and after the conflict. However, the occurrence of the conflicts brought about a reduction of eight percent in 6-10 acre bracket after the conflict. Agro-pastoralists do blame nomads for damaging crops overnight and flee immediately after which discourages the expansion of crop cultivation (Umar, 2003). Restriction to water resources (9.0%) was more suffered for by agro-pastoralists. Than land (5.0%), fodder crops (5.0%) and shelter (4.5%). The effects of the conflict between the Agropastoralists and crop farmers or nomadic pastoralists were not severe and could not lead to re- location as about ninety eight percent of the Agropastoralists stated that they did not re- locate as a result of the conflict.(table 4). This suggests that the crop farmers still accommodate the Agropastoralists after the conflict. However, the crop farmers believed the agropastoralists do not move about and hence do not destroy farm crops with their animals hence no need to drive them away from then camps (Umar, 2003).

Table 6 shows the relationship between the nomadic pastoralists uncontrolled grazing which led to conflict and Agropastoralists access to resources. It has a chi-square value of $X^2 = .002$, $P > 0.05$. This implies that there is no significant relationship between occurrence of conflict and access to resources such as water, land, shelter and fodder crops. The non-significant relationship between the conflict and the accessibility of agro-pastoralists to resources might be justified by the fact that aggression plays a large part in the lives of pastoralists. Their unhindered accessibility to resources might be due to their military prowess (Sean 2003). Similarly, the pastoralists believe in the principle of the "commons" – that nobody owns any of the common property resources such as water, air, land and plants as stated by Bala and Ajuwon (2004), this

may make them to strongly restrict any attempt to hinder their accessibility to any of the resources. Table 7 reveals that there is significant difference in male and female access to resources. It has a mean = 2.901 and .7387, standard deviation 2.945 and .912, t-value = 7.390, $P < 0.05$ respectively. The significant difference in the accessibility of male and female to resources may be due to the difference in male and female livelihood activities. The major resource that may be jointly demanded for is water, yet the rate of demand may be inversely related.

CONCLUSION

The study identified personal characteristics, livelihood activities and accessibility to resources of the agro-pastoralists in Iseyin Local Government Area of Oyo State. The study showed that the agro-pastoralists move about and live together with their household. Majority of the agro-pastoralists are married and they are within their active productive age. All male agro-pastoralists made cattle rearing as their primary occupation and their secondary occupations include crop production, goat rearing and sheep rearing, while milk processing and fowl rearing were primary occupation and secondary occupation of female agro-pastoralists respectively. Majority of the agro-pastoralists had no formal education, and not a native of the study area hence adoption of innovation will be difficult. The agro-pastoralists suffered in numerous forms and ways from the conflict ensuing between them and the crop farmers. The aggressiveness of the nomadic pastoralists was the prominent assumed cause of the nomadic pastoralists uncontrolled grazing.

The competitive use of various natural resources such as land, water, shelter and air by various rural dwellers is inevitable. The study identified that the occurrence of conflict did not significantly hinder the agro-pastoralists access to resources.

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Learning Alliances in Sawah Rice Technology Development and Dissemination in Nigeria and Ghana

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Abstract: Millions of dollars are spent each year on research and development initiative on rice in order to improve the livelihood of farmers and other stakeholders in the rice value chain, however little has been the impact. Major reasons for this failure include the limited collective learning that occurs between various stakeholders and the neglect of building a multi-stakeholder innovation systems for rice in West Africa. This has made research results less relevant and the impact making farmers worse off. This paper describes how Sawah rice production technology has evolved through learning alliances that involves social learning and innovation systems and brings Japanese institutions, research institutes, Ministry of Agriculture, extension agencies, farmers groups, Millennium Village, marketers, and universities in Nigeria and Ghana together on a platform with clear objectives, shared responsibilities, cost and benefits, output as inputs, differentiated learning mechanisms, long term and trust-based relationships. The process is increasingly leading to increased learning and effectiveness in rural entrepreneurial development and improved livelihoods. The paper gives a description of the scenarios based on experience in the sawah rice technology development and concludes with its application in other parts of West African region.

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Keywords: Learning Alliances, Sawah Rice Technology, farmers, Nigeria, Ghana

1. Introduction

Cereal production per capita has been stagnant for more than thirty years in Sub-Saharan Africa, while in Asia it has grown about 1.5 times (FAO, 2006). This contrast is explained by the fact that “Green Revolution” has not taken place in Sub-Saharan Africa. In fact although cereal yields in Sub-Saharan Africa have been increasing during this period, their growth rates are much lower than those achieved in Asia (FAO, 2006). Naturally this raises a concern about future food security in Sub-Saharan Africa. Not only this stagnation in general, if we look at the performance of each crop, we find that gap between regional supply and demand for rice has been widening because of a shift in diet away from traditional coarse grains caused by urbanization (WARDA, 2008). As a result rice imports in West Africa reached 2.8 million tons in 1998, and are projected to be between 6.5 and 10.1 million tons in 2020 (Lançon and Erenstein, 2002). It is well known that while the Green Revolution of rice in Asia was led by the release of modern varieties, irrigation and chemical fertilizer are necessary condition to achieve their potential high yield. In West Africa also varietal improvement of rice has a significant impact on the regional economy (Dalton and Guei 2003)

The dominant paradigms of research have been associated with the frameworks that are concerned with the supply and demand of agricultural

innovation in developing countries. According to Oladele, (1999) these are Transfer of Technology (TOT) which was the main approach of agricultural research in the 1950s, in which the generation and diffusion of innovation is a linear process from rich-country research institutes to poor-country research stations and from them to extension officers and to farmers. The Adaptive technology transfer model recognised the location-specific requirement of technology and farmer behaviour is no longer seriously regarded as a barrier to adoption. The focus is to adapt new technology to local conditions and to remove the socio-economic constraints to adoption by farmers, such as the availability of complementary inputs of credit. This model was prevalent in 1970s and early 1980s. In this model, the generation and diffusion of innovation remains a predominantly linear process with limited feedback from the farmers. Farming Systems Research (FSR): emerged in the mid-1970s and became prevalent in the 1980s to ensure the reach of innovations to resource-poor farmers. FSR greatly changed the status of the farm household and the farm system in the generation and diffusion of new technology. This it did by placing emphasis on discovering from farmers their goals and constraints. Farmer-First Research (FFR): came out of the argument against the FSR solution to the matching of research priorities with farmer needs did not go far enough in drawing on the knowledge and

experimental skills of farmers. The expert staff of the research station - scientist, social scientist and their assistants remain firmly in control of the data elicited from farmers, the design of on-farm trials and the nature of the technology eventually recommended for wide spread adoption. The multiple sources of innovation model (Biggs, 1985; Biggs and Clay, 1981) proposes that ideas and genetic resources for new technology spring from multiple sources, not just from a narrow sequence of basic and applied research carried out by scientists within the formal research system. The model is complementary to the farmer-first model. It emphasizes the non-linearity of the process by which new farm technology is generated and the many different sources in space and time of genetic materials and farming methods. Chambers and Ghildyal (1985) proposed the Farmer-First-and-Last which states that for technologies to better satisfy the needs and conditions of resource-poor farmers there should be a systematic process of scientist learning from and understanding of their resources, needs and problems. Scoones and Thompson (1994) introduced Beyond Farmer-First which points to where the farmer-first approach lacks certain analytical depth and presents a more radical programme that incorporate socio-politically differentiated views of development. The model highlights gender, ethnicity, class, age and religion having important implications for research and extension practice. It emphasizes that different types of local and non-local people hold many divergent, sometimes conflicting, interests and goals, as well as differential access to vital resources. Knowledge, which is diffuse and fragmentary, emerges as a product of the discontinuous and inequitable interactions between the actors i.e. researchers, extensionists and farmers (IIED, 1994). The need for translating research findings into effective development outcomes that improve the livelihoods of the rural poor on a broad scale are often expressed regarding international agricultural research, and research institutes in particular, given their mandates of food security, improved livelihoods, and sustainable resource management.

Learning Alliances are a series of connected stakeholder platforms, created at key institutional levels (typically national, intermediate and local/community) and designed to break down barriers to both horizontal and vertical information sharing and thus to speed up the process of identification, development and uptake of innovation. Each platform is intended to group together a range of partners with complementary capabilities in such areas as implementation, regulation, policy and

legislation, research and learning and documentation and dissemination.

The central premise of the Learning Alliance approach is that, by giving as much attention to the *processes* of innovating and scaling up innovation as is normally given to the subject of the innovation itself, barriers to uptake and replication can be overcome. The Learning Alliance approach has arisen from a sense of frustration over the evident failure of much relevant and effective innovation – technological or institutional – to move beyond the pilot stage (International Water and Sanitation Centre 2005).

At its simplest a Learning Alliances is a series of linked platforms, existing at different institutional levels (national, district, community) and created with the aim of bringing together a range of stakeholders interested in innovation and the creation of new knowledge in an area of common interest. The stakeholders involved should have complementary capabilities which, when combined, will allow the new knowledge created in the innovation process to be brought to scale. Some of the key capabilities required are in: implementation, regulation, policy and legislation, research and learning, and documentation and dissemination. Learning alliances require facilitation to overcome barriers to interaction and communication within and between the stakeholder platforms. They aim to enable a shared learning process in which barriers to horizontal and vertical information sharing are broken down. Learning alliances, by involving key stakeholders at all levels in the process of knowledge creation, aim to ensure that innovation takes place within a framework of local and national conditions and norms that ensure that what is produced is relevant and appropriate (James, 2001).

The concept of Learning Alliances is built around the central proposition that only an integrated approach to the process of innovation, bringing together all stakeholders (practitioners, researchers, policy makers, activists), can address the range of failings described above. At the same time the processes of interaction within the Learning Alliance should foster a sense of ownership of the founding concepts and approaches, ensuring that the innovation developed is appropriate to the local situation and capable of replication with existing (or realistically achievable) resources, institutions, and policies.

2 Learning Alliances and other relevant concepts

This section examines the relationship with some key concepts which preceded Learning Alliances and on which the latter are built. According to

Ruaysoongnern and Penning de Vries (2005) these include, action research, communities of practice, stakeholder platforms and participatory research and learning in the agricultural sector.

Action research- uses approaches designed to solve practical problems in support of and with the active collaboration of stakeholders. It is a flexible process which allows action and multidisciplinary research to be achieved at the same time (Dick, 2002). It is a win-win format: the action is more efficient and the research more relevant. A critical concept of action research is cycles of active experimentation followed by reflection. This cyclical approach is fundamental to any system that wants to create adaptive, flexible and context-specific knowledge. It is therefore of key importance in Learning Alliances.

Capacity building - Traditional approaches to capacity building often confuse it with training. While training and education are of course enablers of increased capacity it is vital that people are, at the same time, given the opportunity to put their new knowledge into practice. Learning Alliances provide a structured framework for doing so by integrating the capacity building process into the ongoing planning and implementation activities of sector organisations and communities. In this way capacity building is also reinforced by the action/reflection cycles of the action research approach.

Multi Stakeholder platforms - There are several definitions and types of Multi Stakeholder Platform (MSP) but in essence an MSP is a "negotiation and/or decision-making body (voluntary or statutory) comprising different stakeholders who perceive the same resource management problem and realize their interdependence (Warner, and Verhallen 2004)

4. Stakeholder identification, and roles and responsibilities with LAs

Learning alliances begins with a core or founding group of actors whose interest in innovation is to be served by the creation of a learning alliance. It is crucial that this core group has a clear idea of what they want to achieve and how they intend to do it. Only in this way will they be able to attract the interest of other key stakeholders. The core group will get bigger as the work of the alliance increases and more stakeholders buy into the idea.

Stakeholders involvement depend on such factors as the specific work topic, the organisations available and interested, the resources available. What is important is that stakeholders have a shared vision of the objectives of the alliance and background skills that can contribute to achieving them. Which stakeholders should be involved at the different levels (and different stages) is something to

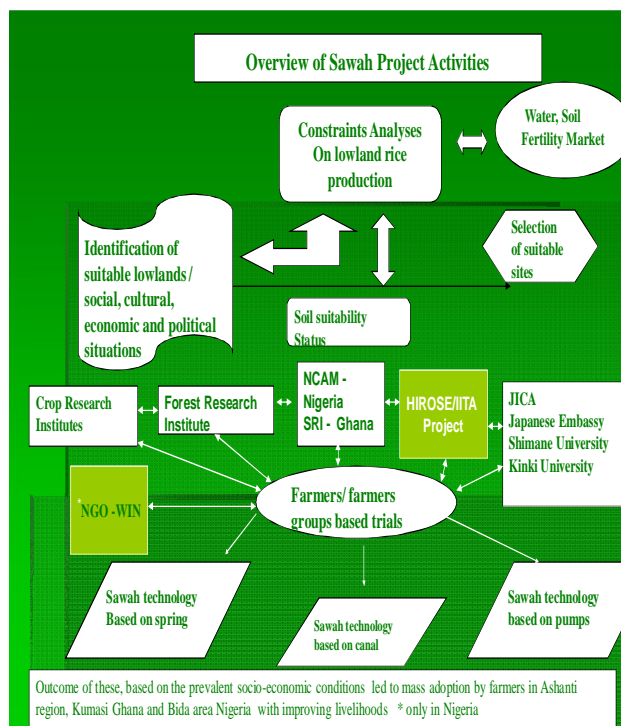
be worked out organically by the founding members as they seek to develop a coalition around their area of interest and innovation. Ideally, each participating organisation should have some existing level of interest in innovation related to a specific area. An important exception is actors without such a direct interest who, because of their position, could impede or block progress at a later stage. They should be drawn in to the Alliance to avoid or reduce that possibility. Figure 1 shows the structure of learning alliances at different levels of operations.

3. Introduction of sawah rice production technology in Nigeria and Ghana

Sawah rice production technology refers to improved man-made rice-growing environment through eco-technology with leveled rice field surrounded by bund with inlet and outlet connecting irrigation and drainage. Sawah fields are the system adaptable to a lowland ecosystem but require eco-technological skills, including those for minimum changing of topographical and ecological features, such as both land leveling, bunding and irrigation/drainage systems. Wakatsuki and Masunaga (2005) reported that the potential of Sawah based rice farming is enormous in West Africa in order to stimulate the long awaited green revolution. This is predicated on the fact that the agro-ecological conditions of the core region of West Africa are quite similar to those of northeastern Thailand, which is one of the rice center in that country.

In Nigeria, Sawah based rice production started after preliminary basic research work on the suitability of inland valleys by Japanese researchers. A 1.5 ha field at Ejeti village was cultivated in 2001. In 2002 three farmers participated in Sawah Package program and farmers increased to 14 and 18 in 2003 and 2004 respectively. In 2010, farmers have increased to 1500. Similarly, there has been tremendous increase in the yield of farmers adopting sawah package on their rice farms. The 3 phases of the sawah development process in Ghana from 1997 till date are: Integrated Watershed Management of Inland Valleys by JICA - CRI (1997-2001); Sawah project by SRI - Shimane Univ. Kinki University Japan (2002 -2004) and Inland Valley Rice Development Project by MOFA – ADB (2004 -2009) with the goal of sustainable rice production (Nakashima et al 2007). The average rice yield obtained from sawah plots of between 4.5 to 5.2 t/ha is enhancing the transformation of the potential for rice production being transformed into actual production in Nigeria and Ghana. Figure 1 present the overview of the alliances in the sawah technology

development process. From the figure the international network that exist are shown in form of relationships between Japanese and research institutes in West Africa. It also highlights the platform levels in the vertical and horizontal levels for alliances to be effective.



6. Empowerment through Learning Alliances

The involvement of farmers' organizations in the technology development process enhances the empowerment process for the technology in terms of human capital (such as skills); social capital (including farmer organizations and laws); economic capital (loans, revolving funds, remittances); physical capital (farm and village infrastructure, internet) and natural capital (land, water, genetic resources). The livelihood approach to rural development recognizes that five capitals are required for development.

The learning alliance at the individual level (promoting human capital) enhances self analysis for self actualization, happiness oriented, cash as a only supporting factor, self reliance system and autonomy, skill building and knowledge and life security through improved production and family system. At the household level (promoting human and natural capital) farmers were able to gain skills and knowledge, autonomy, food quality and security, economic sufficiency, land and water resource

security, biodiversity, local wisdom utilization, and family livelihood and self sufficiency. At the community level (promoting human and social capital), the sawah technology learning alliances enhances skill building and knowledge sharing, caring and sharing society, community business, social security, cultural protection and environmental quality. It has also contributed At the group and network level (promoting human, social, financial and natural capital) for skill building, experimentation and knowledge sharing, learning organization, education for life at all levels, creation of a revolving fund, caring and sharing, local wisdom and cultural conservation, sustainable development, and policy integration (Polak, et al 2004)

5. Learning Alliances as a Vehicle for Scaling Out

LA is a process undertaken jointly by R&D agencies through which research outputs are shared, adapted, used, and innovated upon. This is done to strengthen local capacities, improve the research outputs, generate and document development outcomes, and identify future research needs and potential areas of collaboration. The LA process begins with the identification of research outputs or development outcomes susceptible to scaling out by partners. It is followed by one or many adaptation and learning cycles, and is completed with the detection of new research demands, which feed back into the research process, and contribute to the generation of improved livelihood or policy outcomes. According to Douthwaite, et al (2002), several key issues need to be managed for an LA to be successful, include *Clear objectives*- Clear objectives based on the needs, capacities, and interests of the participating organizations and individuals must be defined. In the case of sawah technology the need to increase rice yield, sustain the increased yield, production of quality rice and demand-driven research were the objectives. *Shared responsibilities and costs* - In the learning alliance for sawah technology development and dissemination LA seeks to benefit all parties; therefore responsibilities and costs should be shared. Responsibility and costs are shared although it was skewed in the beginning towards the Japanese institutions as donor of the project. As time progress and to ensure the sustainability efforts are in place to spread more the costs and responsibilities. *Outputs as inputs*- In order to enhance the overall process of development and livelihoods of the farmers through sawah technology several outcomes of trials and experimentations and discussion are used as inputs into refining the process and the scaling out of the technology. *Differentiated learning mechanisms* -

Learning Alliances have diverse groups of participants ranging from farmers, women, scientists, extension agents, and ministry staff to NGO to international scientists. Identification of each group's questions and its willingness to participate in diverse aspects of learning processes was the key issues of alliance. *Long-term relationships*- The sawah technology development process has stretched over many years as far back as 1986 when preliminary survey and soil analysis started with relationships with farmers, research institutes and international scientists. These relationships should orient researchers' agendas towards key issues that contribute to positive change and, on the other hand, inform development practitioners of new or improved methods or tools that improve their practice. The transaction costs involved in establishing and maintaining LAs and their long-term nature indicate that quality should take precedence over quantity (Solomon, and Chowdhury, 2002).

This paper shows how Sawah rice production technology has evolved through learning alliances that involves social learning and innovation systems and brings Japanese institutions, research institutes, Ministry of Agriculture, extension agencies, farmers groups, Millennium Village, marketers, and universities in Nigeria and Ghana together on a platform with clear objectives, shared responsibilities, cost and benefits, output as inputs, differentiated learning mechanisms, long term and trust-based relationships. The process is increasingly leading to increased learning and effectiveness in rural entrepreneurial development and improved livelihoods. The paper gives a description of the scenarios based on experience in the sawah rice technology development and concludes with its application in other parts of West African region

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The Role of Urban Services` Spatial Dispersion on creation of Ghetto Quarters in Yazd City and Its associated Social Impact

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Abstract: This study investigated the causes shaping ghettos in the city of Yazd in terms of the indices of education, health, culture, business, sport, green space and social reflections from it. With regard to the coefficient of functions and urban services in ghettos and nearby, it is inferred that above mentioned factors affect forming ghettos and there is a relationship between ghetto and underdevelopment. Based on linear regression, there is also a significant relationship between ghettos and unfair distribution of services and underdevelopment. In addition, the results from the cluster model suggest that the settling in a neighborhood, besides lack of services and functions, other factors were also considered. The other finding of this study has been about social impact of ghettos. Based on the finding, the relatively low-income unemployed people commit more crimes and there is no significant relationship between immigration and social offenses.

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1. Introduction

One of the most important social developments in the recent century is urbanization. The ratio of citizenship in Iran has come from 31.4 percent in 1956 to 68.5 percent in 2006. (Statistical Center of Iran, 2006). Creating neighborhoods and ghettos is one of the consequences of urbanization. The important issue in this context is the impact of urban applications on social and economic classification. Social classification emphasizes inequality and the aim of many geographers is to discover that those inequalities which occur due to the distribution of inadequate resources. This has made urban planners and theorists provide urban planning assumptions about the origins of these inequalities (Arbakaf, 2008; Hanik, 2007; Miller, 1999; Blau, 1982). In this context, David Harvey believes that the only work is to eliminate mechanisms which are governing the system of land use preventing ghettos. On the other hand, the ghetto regions structurally differ from the other urban areas. The purpose of this study ghetto settlers are those who could not be absorbed into economic and social system of the city and they often settle in the suburban land in cities as was done illegally.

The main feature of urbanization in the current Third World is in-harmony and inequality. Dissemination of wealth and the other minorities that live in poverty are considered as the frustrations of

urban policy. The consequences of these inequalities are also reflected in the use of space and time which cause low-income groups to reside in the border of cities. This led to the unplanned construction and the formation of ghettos creating a social gradient downwards towards the residence from the core to ghetto areas. Squatting is of the consequences uneven development in the urban system which reflects its structure placing them among poor urban neighborhood. Therefore, when ghetto settlers consider unequal distribution of urban services unjust, they feel that their deprivation has occurred (Kovandzic, 1998; Hyraskar, 2008: 109). In fact, they are considered as an alarm for urban communities and a type of social deviance and damages to the environment which are created in fringe of the cities (Sheikhi, 2001: 200). Therefore, this article reviews the effects of the distribution of urban services and applications on the formation and space distribution of squatting neighborhoods in Yazd. This study also deals with negative consequences squatting due to its impact looking for answers to the following questions.

- 1 - Has the formation of marginalized neighborhoods in the Yazd city been affected by inequality in land use and city services?
- 2 - Do non-marginalized neighborhoods in the city of Yazd benefit land use and desirable urban services?

3 - What is the relationship between factors affecting social damages in the marginalized neighborhoods in Yazd?

2. Related Literature

The first one who could use the term ghetto was Robert E. Park. Park in his paper entitled 'Human migration and ghetto human' knows squatting as a consequence of the political-economic functions (Ansari, 1990: 39). William Foot White (1943) in his book called "the Street Society" clarifies the distinction between neighborhoods. Peter Lloyd from the viewpoints of phenomenology has studied marginal ghettos in the city and has called this type of housing 'hope ghettos'. 'Social system of ghettos' is a work by Satlz (1968) who knows physical space as an essential element in the social processes.

The approach of Urban Ecology analyzes urban location as a place of struggle and survival and as the most appropriate place in urban space (Piran, 2001: 33). In this respect, Ernst Borgs and Lewis believe that the cause of the formation of ghetto regions is the groups' focus in poor areas lacking adequate services (Fokohi, 2006: 190-188). In the theory of urban land, city is specifically shaped and spatial system of the city is established due to different groups competing for getting city status. The losers in this competition can cause phenomena such as squatting, ghetto settlement, shanty towns, and so on emerge (Qarkhelo, 2005: 88). Marshall Clinard and Ernest W. Bergess supporting this theory believe that squatting result from division of urban spaces (Clinard, 1966: 18).

In the view of Liberal, the phenomenon of squatting is accepted as a fact trying to optimize ways of living conditions in squatting neighborhoods, granting various kinds of land, loans and controlling governmental land, the matter should be considered Completed.

Based on perspective of political economy of space, in the process of rapid and heterogeneous urbanization, in parallel to unbalanced economic growth, income increases unequally and lack of structural balances in the society will accelerate. This view attempts to investigate the causes and the genesis of ghetto areas and identify the root of the problem. Modern socialists consider squatting as a result of economic-social inequalities. They believe that ghetto neighborhoods are shaped due to these deficiencies, lack of social structural and infrastructural facilities. Sociologists view that the groups and classes who dominate the scarce resources of the city achieve the position of "in the text of environment" and play an important role in the community. This requires driving the classes to the marginal status who are in the position of "biology in

the sidelines" and are semi-active or passive in urban activities (Rabbani et al., 2002: 83). Manuel Castells regards squatting as a consequence of social-economic inequalities and heterogeneous urbanization.

Part of the perspective of classification is called 'relative deprivation model' emphasizing the dimensions of criminology and social-economic inequality more than the extreme poverty. This feeling of deprivation can be aggravated when people know the unequal distribution of resources as unfair and unable to improve their economic status. The results of several studies have confirmed the expected relationship between relative deprivation and crime (Fowles & Merva, 1996).

The theory of pressure emphasizes blocking social-economic opportunities as a factor leading to crime. Robert Agnyv believes that not attaining positive valuable goals leading people to illegitimate channels. Remove valuable positive motivations (such as divorce) can also cause pressure. Since anyone tries to compensate whatever he has lost, it might lead to crime. Finally, creating pressure may occur because of negative motivations or harmful stimulants (such as corporal punishment and family fight) (Seigel, 199: 180).

3. Research Methodology

Research method of this study is a combination of documentary method, analysis, and field method. To investigate the impact of service and application inequality on shaping ghettos, firstly, six groups of basic services and applications (educational, health, cultural, commercial, green space and sports) were investigated in the neighborhoods. For this study, hypotheses and quantitative analysis of statistical methods and a few models for classification level, including total units of services, standardization of heterogeneous data, Coefficient Model, Numerical Taxonomy Model, the model Morris, Coefficient of Variation Model have been used. The results from these models have been classified by the cluster model or SPSS cluster software. In the next stage, the data gathering tool was a questionnaire that also was analyzed by the data software analysis of SPSS.

4. Squatting and Unfair Distribution of Services and Applications in the city

To measure the amount of inequality, various neighborhoods of Yazd city based on marginalized and non-marginalized were investigated in a separate user and service, using the coefficient of variation model. Based on those, out of 6 in this study, 4 indices like education, health, sports and green space have coefficients of 0.78, 9.58, 2.31 and

175, respectively in the ghetto neighborhood, but the two other ones (cultural and commercial) show coefficients of 0.58 and 0.64 with the appropriate distribution of ghetto neighborhoods because of the establishment of cultural, religious centers and traditional markets in the old context of the city. Therefore, there is a very high correlation between the unfair allocation and squatting settlement in the city of Yazd. Considering the coefficient of variation of all the indices in marginal neighborhoods (188.9) and non-marginal neighborhoods (14.49), it is inferred that these indices are 13.11 times were unbalanced in coefficient of variation and application was focused in non-marginal neighborhoods which was considered as one of the factors influencing in forming marginal neighborhoods (Table and Table 1).

Table 1 - Coefficient of Variation in various neighborhoods in Yazd

Index	Marginal Neighborhood	Non-Marginal Neighborhood
Educational	0.799	0.64
Health	9.589	2.31
Cultural	0.59	175.07
Commercial	0.64	0.87
Sports	2.31	1.82
Green Space	175.07	2.57
Total	188.98	14.49

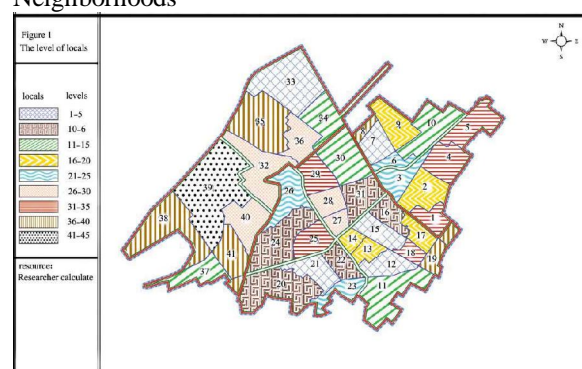
5. An Investigation of Lack of Development and Squatting Settlement

Lack of development is one of adverse consequences of unfair distribution of facilities in different locations. Therefore, to measure degree of development of districts in Yazd city, the rate of allocation has been used. In this part of the paper, the rate of this factor in squatting was measured and expressed as the coefficient between 1 and -1.

To measure this factor, to begin with, the degree of development was calculated through various models of coefficient of variation, Taxonomy, Morris and other models and final degree of development of each area was specified through combination of models in a way that Area 15 stood first, Area 33 second, Area 7 third, Area 12 fourth and finally 39, 19, 8 and 38 stood in the last ranks (Table 2 and Map 2). Then, marginal and non-marginal neighborhoods were specified with numerical values 1 and 0, respectively and qualitative data changed into quantitative data. Finally, using t-test method, a correlation was measured between the amount of lack of development and squatting which was about 0.035 and since it is smaller than 0.05 is valid (Vahidi Asl, 2006: 91-84). To measure the amount of squatting on underdevelopment linear regression analysis was

used (Mahdavi, 1383: 187-178) that this analysis of the correlation coefficient of 0.324 and reliability of 0.039 shows that there is a relationship between squatting and lack of development in the neighborhood in Yazd. However, the hypothesis of the cause and effect relationship between these factors is rejected due to a gap in the number of regression coefficient. So it can be said that there is significant relationship between squatting and unfair distribution of services. But this squatting follows the other independent variables and the compliance rate and its correlation with the other factors compared to other statistical coefficient of variation is 0.676.

Figure 1: Classification of development in Yazd Neighborhoods



6. Classification of Neighborhoods in Yazd Based on the Rate of Urban Services and Facilities

One of the important issues in the analysis of marginal neighborhoods is that to what extent do these neighborhoods basically receive services? And are non-marginalized neighborhoods placed in high level of classification? To study conveniently and to prevent elongating the Table of Ranking, a classification of neighborhood was made based on ranking. For this purpose, the model hierarchical cluster analysis (Kalantari, 1382: 340-330) and SPSS software were used and 41 neighborhoods of Yazd city were divided into 6 levels.

Based on analyzed results, all marginalized neighborhoods that have a minimum level of services and applications are placed in level one and non-marginalized neighborhoods of number 7 were placed in level two, number 9 in level three, number 10 in level four, numbers 15 and 33 in levels five and six, respectively.

Placing all the marginalized neighborhoods in 1st level suggests that the marginalized neighborhoods necessarily lack all kinds of appropriate services and applications in allocating space and land. Also, non-marginal neighborhoods have distinct features and every 31 non-marginal neighborhoods necessarily do not have all desirable

and optimal applications. Therefore, being predominantly a marginal neighborhood except lack of facilities, services and applications, other factors and conditions are taken into consideration. Thus, there is a cause and effect relationship and correlation between loss of applications in the neighborhoods and squatting. Therefore, it can be concluded that one of the features of a marginal neighborhood is lack of public services and unfavorable distribution of spaces, but this lack of facilities can be also evident in non-marginal neighborhoods. Therefore, underdevelopment in land use and services is one of factors increasing squatting, but there are other reasons and features in addition to underdevelopment for squatting.

7. Impact of Various Factors on the Social Impact in Marginal Neighborhoods in Yazd

In this part of the research, the social impact as an outcome of squatting will be analyzed. Therefore, out of the effective factors having social impact on squatting, three indices such as immigration, unemployment and income as independent variables and social impact as the dependent variable were studied. Sample had a common attribute of "squatter" and included all the households predominantly located in the neighborhoods of the city. Sample size using the variance obtained from pre-test with confidence level of 95 percent and five percent of the probable error was 282 people (households).

1) Is there a relationship between immigration and social offenses?

Table 3 shows that among people who have committed crimes, 62.5 percent of them were in the birthplace neighborhood and only 37.5 percent of them moved to his birthplace neighborhood and were considered as immigrants. Of course, there was almost the same ratio among those who have not committed crimes. Also, calculated chi-square test indicated that there was not a relationship between two variables (Sig = 0.767). Thus, there was no significant relationship between immigration and social offenses.

Table 2 - Distribution of respondents according to frequency and immigration offenses

Committing Crime	Respondents' Birth Places (immigrants)		
	Birth place	Changing Residency	Non Birth Place
Yes	62.5	25	12.5
No	60	27.1	12.9

$$\chi^2 = 0.529$$

$$\text{Sig} = 0.767$$

2) Is there a significant relationship between unemployment and social offenses?

According to Table 4, among those people who have committed crimes, 55.6 percent of them mostly are free (unemployed) during the year, while 17.4 percent of those who have not committed crimes during the year are greatly unemployed. Chi-square test indicates that there is a significant relationship existing (Sig = 0.015) between these two variables. In other words, people who are mostly unemployed during the year commit more crimes.

Table 3 - Distribution of respondents according to frequency of offenses and unemployment

Committing Crime	Annual Rate of Unemployment		
	Less	Average	More
Yes	33.3	11.1	55.6
No	64.1	18.5	17.4

$$\text{Cramer's } V = 0.177$$

$$\text{Sig} = 0.015$$

$$\chi^2 = 8.363$$

3) Is there a significant relationship between family income and social offenses?

As Table 5 shows, among those who committed crimes, 50 percent of respondents' monthly income was below 150 thousand Tomans and only 12.5 percent of them have a monthly income of 300 thousand Tomans and more, while 12.8 percent of those who have not committed a crime, their monthly income was 150 thousand Tomans. Tests investigating the relationship between two variables above confirm that there is a significant relationship between the variables (Sig = 0.012). In other words, the less income the family has, the higher the crime is.

Table 4 - Distribution of respondents according to frequency of offenses, and household income

Committing Crime	Income of Households (Rials 10,000)		
	Less than 150	150-300	More than 300
Yes	50.0	37.5	12.5
No	12.8	67.3	19.9

$$\text{Cramer's } V = 0.194$$

$$\text{Sig} = 0.012$$

$$\chi^2 = 8.818$$

According to calculations made on such variables, it indicates that there is a direct relationship between unemployment, the rate of income and social crimes, but there is no significant relationship between immigration and social crime.

8. Conclusion

Squatting is one of the consequences of unequal development and malformation in the urban

system. On one hand, significant proliferation of the wealth and on the other hand, the minorities that live in poverty are considered as the frustrations of urban policy. In the process of expansion of cities during recent decades, many towns and villages have been linked to cities and finally have been mingled. All these areas have formed predominantly marginalized neighborhoods in the city of Yazd. Inequalities have emerged in the neighborhoods of Yazd city when using land and space. Therefore, when squatters found unequal distribution of resources and urban services unfair and were unable to improve their social-economic situation they felt deprived and caused them to forcefully commit social offenses.

With regard to coefficient of variation of all indices in marginal neighborhoods (188.9) and non-marginal neighborhoods (14.49), it is deduced that such indices were unbalanced 13.11 times the coefficient of variation and applications were focused in the non-marginalized neighborhood which was considered as one of the factors influencing in squatting (Table 1). On the other hand, based on models of settlement ranking, Area No. 15 stood First, Area 33 second, Area number 7 third, Area 12 fourth and finally 39, 19, 8 and 38 had the last ranking degree of development (Map No. 2). Based on t-test and linear regression, correlation coefficient, 0.324 and reliability of 0.039 indicates that there is no correlation between squatting and unfair distribution of services and lack of development. Based on cluster model, all the neighborhoods placing in marginal level 1 indicates that essentially all marginalized neighborhoods predominantly lack proper application and services in allocating space and land area and non-marginal neighborhoods are also totally distinctive. Each 31 Areas in non-marginal neighborhoods did not have all the desired and optimal applications. Therefore, for living predominantly in a marginal neighborhood, besides lack of facilities, services and applications, other conditions and factors has been involved.

Therefore, it can be concluded that one of the factors in the formation and distribution of space in the marginalized neighborhoods is lack of space and unfavorable distribution of public services. The findings of this research parallel the perspective of urban ecology, which express that the reason why marginalized neighborhood has been is the focus poor groups had in poor areas lacking adequate facilities and services.

Another finding of this study about social consequences in which there is a relationship between income and rate of crime among squatters. From the perspective of economic geography, this issue is important. People in squatting areas for various reasons are deprived of having high-income

and hardly able to provide livelihoods. Another factor that is significantly related to social offenses is unemployment. Low income and being under economic pressures on one hand and social and psychological pressures on the other hand, has led to wrong ideas that occur to the mind of unemployed people and their felonious behavior and may induce social offenses. The findings of this part of the study is consistent with theories of social classification and pressure, especially deprivation theory claims in which people because of economic problems and lack of income on one hand and comparing themselves with the others who are in the city on the other hand, have a high tendency to commit criminal behavior.

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A Scatter Search Algorithm for the RCPSP with Discounted Weighted Earliness-Tardiness Costs

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Abstract: In this paper, we study a resource-constrained project scheduling problem in which a set of project activities have due dates. If the finish time of each one of these activities is not equal to its due date, an earliness or a tardiness cost exists for each tardy or early period. The objective is to minimize the sum of discounted weighted earliness-tardiness penalty costs of these activities. Scatter Search algorithm is used to deal with this extended form of resource-constrained project scheduling problem. Our implementation of Scatter Search integrates the advanced methods such as dynamic updating of the reference set and the use of frequency-based memory within the diversification generator. Finally, some small and medium size test problems are examined and the computational results are presented. The computational results show the efficiency of the proposed meta-heuristic procedure.

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1. Introduction

The resource-constrained project scheduling problem (RCPSP) involves the scheduling of project activities subject to precedence constraints as well as renewable resource restrictions in order to minimize the make span of the project. The RCPSP under minimization of the sum of weighted earliness-tardiness costs (RCPSPWET) is an altered version of the RCPSP in which all assumptions and constraints of the RCPSP are held but the objective has changed. In this paper, we extend the RCPSPWET problem by taking into account the time value of earliness and tardiness costs. We call this problem the RCPSP-DCWET (Resource-Constrained Project Scheduling Problem with Discounted Cash Flows of Weighted Earliness-Tardiness Costs). In the RCPSPWET we assume that a set of project activities have due dates. For each one of these activities if due date is not met, a penalty cost exists for each tardy or early period.

Considerable number of exact and heuristic methods has been presented in the literature for the RCPSP problem with the discounted cash flow, known as RCPSPDC. Russell (Russell, 1986) studied unconstrained resource project scheduling problem with positive and negative cash flows and formulated a non-linear programming model. Elmaghraby and Herroelen (Elmaghraby and Herroelen, 1990) presented an optimal algorithm based on tree structures in activity on arch (AOA) network. Etgar *et al.* (Etgar *et al.*, 2003) examined the AOA network

of a project scheduling problem assuming that cash flows are associated with events. Shtub and Etgar (Shtub and Etgar, 1997) also offered an exact method to solve the NPV problem with a branch-and-bound approach. Etgar and Shtub again took into account special version of this problem in which cash flows are linear functions of the events realization times. Vanhoucke *et al.* (Vanhoucke *et al.*, 2001c) considered a fixed deadline for the unconstrained max-npv problem.

Some recent studies on the RCPSPDC problems are presented by (Icmeli and Erenguc, 1996), (Smith-Daniels and Aquilano, 1987) and (Vanhoucke *et al.*, 2001a). Doersch, and Patterson (Doersch, and Patterson, 1977) formulated the RCPSPDC with a zero-one integer programming model. Yang *et al.* (Yang *et al.*, 2003) developed a branch and bound method to tackle this problem. Baroum and Patterson (Baroum and Patterson, 1996) developed a branch and bound algorithm for an activity on node (AON) network with non-negative cash flows associated with the activities. Heuristic approaches to the RCPSPDC have been proposed in (Sepil and Ortac, 1997) and (Smith-Daniels and Aquilano, 1987). Some recent surveys on the RCPSPDC are mentioned in (Demeulemeester and Herroelen, 2002). Yang *et al.* (Yang *et al.*, 1995) developed nine stochastic scheduling rules to solve the RCPSPDC problem. Baroum and Patterson (Baroum and Patterson, 1996)

introduced a number of priority rule heuristics and discovered their differences based on computational experiments. Pinder and Marucheck (Pinder, and Marucheck, 1996) proposed and compared new scheduling heuristics with different well-known rules. Vanhoucke (Vanhoucke, 2010) presented a scatter search algorithm for the resource-constrained project scheduling problem with discounted cash flows. He assumed fixed payments associated with the execution of project activities and developed a heuristic optimization procedure to maximize the net present value of the project subject to the precedence and renewable resource constraints.

Another non-regular performance measure, which is gaining attention in just in time environments, is the minimization of the weighted earliness-tardiness penalty costs of the project activities (Demeulemeester and Herroelen, 2002). In this problem setting, activities have an individual activity due date with associated unit earliness and unit tardiness penalty costs. If an activity has been accomplished earlier or later than the predetermined due date, the earliness or tardiness penalty cost can be imposed. The objective then is to schedule the activities in order to minimize the weighted penalty cost of the project subject to the precedence constraints. On the basis of classification scheme introduced by Herroelen *et al.* (Herroelen *et al.*, 1999) the problem can be categorized as cpm|early|tardy. This problem, also known as min-wet problem, is experienced by many firms outsourcing all or some of their activities, such as hiring subcontractors, maintenance crews as well as research teams. Costs of earliness include additional inventory requirements and idle times and implicitly incur opportunity costs. Tardiness may cause customer dissatisfaction or complaints, loss of reputation and profits, monetary penalties and goodwill impairment. Nadjafi and Shadrokh (Nadjafi and Shadrokh, 2009) studied unconstrained resource project scheduling problem considering the time value of the money by continuous discounting the cash flows and minimum as well as maximum time-lags between different activities. They proposed a branch and bound algorithm for this project scheduling problem with generalized precedence relations among activities. The literature on solution procedures for the weighted earliness-tardiness project scheduling problem (WETPSP) is very limited. Vanhoucke (Vanhoucke, 2001) developed an exact recursive search algorithm for unconstrained resource project scheduling problem. The algorithm makes use of the primary idea that each project's earliness-tardiness costs can be minimized by first scheduling activities at their due dates or at a later immediate time if compulsory due to obligatory

precedence constraints, followed by a recursive search which figures out the optimal movement for those activities for which a shift towards time zero demonstrates to be favorable. Vanhoucke *et al.* (Vanhoucke *et al.* 2000) used the logic of the recursive approach to solve the WETPSP problem in their branch and bound method for maximizing the net present value of a project in which progress payment takes place. Kazaz and Sepil (Kazaz and Sepil, 1996) solved the WETPSP problem with benders decomposition method. Sepil and Ortac (Sepil and Ortac, 1997) proposed heuristics for the related project scheduling problem under renewable resource constraints. Vanhoucke *et al.* (Vanhoucke *et al.*, 2001b) proposed a branch and bound algorithm to solve the Resource-Constrained Project Scheduling Problem with Weighted Earliness-Tardiness Penalty Costs (RCPSPWET).

In this paper, we extend the RCPSPWET problem by considering the time value of money. This problem is denoted as Resource-Constrained Project Scheduling Problem with Discounted Cash Flows of Weighted Earliness-Tardiness Costs (RCPSP-DCWET). We propose a meta-heuristic-based Scatter Search approach to solve the RCPSP-DCWET in the following sections.

This paper is organized as follows. We commence in Section 2 with the problem modeling and formulation. In Section 3 we describe our schedule representation scheme. In section 4, we briefly review the literature on Scatter Search Algorithm and describe our approach for solving the RCPSP-DCWET problem. Computational results are presented in Section 5. Finally, we end with the conclusions in Section 6.

2. Problem modeling and formulation

The RCPSPWET problem minimizes the weighted earliness-tardiness costs under resource constraints. The project network is depicted by an AON representation where the set of nodes N denotes activities and the set of arcs A indicates finish to start precedence constraints with a zero time lag. Dummy activities 1 and n correspond to start and completion of the project. The list of activities is topologically numbered, i.e., each predecessor of every activity has a smaller number than the number of activity itself.

The parameters of the model are:

D = The set of activities with due date,

e_i = Earliness penalty cost of activity i ,

t_i = Tardiness penalty cost of activity i ,

d_i = Duration of activity i ,

h_i = Due date of activity i ,

A = The set finish to start precedence constraints with a zero time lag,

N = The set of activity nodes,
 r_{ik} = The resource requirement of activity i for resource type k ,
 m = The total number of resource types,
 a_k = The availability of the k^{th} resource type,
 T = The feasible project length,

The variables of the model are:

f_i = The completion time of activity i ,
 E_i = The earliness of activity i determined by:
 $E_i = \max\{0, h_i - f_i\}$,
 T_i = The tardiness of activity i determined by:
 $T_i = \max\{0, f_i - h_i\}$,
 $S(t)$ = The set of activities that are in progress in time period $]t-1, t]$,

The RCPSPWET can be formulated as follows (Vanhoucke *et al.*, 2001b).

$$\text{Minimize } \sum_{i \in D} (e_i E_i + t_i T_i) \quad (1)$$

Subject to:

$$f_i \leq f_j - d_j \quad \forall (i, j) \in A \quad (2)$$

$$E_i \geq h_i - f_i \quad \forall i \in N \quad (3)$$

$$T_i \geq f_i - h_i \quad \forall i \in N \quad (4)$$

$$f_1 = 0 \quad (5)$$

$$\sum_{i \in S(t)} r_{ik} \leq a_k \quad k = 1, 2, \dots, m, \quad (6)$$

$$t = 1, 2, \dots, T$$

$$f_i \geq 0, E_i \geq 0, T_i \geq 0 \text{ and integer} \quad \forall i \in N \quad (7)$$

The objective function (1) is to minimize the weighted earliness-tardiness cost of the project, e_i and t_i denote the unit cost of earliness and tardiness for activity i . Equation (2) forces the finish to start precedence constraints among activities. Equation (3) and (4) determine the earliness E_i and tardiness of each activity T_i . Constraint (5) forces the completion time of dummy start activity to be at zero time. Equation (6) introduces the resource constraints. Equation (7) ensures that the activity completion times, earliness and tardiness of activities are non-negative integer values.

Problem Model for the RCPSP-DCWET

In the real world problems, time value of money plays an important role in managerial decision making. Hence, we incorporate Net Present Value (NPV) into the basic form of the RCPSPWET by discounting the cash flow. A continuous discount rate of α is chosen to determine the amount of net present value. Subsequently the continuous discounted factor $e^{-\alpha T}$ represents the present value of each unit of money paid at the end of period T , using the discount rate α . Only the objective function of the RCPSP-

DCWET is different from the model of the RCPSPWET. The object of this problem is to minimize the net present value of the sum of the earliness-tardiness costs of the activities with due dates, and can be formulated as follows:

$$\text{Min} Z = \sum_{i \in D} (e_i \sum_{k=f_i}^{h_i-1} e^{-\alpha k} +$$

$$t_i \sum_{k=1+h_i}^{f_i} e^{-\alpha k}) \quad (8)$$

subject to constraints (2) to (7) in the RCPSPWET model.

It is easy to show that the RCPSP-DCWET is an extended form of the Resource-constrained Project Scheduling Problem (RCPSP). Since the RCPSP is NP-hard, the RCPSP-DCWET is NP-hard too (Blazewicz *et al.*, 1983).

3. The schedule representation scheme

Knowing the RCPSP-DCWET is NP-hard, we have to abstain from always struggling to solve the corresponding problem instances optimally. Sometimes, the required computation time will just be huge and project managers might effortlessly tend to practical project schedules that are gained within small computation times. This necessity can only be achieved by employing noble heuristic procedures.

We use the serial schedule generation scheme (SSGS) for scheduling activities. This schedule generation scheme (SGS) in line with the parallel schedule generation scheme are two basic ones which have the most efficiency and applications, but usually the serial schedule generation scheme results in better outcomes than the parallel schedule generation scheme. In Lova *et al.* (Lova, *et al.*, 2006) these two schedule generation schemes have been compared in different heuristics and serial schedule generation scheme have generally resulted better. The SSGS adds activities to the schedule until a feasible accomplished schedule is generated. In each iteration, the next activity in the priority list is chosen and for that activity the first possible starting time is assigned such that no precedence or resource constraint is violated.

We represent a schedule S of the RCPSP-DCWET by a list of activities $(s_1, s_2, s_3, \dots, s_n)$ where s_i represents the starting time of activity i . We apply the topological order (TO) condition (Valls, *et al.*, 2003) by first scheduling the activities using a serial SGS (SSGS) and then sequencing them in non-decreasing order of their finish times, i.e. for all i and j , if $f_i(S) < f_j(S)$, where $f_i(S)$ and $f_j(S)$ indicate the finish time of activities i and j in schedule S , respectively, activity i appears before activity j in the topological ordered activity list. The benefit of this method is that although several activity lists can yield the similar scheduling using a SSGS, each topological order

matches a unique schedule, excluding the case of same activity finish times.

4. Our scatter search approach

Scatter Search was first introduced by Glover (Glover, 1977) as a Meta heuristic method that uses a sequence of matched initializations to generate solutions. Scatter Search is an evolutionary population-based algorithm that combines the solutions to obtain new solutions using convex or non-convex linear combinations. The approach of combining existing solutions to generate new ones dates back to 1960s. The intention of this combination mechanism is to integrate both diversity and quality. Recent studies demonstrate the empirical advantages of this meta-heuristic approach for solving a diverse array of optimization problems from both classical and real world settings. We refer the reader to (Marti, 2006) for more information on Scatter Search (SS) algorithm. The general pseudo-code for any Scatter Search method can be outlined as follows:

Algorithm Scatter Search

Diversification Generation Method to produce a pool of various trial solutions, using a random trial solution (or seed solution) as an input.

While Stop Criterion not met:

Improvement Method to convert a trial solution into one or more improved trial solutions (Neither the input nor the output solutions are required to be feasible, though the output solutions will more generally be likely to be so. If no improvement of the input trial solution results, the "improved" solution is considered to be the same as the input solution.)

Reference Set Update Method to construct and uphold a reference set consisting of the b "best" solutions found (where the value of b is usually small, e.g., no more than 20), structured to yield efficient accessing by other parts of the method. Solutions acquire membership to the reference set in accordance with their quality or their diversity.

Subset Generation Method to perform on the reference set, to generate a subset of its solutions as a base for building combined solutions.

Subset Combination Method to transform a particular subset of solutions created by the Subset Generation Method into one or more combined solution vectors.

Scatter Search Illustration

In the following, we describe our Scatter Search algorithm for solving the proposed RCPSP-DCWET problem.

1. Start with $P = \emptyset$. Use the diversification generation method to construct a solution and apply

the improvement method. Let x be the resulting solution. If $x \notin P$ then add x to P ($P = P \cup x$), otherwise, discard x .

Repeat this step until $|P| = P$ Size.

2. Use the reference set update method to build Ref Set = $\{x_1, \dots, x_b\}$ with the best b solutions in P . Order the solutions in Ref Set according to their objective function value such that x_1 is the best solution and x_b the worst.

Make New Solutions = TRUE.

while (New Solutions) do

3. Generate New Subsets with the subset generation method. New Solutions = FALSE.

while (New Subsets $\neq \emptyset$) do

4. Select the next subset s in New Subsets.

5. Apply the solution combination method to s to obtain one or more new trial solution x .

6. Apply the improvement method to the trial solutions.

7. Apply the reference set update method.

if Ref Set has changed then

8. Make New Solutions = TRUE.

end if

9. Delete s from New Subsets.

The above nine-step procedure briefly illustrates the primary framework of our algorithm. At the first stage, an initial population P including $|P|$ solutions is generated. Next, the initial population P is arranged in non-descending order based on their objective functions. In another word, the first solution of P is the best solution (with the lowest objective function) so far. At the third stage, the reference set of high quality solutions, RefSet1 is built. RefSet1 comprises b_1 solutions with the low objective functions. The solutions of RefSet1 are deleted from the list of P initial solutions.

RefSet1 = $\{x_1, x_2, x_3, \dots, x_{b_1}\}$. The initial population P is updated: $P = P - \text{RefSet1}$. At the next stage, the reference set of diverse solutions, RefSet2 is constructed by the following approach: for each initial solution of P , the minimum distance from the RefSet1 solutions is calculated and the initial solution with the maximum distance from the RefSet1 solutions is selected, deleted from P and entered RefSet2:

$$\forall x \in P \quad d(x) = \min_{y \in \text{RefSet1}} \text{distance}(x, y)$$

$$m = \max_{x \in P} d(x) \quad P = P - \{m\}$$

Where $\text{distance}(x, y)$ is the Euclidean distance between x and y . This step is repeated b_2 times until the RefSet2 is completed. Hence, RefSet2 contains solutions with high diversity ($b = b_1 + b_2$). At the next stage, the new subsets are produced from r solutions

selected from RefSet1 and RefSet2. The number of constructed subsets can be determined by: $\binom{b}{r} = \frac{b!}{r!(b-r)!}$. To describe the combination method, we consider the following procedure. Assume we have a precedence feasible solution in which $[i]_l$ represents the activity i located at position l and similarly $[j]_u$ denotes the activity j situated at position u . If we swap activities $[i]$ and $[j]$, we obtain a new solution, which may not be precedence feasible. Suppose that activity $[j]$ in position l denoted by $[j]_l$ is precedence feasible and we are seeking for a precedence feasible solution which has activity $[j]$ in position l . For this purpose, we start from position $l + 1$ and move forward, at each position, say position p , if the activity at position u of the current solution is the precedence of activity x in position p denoted by $[x]_p$, we swap these two activities in position p and u . This move is continued till $p = u$ and we gain the desired precedence feasible solution.

The solutions of each subset are combined to gain preliminary solutions to implement an improvement method. The result of the improvement procedure can trigger the reference set and even the solution population to be updated. Three improvement procedures are employed in our solution method to enhance the efficiency of the algorithm. The first improvement procedure randomly selects a project activity and tries to shift it as the closest as possible to its due date h_i without violating the precedence constraints and the resource restrictions. The second and third improvement procedures are executed simultaneously. The second method combines two solutions selected from the reference set and check the feasibility. Then the first improvement procedure runs automatically. The third improvement method takes into account the earliness or tardiness of all project activities and then finds the maximum value of them and attempts to shift that activity close to its due date considering the precedence constraints.

In the next step, step 6, we exploit the Dynamic Reference Set Updating rule (Ref Set Update Method) as it is likely all the reference solutions are similar and the Scatter Search Methodology will possibly be unable to improve upon the best solution found to execute combinations or improve new trial solutions. The new solution is entered in RefSet1 provided its objective function is better than the worst solution in current Ref Set denoted by x_{b1} . In our minimization problem, if $f(x) < f(x_{b1})$, x is replaced by x_{b1} and RefSet1 is automatically updated. Similarly, the new solution is entered into RefSet2 if its minimum distance from the solutions of RefSet1 is more than the minimum distance of solution in RefSet2 from solutions in RefSet1, $d(x) > d(x_b)$. In

another word, while RefSet1 contains the best solutions found so far, RefSet2 is rebuilt from scratch during each iteration.

The main advantage of this method is that the undesirable solutions are taken out from the reference set sooner and consequently the next combined solutions will be better. The combination procedure is narrowed by the reference set which is used as input.

5. Computational Result

In this section, we demonstrate the performance of our proposed Scatter Search algorithm on the problem instances generated by Random Network Generator RanGen (Demeulemeester *et al.*, 2003). Each project test problem has been extended by activity due dates, and unit penalty costs for the earliness and tardiness of the activity completions

For the simplicity of illustration, we suppose the unit earliness costs are equal to the unit tardiness costs. Using fine tuning, we set the size of initial population to $|P| = 10b$, the size of RefSet1, b_1 to $0.75b$ and the size of RefSet2, b_2 to $0.25b$. Consequently for the test problems, the parameters are set as follows: $|P| = 200$, $b = 20$, $b_1 = 15$, $b_2 = 5$, and daily discount rate $\alpha = 0.01(1\%)$.

The Scatter Search procedure has been coded in MATLAB version R2008A under Windows 7 and performed all computational experiments on a laptop (CPU 2.53 GHz processor, and 2 GB of internal memory).

In order to evaluate the performance of the proposed Scatter Search Algorithm, We have generated a problem set of 192 instances using the Random Network Generator RanGen (Demeulemeester *et al.*, 2003). The test problems were generated on the basis of a full factorial design of three parameters, i.e., the number of activities (n), the network shape parameter order strength (OS), and the resource factor (RF). We considered four values 10, 20, 30, and 50 for n , three values 0.25, 0.50 and 0.75 for OS and four values 0.25, 0.50, 0.75 and 1.00 for RF . For each combination of n , OS and RF , we generated four test instances resulting in $4*3*4*4=192$ with two resource types. The test problems were extended with unit earliness-tardiness penalty costs for each activity which were randomly selected from the interval 1 and 10. The due dates were generated in the same way as described by Vanhoucke *et al.* (Vanhoucke *et al.*, 2000). We generated random numbers between 1 and maximum due date. The numbers were sorted and assigned to the activities in increasing order. Activity durations were randomly selected from the interval 1 and 10. We also considered the maximum number of 10,000

generated schedules as the termination criterion for our Scatter Search algorithm.

Table.1 represents the average CPU-time and its standard deviation in second for a different number of project activities. Comparing these results with the results obtained by the branch and bound algorithm shown in Table.2, we find out the proposed Scatter Search procedure attains the results close to the optimal in less time comparing with the exact branch and bound algorithm for the problems with 20, 30 and 50 activities. Also the percentage deviations shown in Table.1 are negligible and prove the credibility of the algorithm.

Table.1. The average CPU-time and the standard deviation which Scatter Search algorithm needed to solve RCPSP-DCWET with a different number of activities

Number of activities	Number of Problems	Average CPU-time	Standard Deviation
10	48	0.274	0149
20	48	0.388	0.341
30	48	0.736	0.685
50	48	1.649	0.967

Table.2. The average CPU- time and the standard deviation which Branch and Bound algorithm needed to solve RCPSP-DCWET with a different number of activities

Number of activities	Number of Problems	Average CPU-time	Standard Deviation
10	48	0.002	0.003
20	48	1.476	6.857
30	48	14.389	32.073
50	48	2135.517	4651.966

Table.3. The effect of the Order Strength (OS) for the RCPSP-DCWET

OS factor	Average CPU-time
0.25	1.034
0.50	0.728
0.75	0.523

Table.4. The effect of the Resource Factor (RF) for the RCPSP-DCWET

RF factor	Average CPU-time
0.25	0.531
0.50	0.685
0.75	0.834
1.00	0.997

6. Conclusions

In this paper, we introduced the extended form of the problem of minimizing weighted earliness-tardiness penalty costs in the resource-

constrained project scheduling by taking into account the continuous discounted negative cash flows for the first time. Negative cash flows are considered where an activity is accomplished earlier or later than its predetermined due date and negotiated penalty costs may be applied to it. We employed the meta-heuristic-based Scatter Search procedure to tackle this project scheduling problem. The computational results clearly show that the proposed Scatter Search algorithm is effective in solving this kind of combinatorial optimization problem. An interesting research topic that can be examined in the future is developing other meta-heuristic algorithms and benchmarking them for the problem described in this paper.

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5/2/2011

Effect of Flavonoid Quercetin Supplement on the Progress of Liver Cirrhosis in Rats**Gehane M. Hamed¹, Nehal Mohammad Bahgat^{*1}, Fayda I. Abdel Mottaleb² and Maher M. Emar³**¹Physiology Dept., ²Biochemistry Dept., ³Histology Dept., Faculty of Medicine, Ain Shams University, Egypt
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Abstract: Liver cirrhosis is a serious health problem as it represents an irreversible stage of liver damage in both the developed and developing countries. Up till now no successful therapeutic approach has been developed for this disease. The objective of this study was to evaluate therapeutic efficacy of the flavonoid quercetin on liver cirrhosis induced by the hepatotoxin thioacetamide. Thirty male Albino rats weighing 160-200gm were randomly divided into 3 equal groups, Control group (C), Thioacetamide group (TA) treated with thioacetamide (100 mg/kg i.p.) twice weekly for 6 weeks, Thioacetamide /Quercetin group (TA/Q) treated with thioacetamide (100 mg/kg i.p.) twice weekly for 6 weeks as well as quercetin (50 mg/kg i.p.) for the last 3 weeks. After 6 weeks, all rats were sacrificed; blood samples were taken for determination of serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total bilirubin, and adiponectin levels. Livers were weighed and were used for measurement of liver glutathione peroxidase (GPx), catalase (CAT), lipid peroxides and histopathological examination. TA rats showed significant increase of absolute and relative liver weights, liver peroxides, serum ALT, AST, ALP, and total bilirubin, while body weight, body mass index (BMI), Liver antioxidants (GPx, CAT) and serum adiponectin were significantly decreased compared to C rats. TA/Q group exhibited a decrease of liver peroxides, serum ALT, AST, ALP, and total bilirubin, while body weight, liver antioxidants (GPx, CAT) and serum adiponectin levels were significantly increased compared to TA group. Histopathological examination showed loss of normal liver architecture in TA rats (very thick septa and leukocytic infiltration). On the other hand, TA/Q rat livers had almost normal hepatic architecture. In conclusion. The natural flavonoid quercetin could ameliorate thioacetamide induced - liver cirrhosis and dysfunction in adult rats.

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Key words: thioacetamide, liver cirrhosis, quercetin, lipid peroxides, liver antioxidants, serum liver enzymes, serum bilirubin.

Abbreviations: CYP2E : Cytochrome oxidase P450, 5HT :serotonin , MAPK: Mitogen-activated protein kinase, Akt: serine /threonine protein kinase , PI3- Kinase; Phosphoinositide 3-kinase. NF- κ B : nuclear factor kappa-light-chain-enhancer of activated B cells. TNF- α :Tumor necrosis factor α . TNF- β 1:Tumor necrosis factor- β 1 HSC :hepatic stellate cells. PPAR α : peroxisome proliferators activated receptor alpha. AMPK : 5' AMP-activated protein kinase

1. Introduction

Chronic liver injury in response to a variety of insults like alcohol abuse, drugs, metabolic diseases, and autoimmune attack on hepatocytes or bile duct epithelium eventually leads to liver fibrosis (Amalia *et al.*, 2007). Cirrhosis is a progressive hepatopathy constituting an irreversible stage of liver dysfunction (Amalia *et al.*, 2007). In Africa and Asia hepatitis B virus & hepatitis C virus are the leading causes of liver cirrhosis while in developed countries; it is most commonly linked to alcohol abuse (Fattovich *et al.*, 1997; Yu *et al.*, 2000 and Anthony. 2001). Although no successful therapeutic approach has been developed to this pathogenic process in liver disease. Yet, antioxidant therapies have been shown to achieve some positive effects (Pavanoto *et al.*,

2003). The hepatotoxin thioacetamide (TAA) was used in different doses to induce liver cirrhosis, severe bile duct proliferation and cholangiocarcinoma at longer intervals (Al-Bader *et al.*, 2000). Liver damage is associated with biochemical changes in the form of higher baseline levels of total serum bilirubin, alkaline phosphatase, alanine aminotransferase, aspartate aminotransferase (Cucchetti *et al.*, 2011) as well as histopathological changes in the form of mild vascular congestion and moderate inflammatory changes with congested sinusoids, nuclear changes, and centrilobular necrosis (Lim *et al.*, 2010). Flavonoids are groups of more than 4000 polyphenolic compounds that occur naturally in foods of plant origin. These compounds possess a common phenylbenzopyrone structure (C6-

C3-C6), and they are categorized according to the saturation level and opening of the central pyran ring, mainly into flavones, flavanols, isoflavones, flavanones, and flavanonols (Masoodi and Alhamdanz, 2010). Human intervention studies have suggested beneficial effects of flavonoid-rich foods on biomarkers of inflammation and endothelial function (Landberg *et al.*, 2011). Quercetin (3,5,7,3,4-pentahydroxy flavon) is one of the most distributed flavonoids in human diet (Mink *et al.*, 2007) which has been reported to function as carcinostatic, antiviral, inhibitor of platelet aggregation and oxidation of LDL, (Parl *et al.*, 2003), cardioprotective and anti-inflammatory (Comalada *et al.*, 2006). The present study aimed at investigating the effect of quercetin administration on the prognosis of chronic liver cirrhosis induced by thioacetamide in adult Swiss Albino rats.

2. Materials and Methods

The present study was approved by the Ethics Committee FMASU 936/2011

Experimental animals:

The present study was carried out on 30 adult male Swiss Albino rats weighing 160-200 gm at the start of the study. Rats were purchased from Ophthalmic Diseases Research Institute (Giza) and housed 3/cage in plastic cages and maintained in the Physiology Department Animal House under standard conditions of boarding at normal room temperature and in a controlled environment of 12h light /dark cycle with free access to water and rat chow. All rats were fed standard rat chow (AIN-93 M diet formulated for adult rodents) prepared according to the National Research Council (NRC) 1978 and Reeves *et al.* (1993).

Rats were randomly divided into three equal groups:

- 1-Group I; Control group (n= 10); C rats were given the vehicle at a dose of 1ml/Kg b.w.
- 2- Group II; Thioacetamide group (n=10); TA rats were treated with thioacetamide in a dose of 100 mg/kg b.w. dissolved in 1 ml distilled water, twice weekly for 6 weeks intraperitoneally (Apte *et al.* 2003).
- 3-Group III; Thioacetamide /quercetin group (n=10); TA/Q rats were treated with thioacetamide in a dose of 100 mg/kg b.w. dissolved in 1 ml distilled water twice weekly for 6 weeks. Quercetin was given daily for the last 3 weeks in a dose of 50 mg/kg b.w. dissolved in 1 ml of 1% methyl cellulose, intraperitoneally (Tieppo *et al.*, 2007). Thioacetamide & quercetin were purchased from (Sigma- Aldrich, St Louis, MO, USA)

Experimental procedures:

At the end of the experimental period, all rats were fasted overnight, weighed and anaesthetized with intraperitoneal thiopental sodium (40 mg/Kg b.w.). Height (from the tip of the nose to the anus) was measured to calculate body mass index (BMI). A midline abdominal incision was made, the abdominal aorta was exposed and blood samples were collected in plastic tubes, centrifuged at 4000 r.p.m. for 15 minutes for separation of serum and were stored at -80° till used for determination of the following biochemical measurements:

- 1-Serum aspartate aminotransferase (AST) (Roche Diagnostics, colorimetric method) as described by Moss *et al.* (1987).
- 2-Serum alanine aminotransferase (ALT) (Roche Diagnostics, colorimetric method) as described by Moss *et al.* (1987).
- 3-Serum alkaline phosphatase (ALP) (Roche Diagnostics, colorimetric method as described by Fischbach and Z awta, 1992).
- 4-Serum total bilirubin (Roche Diagnostics, colorimetric method) as described by Sonntag and Scholer, (2001).
- 3-Serum adiponectin (Ani Biotech Oy, using ELISA kit) as described by Hu *et al.* (1996).

The livers were dissected out, washed with sterilized saline, dried between filter papers, weighed, then divided into two parts: one was homogenized and the supernatant was used for measurement of glutathione peroxidase (Bio.diagnostic company, UV method) as described by Paglia and Valentine (1967), catalase (Bio.diagnostic company, colorimetric method) as described by Aebi, (1984) and lipid peroxides (Malondialdehyde, MDA) as described by Draper and Hadley, (1990). The other part of the liver was used for histopathological study.

Histopathological examinations:

The specimens from the right lobe of the liver were taken and fixed immediately in 10% neutral buffered formalin, processed for light microscopy to get (5 μ m) paraffin sections and stained with: Hematoxylin & Eosin to verify histological details and Masson's trichrome staining to demonstrate the collagen fibers as described by Bancroft and Gamble (2002).

Statistical Analysis:

All statistical data and significance tests were performed by using SPSS (Statistical Program for Social Science) statistical package (SPSS Inc) version 8.0.1 according to Armitage and Berry (1987). Statistical significance was determined by one-way ANOVA for differences between means of different groups; further analysis was made by LSD (least significance difference) to find intergroupal differences. A probability of $P < 0.05$ was considered

statistically significant. Correlations and Lines of Regression were calculated by linear regression analysis using the Least Square Method. A probability of $P < 0.05$ was considered statistically significant. All data were expressed as mean \pm SEM.

3. Results:

Changes in body weight, body mass index (BMI), liver weight (LW) and liver weight/body weight ratio (LW/BW);

Final body weight and BMI decreased significantly ($P < 0.05$) in TA group compared to C group, while in TA/Q group, final body weight and BMI were significantly ($P < 0.05$) increased compared to TA group. Absolute and relative liver weights were significantly ($P < 0.05$) increased in both TA and TA/Q groups compared to control group (Table 1).

Changes in liver malondialdehyde, Glutathione peroxidase (GPx) and catalase (CAT)

Livers of TA group showed significant ($P < 0.05$) increase in malondialdehyde as well as significant ($P < 0.05$) decrease of liver antioxidants (GPx and CAT) compared to C group. On the other hand, TA/Q rats showed significant ($P < 0.05$) decrease in liver malondialdehyde and significant ($P < 0.05$) elevation of the liver antioxidants (GPx and CAT) compared to TA rats although liver GPx was still significantly ($P < 0.05$) lower than C group (Table 2).

Changes in serum adiponectin

Serum adiponectin levels decreased significantly ($P < 0.05$) in TA rats compared to control rats. In TA/Q rats, significant ($P < 0.05$) increase in serum adiponectin was observed compared to TA rats, approaching control values (Figure 1)

Changes in liver enzymes (serum ALT, AST and alkaline phosphatase), and serum total bilirubin

TA rats showed significant ($P < 0.05$) increase in serum liver enzymes (ALT, AST and ALP) as well as total bilirubin compared to C rats. TA/Q rats showed significant ($P < 0.05$) decrease in serum liver enzymes (ALT, AST and ALP) as well as total bilirubin levels compared to TA rats although values were still significantly ($P < 0.05$) higher than C group values (Table 3).

Correlations of serum adiponectin versus other parameters in thioacetamide untreated (TA), and thioacetamide / quercetin treated (TA/Q) groups of rats.

TA rats showed significant -ve correlation between serum adiponectin and liver weight/body

weight ratio ($P < 0.01$), serum liver enzymes (ALT, AST and ALP) ($P < 0.01$, < 0.01 , < 0.05 , respectively), serum total bilirubin ($P < 0.01$) and liver malondialdehyde, ($P < 0.01$), while the correlations between serum adiponectin and liver antioxidants (GPx and CAT) were significantly +ve ($P < 0.01$). However, in TA/Q rats the correlations between serum adiponectin and liver weight/body weight ratio, serum liver enzymes (ALT, AST and ALP), serum total bilirubin, liver malondialdehyde as well as liver antioxidants (GPx and CAT) became insignificant (Table 4, Figure 2).

Correlations of liver malondialdehyde versus other parameters in thioacetamide untreated (TA), and thioacetamide / quercetin treated (TA/Q) groups of rats.

TA rats showed significant +ve correlation between liver malondialdehyde and liver weight/body weight ratio ($P < 0.01$), serum liver enzymes (ALT, AST and ALP) ($P < 0.01$) and serum total bilirubin ($P < 0.01$), while the correlations between liver malondialdehyde and liver antioxidants (GPx and CAT) were significantly -ve ($P < 0.01$). However, in TA/Q rats the correlations between liver malondialdehyde and liver weight/body weight ratio, serum liver enzymes (ALT, AST and ALP), serum total bilirubin, as well as liver antioxidants (GPx and CAT) became insignificant (Table 5, Figure 3).

Histopathological examination of the livers:

Light microscopic examination of the liver of C rats revealed normal architecture of hepatic lobules with hepatocytes radiating from the central veins to the periphery of the lobules (Figures 4 & 5). Livers of TA rats showed disruption of normal architecture of hepatic lobules, in the form of very thick fibrous septa containing numerous fibroblasts in between hepatic lobules, around central veins as well as portal tracts. Central veins were congested with cellular infiltration. Portal tracts were enlarged with dilated branches of portal vein, bile duct proliferation and cellular infiltration. Most hepatocytes had lost most of their cytoplasmic masses and appeared as empty spaces with peripheral cytoplasmic layer, deeply stained nuclei and vacuolations. Blood sinusoids showed congestion and cellular infiltrations rich in fibroblasts (Figures 6, 7, 8). Livers of TA/Q rats showed preservation of nearly normal hepatic architecture. The hepatic lobules appeared with prominent portal areas and congested central veins surrounded with minimal cellular infiltrations (Figures 9, 10).

Table (1): Changes in final body weight (BW, g), body mass index (BMI, Kg/m²), liver weight (LW, g), liver weight/ body weight (LW/BW, mg/g) in control(C), Thioacetamide (TA), and Thioacetamide / quercetin -treated (TA/Q) groups of rats.

Groups	BW (g)	BMI (Kg/m ²)	LW (g)	LW/BW (mg/g)
C (10)	229.5 ± 3.7	4.9 ± 0.07	4.8 ± 0.20	2.1 ± 0.11
TA (10)	210.5 ± 3.7*	4.7 ± 0.05*	7.30 ± 0.22*	3.5 ± 0.13*
TA/Q (10)	221.5 ± 4.6**	4.8 ± 0.06*	6.8 ± 0.44*	3.0 ± 0.22*
P	< 0.05	< 0.05	< 0.001	< 0.001

P: Significance by 1-way ANOVA among the 3 studied group

*: Significance by LSD at P< 0.05 from control group.

** : Significance by LSD at P< 0.05 from untreated TAA group.

In parenthesis is the number of rats.

Results are expressed as Mean ± SEM.

Table (2): Liver malondialdehyde (MDA,umol/g tissue), glutathione peroxidase (GPx,mU/mg protein), and catalase (CAT, U/g tissue) levels in control(C), thioacetamide (TA), and thioacetamide / quercetin-treated (TA/Q) groups of rats.

Groups	MDA (umol/g)	GPx (mU/mg)	CAT (U/g)
C (10)	2.0 ± 0.25	18.7 ± 0.8	2.1 ± 0.2
TA (10)	4.8 ± 0.4*	4.9 ± 0.7*	0.6 ± 0.07*
TA/Q (10)	2.3 ± 0.3**	14.1 ± 1.4*,**	1.6 ± 0.2**
P	< 0.001	< 0.001	< 0.001

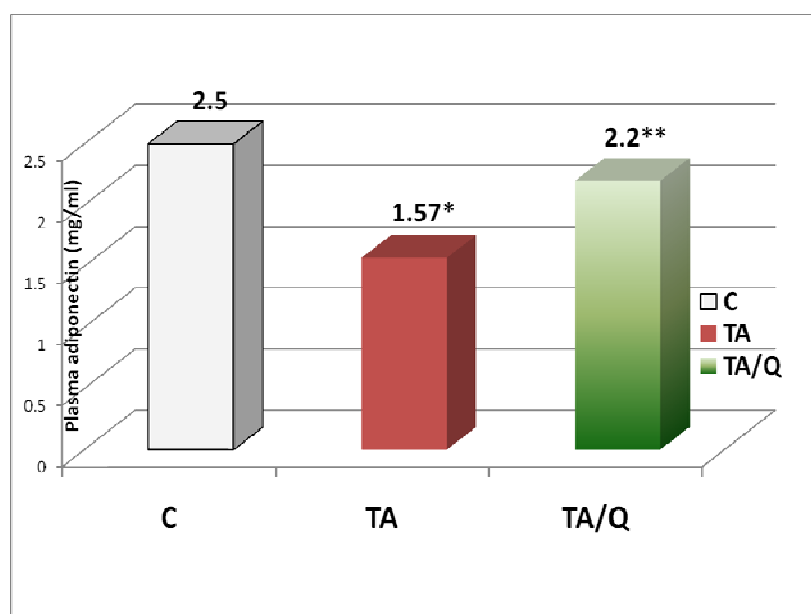
P:Significance by 1-way ANOVA among the 3 studied groups.

*: Significance by LSD at P< 0.05 from control group.

** : Significance by LSD at P< 0.05 from untreated TAA group.

In parenthesis is the number of rats.

Results are expressed as Mean ± SEM.

**Figure (1); Changes in serum adiponectin (ng/ml) in control(C), thioacetamide (TA), and thioacetamide / quercetin- treated (TA/Q) groups of rats.**

*: Significance by LSD at P< 0.05 from control group. **: Significance by LSD at P< 0.05 from untreated TA group

Table (3): Serum alanine transaminase (ALT, IU/L), serum aspartate transaminase (AST, IU/L), total serum bilirubin (T. bilirubin, mg/dl), and alkaline phosphatase (ALP, IU/L) levels in control(C), thioacetamide (TA), and thioacetamide / quercetin -treated (TA/Q) groups of rats.

Groups	ALT (IU/L)	AST (IU/L)	T.bilirubin (mg/dl)	ALP (IU/L)
C (10)	27.9 ± 1.5	47.4 ± 2.9	0.23 ± 0.02	203.1 ± 13.1
TA (10)	55.3 ± 1.9*	88.2 ± 3.6*	0.47 ± 0.03*	404.6 ± 19.1*
TA/Q (10)	43.0 ± 1.5*,**	66.2 ± 2.2*,**	0.34 ± 0.23*,**	286.9 ± 18.2*,**
P	< 0.001	< 0.001	< 0.001	< 0.001

P: Significance by 1-way ANOVA among the 3 studied groups. *: Significance by LSD at P< 0.05 from control group. **: Significance by LSD at P< 0.05 from untreated TAA group. In parenthesis is the number of rats. Results are expressed as Mean ± SEM.

Table (4): Correlations of serum adiponectin versus liver weight/body weight (LW/BW), serum alanine transaminase (ALT), serum aspartate transaminase (AST), serum alkaline phosphatase (ALP), total serum bilirubin (T. bilirubin), liver malondialdehyde (L-MDA), glutathione peroxidase (GPx), Catalase (CAT) levels in thioacetamide (TA), and thioacetamide / quercetin- treated (TA/Q) groups of rats.

Groups		Lw/Bw (mg/g)	ALT (IU/L)	AST (IU/L)	ALP (IU/L)	T.bilirubin (mg/dl)	L- MDA (umol/g)	GPx (mU/mg)	CAT (U/g)
TA(10)	r	-0.683	-0.605	-0.505	-0.566	-0.580	-0.648	0.548	0.755
	P	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01
TA/Q(10)	r	-0.185	0.206	-0.77	-1.10	-0.97	-0.279	-0.161	0.346
	P	NS	NS	NS	NS	NS	NS	NS	NS

In parenthesis is the number of rats.

NS: not significant.

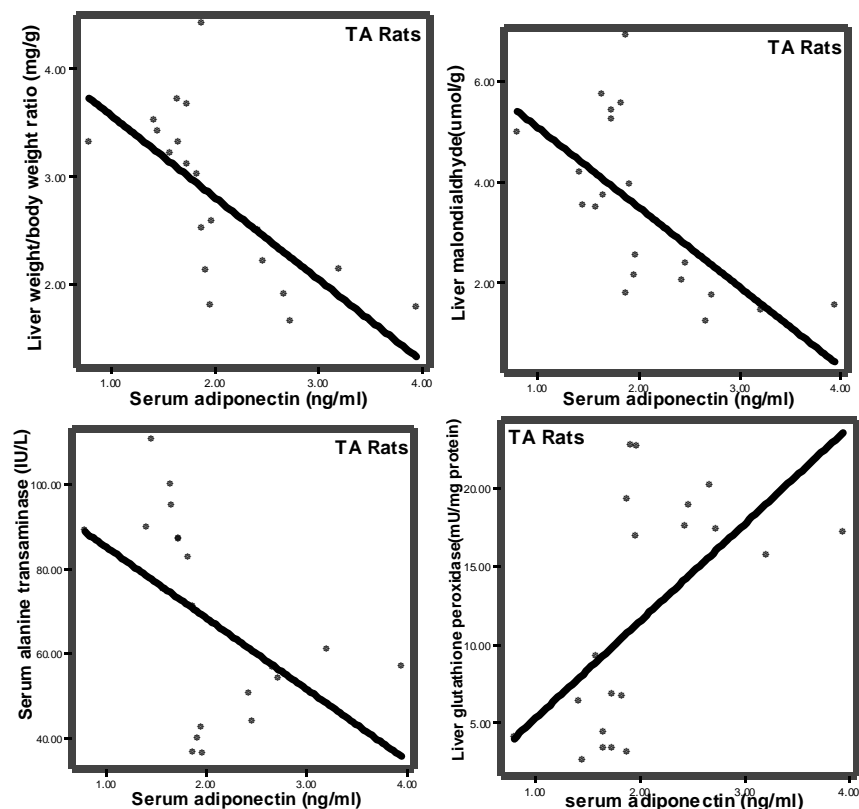


Figure (2): showing correlations of serum adiponectin (ng/ml) versus liver weight/ body weight ratio, liver malondialdehyde, serum alanine transaminase and liver glutathione peroxidase (P< 0.01) in thioacetamide (TA) rats.

Table (5): Correlations of Liver malondialdehyde (L-MDA) versus liver weight/body weight (LW/BW), serum alanine transaminase (ALT), serum aspartate transaminase (AST), serum alkaline phosphatase (ALP), total serum bilirubin (T.bilirubin), glutathione peroxidase(GPx), Catalase (CAT)levels in thioacetamide (TA), and thioacetamide / quercetin treated (TA/Q) groups of rats.

Groups		Lw/Bw (mg/g)	ALT (IU/L)	AST (IU/L)	ALP (IU/L)	T.bilirubin (mg/dl)	GPx (mU/mg)	CAT (U/g)
TA(10)	r	0.860	0.690	0.635	0.860	0.688	-0.748	-0.825
	P	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TA/Q(10)	r	0.420	-0.107	-0.028	-0.219	-0.033	0.333	-0.187
	P	NS	NS	NS	NS	NS	NS	NS

In parenthesis is the number of rats.

NS: not significant.

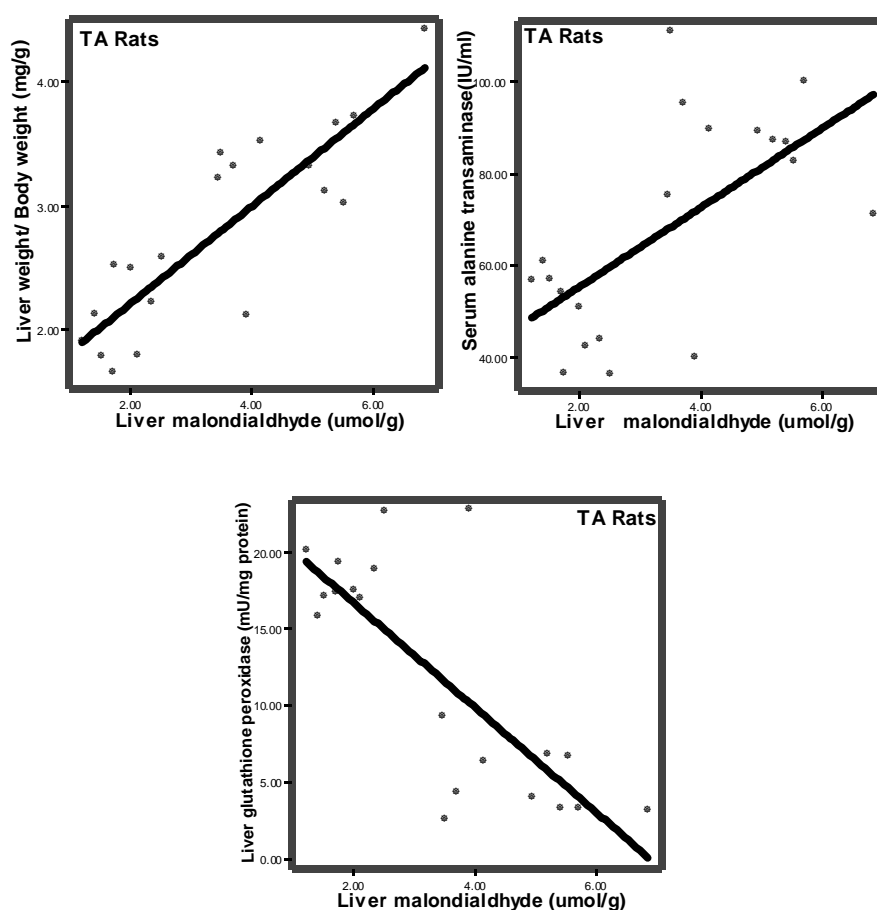


Figure (3): showing correlations of liver malondialdehyde versus liver weight/ body weight ratio, serum alanine transaminase and liver glutathione peroxidase ($P < 0.01$) in thioacetamide (TA) rats.

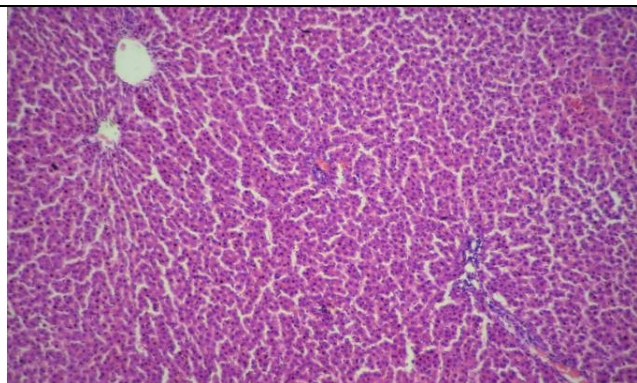


Fig.4: A photomicrograph of section of liver of control group showing normal hepatic lobule (Hx & E, 100 X).

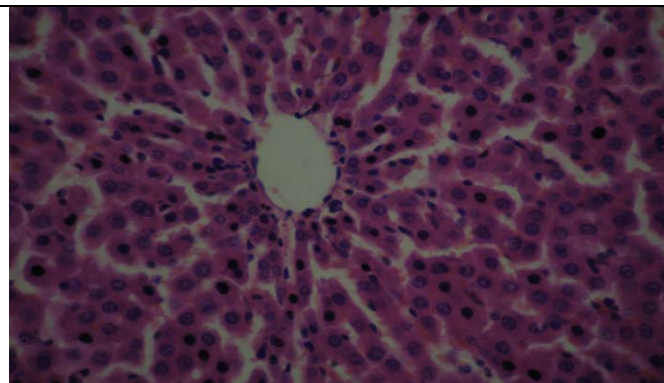


Fig. 5: A photomicrograph of section of liver of control group showing hepatocytes with acidophilic cytoplasm and central vesicular nuclei (Hx & E, 400 X).

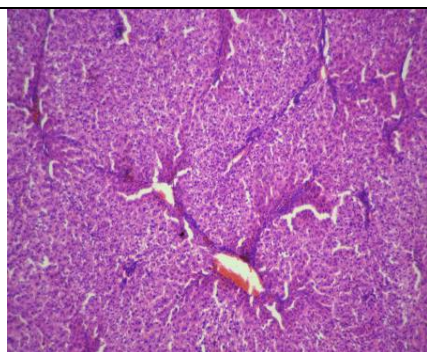


Fig. 6: A photomicrograph of section of liver of TA group showing loss in the normal architecture of the hepatic lobules. (Hx & E, 100 X).

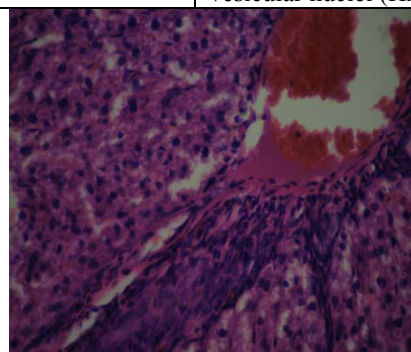


Fig. 7: A photomicrograph of section of liver of TA group showing very thick septa around congested central veins, cellular infiltration and congested blood sinusoid. (Hx & E, 400 X).

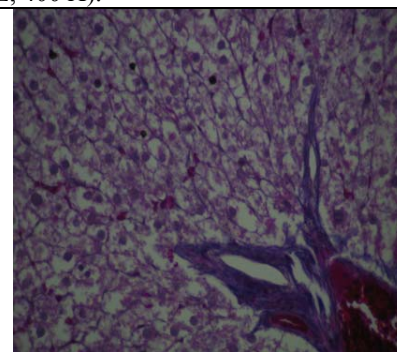


Fig. 8: A photomicrograph of section of liver of TA group showing very thick septa around portal tract, congested portal vein and hepatic artery. (Masson's trichrome, 400 X).

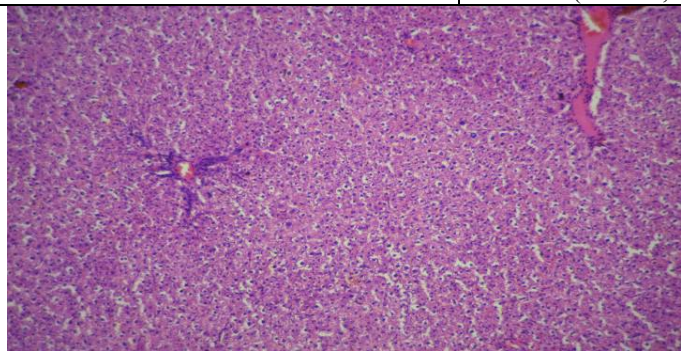


Fig. 9: A photomicrograph of section of liver of TA/Q group showing preservation of nearly normal hepatic architecture. Notice congested portal vein. (Hx & E, 100 X).

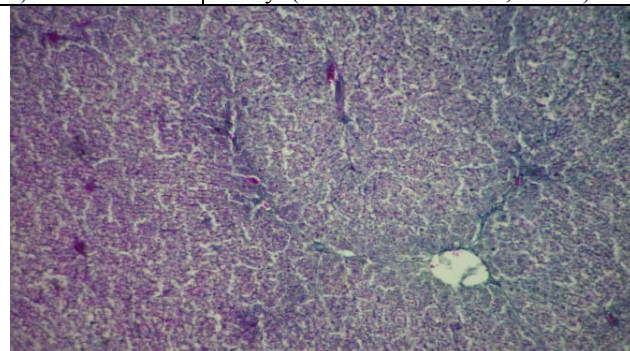


Fig. 10: A photomicrograph of section of liver of TA/Q group showing fibrous septa around central vein and in between hepatic lobules. (Masson's trichrome, 100X).

4. Discussion

In the present study, rats exposed to liver damage by thioacetamide showed significant weight loss possibly due to enhanced lipolysis as evidenced by the significant decrease in BMI in addition to decreased appetite as a result of increased 5-HT as previously reported by Haider *et al.* (2004). Liver weight increased significantly in TA rats which agree

with the findings of Jeon *et al.* (2003) and Amalia *et al.* (2007) and could be explained by the inflammatory changes seen in the liver in the form of vascular congestion, infiltration by leukocytes, and fibrosis. Hepatocellular damage was also evident by the biochemical study in the form of elevated serum levels of liver enzymes and total bilirubin, a picture reported by many authors with different hepatotoxic

agents that eventually lead to liver fibrosis or cirrhosis (Badr *et al.*, 2009 and Jayaraman *et al.*, 2009). In the present study, liver peroxides increased significantly and a significant +ve correlation was established between liver peroxides and relative liver weight as well as liver enzymes in TA rats suggesting that liver peroxides contributed to thioacetamide – induced liver structural and functional changes. Nevertheless, their contribution to the onset of liver injury by thioacetamide is debatable. Thioacetamide was reported to induce liver trauma by interfering with protein synthesis and enzyme metabolism (Liu *et al.*, 2010). Increased lipid peroxides were reported to occur two weeks after the onset of liver necrosis and cholestasis in the bile duct ligation -model of liver cirrhosis (Parola *et al.*, 1996). In the present study, the significant increase in liver peroxides in TA rats could be the consequence of fatty acid accumulation, a condition known as steatosis which was reported by Adenolfi *et al.* (2001) to be the first hit that increases liver sensitivity to a second hit by oxidative stress or inflammation in the pathogenesis of non alcoholic hepatosteatitis (NASH) and insulin resistance was claimed to be a contributing factor to steatosis (Chitturi *et al.*, 2001). The severity of steatosis was found to correlate with the extent of hepatic stellate cell (HSC) activation which is the liver cell responsible for deposition of extracellular matrix proteins and consequently fibrosis (Cortez *et al.*, 2001). In the present study, the cause of fatty acid accumulation in the livers of TA rats was difficult to speculate, but it could be due to decreased fatty acid oxidation by hepatocytes due to cellular injury as reported by Liu *et al.* (2010) as well as decreased hepatocyte sensitivity to insulin due to decreased circulating adiponectin level. Lipid peroxides were reported to induce alterations in cell membrane structure due to induction of (CYP)2E, the primary enzyme involved in bioactivation of thioacetamide to thioacetamide sulfoxide and thioacetamide sulfdioxide which are reactive metabolites that would induce damage of cellular membrane and organelles (Wang *et al.*, 2000 and Jaeschke *et al.*, 2011). Lipid peroxides were found to trigger a series of cytotoxic reactions either directly by interacting with biological macromolecules like proteins and DNA leading eventually to cell death (Czczot *et al.*, 2010) or indirectly by eliciting an autoimmune reaction as reported by Vidali *et al.* (2008). In addition to lipid peroxides, increased oxidative stress could result from activated neutrophils, macrophages and monocytes which were reported to release various malicious prooxidants that might contribute to cellular damage (Lochner *et al.*, 2009). The significant decrease of liver antioxidants in TA rats might be the result of increased

consumption in defense against free radicals as evidenced by the –ve correlation between liver peroxides and liver antioxidants or decreased synthesis by the already injured or damaged hepatocytes or both which would establish a vicious circle in which oxidative stress depletes antioxidant defense with more liver susceptibility to oxidative damage. Administering an antioxidant might have the rationale of interrupting this vicious circle and conferring hepatoprotection. Various antioxidants (Vitamin A, E, C, selenium and Beta carotene) have been tried in liver cirrhosis but the results were conflicting; some authors were with (Mehmetçik *et al.*, 2008 and Passoni and Coelho, 2008) and the others were against (Bjelakovic *et al.*, 2011). However, until now no therapy has proved radical cure.

Fruits, vegetables, spices, and tea provide essential nutrients and many diet-derived phenolics, in particular flavonoids, which have been reported to exert potential anticarcinogenic activities (Middleton *et al.*, 2000 and Surh, 2003). Quercetin is one of the most common flavonoids found in the diet (Yang *et al.*, 2001). In the present study, rats treated with quercetin 3 weeks after induction of hepatotoxicity showed signs of improvement by histological and biochemical studies. We may suggest that quercetin might have potentiated the antioxidant defense in the liver, thus interrupting the vicious circle between oxidative stress and oxidative damage as shown by the significant decrease of liver peroxides and increase of its antioxidants. Quercetin was found to be involved in modulation of enzymes involved in proliferation and signal transduction pathways including members of the MAPK family and Akt (Yoshizumi *et al.*, 2001 and Spencer *et al.*, 2003) as well as inhibition of PI-3-kinase (Agullo *et al.*, 1997).

It was of interest to observe that serum adiponectin level decreased significantly in TA rats which agree with the findings of Latif *et al.* (2010) and disagree with the findings of Salman *et al.* (2010) who reported increased adiponectin level in patients with liver cirrhosis. In the present study, serum adiponectin correlated significantly and negatively with relative liver weight, liver peroxides, serum liver enzymes and bilirubin which further confirm the hepatoprotective role of adiponectin, a finding previously reported by Masaki *et al.* (2004) who found that alcohol -induced steatohepatitis was partially mediated by adiponectin deficiency and was ameliorated by adiponectin administration via induction of hepatic fatty acid oxidation and inhibition of fatty acid synthesis. Adiponectin exerts hepatoprotection via inhibition of steatogenesis and fibrogenesis at multiple levels (Xu *et al.*, 2003). These levels involve attenuation of oxidative stress and proinflammatory cytokine

production. Adiponectin attenuates the effect of TNF- β 1 on the expression of fibrogenic genes such as connective tissue growth factor (Kamada *et al.*, 2003 and Antoniadis *et al.*, 2009), modulation of inflammatory responses in endothelial cells by inhibiting NF-KB, TNF- α release and TNF- α mRNA expression (Ouchi *et al.*, 2000 and Masaki *et al.*, 2004), suppression of macrophage function (Tsatsanis *et al.*, 2005), modulation of the activated phenotype of HSC, which express both adiponectin receptors (Ding *et al.*, 2005 and Caligiuri *et al.*, 2008). Suppression of proliferation and migration of mouse HSC stimulated with platelet derived growth factor (PDGF) –BB, one of the most potent mitogens and chemotactic factors for HSC (Kamada *et al.*, 2003). Two adiponectin receptors have been identified (Adipo R1/R2) and were reported to be responsible for the effect of adiponectin on PPAR α expression and AMPK activation at the hepatic level (Kadowaki & Yamauchi, 2005). It was difficult to speculate whether adiponectin deficiency in TA rats was the cause or the consequence of thioacetamide –induced hepatotoxicity but the observation that adiponectin level was restored almost to normal value by quercetin in TA/Q suggest that oxidative stress was implicated -at least partially in adiponectin deficiency. It could be possible that lipid peroxides and inflammatory mediators that had triggered hepatic damage also decreased adiponectin production by adipocytes which in turn contributed to hepatic damage as previously reported by Lago *et al.* (2007) who found that adiponectin expression was down regulated in the presence of inflammation. Elevated adiponectin level in TA/Q rats by quercetin therapy might have teamed up with the attenuated oxidative stress to confer more hepatoprotection.

In conclusion, increased oxidative stress was implicated in thioacetamide –induced liver cirrhosis and administration of quercetin after onset of hepatic injury by thioacetamide was effective in slowing down the progress of cirrhotic and hepatic functional derangements. Whether an earlier administration of quercetin or the use of a higher dosage could produce better outcome is a matter of speculation that needs further research.

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Silencing a putative cytosolic NADP-malic enzyme gene compromised tomato resistance to *Oidium neolyopersici*

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Abstract: Tomato powdery mildew caused by *Oidium neolyopersici* is a worldwide plant fungal disease distributed in Europe, African, South and North America and Asian, which is responsible for a remarkable reduction in quality and yield of tomato. The most effective way to control this disease is resistant breeding, which depends on the resistant materials and resistance genes. In our previous study, a putative enzyme gene (named *ShME1*) was found to be up-regulated in the *Ol-1* mediated tomato resistance response to *Oidium neolyopersici*. In this study, in order to know whether this gene is a key gene of the resistance response, we further analyzed the function of the gene using virus induced gene silencing (VIGS) in resistant tomato plants *Solanum habrochaites* G1.1560 carrying *Ol-1* gene. It was shown that the resistant *S. habrochaites* G1.1560 became susceptible to *O. neolyopersici* after *ShME1* was silenced in it. Microscopic observation demonstrated that *O. neolyopersici* was able to complete its life cycle on silenced resistant plants, it indicated that *ShME1* was required for *Ol-1* mediated tomato resistance against *O. neolyopersici*. It also suggested that *ShME1* could be involved in hypersensitive response (HR) and H₂O₂ accumulation, which was thought to be tightly linked to the establishment of tomato resistance to *O. neolyopersici*. [Dong-Li Pei, Hong-Zhen Ma, Yi Zhang, Yuan-Song Ma, Wen-Jing Wang, Hui-Xia Geng, Jian-Yu Wu, Cheng-Wei Li. Silencing a putative cytosolic NADP-malic enzyme gene compromised tomato resistance to *Oidium neolyopersici*. Life Science Journal. 2011;8(2):652-657] (ISSN:1097-8135). <http://www.lifesciencesite.com>.

Key words: Tomato; *Oidium neolyopersici*; NADP-malic enzyme; VIGS; HR; H₂O₂

1. Introduction

NADP-malic enzyme (NADP-ME, EC1.1.1.40), which is widely distributed in nature, catalyses the oxidative decarboxylation of L-malate to form pyruvate and CO₂ with concomitant reduction of NADP to NADPH (Chang and Tong, 2003). In plants, NADP-ME functions in different metabolic pathways, the best studied isoform of NADP-ME is the one involved in C₄ photosynthesis, which releases CO₂ to be used in carbon fixation by Ribulose-1,5-bisphosphate Carboxylase Oxygenase (RuBisCO). Apart from this specialized role, in C3 plants, the expression of NADP-ME gene were activated by UV-B, wounding, fungal effectors, NaCl, carbonates, environment pH changes etc (Walter et al., 1994; Schaaf et al., 1995; Pinto et al., 1999; Casati et al., 1999; Cheng and Long, 2007; Liu et al., 2007). It showed that NADP-ME was involved in plant defense responses and stress responses.

Powdery mildew caused by the biotrophic fungus, *O. neolyopersici*, has recently become a very important disease of tomato (*Solanum lycopersicum*) worldwide (Jones et al., 2001). Meanwhile, insecticide spraying to control the disease results in serious environmental

contamination. In March of 2008, powdery mildew appeared as circular, white colonies on leaves, petioles, and stems of tomato plants grown in greenhouses in Shangqiu, Henan Province, China. It is first reported and identified as *O. neolyopersici* in China (Li et al., 2008).

Although the cultivated tomato is susceptible to the fungus, resistance occurs in many wild species of tomato. Researchers have found six resistance genes (termed *Ol-X*) and three resistance QTLs in tomato wild types, which mediate different resistance responses to *O. neolyopersici* (Lindhout et al., 1994 a&b; Ciccarese et al., 2000; Bai et al., 2003 & 2005). In our previous study, gene expression profiles were investigated of susceptible, monogenic and polygenic resistant tomato genotypes in response to *O. neolyopersici* infection using cDNA-AFLP method (Li et al., 2006 & 2007). Among the identified TDFs (Transcript Derived Fragments), eight hundreds and eighty seven TDFs were differentially expressed TDFs (DE-TDFs) upon *O. neolyopersici* challenge. By annotating the sequenced DE-TDFs, the corresponding transcripts were classified to be involved in plant defense, signal transduction,

regulation, protein synthesis and degradation, energy metabolism, etc (Li et al., 2006).

For further functional characterization of important DE-TDFs, a technology VIGS is exploited. VIGS is a widely used, powerful technique for reverse genetics with methodological simplicity, robustness, and speedy results. Many silencing vectors have been derived from viruses recently. Vectors derived from the *Tobacco rattle virus* (TRV) are among the most popular viruses for VIGS, because it is able to spread more vigorously throughout the entire plant, including meristem tissue, causing mild symptoms of infection compared with other viruses. The improved TRV VIGS vector allows the insertion of gene silencing fragments by ligation-independent cloning (LIC). The vector has several advantages over previous vectors, particularly for large-scale gene function analysis, since TRV-LIC vectors containing the desired insert are obtained with 100% efficiency (Dong et al., 2007).

We generated a collection of silencing vectors in this TRV-LIC background based on gene expression pattern and annotation information of the tomato DE-TDFs. Silencing a DE-TDF among them, which is annotated to putative NADP-malic enzyme, led to the compromise of *Ol-1* mediated resistance to *O. neolyopersici* in *S. habrochaites* G1.1560. Microscopic observation demonstrated the influence of silencing the putative NADP-malic gene on hypersensitive response (HR) and H₂O₂ accumulation in tomato against *O. neolyopersici*.

2. Material and Methods

2.1 Plant materials

Different tomato cultivars and species including *S. lycopersicum* Mill [cvs. Moneymaker (MM), Micro-Tom, Zaofen, Fenguo and Zhongza series], and wide type *S. habrochaites* G1.1560 were used in this study.

2.2 Tomato powdery mildew fungi

The Shangqiu isolate of powdery mildew fungus from tomato plants in Henan Province of China, which was identified as *O. neolyopersici* based on morphological, histological and molecular characteristics, was used as the pathogen.

2.3 Pathogen preservation and inoculation

The *O. neolyopersici* was successfully preserved on tomato plants in climate cell under the condition (20±3°C with 70±5% humidity and a 16h photoperiod). The fresh conidia were collected from infected plant leaves with sterile water. Four-week plants were used for inoculation by spraying a spore suspension of 5 × 10⁴ conidia/ml on the whole plants for the histological study.

2.4 RNA extraction and cloning of target tomato DE-TDF

Total RNA was extracted from leaves of wide type G1.1560 using RNAiso Reagent (TaKaRa). First-strand cDNA was synthesized using 1 ug of total RNA and M-MLV RTase cDNA Synthesis kit (TaKaRa) according to the manufacturer's protocol. The target DE-TDF was amplified with primers: 5'-CGACGACAAGACCCT-gagcgctgcaaaaat-3' and 5'-GAGGAGAAGAGCCCT-gctgtccctgtatc-3' by RT-PCR (The capital letters stand for the adapter sequence of ligation-independent cloning TRV vector, the lowercase letters stand for the *ShME1* gene specific sequence) .

2.5 Vector construction

RT-PCR products were cloned into TRV2-LIC vector (pYY13). The recombinant TRV2-LIC-*ShME1* vector carrying target sequence was constructed by the protocol as describe by (Dong et al., 2007).

2.6 VIGS agroinfiltration

After successful construction, VIGS TRV1 and TRV2-LIC-*ShME1* were introduced into *Agrobacterium tumefaciens* strain GV3101 by heat shock. 5mL overnight cultures were grown at 28°C in the appropriate antibiotic selection medium in 15mL glass tube for one day, then cultures were spun down and cells were re-suspended in infiltration medium (10 mM MES, 10 mM MgCl₂, 200µM acetosyringone), adjusted to OD600 of 1, and incubated at room temperature for 3 h. Agroinfiltration was performed as previously reported (Liu et al., 2002). We infiltrated the first and second leaves of four-leaf stage plants with a 1:1 mixture of TRV1 and TRV2-LIC-*ShME1* fragment for the clone. The empty vector TRV2-LIC was as control. After 10 days post inoculation (dpi), the plants were inoculated with *O. neolyopersici*. Ten plants were inoculated per trial and three trials were done.

2.7 Semi-quantitative RT-PCR analysis

The degree of silencing of the target gene monitored by semi-quantitative RT-PCR using gene specific primers 5'-CTATTGTCTACTCCAAC-TGTGC-3' and 5'-ATGCAATAAGCCCTGC-AAGT-3'. Tomato *Actin* gene (GenBank U60480) was as internal control, which was amplified with primers 5'-CCCAAAGGCTAATCGTGAAA-3' and 5'-GCAGCTTCCATTCCAATCAT-3'.

2.8 H₂O₂ accumulation and Microscopic analysis

For detecting H₂O₂ accumulation, the infected leaflets were immersed in the DAB solution (1mg/mL pH3.8) for 8-12 hours till DAB stain can be seen at the vein of leaflet top. Then DAB stained leaflets were fixed and stained with trypan blue as described by Huang and associates (1998). Samples were observed under differential-interference contrast

microscope (Carl Zeiss, Germany), while pictures were taken by using a Color Video Camera with image analyzing software (ImageProPlus 4.1, Media Cybernetics, L.P.).

3. Results

3.1 Identification of tomato cultivars resistance to *O. neolyopersici* Shangqiu isolate

Shangqiu isolate of *O. neolyopersici* from tomato plants in Henan Province of China was identified for the first time (Li et al., 2008). Different tomato cultivars and species including *S. lycopersicum* Mill (cvs. MM, Micro-Tom, Zaofen, Fenguo, and Zhongza series), *S. habrochaites* G1.1560 were inoculated with a conidial suspension of the Shangqiu isolate of *O. neolyopersici* with a concentration of 5×10^4 conidia/ml for disease test. Susceptible symptoms developed on all *S. lycopersicum* cultivars which developed symptoms of powdery mildew as early as 4 days after inoculation, while *S. habrochaites* G1.1560 (carrying *Ol-1*) displayed high resistance to the Shangqiu isolate of *O. neolyopersici* (Figure 1), thirty plants were tested and all of them were free of fungal colonies 14 dpi. In this paper, *S. habrochaites* G1.1560 and MM were chosen as the resistant and susceptible tomato plants for the following experiments, respectively.



Figure 1. Phenotypes of resistant plant G1.1560 and susceptible plant MM inoculated with *O. neolyopersici* Shangqiu isolate

3.2 *In silico* cloning and annotation of a candidate DE-TDF

A DE-TDF was sequenced and annotated in SGN (Solanaceae Genomics Network), obtained full-length sequence of the gene (named *ShME1*) showed 99% similarity to a unigene (SGN-U577798), which was annotated to a putative cytosolic NADP-malic enzyme. Based on the location information of the unigene on tomato genome through *in silico* analysis in SGN, the putative NADP-malic enzyme gene was located on chromosome 5.

3.3 At macroscopic observation, silencing *ShME1* can compromise *Ol-1* mediated resistance against *O. neolyopersici*

ShME1 was silenced in *S. habrochaites* G1.1560 plants by using VIGS, which are wild type tomato carrying *Ol-1* gene. Ten days after the VIGS infiltration, the silenced resistant plants were inoculated with *O. neolyopersici*. Obvious fungal colonies were observed on leaflets of all silenced resistant plants 7 dpi, while no fungal colonies were found on the control empty vector-treated resistant plants (Figure 2). The results showed that silenced G1.1560 plants showed susceptibility to *O. neolyopersici* compared to the high resistance in non-silenced G1.1560 plants. It indicated that silencing NADP-malic enzyme gene can macroscopically compromise *Ol-1* mediated resistance response against *O. neolyopersici*.

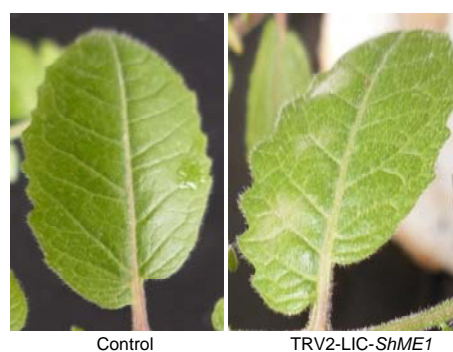


Figure 2. The susceptible phenotype of *ShME1* silenced resistant plant leaflet to *O. neolyopersici*

The *ShME1* silenced resistant plant through VIGS method (right); control resistant plant (left).

3.4 At microscopic observation, silencing *ShME1* resulted in slow HR induced by *O. neolyopersici*

Further microscopic analysis was conducted to check how silenced *ShME1* in resistant plants affected tomato responses to *O. neolyopersici* and finally influenced the fungal growth. The hypha grew long enough to form plenty of conidiophores with conidia on the *ShME1* silenced resistant plants, resulting in successful fungal sporulation (Figure 3A). The haustoria in the live cells were in good shape suggesting with normal function, which promised the fungal growth and conidiophore formation. Microscopic analysis also showed that non-silenced G1.1560 displayed a fast HR, in which the tomato cell intruded by primary haustoria of *O. neolyopersici* became dead quickly, accompanying with H_2O_2 accumulation in response to *O. neolyopersici* (Figure 3B), while *ShME1* silenced resistant plants showed a slow HR, tomato cell intruded by fungal primary haustoria kept alive and cell death happened in tomato cells intruded by secondary haustoria (Figure 3C).

The micrograph of conidiophore of *O. neolyopersici* in silenced plant G1.1560 (Figure 3A), epidermal cells in which primary haustoria formed became necrotic in non-silenced resistant plant (Figure 3B), epidermal cell in which secondary haustoria formed became necrotic, indicating HR and H₂O₂ accumulation in *ShME1* silenced resistant plant (Figure 3C). The bars equal 50 μm.

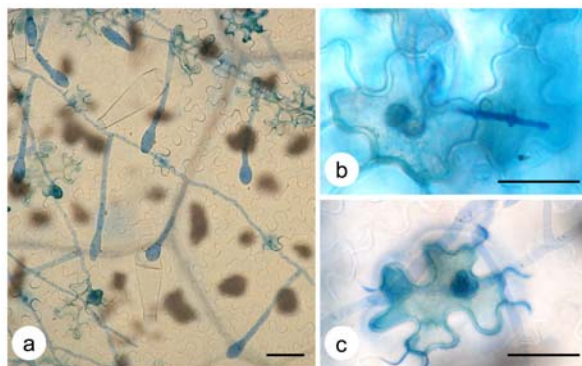


Figure 3. Microscopic observation of *O. neolyopersici* in resistant plant G1.1560.

3.5 RT-PCR confirmation of VIGS effect

Semi-quantitative RT-PCR was conducted to determine whether the target gene was silenced, *Actin* was used as an internal standard (Figure 4). It was estimated that the *ShME1* transcript level was more than 60% reduction in the silenced plants compared to the control plants, suggesting that VIGS of the *ShME1* was successful.

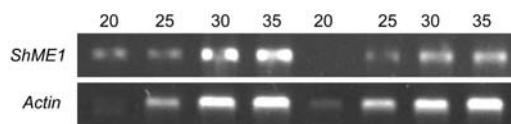


Figure 4. semi-quantitative RT-PCR analysis of *ShME1* VIGS effect

Resistant plant Control plants (left); *ShME1* silenced plants (right); 20, 25, 30 and 35 stand for cycles of PCR; levels of *Actin* transcript were determined as internal controls.

4. Discussion

NADP-ME has multiple functions in plants through reducing NADP to NADPH. NADPH-consuming steps were reported to be involved in plant defense reactions, for example, in phytoalexin biosynthesis (Beggs and Wellman, 1994), in the reductase activity of a disease resistance gene (Johal and Briggs, 1992), and in defense-related deposition of lignin (Whetten and Sederoff, 1995), in which

processes the reductive power could be supplied through NADP-ME. In this paper, we demonstrated that silencing of the NADP-ME gene *ShME1* in resistant tomato plants carrying *Ol-1* gene resulted in the loss of resistance. It indicated that NADP-ME is a key gene in the *Ol-1* mediated disease resistance response of tomato against *O. neolyopersici*. It implied that NADPH production catalyzed by NADP-ME may play an important role in tomato resistance to *O. neolyopersici*.

During pathogen attacks, reactive oxygen species (ROS) including H₂O₂ are often produced to defend pathogens (Sutherland, 1991), the electron donor for activation of oxygen to form ROS is NADPH, NADP-ME is involved in mechanisms producing NADPH, therefore NADP-ME could contribute to provide the reducing power for synthesis of ROS (Minard and McAlister-Henn 2001; Møller, 2001). Previous studies showed that *Ol-1* mediated resistance to *O. neolyopersici* was associated with HR, in which a high frequency of necrosis of epidermal cells accompanying with H₂O₂ accumulation induced by the fungal haustoria was microscopically observed (Bai et al., 2005). The cell necrosis together with H₂O₂ accumulation is the main mechanism to prevent the fungal sporulation in resistant G1.1560 plants. In this paper, compared to non-silenced resistant G1.1560 plants displaying fast HR, the *ShME1* silenced G1.1560 showed slow HR resulted in the loss of *O. neolyopersici* resistance. The point further supports our previous findings that transcriptomic differences between compatible and incompatible interactions of tomato and *O. neolyopersici* are mainly in timing (Li et al., 2006). It also indicated that the expression level of *ShME1* gene affected the level of *O. neolyopersici* induced cell necrosis and H₂O₂ accumulation in tomato, implying that NADP-ME could play a role in tomato and *O. neolyopersici* interaction through adjusting the level of cell necrosis and H₂O₂ accumulation.

In conclusion, our findings suggest that the putative tomato NADP-malic enzyme gene from G1.1560 tomato could be a key gene of *Ol-1* mediated tomato resistance to *O. neolyopersici* being involved in HR forming and H₂O₂ accumulation. However, more evidence is needed to clarify the mechanism.

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3/5/2011

The use of a by-product of paper industry in reclamation of berry-cultivated soilsMohammadi Torkashvand, A.^{1*}, Bizhannia, A.², Mavajpour, M.² and Haghghat, N.¹¹Rasht Branch, Islamic Azad University, Rasht, Iran²Iran Silkworm Research Center, Rasht, Iran*Corresponding E-mail: m.torkashvand54@yahoo.com; Torkashvand@iaurasht.ac.ir,

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Abstract: Using conventional lime in amending acidic soils reform is expensive. Therefore, the importance of using cheaper resources is seems more necessary. A variety of materials including industries by-products are used in reclamation of acidic soil. By-products with the character of lime not only increase the pH and improvement of soils have special priority, but also increase the fertility with create consistency with the aggregate building sustainable soil, air conditioning, increases porosity and cation exchange capacity and soil reactivity. In this study, the possibility of using paper sludge lime had been investigated in berry orchard improvement under cultivation of sericulture in a field experiment. The results indicating the potential of paper lime sludge as acidic soil modifiers in the replacement of conventional calcite sources such as calcite which can reduce the disposal costs and possible environmental contamination of this by-product.

[Ali Mohammadi Torkashvand, Bizhannia A., Mavajpour M, Haghghat N. The use of a by-product of paper industry in reclamation of berry-cultivated soils. Life Science Journal. 2011;8(2):658-661] (ISSN:1097-8135). <http://www.lifesciencesite.com>.

Keywords: Acid soil, Liming, Paper mill sludge.

1. Introduction

Amelioration of acid soils with liming materials is a common management (Haby et al, 1995; Quoggio et al, 1995), but from other materials are also used as acid soil amendment, such as gypsum and phosphate rocks (Hea et al, 1996) and some industrial by-products (Edward et al, 1985; Vityakon et al, 1995; Oguntoinbo, 1996; Stuczynski et al, 1998; Curnoe et al, 2006; Alves et al, 2006; Mohammadi Torkashvand, 2010). The main aim of soil liming is to neutralize acidic inputs and recovering the buffering capacity to the soil (Ulrich, 1983).

Paper mill sludge (PMS) is produced as a by-product of paper industry that disposal of this material presents a problem for the mill (Battaglia et al., 2007; Mahmood and Elliot, 2006). Disposal by land filling, the most common disposal method, is costly and faces increasingly stringent environmental regulations (Feldkinchner et al., 2003). Lime sludge is the solid waste produced as part of the process that turns wood chips into pulp for paper. The major component of lime mud is calcium carbonate (CaCO₃) and it is estimated that about 0.47 m³ of lime mud is generated to produce 1 ton of pulp (Wirojanagud et al., 2004).

A 4-year field study in Alberta (Macyk, 1996) recommended an agronomically sound decomposed pulp mill sludge application rate of 40–80 dry ton ha⁻¹ for brome grass. Kannan and Oblisami (1990) also concluded in a same research

that paper alkaline waste along pulp with paper in irrigating sugar can fields is leading to reduced growth. High consumption of sludge (10 ton/ha) also caused to reduced plant yield. Leon et al. (2006) during a research concluded that the use of paper sludge as soil modifiers significantly caused to decreased rot in bean in sludge treatments compared with control. They knew the reducing disease result from a change in properties of soil biology. Curnoe et al. (2006) identified the positive effects of lime sludge paper factory on maize yield. Gaskin and Morris (2004) indicated that lime mud has potential to be used as an agricultural liming material because of its capability to neutralize soil acidity (increase soil pH) and add calcium and magnesium to the soil. Although high moisture content of lime mud creates more shipping and handling difficulties than typical dry agricultural liming materials (Mahmoudkhani et al., 2004), this obstacle can be overcome as sludge dewatering technology improves (Chen et al., 2002 and Yin et al., 2004).

2. Materials and Methods

In this study, the effect of a by-product of paper industry called Paper Mill Sludge (PMS) was investigated as a liming factor to correct soil acidity of berry fields. The chemical composition of the paper mill sludge (was collected from Pars and Chocka factories, Khoozestan and Guilan provinces, Iran) showed that this compound contained about 58.4% calcium carbonates equivalent and a pH about

13.2 (pH of 1:2.5 dry paper mill sludge/water suspension), and small amounts of Zn, Cu, Cr, Cd and Pb respectively 4.12, 2.35, 7.54, 3.25 and 28.6 mg.kg⁻¹. A field experiment was conducted in a berry orchard of silk worm research center by a randomized completely block design with three replicates pay attention to incubation experiment results. In addition to a control treatment, the amounts of 2.5, 5 and 10 ton.ha⁻¹ of PMS and a treatment of used common lime i.e. calcite amounted 2.5 ton.ha⁻¹ were used. The dimension of every plot was 1×7m including 5 berry plants. All plots received N-P-K fertilizers, uniformly.

The soil analysis of berry field showed a pH=6.3. The E_{Ce}, nitrogen and organic matter, phosphorus and potassium (mg/kg) were 0.32 dS/m, 0.105%, 1.12% and 17.2 and 168.2 mg/kg, respectively. Total concentrations of some elements in the paper mill sludge were determined in the extract after digestion of samples with HNO₃ and HCl (Hossner, 1996) for elemental analysis. The amounts in the digests were determined using inductively coupled plasma atomic emission spectrometry (ICP-AES, LEEMAN LABS, Inc.). The sludge pH and EC (Rhoads, 1996) were determined in a 1:2.5 paper mill sludge/water suspension.

After 90 days, leaf dry matter yield was determined after drying of the harvested shoots at 70°C for 48 h. Total kjeldahl nitrogen (TKN) of samples were estimated by using a micro-kjeldahl method (Singh and Pradhan, 1981). Subsamples of dry leaf were ground and then dry-ashed in a furnace at 550°C and then extracted with 2N HCl. Concentration of K by flame photometry and P by spectrophotometry. Data were analyzed by standard ANOVA procedures using MSTATC and SAS softwares and significance were based on $p < 0.05$ level for LSD Test.

3. Results and Discussion

Many studies have shown that the liming improved the growth of many crops cultivated on acid soils such as red clover (Steiner and Alderman, 2003), wheat and barley (Tang et al., 2003), peanut (Chang and Sung, 2004) and cotton (Pearson et al., 1973). Results of this study showed that the berry leaf dry matter yield increased significantly ($P < 0.05$) in 2.5 and 5 ton/ha of PMS treatments than in the control (Figure 1). This increase in leaf dry matter yield was 1.36 and 1.55 times higher than in the control (L₀). Increase in yield can be due to the correction of soil acidity lead to improved soil conditions for growth berries. Hea et al. (2009) during the research had been used from paper industry lime sludge as soil acidic modifiers and

concluded that the amount between L₂ and L₃ treatments, i.e. between 4.51 and 9.01 tons per hectare cause to a better response of ryegrass yield to application of lime sludge. Pantasiz et al (2009) in a greenhouse experiment in the use of paper alkaline waste concluded that use of it, caused to increase plant growth.

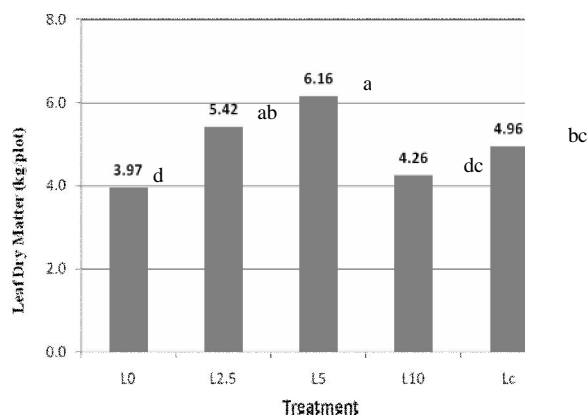


Figure 1. The effect of treatments on leaf dry matter

PMS and calcite lime treatments increased leaf protein, significantly (Figure 2). Sericulture production is depending to the amount of leaves percent of proteins, therefore sludge had been caused to increase the percent of protein and yield of leaf. Increase of leaf protein in sludge treatments is because the increase of leaf N concentration in this treatment (Figure 2). Because leaf nitrogen concentration is more in calcite lime treatment than sludge treatment, so the percentage of protein in the leaves in calcite lime treatments even higher in sludge treatment, so according to leave yield, in the treated soils with 2.5 and 5 ton sludge, is more important in comparison with calcite lime.

Uptake more phosphorus in 2.5 ton/ha treatment due to more concentration of phosphorus in leave dry matter and higher plant yield (dry leaves) is undergoing this treatment. Reducing the treatments of P concentrations in leaves and other paper sludge and lime calcite is considered the result of lower uptake of phosphorus. It is likely that the increases of calcium lead to phosphorus precipitation as calcium phosphates and phosphorus availability it had been restricted for plants. Increasing the potassium uptake in treatments 2.5 and 5 tons per hectare is due to increased leave potassium concentration and increase dry matter of leaf yield. Nunes et al (2008) during a greenhouse study to evaluate potential of paper lime sludge as a cause of calcareous on the growth of wheat in two soil of Cambisols and Arenosol concluded that the use of it cause to significantly increase of soil PH, total nitrogen, available

phosphorus and potassium. They introduced this by-product as a calcareous factor in amending acidic soils which are better for growth of grain crops along with magnesium fertilizers.

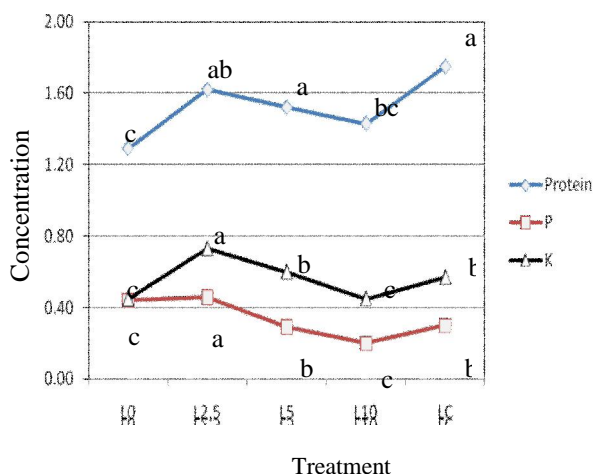


Figure 2. The effect of treatments on phosphorus, potassium and protein concentrations (%) of berry leaves and nutrients uptake of soil (g/plot)

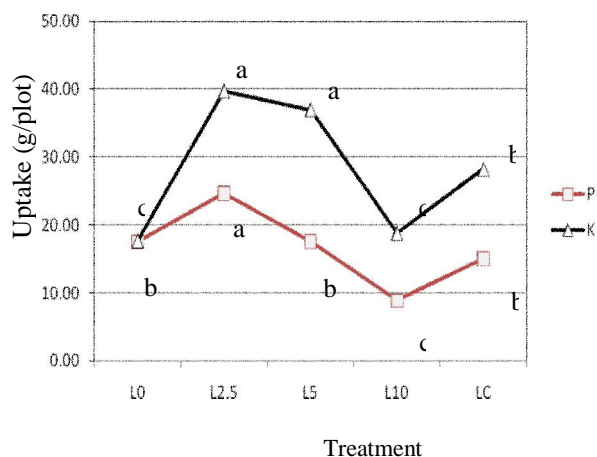


Figure 3. The effect of treatments on phosphorus and potassium uptake by berry leaves

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4. Conclusion

Taking into consideration dry matter yield, protein and nutrient uptake jointly, treatments 2.5 and 5 ha of PMS had better effects in comparison with calcite lime. The results indicated the potential of PMS as acidic soil modifiers in the replacement of conventional calcite sources such as calcite which can reduce the disposal costs and possible environmental contamination of this by-product.

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Evaluation of IL18 in acute coronary syndrome patients and its relation to diabetes

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Abstract: To assess interleukin 18 in patients with acute coronary syndrome (ACS) with and without diabetes and to detect its relation to lipid profile. **Patients and Methods:** The study included 40 ACS patients (20 patients had type 2 diabetes mellitus) and 15 age and sex matched as a control group. **Results:** Total cholesterol is significantly higher and HDL-c is significantly lower in diabetic patients with ACS than the other 2 groups. IL18 is significantly higher in diabetic patients with ACS followed by non diabetic patients with ACS than the control group. No significant correlation was found between IL18 and blood glucose level or lipid profile in the 3 groups. **Conclusion:** IL18 is an inflammatory marker in patients with ACS and diabetes. No relation between IL18 and lipid profile. In addition, IL-18 levels were associated with traditional risk factors such as diabetes mellitus.

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Keywords: IL18; coronary syndrome; diabetes.

1. Introduction

Chronic inflammation causes atherosclerosis and is also involved in atherosclerotic plaque disruption and thrombosis, and may greatly influence the occurrence of acute ischemic syndrome (1).

Interleukin (IL)-18, originally termed interferon (IFN)- γ -inducing factor, is a newly discovered cytokine with pleiotropic activities extending from T-helper 1 cell (Th1) polarization of the immune response to a proinflammatory activity. The multifunctional properties of IL-18 production in numerous diseases, such as infections, several types of cancer, and in-inflammatory and autoimmune diseases, reflect an inappropriate immune response (2).

IL-18 is found in the unstable atherosclerotic plaque, in adipose tissue and in muscle tissue, and is subjected to several regulatory steps including cleavage by caspase-1, inactivation by IL-18 binding protein and the influence of other cytokines in modulating its interaction with the IL-18 receptor (3). A recent study showed significant expression of IL-18 in human carotid atherosclerotic plaques (4). Increasing plasma levels of IL-18 in patients with acute coronary syndrome were reported to be associated with increased mortality (5). Moreover, the serum IL-18 level was identified as a strong independent predictor of death from cardiovascular causes in patients with coronary artery disease (6). However, the effects of IL-18 on the production of other cytokines in coronary artery disease are still unknown.

The objectives of the present study were to analyze the serum levels of IL-18 in patients with

acute coronary syndrome and to compare possible variations of serum levels between the groups according to the presence of diabetes.

2. Materials and Methods

Patients:

The study population consisted of 40 patients with acute coronary syndrome admitted to ICU. ACS was diagnosed by ; persistent typical chest pain (precordial radiating to the left shoulder and back) on admission, ECG changes, ST segment depression and / or T wave changes and elevated cardiac enzymes (CK, MB, LDH and Troponin), non-ST segment elevation myocardial infarction, or unstable angina. Diabetes was present among 20 patients only and 15 age and sex matched healthy persons served as a control group.

Exclusion criteria:

Pregnancy; Class III or IV congestive heart failure; Valvular heart disease; History of acute myocardial infarction in the preceding four weeks; Atrial fibrillation; Any ECG abnormality that could affect the analysis of the ST-segment; History of surgery or trauma in the preceding four weeks; History of chronic or acute inflammatory disease and History of malignancies.

Methods:

The study was done after obtaining approval from the local institutional review board and human subject's protection. Written informed consent was obtained from all patients.

Patients were subjected to ECG recording on admission and every 6 hours during the first 24 hr. Also serial cardiac enzymes were done on admission and every 8 hr during the first 24 hr.

Venous blood samples (10 ml) were drawn in the morning after an overnight fasting from each subject. The venous blood sample was divided into three test tubes. 1 ml was added to a mixture of potassium oxalate and sodium fluoride (for plasma glucose estimation by oxidase/peroxidase kit (7)), 2 ml was added to EDTA powder (whole blood to estimate HbA1c by cationic exchange resin(8)) and the remaining 7 ml were allowed to clot at room temperature then centrifuged at 1000 rpm for 15 minutes. Serum was separated and divided into aliquots then frozen at -70 °C till the time of assay. The serum samples were used to estimate the Interleukin 18: by a solid phase enzyme linked immunosorbent assay (ELISA) Kit (9).

Plasma concentrations of cholesterol and triglycerides, LDL and HDL were determined by quantitative colorimetric kit.

Statistical Methods:

Statistical Package for social science (SPSS) version 9.0 was used for analysis of data (Chicago, Illinois, USA). Non Parametric test (Mann Whitney U) test was done for analysis of 2 quantitative data, as data was not symmetrically distributed. One way ANOVA was used for comparison of the 3 groups followed by post hoc test (LSD) for detection of significance. Pearson's correlation was also done.

3. Results:

The study included 40 patients with ACS their mean age was 55.5 ± 3.2 yrs (54 – 72 yrs). Twenty patients did not have diabetes, their mean age was 64.5 ± 2.6 yrs (54 – 70 yrs), 20 diabetic patients, their mean age was 65.8 ± 3.3 yrs (60 – 72 yrs) and 15 age and sex matched as a control group, their mean age was 64.2 ± 3.1 yrs(55 – 68 yrs).

Table 1 : Comparison between laboratory data of patients with acute coronary syndrome and controls included in the study

Variables	Patients with acute coronary syndrome Mean \pm SD N = 40	Controls Mean \pm SD N = 15	P –value
Fasting blood glucose (mg \ dl)	148.0 \pm 82.7 (73 – 360)	89.7 \pm 9.4 (70.0 – 105.0)	0.01*
Total cholesterol (mg\dl)	194.7 \pm 36.4 (109 – 290)	185.6 \pm 9.8 (166.0 – 200.0)	0.4
Triglyceride (mg\dl)	159.6 \pm 32.8 (76 – 225)	169.6 \pm 4.9 (159.0 – 177.0)	0.2
HDL-c (mg\dl)	44.7 \pm 13.9 (28 – 93)	47.4 \pm 5.4 (40.0 – 58.0)	0.5
LDL –c (mg\dl)	147.0 \pm 12.7 (122 – 190)	148.1 \pm 7.3 (136.0 – 159.0)	0.8
IL18	509.1 \pm 237.0 (220 -950)	69.2 \pm 7.8 (55.6 – 80.5)	0.0001*

Table 2: Correlation between IL 18 of patients with acute coronary syndrome included in the study with other laboratory data

Variables	Patients with Acute coronary syndrome	
	R	P- value
Fasting blood glucose (mg \ dl)	- 0.02	0.9
Total cholesterol (mg\dl)	- 0.1	0.8
Triglyceride (mg\dl)	-0.5	0.07
HDL-c (mg\dl)	0.2	0.4
LDL –c (mg\dl)	0.01	1.0
HbA1 (%)	0.5	0.04*

Table 3 : Comparison between laboratory data of diabetic and non diabetic patients with acute coronary syndrome and controls included in the study

Variables	Diabetic with acute coronary syndrome Mean \pm SD N = 20	Non Diabetic with acute coronary syndrome Mean \pm SD N = 20	Controls Mean \pm SD N = 15	P -value
Fasting blood glucose (mg \ dl)	209.9 \pm 76.7 ^a (118.0 – 360.0)	86.1 \pm 8.0 ^b (73.0 – 98.0)	89.7 \pm 9.4 ^b (70.0 – 105.0)	0.0001*
Total cholesterol (mg\dl)	211.2 \pm 41.3 ^a (143.0 – 290.0)	178.2 \pm 21.4 ^b (109.0 – 204.0)	185.6 \pm 9.8 ^b (166.0 – 200.0)	0.005*
Triglyceride (mg\dl)	162.1 \pm 38.1 (83.0 – 225.0)	157.0 \pm 27.6 (76.0 – 185.0)	169.6 \pm 4.9 (159.0 – 177.0)	0.5
HDL-c (mg\dl)	37.1 \pm 6.6 ^a (28.0 – 52.0)	52.3 \pm 15.3 ^b (42.0 – 93.0)	47.4 \pm 5.4 ^b (40.0 – 58.0)	0.001*
LDL -c (mg\dl)	149.6 \pm 15.9 (122.0 – 190.0)	144.3 \pm 8.1 (135.0 – 158.0)	148.1 \pm 7.3 (136.0 – 159.0)	0.4
IL18	662.3 \pm 245.1 ^a (230.0 – 950.0)	355.9 \pm 77.2 ^b (220.0 – 500.0)	69.2 \pm 7.8 ^c (55.6 – 80.5)	0.0001*

Different symbol indicates significance.

Table 4: Correlation between IL 18 of diabetic and non diabetic patients with acute coronary syndrome and controls included in the study with other laboratory data

Variables	Diabetics with acute coronary syndrome		Non Diabetics with acute coronary syndrome		Controls	
	R	P- value	R	P- value	r	P- value
Fasting blood glucose (mg \ dl)	0.3	0.3	-0.2	0.6	- 0.02	0.9
Total cholesterol (mg\dl)	-0.4	0.2	0.1	0.8	0.5	0.07
Triglyceride (mg\dl)	-0.1	0.8	0.1	0.8	0.2	0.4
HDL-c (mg\dl)	-0.3	0.3	-0.4	0.1	0.01	1.0
LDL -c (mg\dl)	-0.03	0.9	-0.2	0.4	0.5	0.07

4. Discussion:

IL-18 is found in the unstable atherosclerotic plaque, in adipose tissue and in muscle tissue, and is subjected to several regulatory steps including cleavage by caspase-1, inactivation by IL-18 binding protein and the influence of other cytokines in modulating its interaction with the IL-18 receptor (3). Interleukin-18 (IL-18), a proinflammatory cytokine, has been associated with atherogenesis and plaque rupture in acute coronary syndrome (ACS). Recent studies suggest that IL-18 may have a long-term prognostic value (10)

In the current study, Patients with acute coronary syndrome had a significantly higher level of fasting blood glucose and IL 18 than controls (table 1).

According to a report that the focus of systemic inflammation in patients with unstable angina is the result of low-grade myocardial necrosis (11), circulating IL- 18 may also reflect the myocardial damage seen in patients with acute coronary syndrome. Thus, the effects of IL-18 on myocardial damage in ischemia are much less well

understood. A recent study showed that the endogenous inhibitor of IL-18 and IL-18 binding protein modulates the development and stability of atherosclerosis in ApoE knockout mice (12).

Evidence from experimental studies has emerged that expression of IL-18 is intimately related to atherosclerotic plaque progression and vulnerability (13 -16). These results could be translated into the clinical setting, as shown in the AtheroGene Study, which suggested that the concentration of circulating IL-18 was one of the strongest predictors of future cardiovascular events in patients with stable and unstable angina (17). Also Furtado et al (10) concluded that Serum IL-18 levels in ACS patients were independent predictors of long-term cardiovascular events. These findings support the association between inflammation and prognosis of ACS patients, as well as the clinical impact of this biomarker

Additionally, Hartford et al (18) found that IL-18 levels were significantly related to cardiovascular mortality. IL-18 independently predicted CHF, MI, and cardiovascular death in both

the short and long term and concluded that the addition of the measurement of IL-18 to clinical variables improved the prediction of risk of cardiovascular mortality

Yamaoka-Tojo et al (19) demonstrated for the first time that measurement of IL-18 provides important information about the severity of myocardial damage in patients with acute coronary syndrome.

Mallat et al, (20), reported two potentially important findings, first, plasma concentrations of IL-18 are increased in patients with acute coronary syndromes with or without myocardial necrosis. Second, plasma concentrations of IL-18 correlate with the severity of myocardial dysfunction.

In the present study, IL 18 has a significant positive correlation with HbA1 in all patients with acute coronary syndrome (table 2). Also, IL18 shows a significant higher level in diabetic patients with ACS followed by non diabetic patients with ACS than the control group (table 3).

In accordance to these results Chazova et al (21) found that serum level of IL18 was increased in patients with type 2 diabetes mellitus and ACS and concluded that IL18, chronic hyperglycemia and depressive disorders play an important role in development of latent inflammation of the vascular wall in patients with type 2 diabetes mellitus and ACS

Hyperglycemia itself, a characteristic of glucose intolerance, is related to the immediate synthesis of markers such as IL-6 and IL-18, with serum level variations positively correlated and with more significant increases in hyperglycemic spikes, a situation that is common in diabetic patients (22).

Since patients with diabetes comprise a significant part of the population with coronary artery disease (20-24%), the understanding of the inflammatory mechanisms in diabetes and also in insulin resistance is fundamental for a proper treatment (23).

Our study showed that, total cholesterol is significantly higher and HDL-c is significantly lower in diabetic patients with ACS than the other 2 groups (table 3). No significant correlation was found between IL18 and blood glucose level or lipid profile in the 3 groups (table 4).

In the contrary, Hulthe et al (24) reported that the plasma IL-18 concentration was associated with a range of traditional cardiovascular risk factors such as BMI, LDL- and HDL-cholesterol, triglyceride, insulin and proinsulin .

5. Conclusion:

Increased plasma IL-18 level is observed in patients with ACS and diabetes. In addition, IL-18

levels were higher in diabetic patients than nondiabetics. No correlation was found between IL18 and lipid profile.

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Beneficial Effects of some beverage consumption and Orlist drug on Diet Induced Obesity in Experimental Rats

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Abstract: Forty two normal male albino rats of Sprague Dawley strain, weighing (170 ± 5 g) strain were fed on high fat diet for six week to induce obesity. The obesity rats were randomly classified into six groups (7 rats each) and treated with orlistat, coffee, green tea, cinnamon and mixture of them for six week.

The results revealed that, obese rat groups which treated with orlistat, green tea, coffee, cinnamon and mixture of them showed lowered values of final weight, weight gain, gain percent, FER, leptin, glucose, cholesterol, total lipids, phospholipids, triglyceride, LDL-C, VLDL-C and cholesterol/HDL-C but a significant increase in the value of serum HDL-C in comparing with control (+ve). The rat group which treated with orlistat showed non significant difference in the values of serum AST, ALT & ALP but all rat groups treated with green tea, coffee, cinnamon and mixture of them showed a significant decrease in serum AST, ALT & ALP, serum creatinine and urea compared with control (+ve).

The rat groups which treated with green tea, coffee, cinnamon and mixture of them showed a significant decrease in the values of serum creatinine and urea but the rat groups which treated with cinnamon and mixture of green tea, coffee and cinnamon showed a significant decrease in the value of serum uric acid compared with control (+ve).

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Key wards: Obesity – Orlistat – Coffee- Green tea – Cinnamon- Rats.

1. Introduction:

Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy and/or increased health problems. Obesity increases the likelihood of various diseases, particularly heart disease, type 2 diabetes, breathing difficulties during sleep, certain types of cancer, and osteoarthritis (Lau et al., 2007). The main treatment for obesity consists of dieting and physical exercise. Diet programs may produce weight loss over the short term, but maintaining this weight loss is frequently difficult and often requires making exercise and a lower calorie diet a permanent part of a person's lifestyle (Strychar 2006).

There are many possible pathophysiological mechanisms involved in the development and maintenance of obesity. Since leptin was discovered, many other hormonal mechanisms have been elucidated that participate in the regulation of appetite and food intake, storage patterns of adipose tissue, and development of insulin resistance. The adipokines are mediators produced by adipose tissue; their action is thought to modify many obesity-related diseases (Flier 2004 and Kushner 2007). There is a little information on drugs affect longer-term

complications of obesity. One medication, orlistat (Xenical), is current widely available and approved for long term use for weight loss. Its primary function is preventing the absorption of fats from the human diet, thereby reducing caloric intake (Torgerson et al., 2004).

Coffee is made from the extract of coffee beans, and is available in a remarkable variety of different types throughout the world. Currently, the influence of coffee on the health of people is considered of great significance due to the enormous consumption worldwide. Coffee contains large amounts of antioxidants, such as chlorogenic acids other than caffeine (Gyntelberg et al., 1995).

The consumption of tea is a very ancient habit and legends from China and India indicate that it was initiated about five thousand years ago. Tea is one of the most widely consumed beverages in the world, second only to water, and its medicinal properties have been widely explored. Polyphenols in tea especially the flavonoids possess a high antioxidant power which can protect cells against the adverse effects of reactive oxygen species. Catechins are a group of very active flavonoids found largely in tea (Balentine et al., 1997).

Cinnamon was imported to Egypt as early as 2000 BCE; Cinnamon bark is widely used as a spice. It is principally employed in cookery as a condiment and flavoring material. It is used in the preparation of chocolate, also in many desserts recipes. In the Middle East, it is often used in savory dishes of chicken and lamb. In the United States, cinnamon and sugar are often used to flavor cereals, bread-based dishes, and fruits, especially apples. In medicine, it acts like other volatile oils and once had a reputation as a cure for colds. It has also been used to treat diarrhea and other problems of the digestive system. Cinnamon is high in antioxidant activity. The essential oil of cinnamon also has antimicrobial properties, which can aid in the preservation of certain foods. Cinnamon could have some pharmacological effects in the treatment of type 2 diabetes mellitus and insulin resistance (Singh et al., 2007).

Therefore, we investigated the effect of coffee, green tea and cinnamon intake on body weight in an experimental model of obesity.

2. Materials and Methods:

Materials:

Orlistat drug was marketed as a prescription under the trade name Xenical by Roche in most countries and also known as tetrahydrolipstatin. Orlistat drug was obtained from the pharmacy in Cairo, Egypt. Kits used for biochemical analysis were obtained from Gama tread Company, Cairo, Egypt. The orlistat rat dose was 5 mg / rat. Green tea (*Camellia sinensis*), coffee (*Coffea arabica*) and cinnamon (*Cinnamomum zillanicum*) packets were obtained from local market. Forty two normal male albino rats of Sprague Dawley strain, weighing (170 ± 5 g) were obtained from the Laboratory Animal Colony, Helwan, Cairo, Egypt.

Methods:

The standard diet was prepared from casein (200g/kg), corn starch (497g/kg), sucrose (100g/kg), cellulose (30 g/kg), corn oil (50g/kg), mineral mixture (100g/kg), vitamin mixture (20g/kg) and DL-methionine (3g/kg) according to NRC (1995). High fat diet was a standard diet in addition to 200 g ghee/kg diet as saturated fat and substituted from the amount of corn starch according to Bhatt et al., (2006).

Green tea, coffee, and cinnamon extract were prepared separately by putting packets in 75 ml boiled water for 4 min according to the method described by Jonathan et al., (2000). Water extracts were prepared freshly every day. The rat dose of these extract was 5 ml / rat three times daily.

Rats were housed in cages under hygienic condition and fed on basal diet for one week for adaptation then fed 6 week on high fat diet to induce obesity. The weight of obese rats reached 255 ± 5 g and then divided into six groups (n = 7 each) fed also on high fat diet all over the period of the experiment. One group served as a positive control. The other rat groups treated daily with orlistat, green tea, coffee, cinnamon and mixture of them for six week. The food intake was calculated daily and the body weight gain was recorded weekly. Feed efficiency ratio, FER, [weight gain (g)/ feed intake (g)] was calculated according to Chapman et al., (1950)

At the end of the experimental period, all rats were fasted overnight then sacrificed. Blood samples were immediately collected in clean and dried Wiesserman tubes from the portal vein. First part of blood was collected in tubes containing potassium oxalate and sodium fluoride for the estimation of glucose by O-toluidine method (Sasaki et al., 1972). Second part of blood was left to coagulate then centrifuged at 3000 rpm for 15 minutes to obtain serum. Serum insulin and leptin were estimated according to Wilson and Miles (1977) and Palacio et al., (2002), respectively.

Serum cholesterol, triglycerides (TG), high density lipoprotein cholesterol (HDL-c), and total lipids were determined by using enzymatic colorimetric methods (Abell et al., 1952, Buccolo and David (1973), Kostener, 1977 and Folch et al., 1957). Very low density lipoprotein cholesterol (VLDL-c) was calculated as TG/5 but low density lipoprotein cholesterol (LDL-c) was calculated as following [LDL-c = Total cholesterol - HDL-c - VLDL-c] according to Fruchart, (1982) while phospholipids calculated as following [phospholipids = total lipid - (TG-Tc)] according to Ketes (1972). Atherogenic index (cholesterol /HDL-c) was calculated according to Castelli and levitar, (1977).

Serum alanine and aspartate aminotransferase (ALT&AST), and alkaline phosphatase (AP) activity enzymes were estimated according to Reitman and Frankel (1957) and Kind and King (1954), respectively. In addition, creatinine, urea and uric were estimated according to Bonsens and Taussky, (1984), Patton and Crouch, (1977), and Fossati et al., (1980), respectively. Blood superoxide dismutase (SOD) catalase, glutathione peroxidase (GPX) and nitric oxide (NO) were estimated according to Mc Cord and Fridovich, (1969), Aebi, (1974), Flohe and Gunzler (1984) and Green et al., (1981), respectively.

Collected data were presented as mean ±SD and statistically analyzed using one way analysis of variance (ANOVA). Student "t" test was used for significance according to Artimage and Berry (1987).

3. Results and Discussion:

Results of table (1) indicated that obese rat groups which treated with orlistate, green tea, coffee, cinnamon and mixture of them showed lowered values of final weight ($p < 0.05$ & 0.01), weight gain ($p < 0.01$ & 0.001), gain percent ($p < 0.001$) and FER ($p < 0.01$) in comparing with control (+ve). The rat groups which treated with orlistate or mixture of the experimental beverage showed a significant decrease in weight gain and gain percent compared with rat groups which treated with green tea, coffee and cinnamon. There were non significant differences in final weight, food intake and FER among treated groups.

It is known that orlistat is the saturated derivative of lipstatin, a potent natural inhibitor of pancreatic lipases isolated from the bacterium *Streptomyces toxytricini*. However, due to simplicity and stability, orlistat rather than lipstatin was developed into an anti-obesity drug (Haslam and James 2005). It is apparent that the tea is a source of a wide range of phytochemicals that are digested, absorbed and metabolized by the body, and that tea

constituents exert their effects at the cellular level. Supplementation with tea catechins resulted in a significant reduction of high-fat diet-induced body weight gain, visceral and liver fat accumulation, and the development of hyperinsulinemia and hyperleptinemia in mice (Murase et al., 2002). The thermogenic properties of green tea could reside primarily in an interaction between its high content in catechins and the presence of caffeine with sympathetically released noradrenaline. The increased and prolonged sympathetic stimulation of thermogenesis by the interaction between polyphenols and caffeine could be of value in assisting the management of obesity (Dulloo et al., 2000). Coffee is appreciated for its aroma and flavor, but caffeine plays also a role in its popularity. Coffee is a mixture of thousands different compounds, like carbohydrates, lipids, vitamins, alkaloids, nitrogenous molecules, and phenolic compounds (Mario 2010). *Cinnamon* was mainly focused on its essential oils which included antioxidant, antimicrobial activity and antidiarrhoeal activity. Cinnamon did not decrease the levels of blood glucose, but did lower circulating insulin concentrations (Singh et al., 2007).

Table (1): Body weight gain, food intake and food efficiency ratio (FER) of the experimental rat groups

Groups Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
weight(g)	255.41± 8.42 ^a	257.14± 7.18 ^a	258.21± 7.35 ^a	255.33± 8.22 ^a	256.41± 7.11 ^a	257.45± 7.18 ^a
Final Weight(g)	430.74± 55.14 ^a	292.28± 47.21 ^{b*}	304.38± 48.61 ^{b*}	296.55± 36.71 ^{b*}	299.72± 51.11 ^{b*}	288.86± 45.14 ^{b**}
Weight gain(g)	175.33± 20.23 ^a	35.14± 3.16 ^{c***}	46.17± 5.21 ^{b**}	41.22± 5.21 ^{b**}	43.31± 6.01 ^{b**}	31.41± 3.20 ^{c***}
Gain %	49.33± 6.19 ^a	9.83± 1.60 ^{c***}	12.88± 1.81 ^{b***}	11.60± 1.65 ^{b***}	12.15± 1.36 ^{b***}	8.78± 1.03 ^{c***}
Food intake (g/w)	39.88± 4.21 ^a	35.45± 4.66 ^a	36.11± 5.20 ^a	35.55± 3.99 ^a	36.75± 4.69 ^a	36.25± 5.11 ^a
FER	0.020± 0.003 ^a	0.004± 0.001 ^{b**}	0.005± 0.002 ^{b**}	0.005± 0.001 ^{b**}	0.006± 0.002 ^{b**}	0.004± 0.001 ^{b**}

Significant with control group * $P < 0.05$ ** $P < 0.01$ *** $P < 0.001$

Mean values in each raw having different superscript (a, b, c, d) are significant

It is evident in table 2 that all treated rat groups showed a significant decrease in the values of leptin ($p < 0.01$ & 0.001) and glucose ($p < 0.01$) but showed non significant difference in insulin value compared with control (+ve). There were non significant differences in leptin, insulin and glucose among treated groups.

Obesity increase incidence of obesity-related disorders type 2 diabetes and cardiovascular diseases. Obesity is a disorder of energy balance and is associated with hyperinsulinemia, insulin resistance, and abnormalities in lipid metabolism. In addition,

hyperinsulinemia and insulin-resistance contribute to vascular dysfunction, because the opposing endothelium-dependent vasodilating and vasoconstrictor effects of insulin are shifted toward a predominant vasoconstriction in patients with obesity. Leptin has been shown in many studies to inhibit insulin release (Haslam and James 2005). It has been reported that leptin is produced by adipose tissue to signal fat storage reserves in the body, and mediates long-term appetitive controls (to eat more when fat storages are low and less when fat storages are high). Leptin participates in the modulation of energy

metabolism, neuroendocrine, angiogenesis, reproduction and immune responses, suggesting an important role of leptin in the recovery of functions. Most obese individuals are thought to be leptin resistant and have been found to have high levels of leptin. Leptin is produced peripherally, and control appetite through their actions on the central nervous system thus a deficiency in leptin signaling, either via leptin deficiency or leptin resistance, leads to overfeeding and may account for some genetic and acquired forms of obesity (Hamann and Matthaei

1996 and Faggioni et al., 2000). Consumption of coffee and tea is associated with a reduced risk of several chronic and degenerative diseases including cardiovascular disorders, diabetes, and obesity and neurodegenerative disorders (Mario 2010). *Cinnamon* has insulin-like action and exerts a blood glucose-suppressing effect by improving insulin sensitivity, signaling and synthesis. *Cinnamon* extract has a regulatory role in blood glucose level and lipids (Kim et al., 2006).

Table (2): Mean values \pm SD of leptin, insulin and glucose of the experimental rat groups

Groups Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
Leptin (μ g/l)	123.20 \pm 15.77 ^a	59.11 \pm 8.20 ^{b***}	63.21 \pm 9.17 ^{b**}	65.71 \pm 8.33 ^{b**}	70.21 \pm 7.20 ^{b**}	55.60 \pm 5.03 ^{b***}
Insulin (μ /ml)	13.37 \pm 2.11 ^a	15.88 \pm 2.25 ^a	15.75 \pm 2.14 ^a	16.35 \pm 2.66 ^a	15.02 \pm 2.19 ^a	16.68 \pm 1.99 ^a
Glucose (mg/dl)	175.11 \pm 18.70 ^a	115.44 \pm 13.28 ^{b**}	117.45 \pm 12.14	110.21 \pm 9.69 ^{b**}	117.24 \pm 10.22 ^{b**}	113.39 \pm 11.31 ^{b**}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001

Mean values in each raw having different superscript (a, b, c, d) are significant

From results of table (3) it could be noticed that all treated rat groups showed a significant decrease in the values of serum cholesterol ($p<0.01$ & 0.001), total lipids ($p<0.001$), phospholipids ($p<0.01$) and triglyceride ($p<0.01$) compared with control (+ve). There were non significant differences in serum cholesterol, total lipids, phospholipids, and triglyceride among treated groups.

Orlistat works by inhibiting gastric and pancreatic lipases, the enzymes that break down triglycerides in the intestine. When lipase activity is blocked, triglycerides from the diet are not hydrolyzed into absorbable free fatty acids, and are excreted undigested instead. Only trace amounts of orlistat are absorbed systemically; the primary effect is local lipase inhibition within the gastrointestinal tract after an oral dose. The primary route of elimination is through the feces (Zhi et al., 1995). Oxidation of LDL induces modification in lipoproteins, stimulates inflammatory reactions, causes monocytes and monocyte-derived macrophages to accumulate in large amounts of oxidized LDL, and forms lipid-laden foam cells and atherosclerotic plaques. The intake of saturated fat accelerates these events. There are several reports indicating that tea inhibits the oxidation of LDL in vitro. A high level of cholesterol is one of the most common problems among overweight or obese people, and this can, over a period of time, cause several other complications, including coronary heart disease and heart attacks (Abd El-Ghany et al., 2004).

Tea extracts, catechin and epicatechin exhibit a dose dependant inhibition on the formation of early lipid peroxidation products and late lipid peroxide decomposition products. Green tea reduces significantly serum and liver cholesterol, atherogenic index, and liver weight by lowering lipid deposition in hypercholesterolemic diet-induced rats. Rats fed with 2.5% green tea leaves in the diet for a long time had a reduction in blood triglycerides and total cholesterol contents (Yang and Koo 1997). Green or black tea at a lower level, also improved plasma lipid profiles and reduced LDL and VLDL oxidation in hamsters fed a normal or a high cholesterol diet (Lin et al., 1998). Green tea extract rich in catechins and caffeine has thermogenic properties and promotes fat oxidation beyond than those explained by its caffeine content. The green tea extract may play a role in the control of body composition via sympathetic activation of thermogenesis, fat oxidation, or both (Dulloo et al., 1999). Boiled coffee has been found extensively to be associated with an increase in serum cholesterol, whereas no association has been shown for coffee prepared by the filter process (Hammar et al., 2003). Cinnamon, or its components, has potential lipid lowering properties in people with Type 2 diabetes and cholesterol-fed animals. Acute oral cinnamon treatment inhibits the increase in postprandial triglycerides and the overproduction of apoB48-containing lipoproteins in fructose-fed, insulin-resistant rats (Khan et al., 2003).

Table (3): Serum cholesterol, total lipids, phospholipids and triglyceride of the experimental rat groups

Groups Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
Cholesterol (mg/g)	371.41± 55.61 ^a	177.31± 20.11 ^{b***}	182.13± 18.14 ^{b**}	179.91± 16.21 ^{b**}	181.19± 20.18 ^{b***}	175.59± 16.16 ^{b***}
Total lipids (mg/g)	699.43± 112.13 ^a	388.31± 70.36 ^{b***}	391.41± 75.12 ^{b***}	395.54± 74.17 ^{b***}	401.14± 81.36 ^{b***}	381.35± 69.16 ^{b***}
Phospholipids (mg/l)	136.75± 12.16 ^a	107.65± 9.11 ^{b**}	102.06± 10.11 ^{b**}	109.35± 12.17 ^{b**}	114.64± 13.15 ^{b**}	106.36± 11.66 ^{b**}
Triglyceride (mg/g)	191.45± 22.41 ^a	103.35± 9.16 ^{b**}	107.22± 11.11 ^{b**}	106.19± 12.21 ^{b**}	105.31± 11.61 ^{b**}	99.40± 9.69 ^{b**}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001

Mean values in each raw having different superscript (a, b, c, d) are significant

Data in table (4) showed that all treated rat groups showed a significant decrease in the values of serum LDL_c (p<0.001), VDL_c (p<0.001) and cholesterol/HDL_c (p<0.01&0.001) but a significant increase in the value of serum HDL_c (p<0.01) compared with control (+ve). There were non significant differences in the above mentioned parameters among treated groups.

Coffee has been widely investigated for its effects on the cardiovascular system (CHD). Moreover, coffee has been reported to raise inflammatory markers and lipid levels, although the effect on lipids is probably influenced by the brewing method, being higher for the boiled compared to the filtered method (Francesco et al., 2007). In general, coffee consumption is not associated with an

increased risk of CHD, whereas a significant association of CHD with high consumption of coffee is reported among case control studies (Hammar et al., 2003). The average flavonol and flavone intake in tea appears to be inversely correlated with mortality rates from coronary heart and play a protective role in the development of CVD (Tijburg et al., 1997). Flavonoids like quercetin, myricetin and kaempferol can also protect LDL from oxidation by regenerating tocopherol, an important endogenous antioxidant in humans (Zhu et al, 2000). Cinnamon has potential lipid lowering properties in animal and human studies. Cinnamon can reduce the level of cholesterol, especially the level of bad LDL cholesterol (Wang, et al., 2008).

Table (4): Serum HDLc, LDLc, VLDLc and cholesterol/HDLc of the experimental rat groups

Groups Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
HDLc (mg/dl)	25.53± 3.21 ^b	45.77± 4.10 ^{a**}	42.60± 4.27 ^{a**}	43.69± 4.26 ^{a**}	41.16± 5.11 ^{a**}	47.91± 5.31 ^{a**}
LDLc (mg/dl)	307.58± 91.16 ^a	110.84± 9.69 ^{b***}	118.09± 10.18 ^{b***}	114.99± 11.14 ^{b***}	118.97± 12.16 ^{b***}	107.80± 9.69 ^{b***}
VLDLc (mg/dl)	38.30± 7.21 ^a	20.70± 3.61 ^{b***}	21.44± 3.25 ^{b***}	21.23± 3.11 ^{b***}	21.06± 2.99 ^{b***}	19.88± 1.81 ^{b***}
Cholesterol /HDLc	12.43± 2.11 ^a	3.87± 0.36 ^{b***}	4.27± 0.48 ^{b***}	4.11± 0.77 ^{b***}	4.40± 0.55 ^{b**}	3.66± 0.43 ^{b***}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001

Mean values in each raw having different superscript (a, b, c, d) are significant

Data presented in table (5) showed that rat group which treated with orlistat showed non significant difference in the values of serum AST, ALT & ALP but all treated rat groups showed a significant decrease in these values (p<0.01&p<0.001) compared with control (+ve). There were non significant differences in the above mentioned parameters among treated groups.

Consumption of coffee and especially caffeine was associated with lower risk of elevated ALT activity. The coffee oils (kahweol and cafestol) and aromatic extracts isolated from coffee beans were associated with lower levels of liver enzymes, mainly serum alanine aminotransferase (ALT) and glutamyltransferase. Caffeine may have antioxidant effects that could be beneficial if oxidative stress

plays a role in liver injury (Honjo et al., 2001 and Constance and James 2005). Coffee consumption has been found to be associated with a reduced risk of chronic liver disease (Ruhl and Everhart 2005). Diterpenes (non triglyceride lipid components of coffee oils), cafestol and kahweol in coffee beans are

found to induce synthesis of glutathione, an important mediator against hepatocellular injury. Cinnamon is responsible for brain function, memory, stomach benign, reducing fat level in the body by lowering the cholesterol level and insulin level (Singh et al., 2007).

Table (5): Serum ALT, AST and ALP of the experimental rat groups

Groups Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
ALT (μ /ml)	55.99 \pm 6.44 ^a	57.31 \pm 6.96 ^a	40.33 \pm 5.88 ^{b**}	35.14 \pm 5.68 ^{b***}	42.31 \pm 5.24 ^{b**}	40.11 \pm 4.77 ^{b**}
AST (μ /ml)	101.31 \pm 9.60 ^a	112.31 \pm 11.29 ^a	66.81 \pm 7.11 ^{b**}	60.61 \pm 6.12 ^{b**}	67.18 \pm 7.30 ^{b**}	55.38 \pm 5.41 ^{b***}
ALP (μ /ml)	110.31 \pm 11.14 ^a	120.31 \pm 12.15 ^a	75.38 \pm 8.21 ^{b**}	61.18 \pm 7.10 ^{b**}	65.61 \pm 6.45 ^{b**}	71.31 \pm 8.24 ^{b**}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001

Mean values in each raw having different superscript (a, b, c, d) are significant

Data presented in table (6) showed that rat group treated with orlistat showed non significant difference in values of serum creatinine, urea and uric acid compared with control (+ve). Rat groups which treated with green tea, coffee, cinnamon and mixture of them showed a significant decrease in values of serum creatinine and urea (p<0.01&p<0.001) but rat groups which treated with cinnamon and mixture of green tea, coffee and cinnamon showed a significant decrease in value of serum uric acid (p<0.05) compared with control (+ve).

The rat groups which treated with green tea or cinnamon showed a significant difference in the value of serum creatinine compared with the rat groups which treated with coffee or mixture. There was non significant difference in the value of serum urea among rat groups which treated with green tea, coffee, cinnamon and mixture of them. There was non significant difference in the value of serum uric acid among rat groups which treated with coffee, cinnamon and mixture of them.

Rats receiving green tea prior to induce nephropathy have decreased blood levels of urea

Table (6): Serum Creatinine, urea and uric acid of the experimental rat groups

Groups Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
Creatinine (mg/dl)	0.99 \pm 0.13 ^a	1.02 \pm 0.36 ^a	0.68 \pm 0.19 ^{b**}	0.55 \pm 0.15 ^{c***}	0.71 \pm 0.19 ^{b**}	0.56 \pm 0.22 ^{c***}
Urea (mg/dl)	51.14 \pm 7.30 ^a	48.65 \pm 5.17 ^a	38.50 \pm 4.14 ^{b**}	35.51 \pm 5.21 ^{b**}	36.21 \pm 6.01 ^{b**}	34.39 \pm 4.66 ^{b**}
Uric acid (μ /ml)	4.99 \pm 1.11 ^a	4.55 \pm 1.21 ^a	4.75 \pm 1.03 ^a	4.11 \pm 1.19 ^{ab}	3.21 \pm 0.87 ^{b*}	3.31 \pm 0.76 ^{b*}

Significant with control group * P<0.05 ** P<0.01 *** P<0.001

Mean values in each raw having different superscript (a, b, c, d) are significant

Data presented in table (7) showed that rat group treated with orlistat showed non significant difference in the values of serum SOD, GPX, and catalase compared with control (+ve). The rat groups which treated with green tea, coffee, cinnamon and mixture of them showed a significant increase in the values of serum SOD, GPX and catalase ($p < 0.05$, $0.01 & p < 0.001$) and a significant decrease in the values of serum NO ($p < 0.05$, $0.01 & p < 0.001$) compared with control (+ve). There was non significant increase in serum SOD and catalase among rat groups treated with green tea, coffee, cinnamon and mixture of them. The rat groups which treated with green tea and cinnamon showed a significant decrease in the value of serum GPX compared with rat groups treated with coffee and mixture of them. There was non significant difference in the value of serum NO among rat groups which treated with green tea, coffee and cinnamon.

The obesity-dependent vascular damage appears to derive from a variety of changes in the adipose tissue, leading to a chronic inflammatory state and to dysregulation of adipocyte-derived factors produce unbalance between the protective

effects of the nitric oxide (NO) pathway (Rucker et al., 2007). Cells have different antioxidant systems such as glutathione and various antioxidant enzymes to protect various tissues from free radicals attacks. Apart from glutathione, the antioxidant enzymes including SOD, CAT and GSH dependent enzymes such as glutathione peroxidase (GPX), and glutathione transferase (GST) may minimize or remove the oxygen radical cascade and reduce cytotoxic oxidative damage in cells (Kaynar et al., 2005 and Meister 1988). Nitric oxide (NO) is a paracrine factor that controls vascular tone, inhibits platelet function, prevents adhesion of leukocytes, and reduces proliferation of the intima. An enhanced inactivation and/or reduced synthesis of NO are seen in conjunction with risk factors for cardiovascular disease (Forstermann 2010). Nitric oxide (NO) plays an important role in inflammatory process. Macrophages may greatly produce both levels of NO and superoxide, which rapidly react with each other to form peroxynitrite which oxidizes LDL, a key process in atherosclerosis. Tea can directly scavenge NO radicals (Duh et al., 2004).

Table (7): Serum SOD, GPX, catalase and NO of the experimental rat groups

Groups Variables	Control (+ve)	Orlistat	Green tea	Coffee	Cinnamon	Mixture
SOD	14.22±	16.35±	18.61±	22.11±	19.61±	21.18±
(µ/ml)	2.17 ^b	2.15 ^{ab}	1.98 ^{a*}	2.49 ^{a**}	2.66 ^{a*}	2.44 ^{a**}
GPX	31.24±	38.66±	57.10±	69.30±	59.11±	71.14±
(µ/ml)	4.76 ^c	5.87 ^c	7.24 ^{b**}	8.42 ^{a***}	7.60 ^{b**}	9.11 ^{a***}
Catalase	95.77±	105.66±	135.65±	151.14±	141.36±	155.33±
(µ/ml)	10.28 ^b	11.87 ^b	12.13 ^{a**}	15.16 ^{a***}	16.14 ^{a**}	13.23 ^{a***}
NO	8.13±	6.01±	5.33±	4.11±	4.22±	3.66±
(µ mol/l)	1.69 ^a	1.29 ^{b*}	1.36 ^{b*}	1.11 ^{bc**}	0.89 ^{bc**}	0.88 ^{c***}

Significant with control group * $P < 0.05$ ** $P < 0.01$ *** $P < 0.001$

Mean values in each raw having different superscript (a, b, c, d) are significant

Rats fed with 2.5% green tea leaves in the diet for a long time had enhancement in the superoxide dismutase and phase II enzyme activities in the liver without any liver or kidney damage (Lin et al., 1998). Both coffee and tea are rich sources of bioactive phytochemicals including methylxanthines, amino acids, phenolic acids and polyphenols. methylxanthine in both beverages is well known for its stimulatory and metabolic effects. The phenolic and polyphenolic constituents of coffee and tea have been reported biological activities including: antioxidant activities (Mario 2010). Cinnamon increases body heat, and thereby speeds up metabolism in order to burn the extra calories or fats deposited in the body.

Cinnamon have cinnamic aldehyde or cinnamaldehyde (about 60 % of the bark oil) and other chemical components of the essential oil include ethyl cinnamate, eugenol, beta-caryophyllene, linalool, and methyl chavicol (Wondrak et al., 2010). Cinnamon increased total antioxidant power and total thiols but a decrease in lipid peroxidation levels in individuals who received regular or cinnamon tea compared with controls. The extent of increase in total antioxidant power and decrease in lipid peroxidation levels were more evident in individuals who received cinnamon compared with those who received regular tea (Akram et al., 2006).

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Petroleum Systems in the North Western Desert of Egypt

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Abstract: The northern part of the Western Desert, bound from the east by the River Nile, occupies a vast area of intracratonic sub-basins covered by the prospective Paleozoic to Tertiary sediments. Structural, stratigraphic and maturation studies indicate that migration studies guided by buoyancy drive, was initiated in the depocenters from potential Devonian and Jurassic source beds during Early Senonian and trapped in pre-Laramide structures. Pods of active sources were defined based on maturity modeling and mapping isopachs and pyrolysis results. Hydrocarbon charges, losses from catchment areas and recovery factors were normalized statistically. The least preservation risk is considered for hydrocarbons migrated from Cretaceous sources after the Alpine tectonics. Accordingly, the WD can be subdivided into five petroleum systems: Safa-Bahariya (!) system, Safa-Alamein (!) system, Safa-Khataba (!) system, Zaitun-Safa (.) system, and Khataba-Kharita (.) system. The five systems are under explored, being estimated to host 48 Boeb Eurr, about 15 times the proven ultimate recoverable reserves in the whole WD.

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Keyword: Petroleum System, North Western Desert.

Introduction:

The Western Desert (WD) of Egypt occupies a vast area of about 700,000 mi² of an intracratonic basin in an unstable shelf region where basinal areas are widespread. The northern part of the WD has about 110,000 mi³ of prospective sedimentary rocks, ranging in age from Paleozoic to Tertiary, in four main basins: Abu Gharadig, Alamein, Matruh-Shushan, and Fagur (shahin, 1989) (Fig 1). The objectives of this study are to classify the WD in terms of Petroleum Systems and carry an evaluation of the possible source of formation in each system.

Methods of Study

The approach used involves:

1. Interpretation of the analytical results of total organic carbon, Pyrolysis, and vitrinite reflectance measurements (Tissot and Welte, 1978 and Espitalie, *et al.*, 1977 and 1985) of over "467" cutting samples from "16" wells.
2. The time of generation and migration as well as the magnitude of the erosional events were estimated through the geochemical-geothermal-geohistory subsidence models (Lopatin, 1971 and Waples, 1980, 1985) combined with and verified by vitrinite reflectance measurements .
3. The Geochemical mass balance method (Tissot and Welte, 1978; Waples, 1985) has the advantage of covering most of the key genetic factors of oil and gas occurrence, e.g. the respective rock and oil densities, the level of maturation reached, and the

volume of the effective source rocks resulted from modeling. Each of these variables was then exposed to quantitative risk analysis employing Mote Carlo simulation technique (Newendrop, 1975) and amounts of oil generated in each system were calculated (Table 1). Based on the expulsion and migration efficiency factors suggested by Momper (1975), Barker and Dickey (1984), and Waples (1985), and the recovery factors established in the SB(!) system (Shahin *et al.*, 1986), the amounts of undiscovered recoverable oil and gas were estimated. For easy comparison among systems, the exploration performance parameters (Table 1) were normalized in relation to sedimentary volumes of the respective basins.

Petroleum Systems

The petroleum system emphasizes the genetic relation between specific source rock(s) and the resulting petroleum accumulations. It includes all essential elements and processes needed for oil and gas accumulations.

1. Elements of the Petroleum Systems

Source rock evaluation

An effective petroleum source rock must be containing organic matter higher than 0.5-1.0 weight percent total organic carbon (wt% TOC), capable of generating hydrocarbons, and reached a level of thermal maturation high enough to generate and expel commercial quantities of oil and / or gas. Peters (1986)

rated a content of 0.5-1 wt% TOC as a fair source, 1-2 wt% TOC as a good source and more than 2 wt% TOC as a very good source. Such rating

was adopted in the present work.(Tissot and Welte (1978) and waples (1980 and 1985).

The geochemical analysis, including organic carbon (Fig 2), pyrolysis S2 (Fig 3), vitrinite reflectance measurements (Fig 4), and kerogen type based on pyrolysis HI and OI (van Krevelen-type cross plot) (Fig 5), suggest the following:

1. Cretaceous Formations (Bahariya, Abu Roash and Kharieta) are immature to mature covering a wide range from poor to v. good potential to generate both oil and gas.

2. Jurassic Formations (Safa, Masajid and Khatatba) are immature to marginally mature covering

a wide range from poor to good potential to generate both oil and gas.

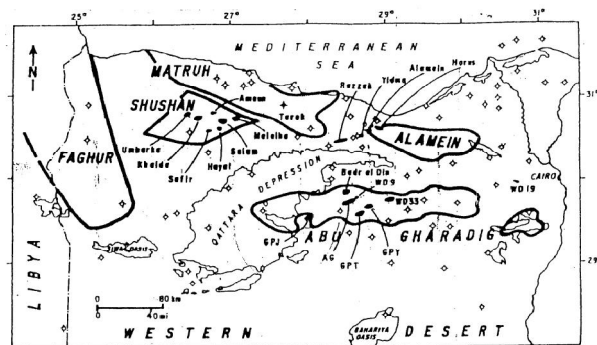
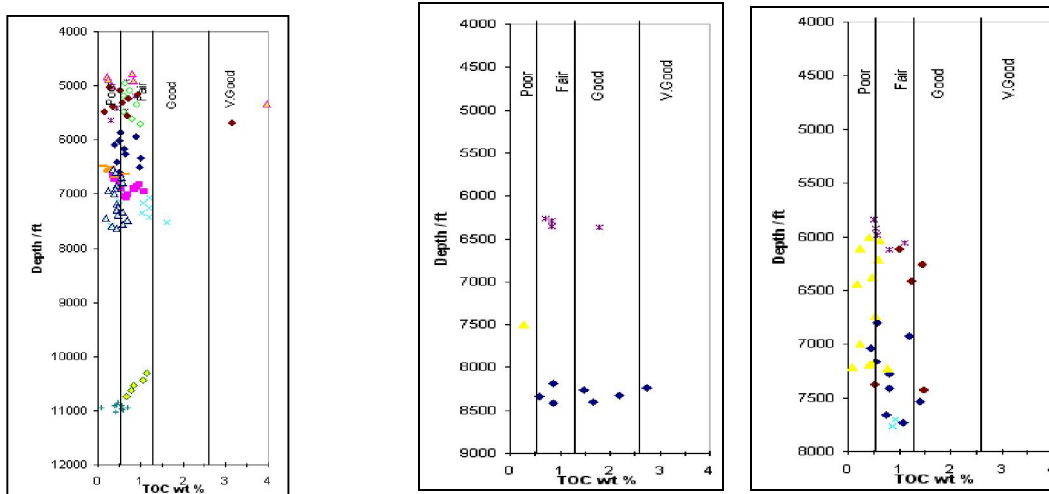


Fig 1: Fields and hydrocarbon generating basins in the northern Western Desert. (Shahin, 1998)

Cretaceous



Jurassic

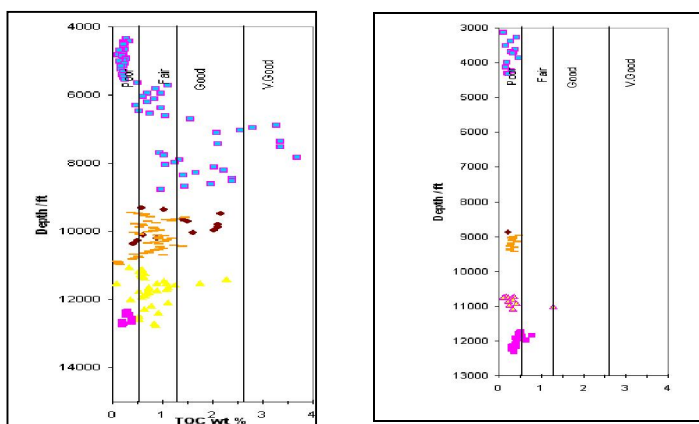
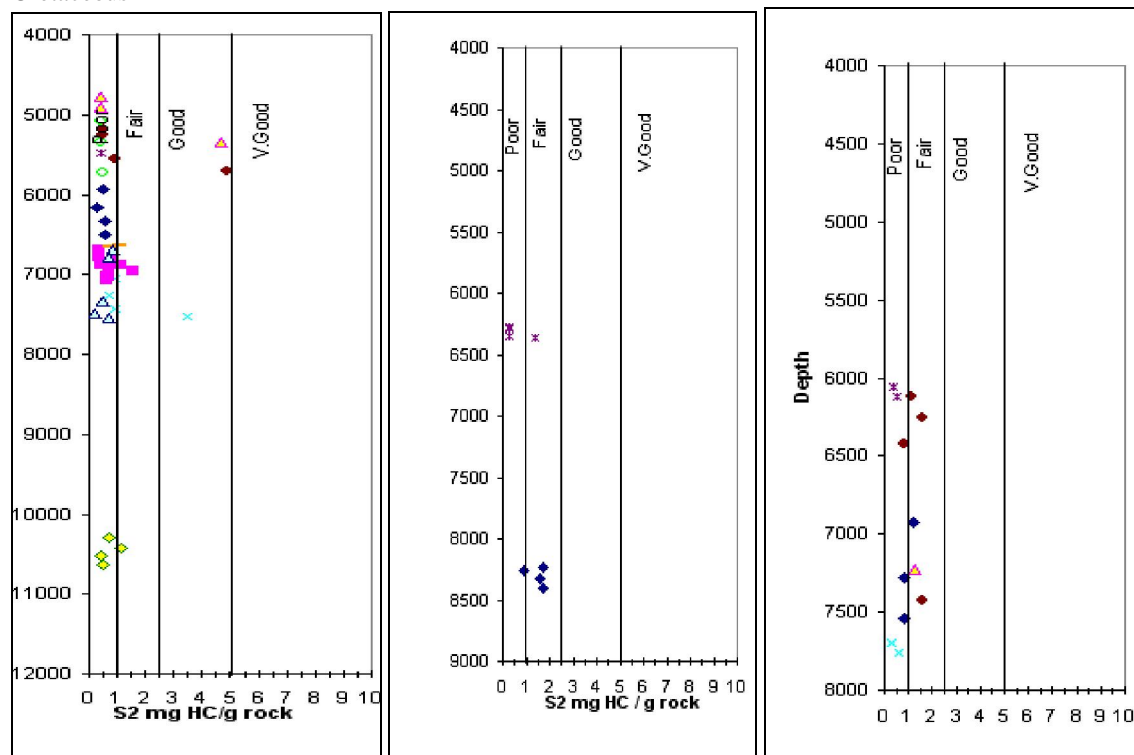


Fig 2: Organic richness of potential source rocks in the northern WD, in weight percent total organic carbon. Symbols represent samples from different wells.

Cretaceous



Jurassic

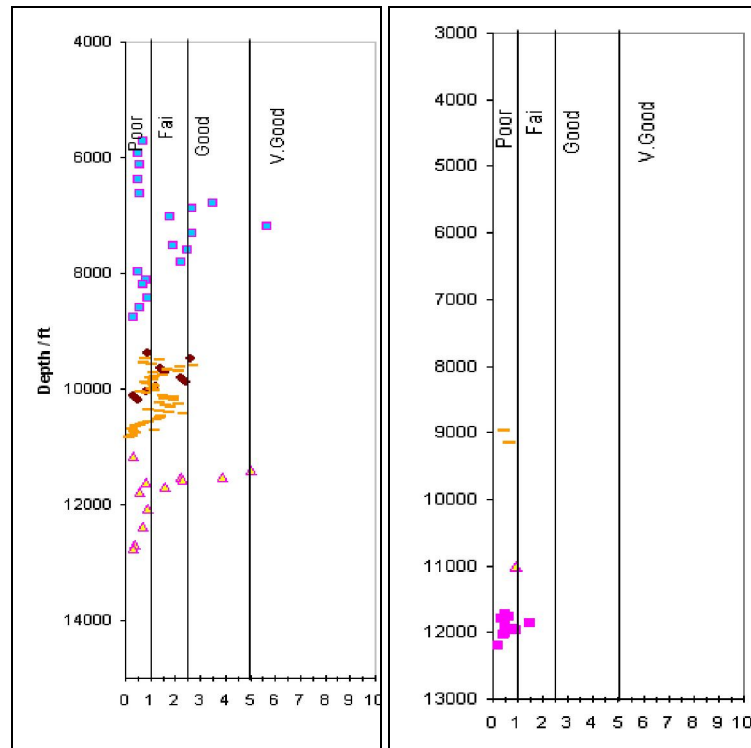
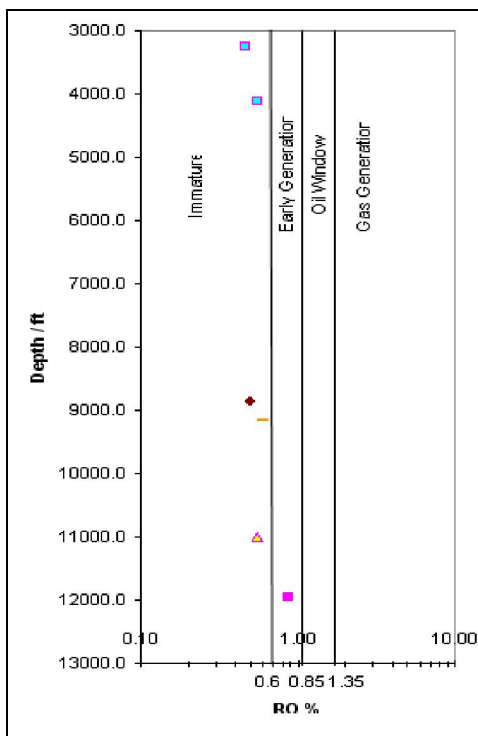
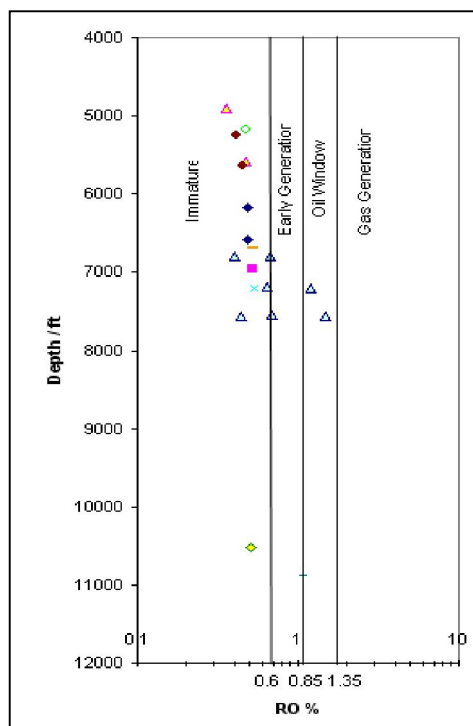


Fig 3: Hydrocarbon generating potential expressed in the pyrolysis – S2 values in ppm. Symbols represent samples from different wells

Cretaceous



Jurassic

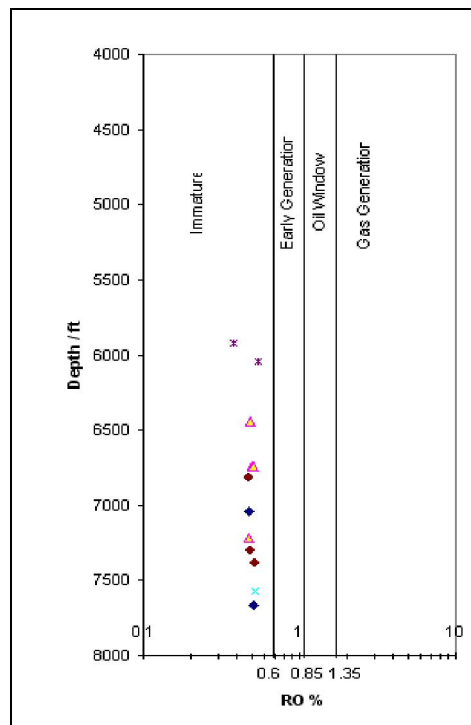
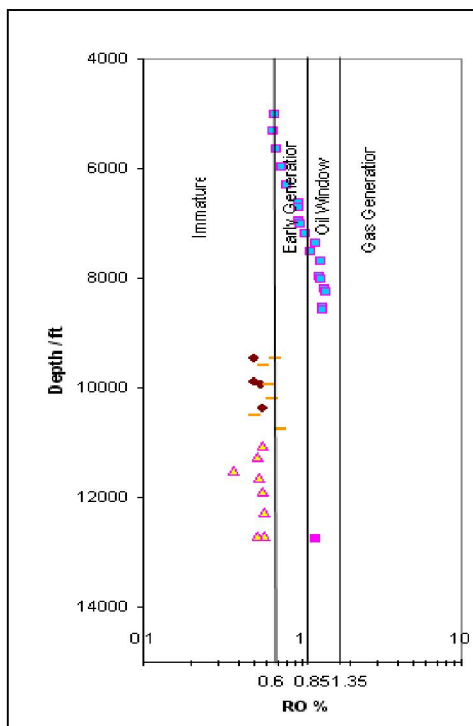
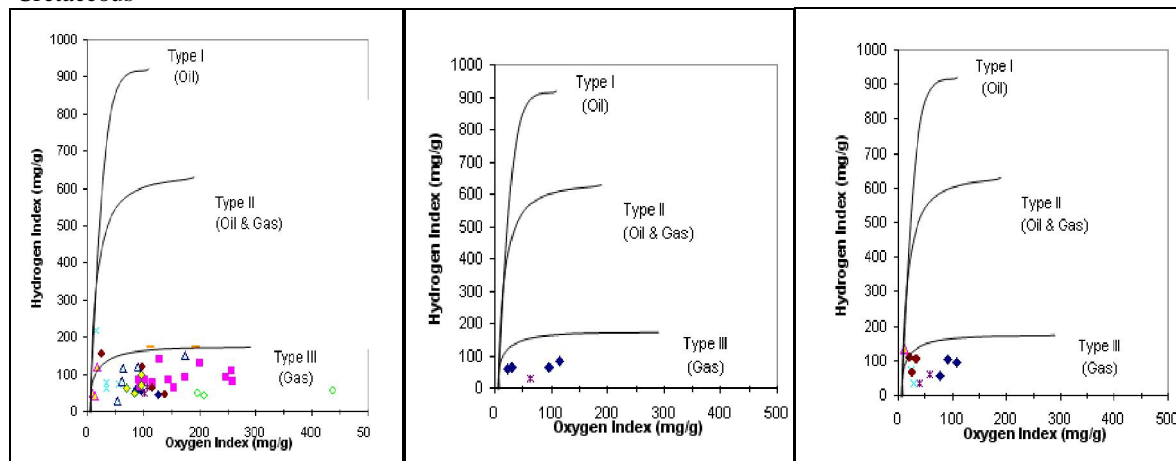


Fig 4: Vitrinite Reflectance, in oil, measurements (Ro%). Symbols represent samples from different wells

Cretaceous



Jurassic

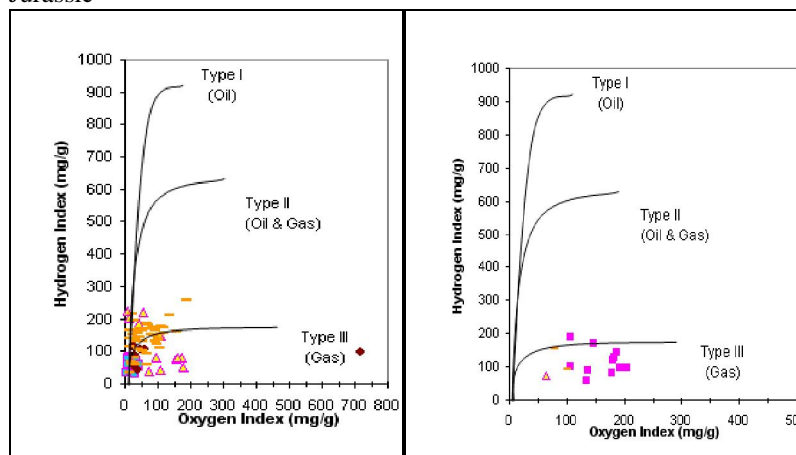


Fig 5: Van Krevelen – type diagram, showing kerogen type of potential source rocks. Symbols represent samples from different wells

2. Petroleum System Processes

Maturation studies indicate that migration studies guided by buoyancy drive, was initiated in the depocenters from potential Devonian and Jurassic source beds during Early Senonian and trapped in pre-Laramide structures. Pods of active sources were defined based on maturity modeling and mapping isopachs and pyrolysis results. Hydrocarbon charges, losses from catchment areas and recovery factors were normalized statistically. The least preservation risk is considered for hydrocarbons migrated from Cretaceous sources after the Alpine tectonics. Accordingly, the WD can be subdivided into five petroleum systems:-

1. The Safa-Bahariya (!), SB (!), system

The SB (!) occupies an area of 15,400 square kilometers (skm) in the central northern WD and includes Abu Ghradig basin (Fig 1). The system has a drilling density of 3.8 meters per cubic kilometer (m/cm³) resulted in eight fields and two discoveries.

Sedimentary rocks of this system range in age from Middle Jurassic through Plio-Pleistocene. The system can be classified " known (!)" as indicated by biomarker correlation and porphyrin analysis that the system is multi-sourced by Jurassic Safa and Masajid members of the Khatatba Fm and also Cretaceous Khoman, Abu Roash, and Bahariya formations. The Paleozoic Dhiffah and Zeitun formations are also possible sources. The reservoirs are the Bahariya Fm and Abu Roash Members.

Hydrocarbon migration in the eastern SB (!) system is suggested to coincide with, or post-date, the Laramide structural trap-forming episode. The western SB (!) system, despite the possible preservation risk for early maturation, its potential became beyond question after the discovery of Badr El-Din (BED) field (Fig 1). The BED

discovery implies that the Laramide-aged structures were not always distributed due to subsequent overprinting by the Oligo-Miocene Alpidic tectonic episode of the "Syrian Arc", although the latter is most prominent in the WD. The latest significant event, the Late Miocene "Messinian" salinity crisis, was a gentle event of regression and erosion, though of high magnitude emergence (Shahin, 1987). (Fig 6)

The system is estimated to host 10.4 billion oil-equivalent barrels (Boeb) recoverable (Table 1).

Table 1 : Data summary of the petroleum systems in the northern Western Desert.

Where: B: billion, Ckm: Cubic kilometer, m: meters, M: thousand, MM: million, oeb: oil-equivalent barrels, skm: square km. (Shahin 1998)

2. the Safa-Alamein (!), SA (!) system

SA (!) system falls to the north of SB (!) system, covers an area of 6,300 skm and includes Alamein basin

Systems	The Safa-Bahariya(!)	The Safa-Alamein (!)	The Safa-Khataba(!)	The Zaitun-Safa(.)	The Khataba-Kharita (.)	All Systems
Basin	AG	Alamein	Matruh	Faghur	Beni Suef	
Fields and Discoveries	10	5	10	1	1	27
Wells Drilled	160	41	135	10	8	354
Drilled Km	556	96	412	21	24	1109
System Volume Mckm	146	50	158	95	40	489
System Area skm	15400	6300	16000	13700	5200	56600
Source rock Age	K,Jr,Pz	Jr	Jr	Pz	Jr	
Estimated Generated Boeb	150	95	315	27	41	628
Proven Rec. Reserves Boeb	0.6	0.25	0.57	0.01	0.1	1.53
Estimated recoverable Boeb	10	7	23	2	3	45
Drilling Density m/ckm	3.8	1.9	2.6	0.2	0.6	
Discovery Density Moeb/ckm	4.1	5	3.6	1	2.5	
Response MMoeb/km drilled	1.1	2.6	1.4	0.4	4.3	
Estimated /Proven Reserves	17	28	40	200	30	

(Fig. 1), which feeds s five fields and one discovery, including Alamein, the first discovered in the WD. Although ranks last in its sedimentary volume, the system has the highest discovery density (5,000 oeb/ckm) and the most successful exploration response of 2,600 oil-equivalent barrels per meter drilled (oeb/m).

The Jurassic Safa Member (Mbr) of the Khataba Fm is considered the main source hydrocarbons in this system. Reservoirs are the Aptian Alamein Dolomite and the bahariya Fm.

The timing of migration is similar to that of the eastern SB(!) system (Fig 7).

The estimated recoverable reserves are seven Boeb (Shahin, 1989).

3. The Safa-Khataba (!), SK(!) system

SK (!) system is the largest, covering about 16,000 skm and extends northward into the Mediterranean. Matruh and Salam basins are the host for the Safa Mbr effective source and reservoir, where the Salam Field was the first in the WD to produce from the Jurassic.

This system holds about the same volume of sediments and proven reserves as SB(!) system to the south-east, though less explored.

Preservation of hydrocarbon accumulations is considered at low risk, as oil migration post-dates the severe Laramide-related tectonics. Only in the vicinity of Umbarka Field, a greater risk is involved as maturation and migration were earlier (pre-Cenomanian) for its high heat flow. However, Umbarka Field itself is an instance of an old structural trap modified by later successive events with no significant leakage. (Fig 8)

This system is estimated to host 23 Boeb, about half of the WD calculated recoverable reserves (Shahin 1989).

Safa-Bahariya(!) system

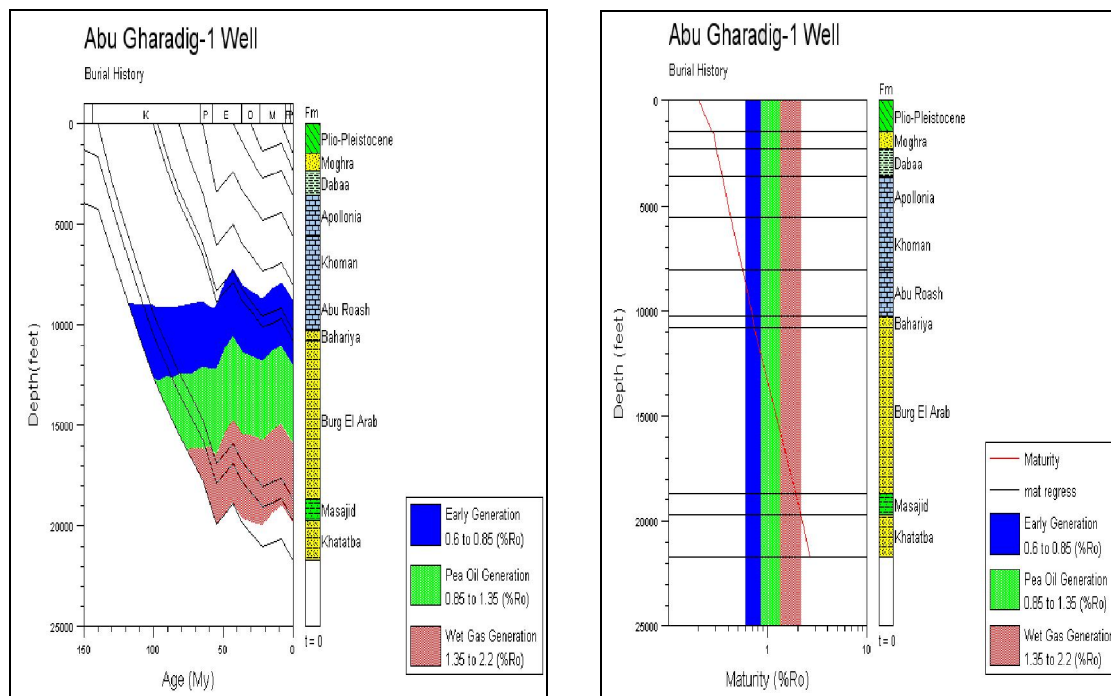


Fig 6 : Thermal burial history of Safa-Bahariya(!) system
 E = Eocene O = Oligocene M = Miocene P = Pliocene Q = Quaternary

Safa-Alamein (!) system

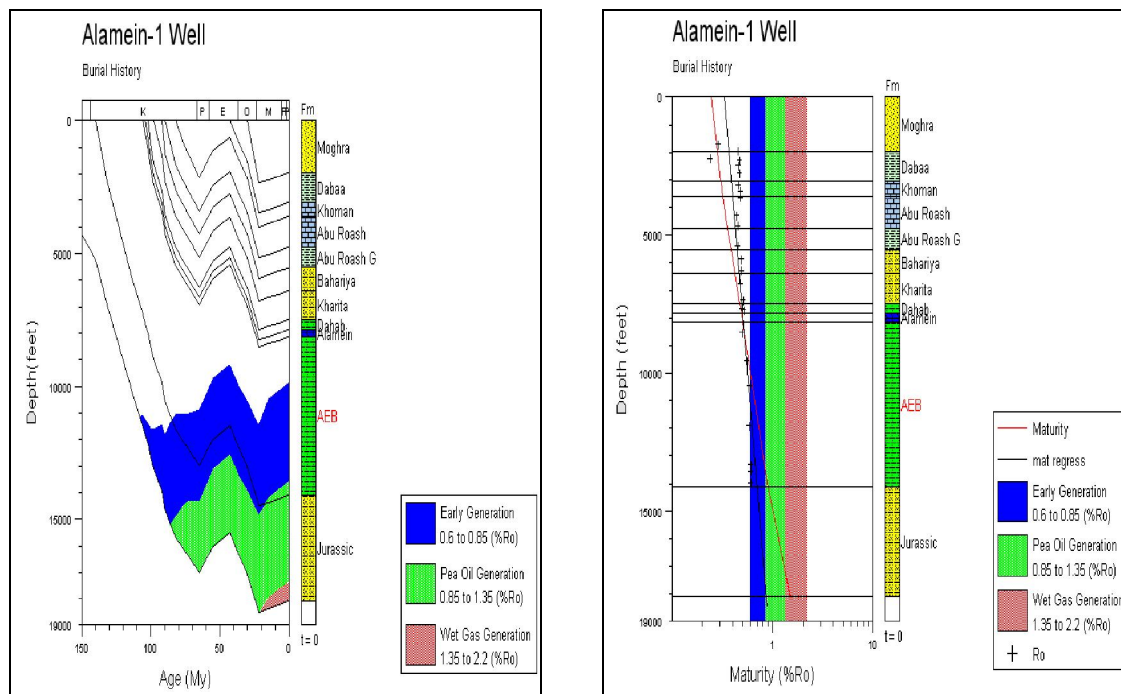


Fig 7: Thermal burial history of Safa-Alamein (!) system.

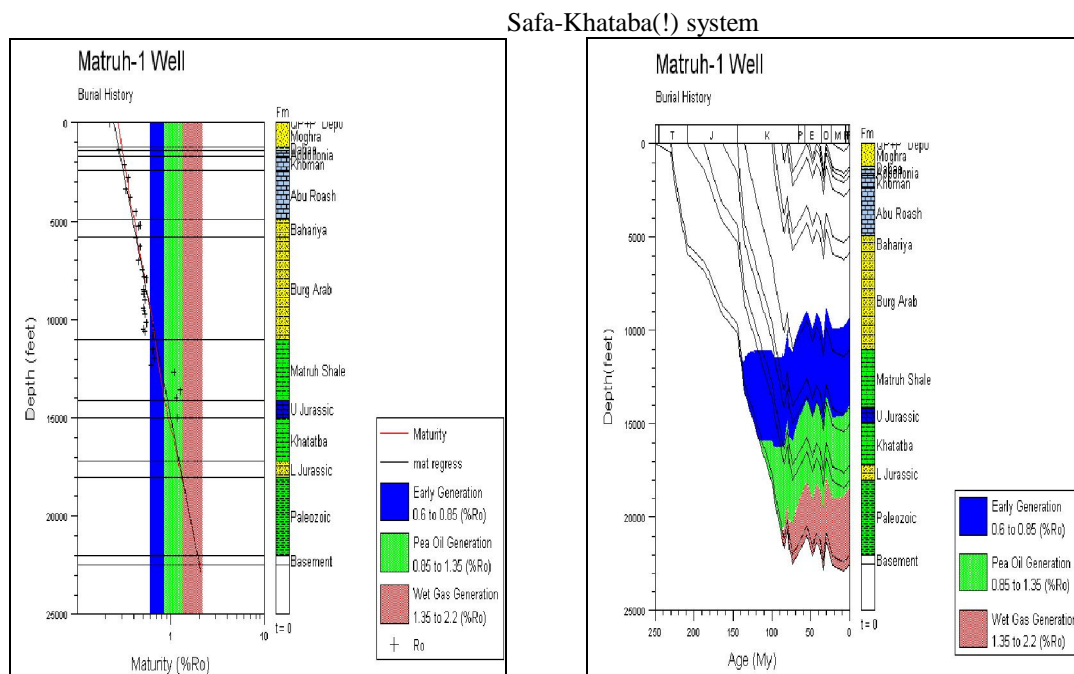


Fig 8: Thermal burial history of Safa-Khataba(!) system

4. The Zaitun-Safa (.), ZS (.) system

This system covers a mature areal extent of 13,700 sq km, extends into the Libyan territory to the west. The system can be classified “hypothetical (.)”. The low discovery density can be attributed to lack of exploration.

High generative capacity is indicated within the the oil-prone Devonian Zeitun Fm (3,500 ppm) and the Carboniferous gas-prone Diffah Fm. (3,000 ppm). Peak oil-generation is suggested to have occurred the earliest in the region. Such timing would imply a degree of preservation uncertainty (Fig 9).

This system is estimated to contain recoverable reserves of two Boeb Paleozoic oil and gas (Shahin 1989).

5. The Khataba-Kharita(., KK(.) system

This system is crossed by the Nile Valley, to the south from Cairo, covers an area of 5,200 sq km. This system was established by a 1997 discovery of East Beni Suef Field, with 0.3 Boeb Preliminary in-place reserves in Albian Kharita sands, sourced by Khataba Fm, and estimated to host three Boeb recoverable reserves (Shahin 1989). (Fig 10)

Cumulatively, the five systems are under explored, being estimated to host 48 Boeb recoverable, about 15 times the proven ultimate recoverable reserves in the whole WD.

Summary

According to the interpretation of the analytical results of total organic carbon, Pyrolysis, and vitrinite reflectance measurements, the time of generation and migration through the geochemical-geothermal-geohistory subsidence models and the Geochemical mass balance method the WD can be subdivided into five petroleum systems.

The Safa-Bahariya(!) system, includes Abu Gharadig basin. The system hosts twelve fields and is multi-sourced by Jurassic and Cretaceous intervals. The system is suggested to host 11 billion oil-equivalent barrels as estimated ultimate recoverable reserves(Eurr)

The Safa-Alamein (!) system, includes Alamein basin, which feeds five fields. The Aptian Alamein Dolomite, the main reservoir, is sourced by the Jurassic Safa Mbr. The Eurr are seven Boeb.

The Safa-Khataba(!) system, is the largest and extends northward into the Mediterranean. Matruh and Shushan basins are the host for the Safa Mbr effective source and reservoir. The newly discovered Cretaceous zones in old fields(e.g. Umbaraka Field) indicate preserved accumulations. This system is estimated to host 25 Boeb of Eurr.

The Zaitun-Safa(.) system, extends into the Libyan territory to the west. A recent (2008) 3,000 bpd discovery West Kalabsha area, proved a Jurassic Safa Mbr oil play. This system is estimated to contain ultimate recoverable reserves in excess of two Boeb of Jurassic oil and gas sourced by Paleozoic.

The Khataba-Kharita (.) system, is crossed by the Nile Valley, to the south from Cairo and includes the East Beni Suef Field, with 0-3 Boeb Preliminary in-place reserves in Albian Kharita sands, sourced by Khataba Fm, and estimated to host three Boeb Eurr.

Zaitun-Safa(.) system

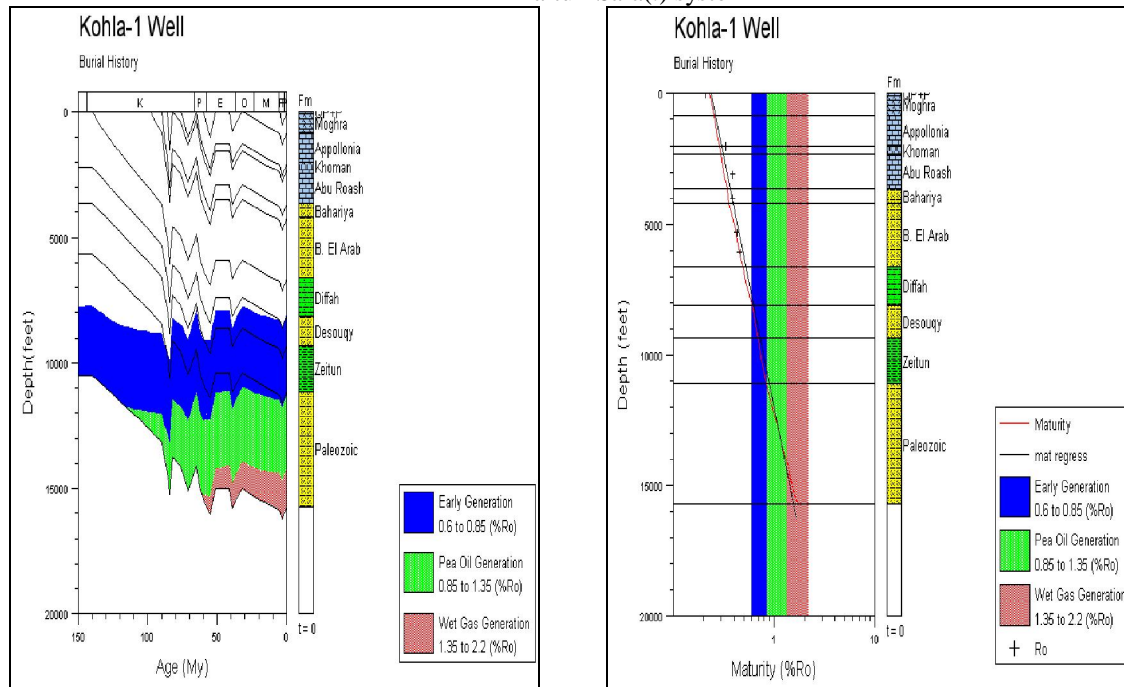


Fig 9: Thermal burial history of Zaitun-Safa(.) system

Khataba-Kharita (.) system

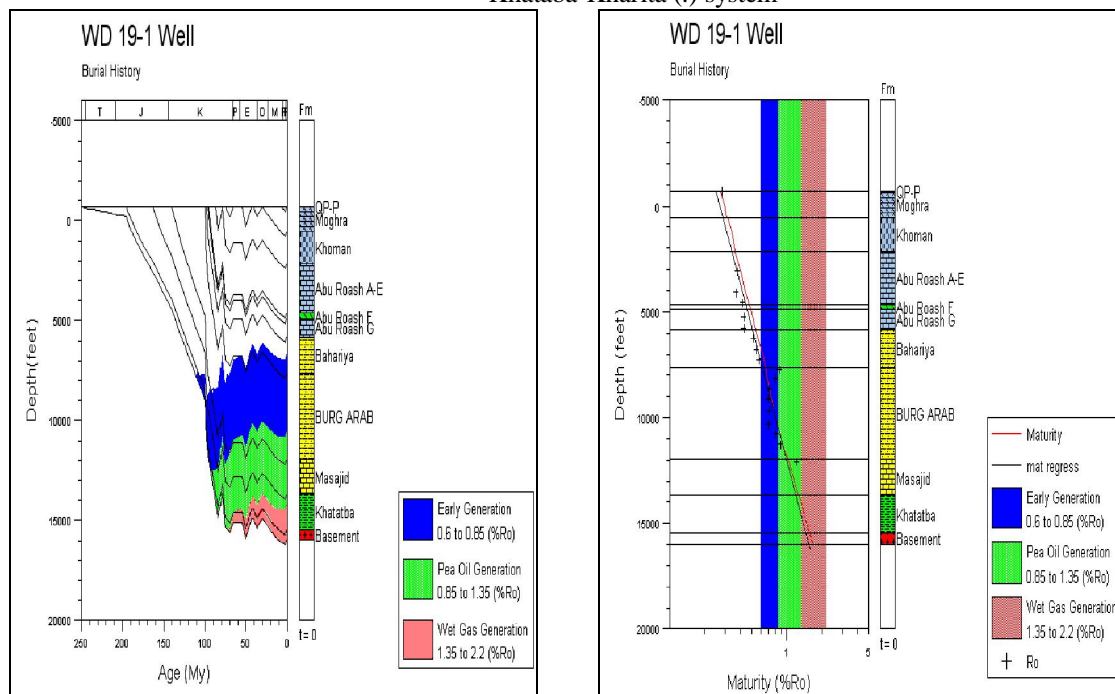


Fig 10: Thermal burial history of Khataba-Kharita (.) system

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Perinatal Exposure to Sodium Fluoride with Emphasis on Territorial Aggression, Sexual Behaviour and Fertility in Male Rats

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Abstract: Territorial aggression, sexual behaviour and fertility parameters were evaluated at adulthood of male rats previously exposed to different concentrations of sodium fluoride (Na-F) at their gestation, lactation and post-weaning period till maturation. Sixty weanling male Wistar rats were received Na-F via their dams from second trimester of their pregnancy onward till weaning at 30 days of age at one of three different concentrations; 0, 50 and 100 ppm, 20 pups for each dose. Na-F was then administered in drinking water, at the same doses, to the three experimental groups throughout the course of the study till completing all investigations. Na-F treatment significantly diminished territorial aggressive behaviour parameters in adult male rats as indicated by reduced lateralization, boxing bouts, fighting as well as ventral presenting postures compared with controls. Likewise, a significant decline in sexual behaviour was also noted for Na-F-exposed rats, where latencies to first mount, intromission and ejaculation were significantly prolonged, and notably for the higher incorporated dose. Moreover, a significant decrease was evident for frequencies of mounts, intromissions and ejaculations when Na-F was given to males compared to their untreated counterparts. Higher post-ejaculatory intervals were observed with Na-F group, particularly at high dose. Compared to control group, high Na-F-treated rats displayed a significant inhibited profile of fertility as reflected in reduced number of impregnated females, implantations as well as viable fetuses, along with increased number of resorptions. Relative weights of reproductive organs were also lessened in Na-F-administered males. Histopathological examination showed degenerative changes in testes, seminal vesicles and prostate gland of Na-F-exposed males with varied degree of severity according to incorporated dose. Our study clearly signifies the adverse effect of fluoride on territorial aggression, sexual performance with inhibited fertility in adult male rats.

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Key words: Sodium fluoride; territorial aggression; sexual behaviour; fertility; Wistar rats.

1. Introduction:

Fluoridation of water supplies is practiced in many parts of the world, where fluoride is recognized as the most effective caries preventive agent (Mahejabeen and Hajira, 2007). Further fluoride sources, other than drinkable water are drinks, tooth pastes, mouth rinses and dietary supplements. There is growing evidence that serious overall health consequences of excessive fluoride intake are significant enough to warrant further precautionary measures with the consumption of fluoride (Spittle, 2009). Maternal-fetal transport of fluoride across human and rat placenta during pregnancy have been reported, with subsequent transfer of fluoride through milk, comprising a real threat for progeny health (Drinkard et al., 1985; Fassman, 1993; Hassunuma et al., 2007). This problem should become the concerns of many researchers dealing with fluoride, particularly with regard to its effects on susceptible generations.

Androgen hormones play a crucial role in control of aggressive and sexual behaviour in males

(Clark and Henderson, 2003). Moreover, anterior hypothalamic-preoptic area was proved to be the primary site of androgen action in the mediation of both types of behaviours in males (Yahr, 1981; Barfield, 2011).

Exposure to toxic elements has been reported to affect both aggressive and antisocial violent behaviours (Werbach, 1995; Mysterud, 2003). However, a paucity of literature is available concerning the influence of Na-F on parameters of aggressive behaviour in male rats, namely territorial aggression.

Among the different effects fluoride can produce in different organ systems of the body, the reproductive tract is susceptible to disruption by fluoride at a concentration sufficient to produce other manifestations of toxicity (Spittle, 2007). A number of animal studies indicated the occurrence of adverse reproductive and developmental outcomes in individuals exposed to relatively high concentrations of fluorides (Dhar and Bhatnagar, 2009). Most of these investigations with diverse animal species, rat,

mice and rabbits, were associated with alterations in reproductive hormones, fertility, histological structure and developmental outcomes (Kumar & Susheela 1994, 1995; Elbetieha et al., 2000; Collins et al. 2001; Zhang et al. 2006). However, little is known about Na-F-induced alterations in sexual behaviour of male rats. Developmental Na-F exposure was shown to induce sexual behaviour deficits in male offspring (Bera et al., 2007), yet more research need to be done in order to further identify Na-F toxicity in animals exposed to its hazard throughout different developmental stages of their life, in particular its perinatal exposure.

Therefore, in the presented work we aimed to study the impact of fluoride toxicity in adult male rats perinatally exposed to different concentrations of Na-F (during their stages of gestation, lactation and post-weaning) till maturation on presentation of territorial aggressive and sexual behaviours. In addition, fertility indices of male rats as well as histopathological evaluation of male sex organs were also detected.

2. Materials and methods:

2.1. Animals and housing:

Rats used in this study were maintained and treated in accordance with ethical guidelines released by Cairo University Policy on Animal Care and Use. Adequate measures were taken to minimize pain, discomfort or stress of the animals. In addition, efforts were made to use only the minimal number of animals necessary to produce reliable scientific data.

Forty five mature female Wistar rats (Unit for Laboratory Animals at Faculty of Veterinary Medicine, Cairo University) weighing 200-220g were used. Animals were housed in polypropylene cages with stainless steel wire lids (bedded with wood shavings) and kept at a room temperature of 20-22°C, 60% humidity on a light cycle of 12 h/day. They were allowed free access to standard laboratory feed and water. Pairs of females were placed with single male rats of the same strain at night.

2.2. Administration of sodium fluoride:

Pregnant females were divided at random into three groups of 15 animals each and received Na-F at one of three different concentrations; 0 (control), 50 and 100 ppm on a mg/kg/day basis of 0, 5.15 and 10.77 Na-F, respectively). Sodium fluoride (Na-F, Sigma Chemical Company) was incorporated in drinking distilled water and administered to pregnant rats for a 44 days period (from day 8 of gestation till termination of lactation and weaning of pups at 30 days of age).

After weaning, all male pups were then collected and distributed into three groups of 20

animals each, divided on 2 replicates, each of 10, as following:

Group (1) control, n=20: weanling males were derived from control dams receiving no Na-F. These pups served as a control group.

Group (2) low-Na-F, n=20: weanling males were derived from dams receiving low dose of Na-F. Pups were then exposed to *ad libitum* supply of low dose of Na-F in drinking water, till completion of the study.

Group (3) high-Na-F, n=20: weanling males were derived from dams receiving high dose of Na-F. Males were then exposed to *ad libitum* supply of high dose of Na-F in drinking water, till completion of the study.

2.3. Behavioural assessment:

Male rats were exposed to different concentrations of Na-F (0, 50 or 100 ppm) during gestational, lactation and post-weaning stages of life until maturity. At 95 days of animals' age, adult male rats were then used for assessment of territorial aggression, sexual behaviour as well as fertility indices. All behavioural measurements were recorded by a single observer unfamiliar with the treated males.

2.3.1. Territorial aggressive behaviour testing:

A rectangular observation cage (45 x 27 x 40 cm: length x breadth x height) was used for testing rats' aggressive behaviour. A stud male rat was placed in the testing arena for 10 days. The tested male rat (control or Na-F-exposed) of no previous contact with the stud was then placed in the test arena, confronted with the stud male for 5-min test period. The following parameters were then recorded: lateralization by stud male (LSM), boxing bouts with stud male (BBSM), fights with stud male (FSM), ventral presenting posture (Supine posture) of the stud male (VP) (Bataineh et al., 1997, Bataineh et al., 1998; Khouri and El-Akawi, 2005). All testing was conducted between 09:00 and 12:00 h. All treatment groups were tested in a randomized order.

2.3.2. Sexual behaviour testing:

Sexual performance of each male rat per treatment groups was evaluated using a stimulus untreated female of the same strain. For induction of estrus in female rats, each female was subcutaneously injected with 5 mg estradiol benzoate and 0.5 mg progesterone (Misr Co. for Pharm. Ind., Cairo, Egypt), dissolved in 0.2 ml of sesame oil, at 54 and 6 h prior to test session, respectively. Male rat was kept alone in the mating cage (45 x 27 x 40 cm: length x breadth x height), 5 min before introducing the receptive female into the center of the arena. The sexual behaviour of the male was monitored during a 15-min

session and the following parameters were measured; mount latency (ML), intromission latency (IL), ejaculation latency (EjL), total mount frequency (TMF), total intromission frequency (TIF), ejaculation frequency (EjF) i.e. mating potential, post-ejaculatory interval (PEjI) i.e. latency period (Cagiano et al., 1998; Khouri and El-Akawi, 2005; Bataineh and Nusier, 2006). Intromissions were distinguished behaviorally from mounts by the presence of a rapid, springing dismount. Ejaculation patterns were characterized by longer, deeper thrusts, slow, relaxed dismounts and a prolonged period of rest (PEjI) following the ejaculation (Tsai et al., 2009). All testing was carried out between 09:00 and 15:00 h in a random order.

2.4. Fertility assessment:

To evaluate the fertility, each male was housed with two virgin untreated females of the same strain for ten days to ensure two successive estrus cycles (Amann, 1982). One week after removal of the males, all females were killed by cervical dislocation under light ether anesthesia. Numbers of pregnant females, implantation sites, viable fetuses as well as fetal resorptions were recorded after cesarean sections (Bataineh et al., 1998).

2.5. Relative weights of male reproductive organs:

Five males per treatment were sacrificed by cervical dislocation under light ether anesthesia. The reproductive tract was then dissected, trimmed free of fat and each organ was weighed separately on electronic balance in relation to body weight. The reproductive organs taken into account for study included testes, seminal vesicles and prostate gland.

2.6. Histopathological examination:

After completion of all assessments, tissue specimens from testes, seminal vesicles and prostate glands were collected and fixed in 10% neutral buffer formalin. The tissue specimens were processed by the convention method and stain with Hematoxylin and Eosin (Bancroft and Gamble, 2008).

2.7. Statistical analysis:

In order to evaluate the influence of Na-F administration, data for all collected variables were analyzed by analyses of variance (AVOVA), using the general linear models procedure in SPSS® statistical software (SPSS, 2006). Comparisons between the groups after ANOVA were made using post hoc Tukey HSD test. A p value of <0.05 was required to consider the difference as significant. All data are expressed as mean ± SEM.

3. Results:

3.1. Territorial aggressive behaviour parameters:

Table 1 illustrates the influence of Na-F on the parameters of territorial aggression in adult male rats. There was a significant marked decline in lateralization, boxing bouts, fighting as well as number of ventral presenting postures ($p < 0.001$) in males treated with Na-F, at both dose levels, compared to their counterparts in the control group.

3.2. Sexual behaviour:

The results presented in Table 2 show the effect of Na-F on male rats' sexual behaviour. Na-F administered dose significantly affect latencies to first mount, intromission and ejaculation, where higher latencies ($p < 0.001$) were observed with high Na-F-treated rats compared to other groups. However, a significant reduction in frequencies of mounts, intromissions and ejaculations ($p < 0.001$) were recorded in Na-F-exposed males when compared with controls, regardless of the incorporated dose. Moreover, Na-F treatment significantly prolonged the post-ejaculatory intervals ($p < 0.001$), where increased intervals were found in high Na-F group. The number of animals ejaculating was reduced in Na-F-treated groups, particularly at high level.

3.3. Male rats' fertility:

Results in Table 3 indicate that Na-F administration to male rats significantly diminished their fertility parameters. Na-F treatment at high dose caused a significant decrease in number of females impregnated by male treated rats ($p < 0.05$) compared to untreated one. A significant reduction in number of implantations as well as number of viable fetuses ($p < 0.01$) accompanied by a significant increase in total number of resorptions sites ($p < 0.05$) was noticed in females impregnated by high Na-F-exposed males when compared to controls. Fertility parameters measured in low Na-F-administered males were not statistically different from those of control group, except for number of viable fetuses, where a significant decrease was found evident in low Na-F treated rats when compared with control rats.

3.4. Reproductive organs weights:

The relative weights of testes, seminal vesicles and prostate gland are demonstrated in Table 4. Regardless of the incorporated level of Na-F, relative weights of all selected reproductive organs were significantly diminished ($p < 0.001$) when male rats were exposed to Na-F compared to their counterparts in control group.

3.5. Histopathological examination:

No pathological changes could be detected in the testes, seminal vesicle and prostate glands of rats in control group receiving no Na-F.

The histopathological examination of the testes of rats in high Na-F-treated group revealed severe pathological lesions represented by severe disorganization and denudation of germinal epithelial cells of most seminiferous tubules with absence of sperm in the lumina. Most of seminiferous tubules appeared atrophied with complete absence of germinal epithelium and Sertoli cells (Fig. 1). Only the basement membranes were detected with multiple numbers of spermatid giant cells (Fig. 2).

Congestion of blood vessels in tunica albuginea and edematous fluid were detected in-between the interstitial tissues. Moreover, some tubules were completely destructed. The seminal vesicle showed hyperplasia of the epithelial lining with desquamated

epithelial cells in the lumen mixed with its secretion (Fig. 3).

Edema in the lamina propria with congestion of submucosal blood vessels was also noticed. The prostate gland revealed edema in the interstitial tissues dispersed the glands. There was severe hyperplasia of epithelium lining as folds in the lumen (Fig. 4). Also, few numbers of inflammatory cells was detected in the interstitial tissues (Fig. 5).

Concerning low Na-F-exposed rats, the testes showed moderate pathological changes as indicated by necrosis in the layers of germinal epithelium of seminiferous tubules and decreased numbers or absence of mature sperms in the lumen (Fig 6). Few numbers of spermatid giant cells were also present in the lumen of some seminiferous tubules. The seminal vesicle appeared normal while the prostate displayed moderate hyperplasia in its epithelial lining (Fig. 7).

Table 1. Effect of perinatal Na-F exposure at different doses on territorial aggression in adult male rats during a 5 min session.

	Experimental Groups		
	(C) Group	(Low Na-F) Group	(High Na-F) Group
LSM	5.2±0.73 ^a	2.1±0.35 ^b	0.9±0.28 ^b
BBSM	4.7±0.73 ^a	1.8±0.33 ^b	0.7±0.22 ^b
FSM	2.8±0.53 ^a	1.1±0.28 ^b	0.4±0.13 ^b
VP	1.9±0.38 ^a	0.6±0.22 ^b	0.1±0.03 ^b

(C) Group: Animals received plain water without any treatment and served as a control.

(Low Na-F) Group: Animals received 50 ppm Na-F.

(High Na-F) Group: Animals received 100 ppm Na-F.

^{a-c}Values within row with unlike superscripts differ significantly ($p < 0.05$), according to ANOVA. Data are expressed as mean±SEM of 10 animals per treatment.

(LSM = lateralization by stud male, BBSM = boxing bouts with stud male, FSM = fights with stud male, VP = ventral presenting posture (supine posture) of the stud male.

Table 2. Effect of perinatal Na-F exposure at different doses on sexual behaviour in adult male rats during a 15 min session.

	Experimental Groups		
	(C) Group	(Low Na-F) Group	(High Na-F) Group
ML (s)	102.7±18.64 ^a	165.2±9.78 ^b	231.5±12.58 ^c
IL (s)	126±14.26 ^a	187.4±10.17 ^b	272.8±20.09 ^c
EjL (s)	170.5±9.63 ^a	240.8±10.85 ^b	306.7±23.79 ^c
TMF	13.7±0.76 ^a	6.8±1.23 ^b	3.6±0.92 ^b
TIF	11.1±0.69 ^a	5.1±1.07 ^b	2.3±0.83 ^b
EjF	5.8±0.76 ^a	1.7±0.47 ^b	0.6±0.27 ^b
PEjI	73.2±5.31 ^a	170.8±10.21 ^b	274.4±14.84 ^c
PME	90%	50%	40%

(C) Group: Animals received plain water without any treatment and served as a control.

(Low Na-F) Group: Animals received 50 ppm Na-F.

(High Na-F) Group: Animals received 100 ppm Na-F.

^{a-c}Values within row with unlike superscripts differ significantly ($p < 0.05$), according to ANOVA. Data are expressed as mean \pm SEM of 10 animals per treatment.

(ML = mount latency, IL = intromission latency, EjL = ejaculation latency, TMF = total mount frequency, TIF = total intromission frequency, EjF = ejaculation frequency (mating potential), PEJl = post-ejaculatory interval (latency period), PME = % of males ejaculating).

Table 3. Effect of perinatal Na-F exposure at different doses on fertility in adult male rats.

	Experimental Groups		
	(C) Group	(Low Na-F) Group	(High Na-F) Group
No. of males	10	10	10
No. of females	20	20	20
No. of pregnant females	16/20 ^a (80%)	13/20 ^{ab} (65%)	8/20 ^b (40%)
No. of implantation sites	7.2 \pm 0.88 ^a	4.95 \pm 0.77 ^{ab}	3.4 \pm 0.97 ^b
No. of viable fetuses	6.35 \pm 0.78 ^a	3.85 \pm 0.62 ^b	2.8 \pm 0.81 ^b
Rats with resorptions	2/20 (10%)	5/20 (25%)	6/20 (30%)
No. of resorption sites/total no. of implantation sites	2/144 ^a (1.39%)	6/99 ^{ab} (6.06%)	17/68 ^b (25%)

(C) Group: Animals received plain water without any treatment and served as a control.

(Low Na-F) Group: Animals received 50 ppm Na-F.

(High Na-F) Group: Animals received 100 ppm Na-F.

^{a-c}Values within row with unlike superscripts differ significantly ($p < 0.05$), according to ANOVA. Data are expressed as mean \pm SEM.

Table 4. Effect of perinatal Na-F exposure at different doses on reproductive organs weights (g/100g b.wt) in adult male rats.

	Experimental Groups		
	(C) Group	(Low Na-F) Group	(High Na-F) Group
Testes	1.32 \pm 0.06 ^a	1.08 \pm 0.07 ^b	0.87 \pm 0.05 ^b
Seminal vesicles	0.59 \pm 0.05 ^a	0.40 \pm 0.01 ^b	0.32 \pm 0.03 ^b
Prostate gland	0.31 \pm 0.02 ^a	0.18 \pm 0.01 ^b	0.14 \pm 0.01 ^b

(C) Group: Animals received plain water without any treatment and served as a control.

(Low Na-F) Group: Animals received 50 ppm Na-F.

(High Na-F) Group: Animals received 100 ppm Na-F.

^{a-c}Values within row with unlike superscripts differ significantly ($p < 0.05$), according to ANOVA. Data are expressed as mean \pm SEM of 5 animals per treatment.

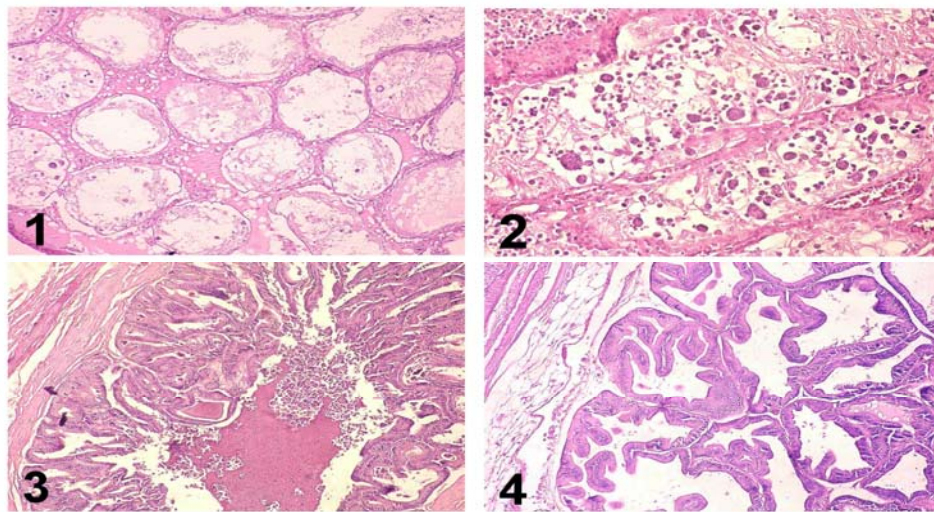


Figure 1: Testes of high Na-F-treated rats showing atrophy of seminiferous tubules with complete absence of germinal epithelium and Sertoli cells. Notice the edema in-between the interstitial tissues. H&E X 200.

Figure 2: Testes of high Na-F-treated rats showing multiple numbers of spermatid giant cells. Notice the congestion of blood vessels in the interstitial tissues. H&E X 400.

Figure 3: Seminal vesicles of high Na-F-treated rats showing hyperplasia of the epithelial lining with desquamated epithelial cells in the lumen mixed with its secretion. H&E X 200.

Figure 4: Prostate gland of high Na-F-treated rats showing severe hyperplasia of epithelium lining forming finger like projection in the lumen. H&E X 200.

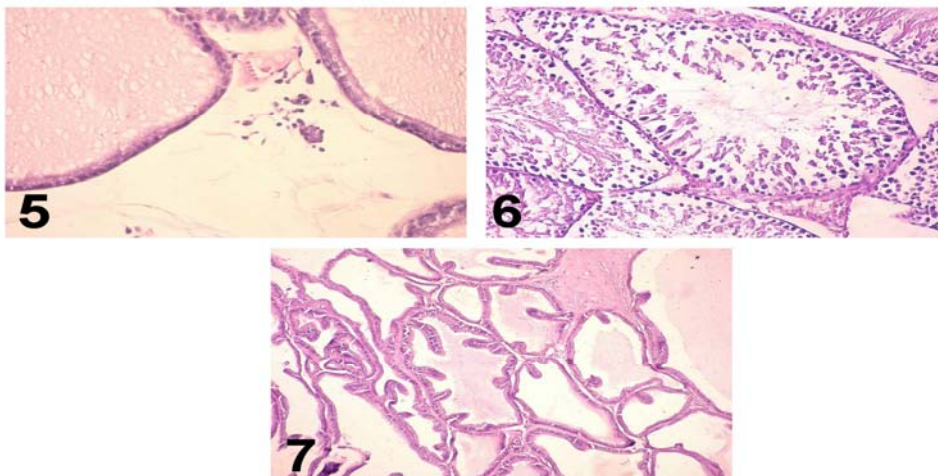


Figure 5: Prostate gland of high Na-F-treated rats showing edema in-between the glands with few numbers of inflammatory cells. H&E X 400.

Figure 6: Testes of low Na-F-treated rats showing necrosis in the layers of germinal epithelium of seminiferous tubules with absence of mature sperms in the lumen. H&E X 200.

Figure 7: Prostate gland of low Na-F-treated rats showing moderate hyperplasia of epithelium lining. Notice the edema in-between the glandular tissues. H&E X 200.

4. Discussion:

The animal model used in the present study has been previously employed in several investigations to evaluate the adverse effects of different compounds on reproductive function in male (Otoom et al., 2004;

Bataineh and Nusier, 2006). Furthermore, the applied concentration of Na-F was selected carefully and according to our former studies with rats reporting no toxicity potentials of the chosen dose, with no side

effects as well (El-Iethy et al., 2010, Kamel et al., 2010).

Marked decline in all parameters of territorial aggression in Na-F-treated males was revealed in the present study. This was reflected in reduced lateralization, boxing bouts and fights. Ventral presenting posture (supine posture) has been evidenced to announce for submission of the target during attack (Scott, 1970). Since behaviour modulating pheromones are proved to control fighting and other behaviours, reduced aggression-stimulating pheromones in Na-F-treated males are assumed to be responsible for altered incidence of supine posture displayed by the stud male (Tirindelli et al., 2009). These results are in accordance with previous research with rats, where ingestion of Na-F greatly abolished aggressive behaviour postures in males (Bataineh and Nusier, 2006).

The latencies to show the first mounts, first intromission, and the post-ejaculatory interval are commonly used for evaluating male's sexual motivation (Everitt, 1990). Negative impact of Na-F administration was shown in sexual behaviour displayed by adult male rats used in the current study. Marked suppression of sexual performance was evidenced by prolonged time to first mount, intromission and ejaculation, accompanied by reduction in total numbers of these parameters. More interestingly, significant increase in post-ejaculatory interval was also noticed in Na-F-exposed males. A significant impairment of sexual behaviour was reported in former study with male rats exposed to different levels of NaF (Bataineh and Nusier, 2006; Bera et al., 2007).

The current suppression of aggression and sexual behaviour might be explained on the basis of Na-F-induced adverse effect on androgen biosynthesis controlling both types of behaviours. Na-F was shown to directly affect the brain, hypothalamus or anterior pituitary gland, which in turn possibly affect sexual behaviour (Bataineh and Nusier, 2006). Males with fluorosis also showed a marked reduction in testosterone hormone which plays an important role in this regulation process (Narayana and Chinoy, 1994; Susheela and Jethanandani, 1996; Huang et al., 2007). Confirmatory results derived from other study for Reddy et al. (2007), where serum testosterone, follicle stimulating hormone and lutenizing hormone were significantly altered in rats after exposure to Na-F. In addition, testicular disorders have been reported to be associated with Na-F-induced oxidative stress in reproductive organs along with possible adverse effects of fluoride on pituitary testicular axis (Ghosh et al 2002, Wan et al., 2006). Antioxidant defenses were also reduced with occurrence of oxidative stress

in rats and mice exposed to Na-F (Zhang et al., 2006; Hunag et al., 2007). Germ cells, in comparison to somatic cells, are more susceptible to oxidative stress, relying on two main reasons. Firstly, germ cells are intimately associated with the free radical-generating phagocytic Sertoli cells (Bauche et al., 1994). Secondly, germ cell plasma membrane contains a higher amount of polyunsaturated fatty acids that are vulnerable to oxidation by free radicals (Lenzi et al., 2000). Supporting evidence derived from our histopathological analysis of reproductive organs; testes, seminal vesicles and prostate gland in Na-F treated males, where severe necrotic degenerative changes in seminiferous epithelium of testicular tissues, deficiency of sperms in lumina, complete absence of Sertoli cells along with multiple numbers of spermatid giant cells were also detected. Our results are in agreement with earlier reports (Ge et al., 2006; Wan et al., 2006; Gupta et al., 2007; Tiwari and Pande, 2009). These findings together with previously mentioned observations go hand in hand with and further confirm the androgenic effect on male reproductive function.

The results reported in this paper also showed a profound negative effect of high concentration of Na-F on male rats' fertility in terms of reduced numbers of females impregnation, decreased numbers of implantation and viable fetuses along with high resorption incidences. Even more compelling were the findings of numbers of viable fetuses which are proved to be the more responsive parameter for Na-F administration, even at low dose. These findings are in contradiction of other previous scientific reports where mating, fertility and survival indices were not affected in Na-F-administered rats (Collins et al., 1995). However, our reported results are in accordance with earlier research with rats and mice (Elbetieha et al., 2000; Bataineh and Nusier, 2006). Again, our histopathological findings of disorganization, decreased numbers of germinal epithelium of seminiferous tubule along with absence of mature sperms in testicles, especially in high Na-F-treated males, confirm diminished male fertility observed in the current study. This diminution in male fertility parameters could be a reflect and might be due to an impairment in spermatogenesis and steroidogenesis of NaF-treated male rats (Pushpalatha et al., 2005). It has been reported that Na-F-generated testicular oxidative stress resulted in damage of sperm cell membrane which might be accountable for inhibition of testicular spermatogenesis with reduced sperm activity (Zhang et al., 2006). Decreased sperm quality (sperm count, sperm motility, sperm viability and sperm function with increased sperm abnormalities) was also formerly observed in male rats and mice exposed to Na-F, which might explain

the reproductive dysfunction experienced here by male rats (Collins et al. 2001; Wan et al., 2006; Huang et al., 2007).

In agreement with Gupta et al. (2007), our findings showed a clear lessening effect of Na-F on relative weight of reproductive organs. In view of the fact that, any decrease in weight of reproductive organs is under hormonal control, this observed diminution further confirmed androgen hormone decline. The weight, size and secretory function of testes, seminal vesicles, ventral prostate are well known to be closely regulated by androgens hormones (Sriraman et al., 2004). So, Na-F treatment might act directly or indirectly on pituitary gland secretory function leading to a decrease in the main hormones controlling spermatogenesis process.

In conclusion, it is hoped that the findings included in this article might help further understand and appreciate the negative outcomes of pre- and post-natal exposure to Na-F on socio-sexual health and fertility potential, ultimately at adulthood in male individuals.

5. References:

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5/5/2011

Review: Electrical study of pipe – soil – earth system

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Abstract: The rate of discharge through the stray electrolytic capacitor between the pipe and the remote earth is to be considered as the corrosion current. The electrochemical properties of the soil, which are the soil resistivity of the soil volume, the relative permittivity of the soil layer around the pipe and the chemical properties which could be considered as the pH of the soil film layer around the pipe, are affected directly by the humidity change. When considering the room temperature and by neglecting the effect of CO₂ content in the soil, these values of the electrochemical properties of any soil returns back to its initial conditions after soil dryness to its initial condition. This means that corrosion rate will also be changed during the humidity change around the pipe segment. So, when considering the fact that the pipeline will not be changed or replaced and the surrounding medium around it will not be changed or replaced by another kind of soil, then the behavior of the electrical parameters (stray electrolytic capacitance, stray potential, surface created charge) of the pipe-soil-earth system will act as a print of this combination of this pipe and this soil. The average error reduced to be less than $\pm 5\%$ for the general equations of the electric parameters while the print curves & constants at natural condition with and without applying cathodic protection system in terms of the electrochemical properties around the pipe were deduced. This will help to study both the corrosion problem and cathodic protection for a complete pipeline by an electric concept with an electric analogue circuit which is the aim of this study. This will help, in the future, in the choice of pipeline route, pipeline cathodic protection design and cathodic protection maintenance process for the pipe line along its route, however long it is. One of the most critical problems in CP systems is the effect of a sudden change of the soil humidity around the protected pipe line. The behavior of the protection current demand of the pipe-soil-earth system during the change of the electrochemical properties of the soil could be plotted as protection current print which will be always valid in all times as the pipe-soil-earth system is maintained and without any external interference. In other words, if the system is subjected to humidity change, there will be another new protection current demand with new print for this pipe-soil-earth system to keep the pipe cathodically protected. Of course, as a result of humidity change, the pipe to soil potential will be changed. This paper tries to calculate segmental pipe to soil potential along the pipe line without the need of both the test point and Cu/CuSO₄ half cell by a general equation of the pipe to soil potential which is function of both the segmental protection current and the soil factor around the pipe segment during such humidity change. Another critical problem in CP systems is the presence of the earthing network beside the protected pipe line. The behavior of the stray potential between the external surface of the pipe and earth could be plotted as stray potential print which will be always valid in all times as the pipe-soil-earth system is maintained and without any external interference. This paper tries to calculate pipe to soil potential along the pipe line without the need of Cu/CuSO₄ half cell by the deduction of a general equation of the pipe to soil potential which is function of an electric quantity and system's print. In other words, the aim is to deduce a correlation between pipe to soil potential and both of the measured stray potential of the pipe segment and the measured soil factor around it in the presence of an earthing grid.

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Keywords: corrosion current; electrolytic capacitor; soil; earth

1. Introduction:

At humidity equal to zero, the soil medium around pipeline could be considered as a dielectric material which has its relative permittivity. If the humidity is increased, the soil medium is considered to be as an electrolyte associated with a change happened in the values of the relative permittivity, resistivity and pH of the soil. This change happened in the electrochemical properties of the soil will continue by increasing the humidity but these values will return back to their original values, or nearby initial values, after soil dryness. This nature of the soil medium

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between isolation medium and electrolytic medium according to the percentage of the humidity could be studied electrically.

If two dissimilar electrodes buried in a box which is containing a soil medium, a corrosion current will take place between these electrodes due to the difference in electrodes' natural potential while a capacitance in nano farad could be measured between these dissimilar electrodes (through the soil). The potential difference, the capacitance and the corrosion current between the positive and negative electrodes are electric quantities. Then, it may be

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possible to understand the corrosion and cathodic protection by an electrical concept beside the electrochemical and thermodynamic concepts.

Now the corrosion may be described electrically by the equation: ($Q = C \times V$), while the rate of discharge dQ/dt is equal to the corrosion current from the +ve electrode to the -ve one [1] [2]. The same concept could be applied on the system of buried pipeline and the surrounding soil medium. The pipeline may be considered the +ve electrode while the remote earth may be considered the -ve electrode. In case of pipe-soil-earth system, the behavior of the electrical parameters (stray potential $V_{p,PE}$, stray capacitor $C_{p,PE}$, surface total charge Q and protection current I_p) of the pipe-soil-earth system, during the change of the electrochemical properties of the soil, with and without applying cathodic protection system, could be plotted as an electrical parameter PRINT which will be always valid in all times as the pipe-soil-earth system is maintained and without any external interference [6] [7] [8] [9] [10]. Once the system is changed by replacement another pipe with different dimension and/or the replacement of the soil (or by humidity change), there will be another new electrical parameter PRINT for the new pipe-soil-earth system.

Also, the buried pipe line segment with soil surrounding medium could be simulated electrically by an electric circuit where the system is subjected to the law $Q = C \times V$ between the pipe surface and remote earth. This is where each of circuit electric parameter could be obtained by an equation which is function of the measured electrochemical properties of the soil (soil factor), 4th degree polynomial at room temperature but the A's constants are different for each electric quantity. The constants of each equation (A's) are considered to be as a PRINT of such pipe-soil-earth system [10] [12]. The useful of these PRINTS are to obtain complete electrical data correlated with many cathodic protection levels which help, after complete erection of the pipeline, in defining the pipe to soil potential of any pipe line segment through its length by measuring the protection current and / or the stray potential with of course computing of the soil factor at the pipe segment from direct field measurements [14][15]. The average error of the electrical parameters equations is reduced to be less than $\pm 5\%$. The most important advantage of such electrical analogue circuit of pipe-soil-earth system is the possibility to simulate a complete pipeline-soil-earth system by an electric circuit and to convert the corrosion problem and cathodic protection of the pipeline to an electric problem [11] [13].

One of the most critical problems in CP systems is the presence of the earthing network beside the

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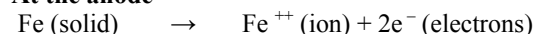
protected pipe line. The question now is: To what extent, the earthing grid would affect the cathodic protection system? In this review, we tried to calculate the pipe to soil potential along the pipe line without using Cu/CuSO₄ half cell by measuring both the stray potential and/or the protected current of the pipe and the soil factor around the pipe. In other words, a direct correlation between the pipe to soil potential and the electrical parameters of the pipe for all boxes under test are deduced.

In the near future after completing such electrical studies of the pipe-soil-earth systems, this will help in corrosion monitoring and the maintenance of c.p systems. Not only has that but also to define the most suitable route of the pipe line, before the erection process, which generates the minimum surface charge. The most important result is that: the pipe to soil potential of any buried pipeline could be obtained segmental along its route without the need of both the test point and Cu/CuSO₄ half cell. This is by the use of the new electric study of the pipe-soil-earth system [14][15].

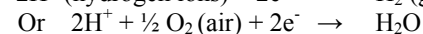
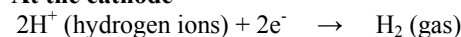
2. Literature Review

The only way in which atoms of the metal may detach themselves from the surface and enter the solution is in the form of positively charged ions. In electrochemical concept of corrosion process, for buried metal pipe in the ground, the following equations describe the corrosion process:

At the anode



At the cathode



Then,



In the proposed electrical concept of the corrosion process of bare pipe-soil-earth system, the anodic reaction and the surrounding soil around the pipe may be represented, electrically, by formation of a charged electrolytic stray capacitor as shown in Fig.1 and Fig.2a [1] [2]. The electrolytic capacitor is consisting of pipe segment as the positive electrode, thin film of soil layer as the dielectric material of the capacitor and an imaginary co-axial earthing cylinder as the negative electrode. This is while for coating pipe-soil system, the stray capacitor may be considered as cylindrical capacitor with compound dielectric materials (coating of the pipe + thin film

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soil layer) as shown in Fig.2b [1] [2]. The formation of $Fe(OH)_2$ & $Fe(OH)_3$ in the electrochemical concept may be understood electrically by the positive charge discharged through the electrolytic stray capacitor to the imaginary co-axial earthing cylinder of radius r_3 (self discharge of the capacitor). The rate of discharge is equal to the stray corrosion current (equivalent to electron loss).

In other words, the cathodic reaction at the imaginary co-axial earthing cylinder (the negative electrode) and formation of hydroxyl ion (OH^-), detach the positive ion from metal surface and form ferric oxides. Electrically, it may be understood as the discharge of the positive charge from the positive electrode to the imaginary grounded negative electrode through thin film of soil layer as shown in Fig.1. The above clarification could be summarized as follow:

The electric concept of corrosion for pipe-soil-earth system may be written by the following proposed concept:

“Due to surrounding medium effect around metal structure buried in the ground, the charge created on metal outer surface area (o.s.a) builds up a potential through a stray electrolytic capacitor between metal o.s.a and an imaginary coaxial earthing cylinder where rate of discharge is equal to the corrosion current “[1][2].

The electric concept of corrosion for pipe-soil-earth system may be written by the following proposed concept:

“Due to surrounding medium effect around metal structure buried in the ground, the charge created on metal outer surface area (o.s.a) builds up a potential through a stray electrolytic capacitor between metal o.s.a and an imaginary coaxial earthing cylinder where rate of discharge is equal to the corrosion current “[1][2].

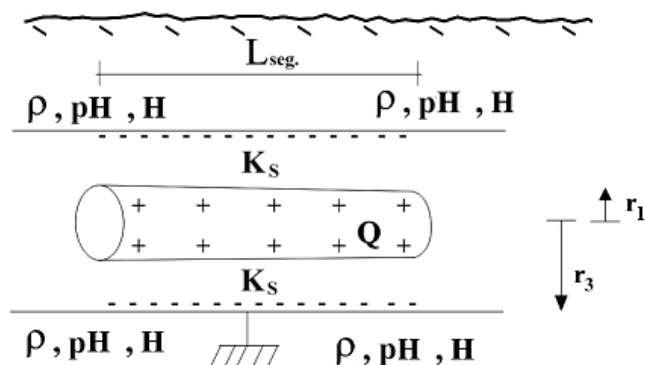


Figure 1: Proposed electrical concept of bare pipe segment with soil medium

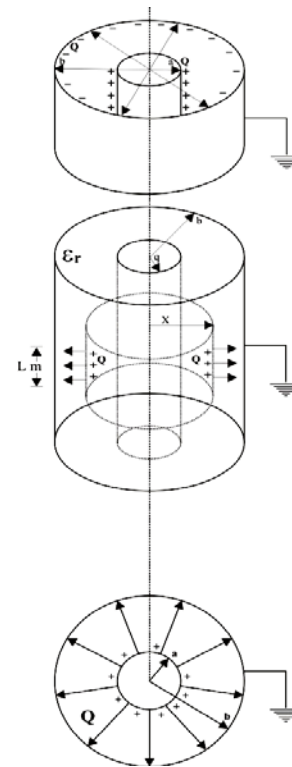


Figure 2a: Bare pipe segment with an imaginary Coaxial earthing cylinder form a charged electrolytic capacitor

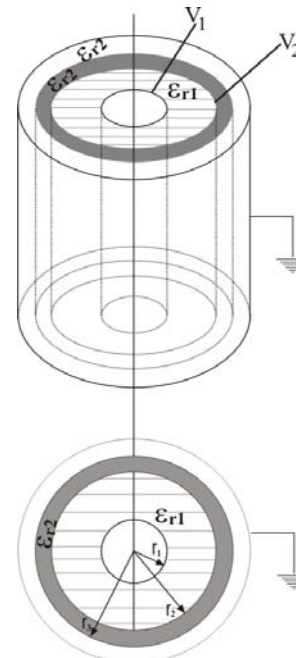


Figure 2b: Cylindrical capacitor of the pipe seg. and the compound dielectric of coating material and soil layer

The dielectric constant of the soil layer around the pipe K_s acts with the dielectric constant of the

pipe coating material K_C as a coaxial cylindrical capacitor with compound dielectric. As K_C of the coating material is decreased, the total capacitance value is decreased (two capacitors are in series) then charge is decreased. That's to say, the corrosion process (electrons losses) is decreased. If deterioration of coating material occurred, then K_C is increased i.e. total capacitance value of the compound dielectric is increased. That's to say that corrosion process (electrons losses) is increased as the created charge on metal outer surface area Q will be increased. Now, what are these electrical prints? What is the equivalent electrical circuit of bare pipe segment-soil-earth system with and without applying cathodic protection system? How to calculate the pipe to soil potential from these electrical prints? .

3. The Soil Factor

As the values of the electrochemical properties of any soil medium are changed by the change of humidity, they return back to their initial conditions, or nearby the initial values, after some time, when humidity returns back to its initial value. Then we can define a new factor named the soil factor as:

“The soil factor is the instantaneous or present value of the electro-chemical properties of the soil based on the electrical properties at Humidity equal to 10% “[1] [2] and is equal to:

$$S_f = (1/K_s) \rho H \log p \quad \text{at room temperature} \quad (1)$$

Dimension of $[S_f] = [1/K_s] [pH] [H] [\log p] = \Omega.m \%$ (% is added to differentiate between S_f and ρ)

Where:

S_f = soil factor

K_s = Dielectric constant of the soil at $H = 10\%$
(a reference value of this property)

pH = power of Hydrogen of the soil

ρ = Soil resistivity in $\Omega.m$. at $H = 10\%$
(a reference value of this property)

H = Humidity of the soil %

Fig. 3 shows the range of the soil factor S_f and the range of humidity for ten soils under test.

The importance of this new parameter, the soil factor, is that it is combining all parameters which can affect directly on the cathodic protection level or in corrosion process (the effect of temperature and CO_2 could be added in future studies). Such electrical parameters which can be obtained by a direct measurement from the field only one time then use both the humidity & pH in the soil factor calculations. This means that if it is possible to study the relationship between the soil factor and the electrical parameters (C , V , Q and I_p) of the pipe-soil system at natural condition with and without applying cathodic protection system, then the electrical

parameters PRINTS of the pipe-soil-earth system could be obtained.

The soil factor can be considered to be as the main key of many studies based on the proposed electrical concept of corrosion. For an example, the general equation of the natural stray capacitance, without applying CP, between external surface area of bare pipe segment and earth is obtained in terms of the soil factor with an average error less than $\pm 5\%$ and its print curves are obtained for pipe-soil-earth system for 10 different soils [3][10]. Also, the general equation of both the natural stray potential and the natural surface charge, without applying CP, are obtained in terms of the soil factor with an average error less than $\pm 5\%$ and their print curves are obtained for pipe-soil-earth system for 10 different soils [4] [5] [10]. Also, by the use of this new parameter, the soil factor, it is possible to find a correlation between the electrical parameters and the electrochemical properties of the soil, with applying CP, at different humidity and at many cathodic protection levels with the results to be considered as an electrical parameters print or as a data sheet of this pipe-soil-earth system [6] [7] [8] [9] [10].

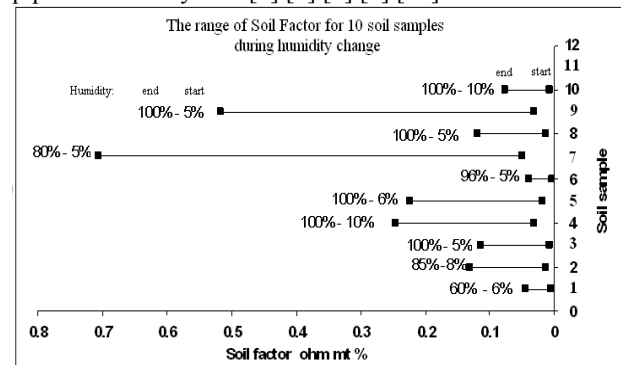


Figure 3: The range of the soil factor & humidity range for the soils under test

4. Circular ΔV PIG Idea: [1][2]

This is a new idea of the voltage drop technique to measure the protection current I_p passed through the buried pipeline. By considering a pipe line with total length L m, if such length is divided into segments with length L m./segment Then:

Total length $L =$ segment length $L_{Seg} \times$ number of segments n

Electrically, the pipe line could be considered as: total resistance = segment resistance \times number of segments n as shown in Fig.3.

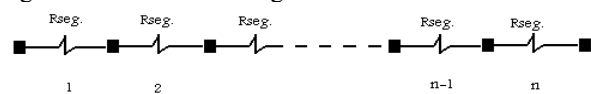


Figure 3: Electrical analogue resistance of the total pipe line length

Now if the voltage between circular points a & b of the segment is measured, as shown in figure 4, then the instantaneous measured protection current will equal to:

$$I_p = \frac{\Delta V}{R_{seg.}}$$

That means that an additional circular voltage drop canister could be added in the future with the available intelligent pig to measure the protection current I_p . Figure 4 shows such canister, and in the meantime by using GPS technology to determine the segment position. By the use of this voltage drop canister which pigged with the intelligent pig and by the use of GPS system, each segment flow current I_p could be measured.

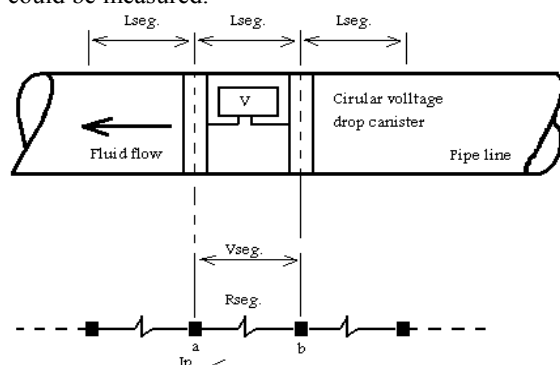


Figure 4: Idea of voltage drop canister to be pigged with the fluid through the pipeline

Then by measuring the humidity around this pipe segment, the soil factor could be determined. Finally, from the ONION curves obtained before [9] (which correlate I_p , S_F and $V_{H.C}$), the equivalent pipe to soil potential of this buried pipe segment could be determined without the need of test point and without the need of Cu/CuSO₄ half cell. The most important result is that: the pipe to soil potential of any buried pipeline could be obtained segmental along its route without the need of any test points. This target could be achieved by another technique which is a direct calculation of the pipe to soil potential from a general equation. This paper deduces this general equation of the pipe to soil potential for all boxes under test.

A. Experimental Natural Prints And The Re-Calculated General Equations Of The Electrical Parameters For Buried Bare Pipe -Soil- Earth System With And Without Applying Cathodic Protection System

5. Case1:

5.1 Pipe – Soil – Earth System Without C.P System

5.1.1 The Experiment

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At natural condition system without any influence of any external systems such as cathodic protection systems, pipe crossing... (only bare pipe + soil + point earth), the experiment is consisting of a system with bare pipe segment (2.1cm diameter, 1mm thickness and 31.1cm length), buried in a soil with humidity equal to 10% and the soil have soil resistivity equal to $\rho \Omega.m$, soil power of hydrogen pH and soil relative permittivity K_s . Table 1 shows the different kind of soils used in this experiment and the range of humidity.

When considering the system pipe-soil-earth for ten different kind of soil as shown in table 1, the test procedures are as follow:

- 1) Calculate the value of the soil factor according to the eq.1 :
- 2) Measure both the stray potential V_{P-PE} , the stray capacitance C_{P-PE} and the correspondent pipe to soil potential V_{H-C} by using Cu/CuSO₄ half cell. Calculate total surface charge $Q = V_{P-PE} * C_{P-PE}$
- 3) Increase the Humidity and calculate the new value of the soil factor.
- 4) Repeat steps 2 & 3 until humidity around the pipe segment reaches its maximum as shown in table 1.
- 5) Change this type of soil by another kind of soil and repeat all the steps done before.
- 6) Repeat again the steps for 10 different kind of soil shown in table 1.
- 7) Build up the results table.

5.1.2 Analysis

If we plot the measured electric quantity (natural stray potential V_{P-PE} , natural stray capacitance C_{P-PE} and surface total charge Q) individually as y axis in terms of the correspondent measured soil factor as x axis, we will obtain such following curves as shown in figures 5&6. Except box 4 and box 13, the curves and equations show eight boxes which could be expressed by a 4th degree polynomial equation with an average error equal to zero percent. Table 2 shows the error table for the 10 different soil resistivity.

5.2 Electrical Parameters Print Curves For Pipe – Soil – Earth Under Test

By considering the measured soil factor as x axis against the measured electrical parameter (stray potential V_{P-PE} , stray capacitance C_{P-PE} , surface total charge Q) as y axis, the next following print curves were obtained for the pipe - soil - earth systems under test as shown in figures 5&6. The stray capacitance is illustrated by group a, figures 5a & 6a. The stray potential is illustrated by group b, figures 5b & 6b. The surface total charge is illustrated by group c, figures 5c & 6c. All points resulting from the experiment could be represented by a trend line for

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each measured electric quantity and could be represented by a PRINT for each pipe-soil-earth under test, with 4th degree polynomial equation. The average error for all equations is less than $\pm 5\%$. The above result is very important. This proves that it may be possible to complete this electrical study of pipe-soil-earth system to find an electric circuit

diagram of this combination of pipe segment-soil-earth system which is one of the real targets. This means that, beside the electrochemical and thermodynamic concepts of corrosion, it is possible to have an electric concept of the corrosion process and to convert both the corrosion and cathodic protection problems into an electric problem.

Table 1: 10 different kind of soil and operating range of H & pH

Kind of soil	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
Box under test	1	4	9	10	13	18	19	24	27	28
Resistivity Ω m	31	37	43	62	125	138	1382	2010	5654	7539
Relative permittivity K_S	138	66	86	43	51	274	22	154	43	355
Humidity %	Start	6	8	5	10	6	5	5	5	10
	End	60	85	100	100	100	100	96	80	100
pH	Start	7.8	7.3	7.8	7.8	7.3	7.6	7.2	7	7.2
	End	7	6.5	6	6	5	5	5.3	7	6

Table 2: Error table for 10 different kinds of soil and operating range of Humidity

Kind of soil	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
Box under test	1	4	9	10	13	18	19	24	27	28
Polynomial degree	4 th	4 th	4 th	4 th	4 th	4 th	4 th	4 th	4 th	4 th
V_{P-PE} Error %	0	± 30	0	0	0	0	0	0	0	0
C_{P-PE} Error %	0	± 30	0	0	± 20	0	0	0	0	0
Q_{TOT} Error %	0	± 50	0	0	± 25	0	0	0	0	0
Humidity %	Start	6	8	5	10	6	5	5	5	10
	End	60	85	100	100	100	100	96	80	100

5.3 Stray Potential General Equation For Pipe – Soil – Earth Under Test

For each soil under test and from natural stray potential curves and equations, it can easily observe that the general equation of the natural stray potential from pipe segment to the earth during humidity change is a 4th degree polynomial equation which is function of the soil factor, $V_{n\text{ stray}} = f(X = S_f)$. For each soil under test, the general stray potential equation is function of the measured soil factor $V_{n\text{ stray}} = f(X=S_f)$, 4th degree polynomial. The stray potential general equation is given by Eq.2:

$$V_{n\text{ stray}} = A_{4vn}X^4 + A_{3vn}X^3 + A_{2vn}X^2 + A_{1vn}X + A_{0vn}(2)$$

Where:

A's: = $A_{()v}$ are the natural stray potential print constants of the pipe soil under test

X = is the value of the soil factor at certain humidity

5.4 Stray Capacitance General Equation For Pipe – Soil – Earth Under Test

For each kind of soil under test and from stray capacitance curves and equations, it can easily observe that the general equation of the stray capacitance, at natural condition without applying

cathodic protection, to the earth during humidity change is a 4th degree polynomial equation which is function of the soil factor, $C_{n\text{ stray}} = f(\text{soil factor } X)$

For each soil under test, the general stray capacitance equation is function of the measured soil factor, $C_{\text{stray}} = f(X=S_f)$, 4th degree polynomial. The stray capacitance general equation is equal to Eq. 3:

$$C_{n\text{ stray}} = A_{4cn}X^4 + A_{3cn}X^3 + A_{2cn}X^2 + A_{1cn}X + A_{0cn}(3)$$

Where:

A's: = $A_{()CN}$ are the stray capacitance print constants of the pipe soil under test

X = is the value of the soil factor at certain humidity

5.5 Surface Total Charge General Equation For Pipe – Soil – Earth Under Test

For each kind of soil under test and from the natural surface charge curves and equations, it can easily observe that the general equation of the surface charge, at natural condition without applying cathodic protection, is a 4th degree polynomial equation which is function of the soil factor $Q_N = f(X = \text{soil factor})$. For each soil under test, the general surface natural charge equation is function of the measured soil factor, $Q_N = f(X=S_f)$, 4th degree

polynomial. The surface natural charge general equation is equal to Eq. 4:

$$Q_N = A_{4qn}X^4 + A_{3qn}X^3 + A_{2qn}X^2 + A_{1qn}X + A_{0qn} \quad (4)$$

Where:

A's: = A () q are the surface natural charge print constants of the pipe - soil under test

X = is the value of the soil factor at certain humidity

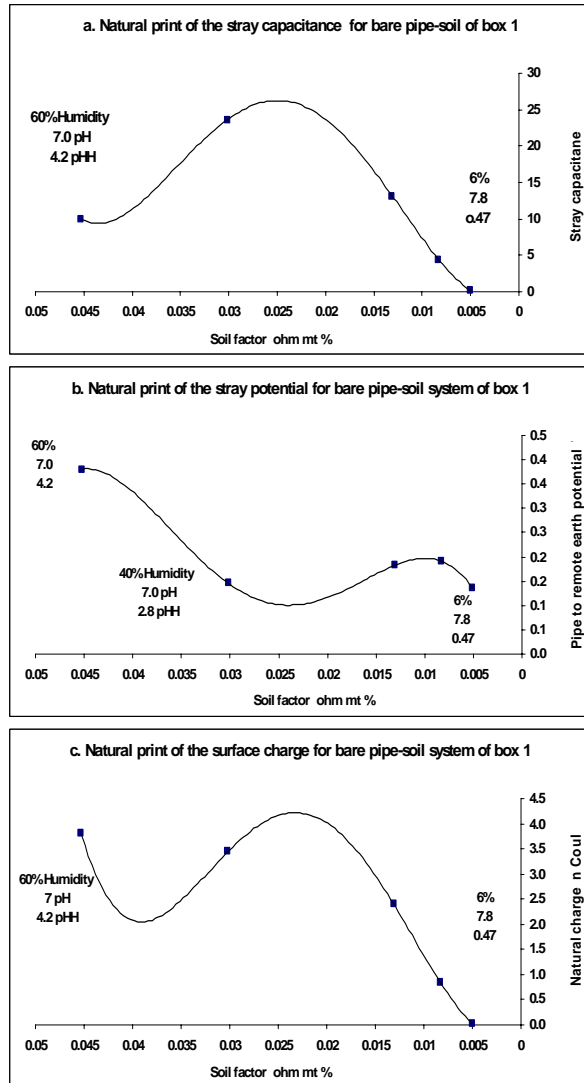


Figure 5: Natural prints of the electrical parameters for buried bare pipe-soil-earth of box 1

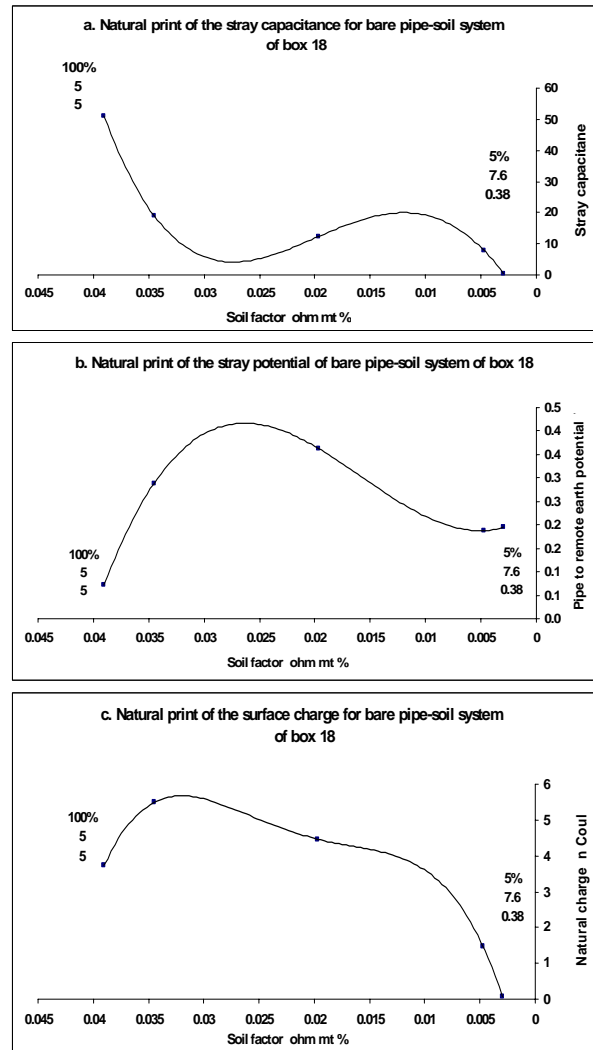


Figure 6: Natural prints of the electrical parameters for buried bare pipe-soil-earth of box 18.

5.6 The Electrical Parameter General Equation Of Pipe-Soil-Earth System At Natural Condition Without Applying CP System

We can observe clearly that the general form of any electrical parameter equation is function of the measured soil factor, 4th degree polynomial but the A's print constants are different. From equations 2, 3 and 4, we can easily summarize the natural electrical parameters equations for the pipe-soil-earth under test, without applying cathodic protection system, as follow:

$$C_{n \text{ stray}} = A_{4cn} X^4 + A_{3cn} X^3 + A_{2cn} X^2 + A_{1cn} X + A_{0cn}$$

$$V_{n \text{ stray}} = A_{4vn} X^4 + A_{3vn} X^3 + A_{2vn} X^2 + A_{1vn} X + A_{0vn}$$

$$Q_{n \text{ stray}} = A_{4qn} X^4 + A_{3qn} X^3 + A_{2qn} X^2 + A_{1qn} X + A_{0qn}$$

We can observe clearly that the general form of any electrical parameter equation, at natural condition without applying cathodic protection, is function of the measured soil factor, 4th degree polynomial but the A's PRINT constants are different. Then, the general form of any electrical parameters equation of the pipe-soil-earth system under test at natural condition without applying cathodic protection with the same amount of soil volume will be as shown by the following equation :

Natural electrical parameter of pipe-soil-earth system under test

$$= A_4 X^4 + A_3 X^3 + A_2 X^2 + A_1 X + A_0$$

The A's are obtained from the correspondent print tables and X is the measured soil factor

The natural electric parameters general equation and PRINT curves show the following important results:

- Buried pipe in a soil which generates the minimum natural created charge at bare pipe surface at normal steady humidity is defining the most suitable choice of soil to be around the pipe.
- In case of space or vacuum is the medium which is surrounding the pipeline instead of soil medium, the value of the soil factor will be zero as $K_S = 1$, H

= 0% , $\rho = \text{infinity}$. That's to say that the natural created charge will equal to zero (A_0 will equal to zero for pipe-vacuum system) which is the ideal case of corrosion prevention.

c) In case of air is the medium which is surrounding the pipeline instead of soil medium, the value of the soil factor will be smaller than that of the soil at same humidity as $K_S \approx 1$ (it is not almost that $K_S \approx 1$ if the humidity exists in air), H = 10% up to 60% or more, pH = 7 & $\rho = \text{value according to H\%}$. Consequently, the natural created charge exists in air but with smaller amount than that of soil at same humidity. That's to say that air is most proper surrounding medium for a pipe than soil at same humidity condition.

5.7 Natural Stray Potential Print Constants For Pipe-Soil-Earth Under Test

Now, the natural stray potential print constants of the pipe-soil-earth system under test are A_{4VN} , A_{3VN} , A_{2VN} , A_{1VN} and A_{0VN} . This means that these print values are valid for these pipe-soil systems under test at any time at the correspondent electrochemical properties (soil factor). Table 3 shows result example of the natural stray potential print.

Table 3: PRINT constants of the stray potential for 10 different soil under test

Soil	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
Error	0	±30%	0	0	0	0	0	0	0	0
A_{4VN}	-2.E+06	0	321339	5620	8822.1	0	118.12	140960	0	546856
A_{3VN}	202688	698.68	-78007	-3154.1	-3710.9	-48181	-153.09	-37414	-110.64	-110280
A_{2VN}	-6782.5	-157.71	6025.9	599.26	407.17	2278.7	54.029	3218.8	100.61	7753.7
A_{1VN}	82.539	9.8253	-159.72	-44.958	-3.3452	-19.695	-3.1804	-99.254	-24.97	-215.37
A_{0VN}	-0.133	0.0009	1.377	1.412	0.0954	0.2352	0.1245	0.9629	1.2357	1.8678

5.8 Natural Stray Capacitance Print Constants For Pipe-Soil-Earth Under Test

Now, the stray capacitance print constants of the pipe-soil-earth system under test are A_{4CN} , A_{3CN} , A_{2CN} , A_{1CN} and A_{0CN} . This means that these print

values are valid for these pipe-soil systems under test at any time at the correspondent electrochemical properties (the soil factor). Table 4 shows the natural stray capacitance print constants.

Table 4: PRINT constants of natural stray capacitance for 10 different soils under test

Soil	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
Error	0	±30%	0	0	±30%	0	0	0	0	0
A_{4CN}	1.E+08	0	-4.E+06	1.E+06	0	6.E+07	26675	-9.E+06	21770	1.E+07
A_{3CN}	-1.E+07	262166	1.E+06	-620109	-269270	4.E+06	-35297	2.E+06	-16925	-1.E+06
A_{2CN}	322980	-47807	-88692	99288	69267	-379156	13424	-203776	3178	21862
A_{1CN}	-1549	2428	2780	-5207	-1953	6969	-1209	6766	120	874
A_{0CN}	1.27	-24.8	-15.55	84	12.77	-17	31	-58	-6	-6.8

5.9 Surface Natural Charge Print Constants For Pipe-Soil-Earth Under Test

Now, the surface natural charge print constants of the pipe-soil-earth system under test are A_{4q} , A_{3q} , A_{2q} ,

A_{1q} and A_{0q} . This means that these print values are valid for these pipe-soil systems under test at any time at the correspondent electrochemical properties

(soil factor). Table 5 shows surface natural charge print constants.

Table 5: Natural charge PRINT at the pipe surface for 10 different soils under test

Soil	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
Error	0	$\pm 50\%$	0	0	$\pm 25\%$	0	0	0	0	0
A_{4qn}	3.E+07	0	-919280	526631	0	-4.E+07	9205.4	-376311	-9566.4	-715518
A_{3qn}	-2.E+06	45298	242778	-267958	-26967	4.E+06	-12309	101374	9162.1	157730
A_{2qn}	60696	-8408	-20512	43238	6411	-110112	4771.1	-9536	-2632	-10306
A_{1qn}	-261	432.74	622.04	-2329	-41.27	1486.5	-461.4	360.12	227.38	253
A_{0qn}	0.1	-4.46	-3.368	38.55	-1.36	-3.463	12.625	-3.27	-4.63	-1.168

6. Case 2:

6.1 Pipe – Soil – Earth System With applying Cathodic Protection System

6.1.1 The Experiment

At natural condition system without any influence of any external systems such as cathodic protection systems, pipe crossing... (only bare pipe + soil + impressed current system + point earth), the experiment is consisting of a system with bare pipe segment (2.1cm diameter, 1mm thickness and 31.1cm length), buried in a soil with humidity equal to 10% and the soil have soil resistivity equal to $\rho \Omega.m$, soil power of hydrogen pH and soil relative permittivity K_s . The impressed current system is consisting of a nail as an anode which is connected to the positive terminal of variable d-c source while the negative terminal is connected to the bare pipe segment. Table 1 shows the different kind of soils used in this experiment and the range of humidity.

When considering the system pipe-soil-earth for ten different kind of soil as shown in table 1, the test procedures are as follow:

- 1) Calculate the value of the soil factor according to the Eq.1 :
- 2) Measure both the stray potential V_{P-PE} , the stray capacitance C_{P-PE} , the protection current I_p and the correspondent pipe to soil potential V_{H-C} by using Cu/CuSO₄ half cell. Calculate total surface charge $Q = V_{P-PE} * C_{P-PE}$

- 3) Increase the c.p protection current I_p
- 4) Repeat step 2&3 up to $V_{H-C} = -2$ volt
- 5) Increase the Humidity and calculate the new value of the soil factor.
- 6) Repeat steps 2, 3&4 until humidity around the pipe segment reaches its max. as shown in table 1.
- 7) Change this type of soil by another kind of soil and repeat all the steps done before.
- 8) Repeat again the steps for 10 different kind of soil as shown in table 1.
- 9) Build up the results table.

6.1.2 Analysis

If we plot the measured electric quantity (stray potential V_{P-PE} , stray capacitance C_{P-PE} , surface total charge Q and protection current I_p) individually as y axis in terms of the correspondent measured soil factor as x axis at the correspondent different levels of pipe to soil potential V_{H-C} by using Cu/CuSO₄ half cell from -0.2 v to -2 volt, we will obtain such following curves as shown in figures 7, 8 & 9. Except box 4 and box 24, the curves and equations of the electrical parameters show eight boxes which could be expressed by a 4th degree polynomial equation with an error equal to zero percent. Table 6 shows the error table for the 10 different soil resistivity under test.

Table 6: Average error table for 10 different kinds of soil and operating range of Humidity

Soil	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
Box under test	1	4	9	10	13	18	19	24	27	28
Polynomial degree	4 th	4 th	4 th	4 th	4 th	4 th	4 th	4 th	4 th	4 th
V_{P-PE} Error %	0	± 30	0	0	0	0	0	± 30	0	0
C_{P-PE} Error %	0	± 30	0	0	0	0	0	± 30	0	0
Q_{TOT.} Error %	0	± 30	0	0	0	0	0	± 30	0	0
I_p Error %	0	± 30	0	0	0	0	0	± 30	0	0
Humidity %	Start	6	8	5	10	6	5	5	5	10
	End	60	85	100	100	100	100	96	80	100

6.2 Stray Potential For Pipe-Soil-Earth Under Test

From the stray potential PRINT curves and trend lines equations, as shown in figures 7b, 8b and 9b, it can easily observe that the general equation of the stray potential of a cathodically protected bare pipe segment during humidity change under multi level of cathodic protection levels is a 4th degree polynomial equation which is function of the soil factor $V_{Str.} = f(X = \text{soil factor})$. For each soil under test, the general stray potential equation is function of the measured soil factor, $V_{Str.} = f(X=S_f)$, 4th degree polynomial. The stray potential general equation is equal to Eq. 5:

$$V_{Str.} = A_{4V}X^4 + A_{3V}X^3 + A_{2V}X^2 + A_{1V}X + A_{0V} \quad (5)$$

Where:

A's: = $A_{()V}$ are the stray potential print constants of the pipe - soil under test
 $X =$ is the value of the soil factor at certain humidity

6.3 Stray Capacitance For Pipe-Soil-Earth Under Test

From the stray capacitance PRINT curves and trend lines equations, as shown in figures 7a, 8a and 9a, it can easily observe that the general equation of the stray capacitance of a cathodically protected bare pipe segment during humidity change under multi level of cathodic protection levels is a 4th degree polynomial equation which is function of the soil factor $V_{Str.} = f(X = \text{soil factor})$, the same equation as that of pipe – soil – earth system without applying cathodic protection. For each soil under test, the general stray capacitance equation is function of the measured soil factor,

$C_{Str.} = f(X=S_f)$, 4th degree polynomial. The stray potential general equation is equal to Eq. 6:

$$C_{Str.} = C_{n\text{ stray}} = A_{4cn}X^4 + A_{3cn}X^3 + A_{2cn}X^2 + A_{1cn}X + A_{0cn} \quad (6)$$

Where:

A's: = $A_{()cn}$ are the stray capacitance print constants of the pipe - soil under test
 $X =$ is the value of the soil factor at certain humidity

6.4 Surface Total Charge For Pipe-Soil-Earth Under Test

From the surface total charge PRINT curves and trend lines equations, as shown in figures 7c, 8c and 9c it can easily observe that the general equation of the surface total charge of a cathodically protected bare pipe - segment during humidity change under multi level of cathodic protection levels is a 4th

degree polynomial equation which is function of the soil factor $Q_{tot.} = f(X = \text{soil factor})$.

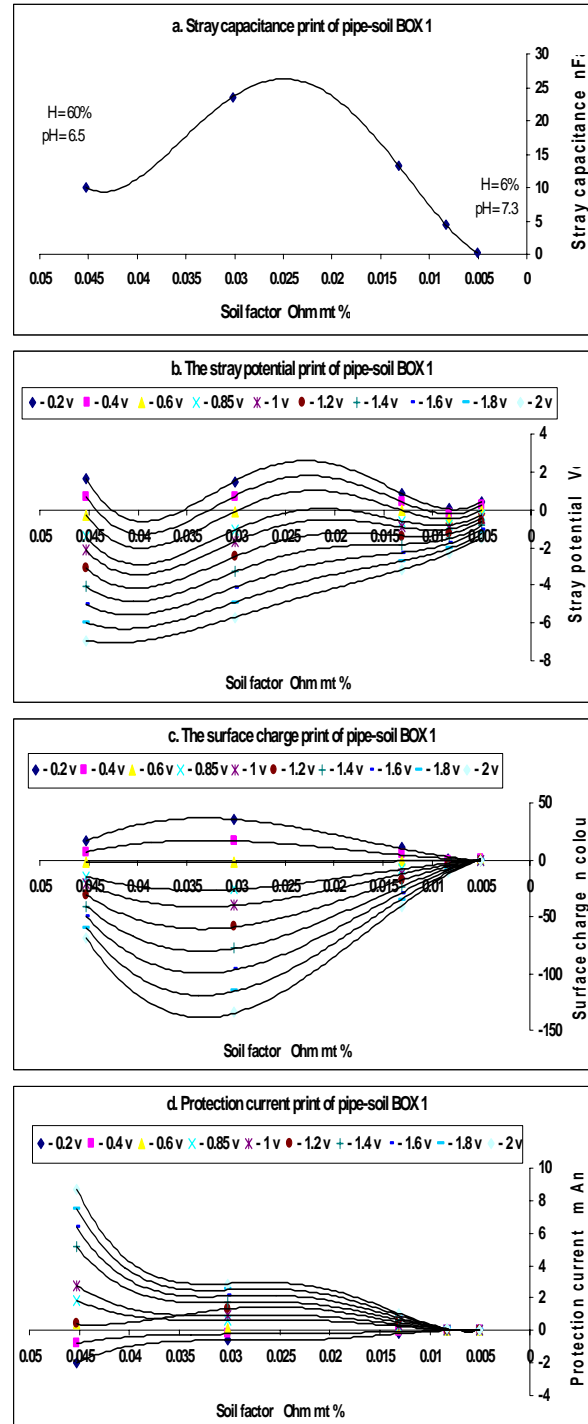


Figure 7: Electrical Parameters PRINT curves of pipe-soil-earth of BOX 1

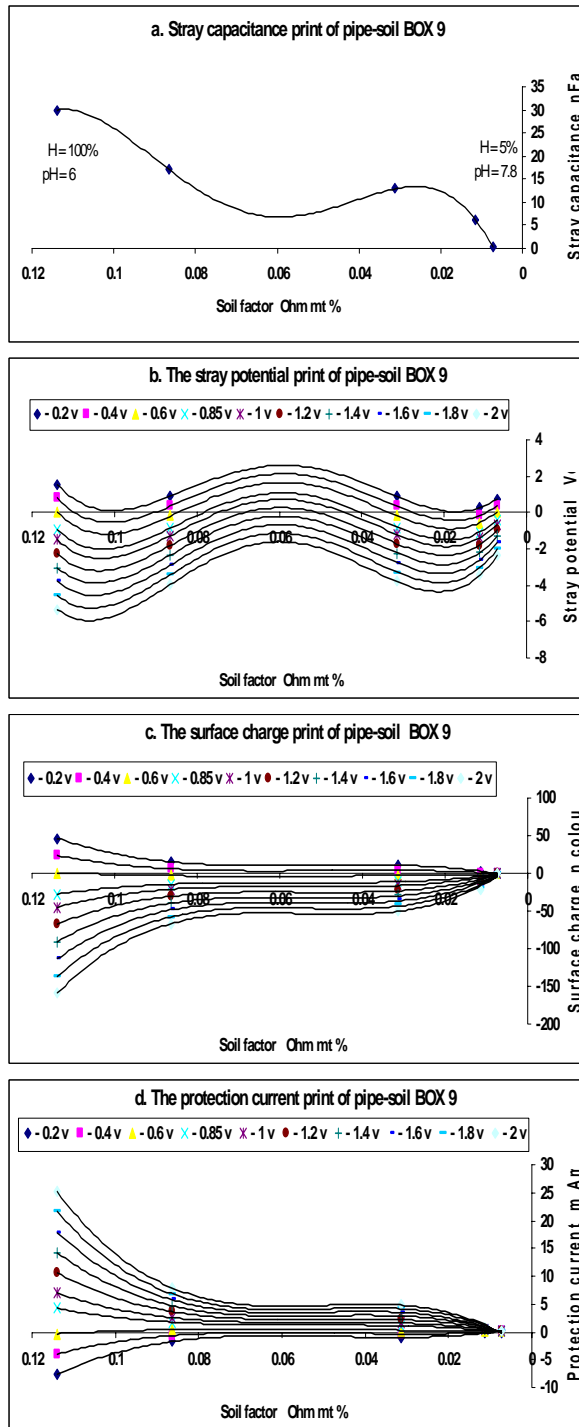


Figure 8: Electrical Parameters PRINT curves of pipe-soil-earth of BOX 9

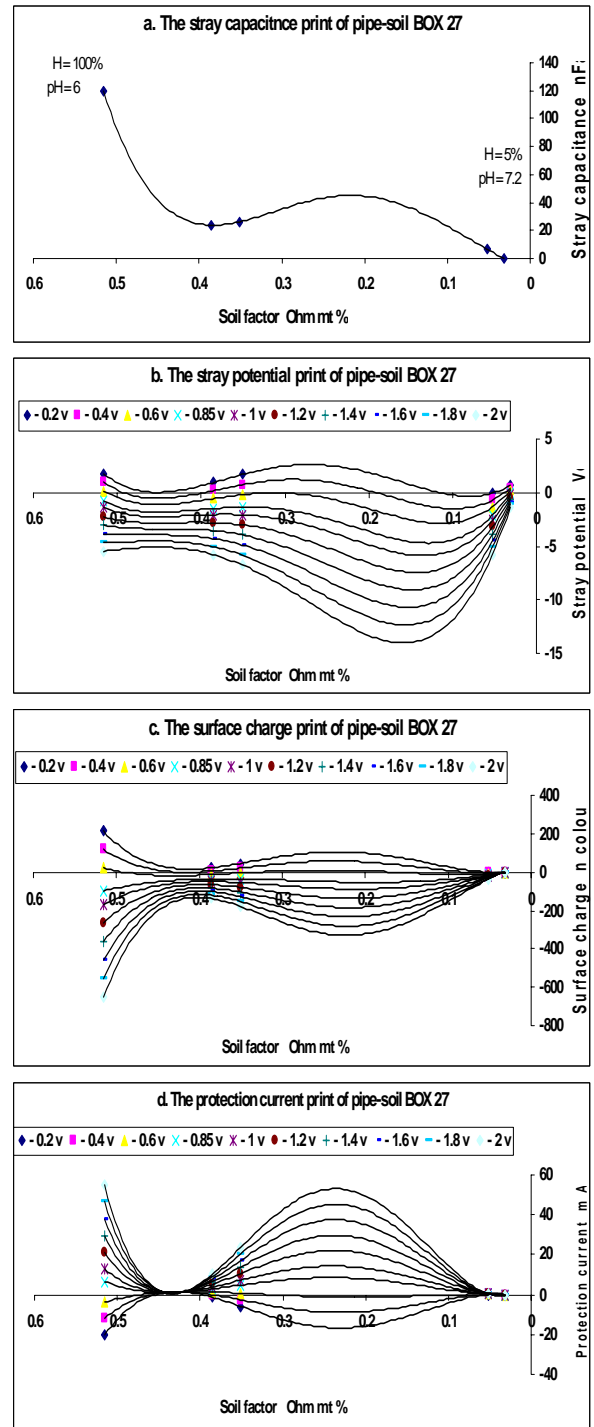


Figure 9: Electrical Parameters PRINT curves of pipe-soil-earth of BOX 27

For each soil under test, the general surface total charge equation is function of the measured soil

factor, $Q_{tot} = f(X=S_f)$, 4th degree polynomial. The surface total charge general equation is equal to Eq.7:

$$Q_{tot} = A_{4q}X^4 + A_{3q}X^3 + A_{2q}X^2 + A_{1q}X + A_{0q} \quad (7)$$

Where:

A's: = A () q are the surface total charge print

constants of the pipe - soil under test

X = is the value of the soil factor at certain humidity

6.5 Protection Current General Equation For Pipe – Soil – Earth Under Test

Definition: “The ONION curves are the curves of the protection current I_p in terms of the soil factor S_f at different half cell voltage $V_{H,C}$ levels”. From the PRINT ONION curves, , as shown in figures 7d, 8d and 9d and trend lines equations, it can easily observe that the general equation of the protection current of a cathodically protected bare pipe segment during humidity change under multi level of cathodic protection levels is a 4th degree polynomial equation which is function of the soil factor, $I_p = f(X = \text{soil factor})$

For each soil under test, the general protection current equation is function of the measured soil factor $I_p = f(X=S_f)$, 4th degree polynomial. The protection current general equation is equal to Eq. 8:

$$I_p = A_{4I}X^4 + A_{3I}X^3 + A_{2I}X^2 + A_{1I}X + A_{0I} \quad (8)$$

Where:

A's: = A ()_I are the protection current print constants of the pipe soil under test

X = is the value of the soil factor at certain humidity

6.6 The Electrical Parameter General Equation Of Pipe-Soil-Earth System With Applying C.P System

We can observe clearly that the general form of any electrical parameter equation is function of the measured soil factor, 4th degree polynomial but the A's constants are different and are dependant on the pipe to soil potential except the stray capacitance which is independent of the pipe to soil potential . From equations 5, 6, 7 and 8, we can easily summarize the electrical parameters trend lines equations for the pipe-soil-earth under test, with applying c.p system, are in the form as follow:

$$C_{stray} = A_{4cn}X^4 + A_{3cn}X^3 + A_{2cn}X^2 + A_{1cn}X + A_{0cn}$$

$$V_{stray} = A_{4v}X^4 + A_{3v}X^3 + A_{2v}X^2 + A_{1v}X + A_{0v}$$

$$Q_{tot} = A_{4q}X^4 + A_{3q}X^3 + A_{2q}X^2 + A_{1q}X + A_{0q}$$

$$I_p = A_{4IP}X^4 + A_{3IP}X^3 + A_{2IP}X^2 + A_{1IP}X + A_{0IP}$$

Then, the general form of any electrical parameters equation of the pipe-soil-earth system under test, with applying cathodic protection, will be as shown in the following general equation which is the same as that of the system without applying cathodic protection:

$$EP = A_4X^4 + A_3X^3 + A_2X^2 + A_1X + A_0$$

The A's are obtained from the print constant tables and the X is the measured soil factor.

6.7 Stray Potential Print Constants For Pipe-Soil-Earth Under Test

Now, the stray potential PRINT constants of the pipe-soil-earth systems under test are A_{4V} , A_{3V} , A_{2V} , A_{1V} and A_{0V} at a definite cathodic protection level. This means that these print values are valid for these CP levels for these pipe soil systems under test at any time at the correspondent electrochemical properties (the soil factor). Table 7 shows result example of the stray potential print constants at CP level equal to -0.85 volt.

Table 7: Stray potential print constants at pipe to soil potential equal to -0.85 volt

BOX	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
	1	4	9	10	13	18	19	24	27	28
A_{4V}	3.00E+07	0	925051	17354	1149.5	7.00E+07	861.17	0	2228.7	1.00E+06
A_{3V}	-3.00E+06	-1858.9	-223313	-9862.3	-4002.1	-7.00E+06	-1531.8	61.62	-2755.3	-194014
A_{2V}	91780	507.49	16975	1905.4	1569.6	211211	926.56	-232.3	1155.8	12478
A_{1V}	-1023	-37.7	-428	-143	-176.7	-2389.4	-204.8	35.484	-179.3	-321.02
A_{0V}	2.9327	-0.61	1.9	2.6	2.37	4.66	7.154	-2.19	4.49	1.6
Error	0	±30%	0	0	0	0	0	±30%	0	0

6.8 Stray Capacitance Print Constants For Pipe-Soil-earth Under Test

The stray capacitance PRINT constants of the pipe-soil-earth systems under test are A_{4C} , A_{3C} , A_{2C} , A_{1C} and A_{0C} at any cathodic protection level. This

means that these print values are valid at any CP levels for these pipe-soil systems under test at any time at the correspondent electrochemical properties (the soil factor). Table 8 shows the stray capacitance print constants at all CP levels.

Table 8: Stray capacitance print constants at any pipe to soil potential

BOX	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
	1	4	9	10	13	18	19	24	27	28
A _{4C}	1E+08	0	-4E+06	1E+06	0	6E+07	26675	-9E+06	21770	1E+07
A _{3C}	-1E+07	262166	1E+06	-620109	-269270	4E+06	-35297	2E+06	-16925	-1E+06
A _{2C}	322980	-47807	-88692	99288	69267	-379156	13424	-203776	3178	21862
A _{1C}	-1549	2428	2781	-5207	-1953	6970	-1209	6766	120.2	874.8
A _{0C}	1.27	-24.8	-15.5	84.15	12.77	-17.1	31.27	-58.51	-6	-6.82
Error	0	±30%	0	0	±30%	0	0	0	0	0

6.9 Surface Total Charge Print Constants For Pipe-Soil Under Test

The surface total charge PRINT constants of the pipe-soil-earth systems under test are A_{4q}, A_{3q}, A_{2q}, A_{1q} and A_{0q} at a definite cathodic protection level.

This means that these print values are valid for these CP levels for these pipe soil systems under test at any time at the correspondent electrochemical properties (the soil factor). Table 9 shows result example of the surface total charge print constants at CP level equal to -0.85 volt.

Table 9: Print constants of the surface total charge at pipe to soil potential equal to -0.85 volt

BOX	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
	1	4	9	10	13	18	19	24	27	28
A _{4q}	0	0	6E+06	50596	0	5E+08	-11047	0	-5597	-9E+06
A _{3q}	1E+06	303338	-1E+06	-36942	57793	-6E+07	12317	-22910	135.97	980353
A _{2q}	-70717	57990	119052	8379	-9785	2E+06	-2698	3326.1	2662	-12884
A _{1q}	-84.36	-3046	-3394	-846	-857	-24242	-460	-120	-881.7	-922.4
A _{0q}	1.71	31.3	18.7	19.6	18.61	55.6	28.1	-6.62	25	7
Error	0	50%	0	0	15%	0	0	50%	0	0

6.10 Protection current Print Constants For Pipe-Soil Under Test

The protection current PRINT constants of the pipe-soil-earth systems under test are A_{4i}, A_{3i}, A_{2i}, A_{1i} and A_{0i} at a definite cathodic protection level. This means that these print values are valid for these

CP levels for these pipe-soil systems under test at any time at the correspondent electrochemical properties (the soil factor). Table 10 shows result example of the protection current print constants at CP level equal to -0.85 volt.

Table 10: The PRINT constants of the pipe current at pipe to soil potential equal to -0.85 volt

BOX	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
	1	4	9	10	13	18	19	24	27	28
A _{4i}	7E+06	0	14928	32198	-452755	-1E+07	-206.1	23296	4596.1	4.00E+06
A _{3i}	-636953	-6223	9231	-16158	216364	906336	296.1	1329	-4409	-617139
A _{2i}	17742	1138.7	-1749	2569	-30555	-25814	-118	-596.9	1202	26816
A _{1i}	-148.8	-25.2	99.9	-129	1139	371	12.56	47.3	-66.9	-345.4
A _{0i}	0.4	0.2	-0.62	2	-11.77	-0.88	-0.37	-0.5	1.1	1.34
Error	0	30%	0	0	0	0	0	0	0	0

B. The Proposed Electric Circuit Diagram Of The Buried Bare Pipe Segment- Soil - Earth System With And Without Applying Cathodic Protection System

7. Case 1:

7.1 Proposed Electrical Analogue Circuit of The Pipe Segment – Soil - Earth System Without CP System [1] [2]

<http://www.sciencepub.net/life>

In a corrosion process, the metal pipe could be considered as a current source (stray corrosion current) to the surrounding medium (stray capacitor to the remote earth). The electrical analogue circuit of the pipe line segment with the surrounding medium effect could be represented as a current source connected in series with the stray capacitance between

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metal o.s.a and the remote earth. Consequently, the corrosion process could be electrically simulated for both bare pipe and at bad condition of coating material as shown in Fig.10.

The general electrical analogue circuit of pipe segment-soil-earth system will consists of current source in series with an equivalent impedance Z_{eq} correlated to humidity (R_{eq} in parallel with C_{eq}) which is connected from pipe to the remote earth as shown in Fig.11. The importance of this proposed electrical circuit is that it converts both the corrosion and/or cathodic protection process into an electric problem. This is as we obtained before the electric parameters

C, V and Q of the bare pipe segment-soil-earth system in terms of the electrochemical properties of the soil i.e. the general equations of the natural stray capacitance [3],[10], the natural stray potential [4][10], the surface natural created charge[5][10]. All electrical parameters are deduced in terms of the soil factor, 4th degree polynomial equations with an average error less than $\pm 5\%$. In this paper, we will continue and use the results obtained before to deduce the electric analogue circuit of the natural condition pipe-soil-earth system without applying cathodic protection system.

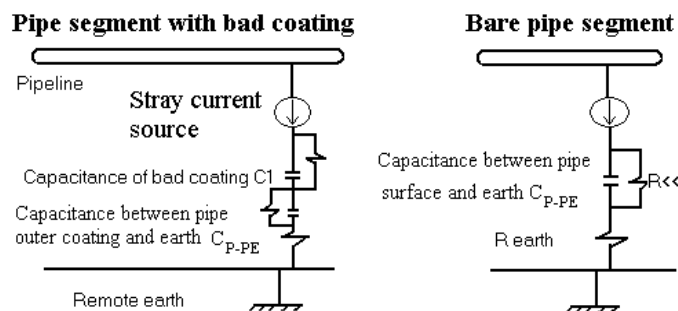


Figure 10: Proposed electrical analogue circuit of the pipe segment – soil system at the corrosion process

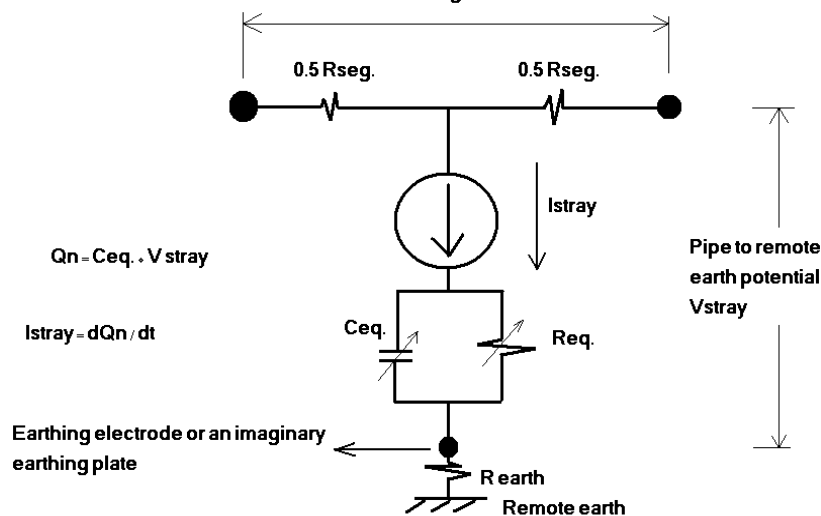


Figure 11: The proposed general electrical analogue circuit of pipe-soil system

7.2 Calculations Of The Electrical Parameters Of The Pipe-Soil-Earth system Without Applying CP System

Now, to obtain the pipe segment natural electric parameters without applying cathodic protection system, we have for the pipe-soil-earth system the following results:

7.2.1 General Equation Of The Natural Stray Electrolytic Capacitor [3],[10]

This is equal to Eq. 3:

$$C_{n \text{ stray}} = A_{4cn}X^4 + A_{3cn}X^3 + A_{2cn}X^2 + A_{1cn}X + A_{0cn} \quad (3)$$

Where:

$A_s = A_{()CN}$ are the stray capacitance PRINT constants of the pipe soil under test

X = instantaneous value of the electrochemical value of the soil, the soil factor

7.2.2 General Equation Of The Natural Stray Potential [4],[10]

This is equal to Eq. 2:

$$V_{n\text{ stray}} = A_{4vn}X^4 + A_{3vn}X^3 + A_{2vn}X^2 + A_{1vn}X + A_{0vn} \quad (2)$$

Where:

A's: = A () v are the natural stray potential print constants of the pipe soil under test

X = instantaneous value of the electrochemical value of the soil, the soil factor

7.2.3 General Equation Of The Natural Surface Charge [5],[10]

This is equal to Eq. 4:

$$Q_N = A_{4qn}X^4 + A_{3qn}X^3 + A_{2qn}X^2 + A_{1qn}X + A_{0qn} \quad (4)$$

Where:

A's: = A () qn are the surface natural charge print constants of the pipe - soil under test

X = instantaneous value of the electrochemical value of the soil, the soil factor

7.2.4 General Equation Of The Protection Current:

As we consider the natural condition without applying cathodic protection system, then the rectifier output will equal to zero.

$$I_p = 0 \quad (5)$$

7.2.5 The Earthing Resistance

The earthing resistance R_E could be easily measured from the field by the use of earth tester.

$$R_E = \text{Measured from the field} \quad (9)$$

7.2.6 The Pipe Segment resistance

The resistance of the pipe segment will equal to:

$$R_{SEG} = (\rho_{IRON} \times L_{SEG}) / a \quad (10)$$

Where:

$$a = \frac{1}{4} \pi (D_o^2 - D_i^2)$$

D_O = Outer diameter of the pipe segment

D_I = Inner diameter of the pipe segment

L_{SEG} = Length of the pipe segment

ρ_{IRON} = Iron Resistivity (pipe material)

7.2.7 The Natural Stray Corrosion Current Calculation

As per Eq. 4:

$$Q_N = A_{4qn}X^4 + A_{3qn}X^3 + A_{2qn}X^2 + A_{1qn}X + A_{0qn}$$

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Then, rate of discharge dQ_N /dt will equal to the corrosion current

$$dQ_N/dt = \dot{X} [(4A_{4qn}X^3 + 3A_{3qn}X^2 + 2A_{2qn}X) + A_{1qn}] \quad (11)$$

As X = soil factor as per Eq.1, applying in Eq.11,then:

$$dQ_N/dt = \dot{X} [4A_{4qn}((1/K_S) \log \rho)_{H=10\%}^3 (\text{pH.H})^3 + 3A_{3qn}((1/K_S) \log \rho)_{H=10\%}^2 (\text{pH.H})^2 + 2A_{2qn}((1/K_S) \log \rho)_{H=10\%} (\text{pH.H}) + A_{1qn}]$$

Now, for bare pipe segment-soil-earth system under test, without applying any c.p system, without any external interference, at room temperature, with soil volume under test and by neglecting CO₂ effect, the natural corrosion current from pipe surface to the surrounding medium could be obtained from an electrical concept of the corrosion and will equal to third order polynomial equation function of measured humidity and pH of the soil as shown in equation 12.

Natural corrosion current of the bare pipe segment to the surrounding medium I_{STRAY} will equal to:

$$I_{STRAY} = \dot{X} [B_{3qn}(\text{pH.H})^3 + B_{2qn}(\text{pH.H})^2 + B_{1qn}(\text{pH.H}) + A_{1qn}] \quad (12)$$

Where:

pH.H = Variable quantity equal to (pH *Humidity) measured around the pipe segment

\dot{X} = Rate of soil factor change by time dx/dt = d(S_f)/dt

B_{3qn} = Cons. print equal to 4A_{4qn} ((1/K_S) log ρ)³_{at H=10%}

B_{2qn} = Cons. print equal to 3A_{3qn} ((1/K_S) log ρ)²_{at H=10%}

B_{1qn} = Cons. print equal to 2A_{2qn} ((1/K_S) log ρ)_{at H=10%}

A_{1qn} = Constant print from natural charge equation

A_{2qn} = Constant print from natural charge equation

A_{3qn} = Constant print from natural charge equation

A_{4qn} = Constant print from natural charge equation

K_S = Constant equal to the dielectric constant of the soil at H = 10%

ρ = Constant equal to the soil resistivity in Ω.m at H = 10%

Referring to the proposed electrical circuit of bare pipe segment-soil-earth system in figure 11, the stray current source may be represented by equation 12. Then, the final proposed electric circuit of such system may be as the circuit diagram shows in figure 12 taking into account that the pipe-soil-earth system is without applying cathodic protection system and without any external interference i.e. natural condition.

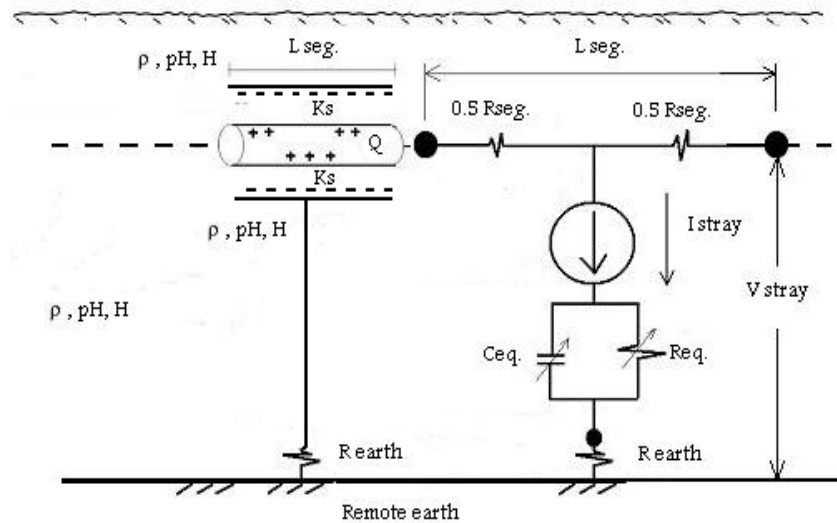


Figure 12: Final proposed electric circuit diagram of bare pipe segment-soil-earth system at natural condition without applying CP system

8. Case 2:

8.1 Proposed Electrical Analogue Circuit Of The Pipe Segment – Soil - Earth System With CP System [1] [2]

In case of cathodic protection process, the protection current either it is greater than the stray current (net current will flow through the pipe) or less than the stray current (net current will flow through the stray capacitor to the remote earth). The c.p level of the pipe line segment could be determined if the protection current before and after the pipe line segment is measured by using the proposed voltage drop canister pigged with an intelligent pig tool [1] [2]. For well coated pipe line segment, the electrical analogue circuit is as in Fig.13a. Also, Fig.13b shows the electric analogue circuit of the pipe segment which is cathodically protected by galvanic system or impressed current system Fig.13c.

The general electrical analogue circuit of pipe segment-soil-earth system will consist of current source in series with an equivalent impedance Z_{eq} .

correlated to humidity (R_{eq} in parallel with C_{eq}) which is connected from pipe to the remote earth as shown in figure 14. The importance of this proposed electrical circuit is that it converts both the corrosion and/or cathodic protection process into an electric problem. This is as we obtained before the electric parameters C, V and Q of the bare pipe segment-soil-earth system in terms of the electrochemical properties of the soil i.e. the general equations of the stray capacitance at many CP levels [6][10], the stray potential at many CP levels [7],[10], the surface total charge at many CP levels [8],[10] and finally the amount of the protection current at many CP levels [9],[10]. All electrical parameters deduced in terms of the soil factor, 4th degree polynomial equations with an average error less than $\pm 5\%$. In this paper, we will continue and use the results obtained before to deduce the electric analogue circuit at the natural condition pipe-soil-earth system with applying cathodic protection system.

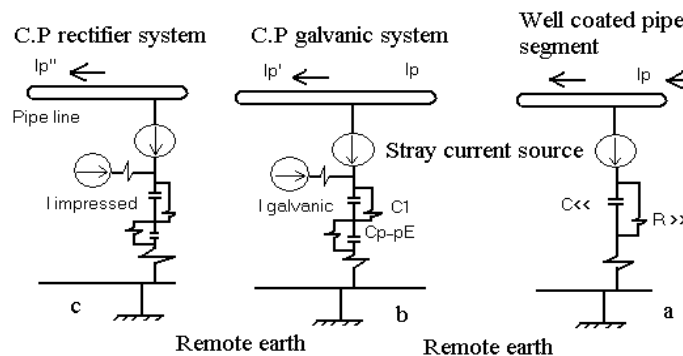


Figure 13: Proposed electrical analogue circuit of the pipe segment-soil system at the cathodic protection process (a) By well coating material (b) By galvanic system (c) By using impressed current system

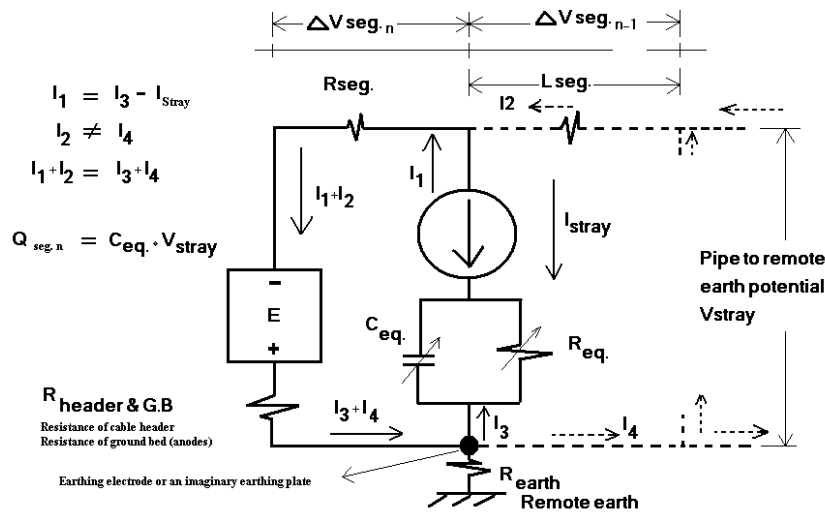


Figure 14: The proposed general electrical analogue circuit of pipe-soil system

8.2 Calculations of The Electrical Parameters Of The Pipe-Soil-Earth system With Applying CP System

Now, to obtain the pipe segment natural electric parameters with applying cathodic protection system, we have for the pipe-soil-earth system the following results:

8.2.1 General Equation Of The Electrolytic Capacitance [6][10]

This is equal to Eq. 10:

$$C_{stray} = A_{4C}X^4 + A_{3C}X^3 + A_{2C}X^2 + A_{1C}X + A_{0C} \quad (6)$$

Where:

A's: = A_{()C} are the stray capacitance print constants of the pipe soil under test
 X = instantaneous value of the electrochemical value of the soil, the soil factor

8.2.2 General Equation Of The Stray Potential [7][11]

This is equal to Eq. 11:

$$V_{stray} = A_{4V}X^4 + A_{3V}X^3 + A_{2V}X^2 + A_{1V}X + A_{0V} \quad (5)$$

Where:

A's = A_{()V} are the natural stray potential print constants of the pipe soil under test
 X = instantaneous value of the electrochemical value of the soil, the soil factor

8.2.3 General Equation Of The Surface Charge [9],[10]

This is equal to Eq. 12:

$$Q = A_{4q}X^4 + A_{3q}X^3 + A_{2q}X^2 + A_{1q}X + A_{0q} \quad (7)$$

Where:

A's: = A_{()q} are the surface charge print constants of the pipe - soil under test
 X = instantaneous value of the electrochemical value of the soil, the soil factor

8.2.4 General Equation Of The Protection Current Flow To The Pipe Segment (I₁) [10]

This is equal to Eq. 13:

$$I_1 = I_P = A_{4I}X^4 + A_{3I}X^3 + A_{2I}X^2 + A_{1I}X + A_{0I} \quad (8)$$

Where:

A's: = A_{()I} are the protection current print constants of the pipe soil under test
 X = instantaneous value of the electrochemical value of the soil, the soil factor

8.2.5 Natural Stray Corrosion Current I_{STRAY} [10]

This is equal to Eq. 12:

$$\frac{dQ_n}{dt} = \dot{X} [\frac{B_{3qn}(pH.H)^3}{B_{1qn}(pH.H)} + \frac{B_{2qn}(pH.H)^2}{A_{1qn}}] \quad (12)$$

Where:

pH.H = Variable quantity equal to (pH* Humidity) measured around the pipe segment
 \dot{X} = Rate of soil factor change by time = d(S_f)/dt
 B_{3qn} = Cons. print equal to 4A_{4qn} ((1/Ks) log ρ)³ at H=10%
 B_{2qn} = Cons. print equal to 3A_{3qn} ((1/Ks) log ρ)² at H=10%
 B_{1qn} = Cons. print equal to 2A_{2qn} ((1/Ks) log ρ) at H=10%
 A_{1qn} = Constant print from natural charge equation
 A_{2qn} = Constant print from natural charge equation

A_{3qn} = Constant print from natural charge equation

A_{4qn} = Constant print from natural charge equation

K_S = Dielectric constant of the soil at H = 10%

ρ = Soil resistivity in $\Omega.m$ at H = 10%

8.2.6 Earthing Resistance

The earthing resistance R_E could be easily measured from the field by the use of earth tester.

$$R_E = \text{Measured from the field} \quad (9)$$

8.2.7 Pipe Segment Resistance

The resistance of the pipe segment will equal to:

$$R_{SEG} = (\rho_{IRON} \times L_{SEG}) / a \quad (10)$$

Where:

$$a = \frac{1}{4} \pi (D_O^2 - D_I^2)$$

D_O = Outer diameter of the pipe segment

D_I = Inner diameter of the pipe segment

L_{SEG} = Length of the pipe segment

ρ_{IRON} = Iron Resistivity (pipe material)

8.2.8 Calculation Of The Net Current Flow Through The Pipe Segment ($I_1 + I_2$) [9]

5.2.8.1 Calculation of Pipe Segment Flow Current

As total surface charge is equal to;

$$Q_{\text{surface}} = A_{4q} X^4 + A_{3q} X^3 + A_{2q} X^2 + A_{1q} X + A_{0q}$$

Then, the pipe segment flow current, ($I_1 + I_2$) components as shown in Fig.14 is equal to:

$$dQ_{\text{surface}}/dt = \dot{X} [4A_{4q} X^3 + 3A_{3q} X^2 + 2A_{2q} X + A_{1q}]$$

From Eq. 1, applying the value of the soil factor as $X = S_f = (1 / K_S) \text{pH} H \log \rho$. Then: $dQ_{\text{surface}}/dt =$

$$\dot{X} [4A_{4q} ((1/K_S) \log \rho)_{\text{at H=10\%}}^3 (\text{pH.H})^3 + 3A_{3q} ((1/K_S) \log \rho)_{\text{at H=10\%}}^2 (\text{pH.H})^2 + 2A_{2q} ((1/K_S) \log \rho)_{\text{at H=10\%}} (\text{pH.H}) + A_{1q}]$$

$$dQ_{\text{surface}}/dt = \dot{X} [C_{3q} (\text{pH.H})^3 + C_{2q} (\text{pH.H})^2 + C_{1q} (\text{pH.H}) + A_{1q}] \quad (13)$$

Now, for bare pipe segment-soil-earth system under test which applying c.p system, without any external interference, at room temperature, with soil volume under test and by neglecting CO_2 effect, the flow current of the pipe segment-soil under test could be obtained from an electrical concept of the corrosion and will equal to third order polynomial equation function of the measured (pH*humidity) as shown in equation 14.

Flow current of the pipe segment under test

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$$I_1 + I_2 = \dot{X} [C_{3q} (\text{pH.H})^3 + C_{2q} (\text{pH.H})^2 + C_{1q} (\text{pH.H}) + A_{1q}] \quad (14)$$

Where:

pH.H = Variable quantity equal to (pH*Humidity) measured around the pipe segment

\dot{X} = Rate of soil factor change by time $dx/dt = d(S_f)/dt$

C_{3q} = Cons. print equal to $4A_{4q} ((1/K_S) \log \rho)_{\text{at H=10\%}}^3$

C_{2q} = Cons. print equal to $3A_{3q} ((1/K_S) \log \rho)_{\text{at H=10\%}}^2$

C_{1q} = Cons. print equal to $2A_{2q} ((1/K_S) \log \rho)_{\text{at H=10\%}}$

A_{1q} = Constant print from surface charge equation

A_{2q} = Constant print from surface charge equation

A_{3q} = Constant print from surface charge equation

A_{4q} = Constant print from surface charge equation

K_S = Dielectric constant of the soil at H = 10%

ρ = Soil resistivity in $\Omega.m$ at H = 10%

8.2.8.1 Calculation of the Current Reaches the Pipe Segment from d-c Source (I_3)

We have: Total surface charge Q_{surface} = charge supplied by cathodic protection $Q_{C.P}$ – natural charge i.e $Q_{\text{surface}} = Q_{C.P} - Q_n$, then:

$$dQ_{C.P}/dt = dQ_{\text{surface}}/dt + dQ_n/dt$$

As:

$$dQ_n/dt = \dot{X} [B_{3qn} (\text{pH.H})^3 + B_{2qn} (\text{pH.H})^2 + B_{1qn} (\text{pH.H}) + A_{1qn}] = I_{\text{stray}} \quad \text{from Eq.(12)}$$

$$dQ_{\text{surface}}/dt = \dot{X} [C_{3q} (\text{pH.H})^3 + C_{2q} (\text{pH.H})^2 + C_{1q} (\text{pH.H}) + A_{1q}] = I_1 + I_2 \quad \text{from Eq.(13)}$$

$$I_1 = I_3 - I_{\text{stray}}$$

$$I_{DC} = I_3 + I_4$$

In our case of pipe segment study, $I_4 = 0$ & $I_2 = 0$
Then I_{DC} will equal to:

$$dQ_{C.P}/dt = \dot{X} [(B_{3qn} + C_{3q}) (\text{pH.H})^3 + (B_{2qn} + C_{2q}) (\text{pH.H})^2 + (B_{1qn} + C_{1q}) (\text{pH.H}) + (A_{1qn} + A_{1q})]$$

$$dQ_{C.P}/dt = \dot{X} [D_3 (\text{pH.H})^3 + D_2 (\text{pH.H})^2 + D_1 (\text{pH.H}) + D_0] \quad (15)$$

Now, for bare pipe segment-soil-earth system under test which applying c.p system, without any external interference, at room temperature, with soil volume under test and by neglecting CO_2 effect, the amount of rectifier current reaches the pipe – soil system under test could be obtained from an electrical concept of the corrosion and will equal to third order polynomial equation function of the measured (pH*humidity) as shown in Eq.16. **Amount of rectifier current reaches the pipe segment under test**

$$I_{DC} = \dot{X} [D_3 (\text{pH.H})^3 + D_2 (\text{pH.H})^2 + D_1 (\text{pH.H}) + D_0] \quad (16)$$

Where:

pH.H = Variable quantity equal to (pH* Humidity) measured around the pipe segment

\dot{X} = Rate of soil factor change by time = $d(S_f)/dt$

D_3 = Constant equal to $(B_{3qn} + C_{3q}) = 4(A_{4q} + A_{4qn}) ((1/Ks) \log \rho)^3$ at H=10%

D_2 = Constant equal to $(B_{2qn} + C_{2q}) = 3(A_{3q} + A_{2qn}) ((1/Ks) \log \rho)^2$ at H=10%

D_1 = Constant equal to $(B_{1qn} + C_{1q}) = 2(A_{2q} + A_{2qn}) ((1/Ks) \log \rho)$ at H=10%

D_0 = Constant equal to $(A_{1qn} + A_{1q})$

Ks = Dielectric constant of the soil at H = 10%

ρ = Soil resistivity in $\Omega.m$ at H = 10%

Referring to the proposed electrical circuit of the bare pipe segment-soil-earth system in figure 14, all current values are now determined for the pipe segment-soil-earth system under test. Also the values of the equivalent stray electrolytic capacitor, the potential across it, the natural stray current source from the pipe segment, pipe segment net current flow and finally the amount of DC current share for the pipe segment are determined. Then, the final proposed electric circuit of such system may be as the electrical

circuit diagram shown in figure 15a & 15b. **The electrical parameters of the bare pipe segment-soil-earth system under test with applying CP system are as follow:**

$$C_{eq} = C_{stray} = A_{4cn}X^4 + A_{3cn}X^3 + A_{2cn}X^2 + A_{1cn}X + A_{0cn}$$

$$V_{stray} = A_{4v}X^4 + A_{3v}X^3 + A_{2v}X^2 + A_{1v}X + A_{0v}$$

$$I_{stray} = \dot{X} [B_{3qn}(pH.H)^3 + B_{2qn}(pH.H)^2 + B_{1qn}(pH.H) + A_{1qn}]$$

$$I_1 + I_2 = \dot{X} [C_{3q}(pH.H)^3 + C_{2q}(pH.H)^2 + C_{1q}(pH.H) + A_{1q}]$$

$$I_{DC} = I_3 + I_4 = \dot{X} [D_3(pH.H)^3 + D_2(pH.H)^2 + D_1(pH.H) + D_0]$$

$$I_2 = I_4 = 0 \quad \text{for pipe segment under test}$$

Where:

A's, B's, C's and D's: are the PRINT constants of the bare pipe-soil-earth system

X : instantaneous value of the electrochemical value of the soil, the soil factor (Eq.1)

\dot{X} = Rate of soil factor change by time $dx/dt = d(S_f)/dt$

H: is the measured humidity

pH: is the measured power of hydrogen

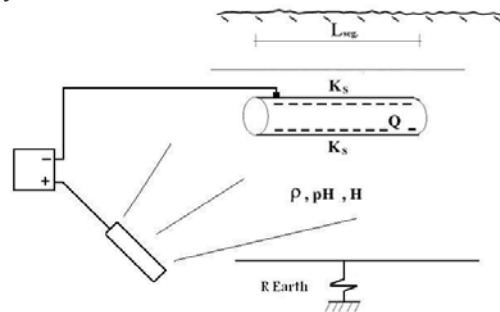


Figure 15a: schematic diagram of buried bare pipe segment with applying cathodic protection

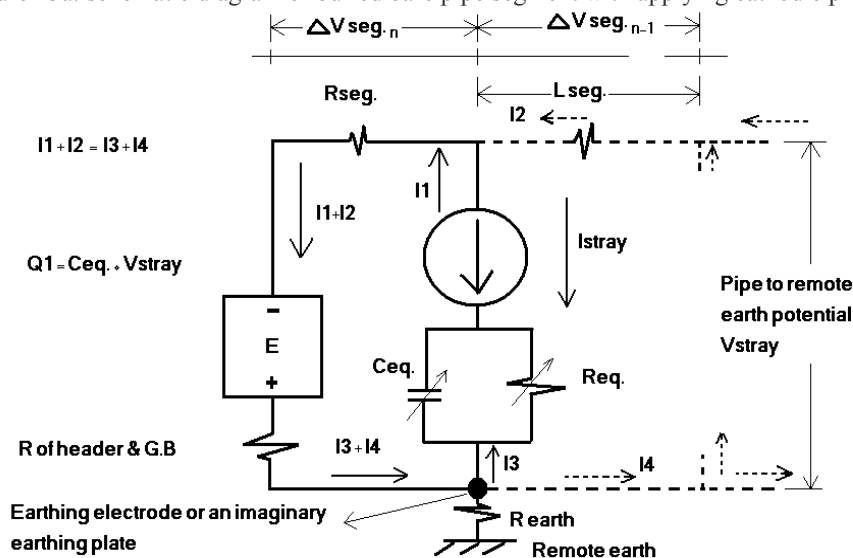


Figure 15b: The final proposed electric circuit diagram of bare pipe segment – soil – earth system with cathodic protection system

Now, by the use of the voltage drop canister which pigged with the intelligent pig and by the use of GPS system, each segment flow current I_p could be measured. Then by measuring the humidity around this pipe segment, the soil factor could be determined. Finally, from the ONION curves obtained before [9] (which correlate I_p , S_F and V_{H-C}), the equivalent pipe to soil potential of this buried pipe segment could be determined without the need of test point and without the need of Cu/CuSO₄ half cell. The most important result is that: the pipe to soil potential of any buried pipeline could be obtained segmental along its route without the need of any test points.

C. The General Equation Of Pipe To Soil Potential During Humidity Change By The Use Of Both Soil Factor and Protection Current For Pipe – Soil – Earth System

Table 11: Protection current print constants of box 19 at pipe to soil potential equal to -0.2 volt to -2 volt

		Box 19 ρ_7									
V_{H-C} Volt		-0.2	-0.4	-0.6	-0.85	-1	-1.2	-1.4	-1.6	-1.8	-2
A_{4I}		-2919.6	-2084.6	-1249.7	-206.05	420.24	1255.3	2.09E+03	2925.2	3760.1	4595.1
A_{3I}		3825.4	2739.4	1653.4	296.05	-518.53	-1604.6	-2.69E+03	-3776.5	-4862.5	-5948.5
A_{2I}		-1481.1	-1061.6	-642.13	-117.82	196.83	616.33	1.04E+03	1455.3	1874.8	2294.3
A_{1I}		150.62	108.14	65.66	12.562	-19.303	-61.787	-1.04E+02	-146.75	-189.23	-231.71
A_{0I}		-4.2838	-3.0782	-1.8728	-0.366	0.5383	1.7439	2.95E+00	4.1549	5.3604	6.5659
% error		0	0	0	0	0	0	0	0	0	0

9.1 A_{0I} print constant

The protection current A_{0I} print constant is linearly proportional to the pipe to soil potential V_{H-C} measured by Cu/CuSO₄ half cell. Figures 16 and 17 shows boxes 4&19 as an example and the correlation between them is governed by equation 17 for all boxes under test as follow:

$$A_{0I} = B_{1A0I} V_{H-C} + B_{0A0I} \tag{17}$$

9.2 A_{1I} print constant

The protection current A_{1I} print constant is linearly proportional to the pipe to soil potential V_{H-C} measured by Cu/CuSO₄ half cell. Figures 16 and 17 shows boxes 4&19 as an example and the correlation between them is governed by equation 18 as follow:

$$A_{1I} = B_{1A1I} V_{H-C} + B_{0A1I} \tag{18}$$

9.3 A_{2I} print constant

The protection current A_{2I} print constant is linearly proportional to the pipe to soil potential V_{H-C}

9. Analysis

As we said before, the print A's of the protection current passed through the pipe segment could be obtained from the general equation of the protection current (8) and easily we can construct the print of the protection current A's table for all boxes under test at pipe to soil potential, by the use of Cu/CuSO₄ half cell, from -0.2V up to -2V as per tables 10 as an example. The question now is: is it possible to rearrange the table results such that to be as the protection current A's for each box against the pipe to soil potential? This is as per table 11 as an example for the protection current A's against pipe to soil potential for box 19. What would be the results for all boxes under test?

measured by Cu/CuSO₄ half cell. Figures 16 and 17 shows boxes 4&19 as an example and the correlation between them is governed by equation 19 as follow:

$$A_{2I} = B_{1A2I} V_{H-C} + B_{0A2I} \tag{19}$$

9.4 A_{3I} print constant

The protection current A_{3I} print constant is linearly proportional to the pipe to soil potential V_{H-C} measured by Cu/CuSO₄ half cell. Figures 16 and 17 shows boxes 4&19 as an example and the correlation between them is governed by equation 20 as follow:

$$A_{3I} = B_{1A3I} V_{H-C} + B_{0A3I} \tag{20}$$

9.5 A_{4I} print constant

The protection current A_{4I} print constant is linearly proportional to the pipe to soil potential V_{H-C} measured by Cu/CuSO₄ half cell. Figures 16 and 17 shows boxes 4&19 as an example and the correlation between them is governed by equation 21 as follow:

$$A_{4I} = B_{1A4I} V_{H-C} + B_{0A4I} \tag{21}$$

Table 12 shows the result table of protection current print constants (A's) in terms of pipe to soil potential for all boxes under test.

9.6 The deduction of the general equation of the pipe to soil potential

We have the protection current general equation from equation 8 as follow:

$$I_p = A_{4i} X^4 + A_{3i} X^3 + A_{2i} X^2 + A_{1i} X + A_{0i} \quad (8)$$

Where:

A's: = A_(i) are the protection current print constants of the pipe soil under test

X = is the value of the soil factor at certain humidity

By substituting the values of A's from equations 17, 18, 19, 20 and 21 in equation 8, the general equation of the pipe to soil potential will equal to equation 22 as follow:

$$V_{H.C} = \frac{I_p \cdot [B_{0A4i} X^4 + B_{0A3i} X^3 + B_{0A2i} X^2 + B_{0A1i} X + B_{0A0i}]}{[B_{1A4i} X^4 + B_{1A3i} X^3 + B_{1A2i} X^2 + B_{1A1i} X + B_{1A0i}]} \quad (22)$$

Where:

V_{H.C}: The equivalent value of the pipe to soil potential in volt measured by Cu/CuSO₄ half cell.

I_p: Segmental protection current in m Amp measured by the voltage drop canister of the intelligent pig.

X: Segmental soil factor in Ω.m%.

B's: New print constants of pipe-soil-earth system

Table 13 shows the error for all boxes under test while tables 14 & 15 are showing the detailed comparison between the pipe to soil potential obtained by equation 22 and the pipe to soil potential obtained by direct measurement by the use of Cu/CuSO₄ half cell for boxes 4 & 19 respectively during humidity change.

Table 12: The protection current print constants (A's) in terms of pipe to soil potential for all boxes under test

		ρ ₁	ρ ₂	ρ ₃	ρ ₄	ρ ₅	ρ ₆	ρ ₇	ρ ₈	ρ ₉	ρ ₁₀
		Box 1	Box 4	Box 9	Box 10	Box 13	Box 18	Box 19	Box 24	Box 27	Box 28
A _{4i}	B _{1A4i}	-2.00E+07	0.00E+00	-7.23E+04	-3.34E+04	-1.00E+06	-1.00E+08	-4.17E+03	-3.52E+04	-2.64E+04	-2.00E+07
	B _{0A4i}	-1.00E+07	0.00E+00	-4.79E+04	-2.53E+04	-2.00E+06	-1.00E+08	-3.75E+03	-2.76E+04	-1.78E+04	-1.00E+07
	error	H	H	H	0%	H	0%	0%	0%	0%	H
A _{3i}	B _{1A3i}	2.00E+06	7.24E+03	1.57E+04	1.70E+04	6.59E+04	7.00E+06	5.43E+03	5.63E+04	2.49E+04	3.00E+06
	B _{0A3i}	1.00E+06	-6.99E+01	1.43E+04	1.29E+04	1.00E+06	8.00E+06	4.91E+03	4.92E+04	1.67E+04	2.00E+06
	error	H	0%	0%	0%	H	H	0%	0%	0%	H
A _{2i}	B _{1A2i}	-5.53E+04	-1.99E+03	-7.41E+03	-2.75E+04	-9.94E+04	-1.22E+04	-2.10E+03	-2.77E+03	-6.75E+03	-1.21E+04
	B _{0A2i}	-2.97E+04	-5.54E+02	-8.04E+03	-2.09E+04	-1.48E+04	-1.33E+04	-1.90E+03	-2.95E+03	-4.54E+03	-8.30E+04
	error	0%	0%	0%	0%	H	H	0%	0%	0%	H
A _{1i}	B _{1i}	4.81E+02	4.11E+01	-1.23E+01	1.52E+03	3.70E+03	4.01E+02	2.12E+02	5.25E+00	4.22E+02	1.53E+03
	B _{0i}	2.63E+02	9.69E+00	8.94E+01	1.17E+03	5.49E+03	7.27E+02	1.93E+02	5.17E+01	2.92E+02	9.79E+02
	error	0%	0%	0%	0%	H	0%	0%	0%	0%	0%
A _{0i}	B _{1A0i}	-1.26E+00	-2.00E-01	3.93E-01	-2.57E+01	-3.79E+01	-3.07E-01	-6.03E+00	2.59E-01	-7.33E+00	-6.15E+00
	B _{0A0i}	-7.00E-01	-1.20E-02	-2.85E-01	-1.99E+01	-5.63E+01	-1.17E+00	-5.49E+00	-2.80E-01	-5.17E+00	-3.97E+00
	error	5%	0%	0%	0%	30%	5%	0%	0%	0%	0%

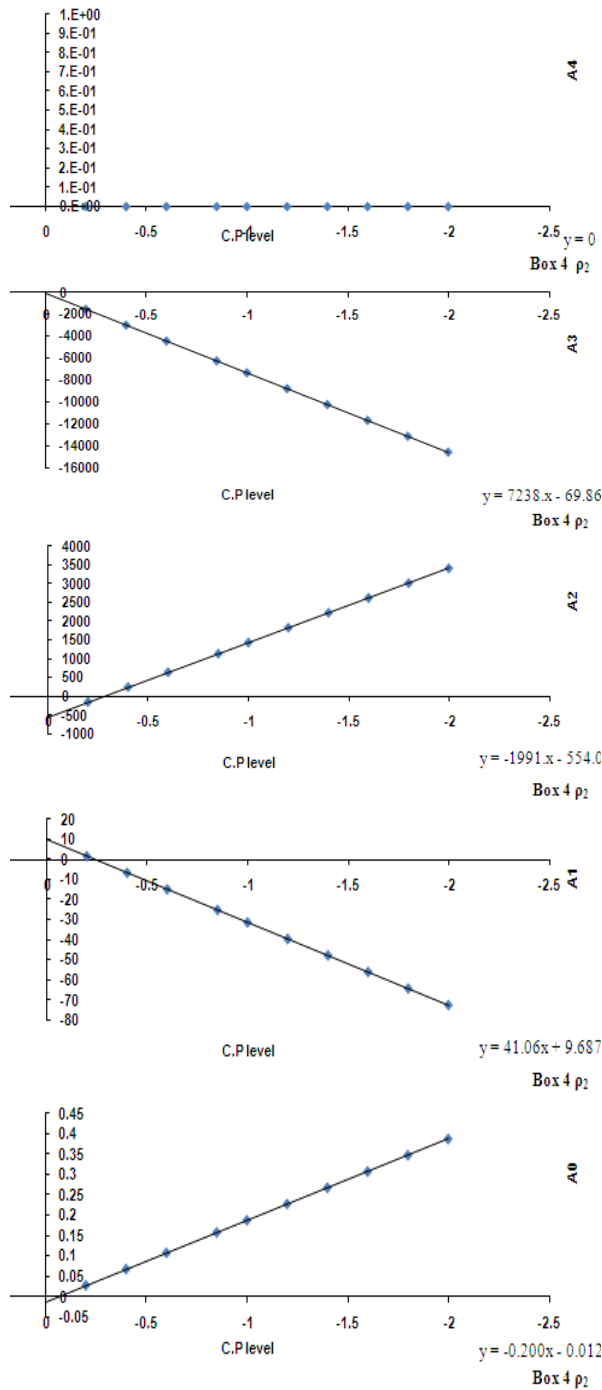


Figure 16: The protection current print constants against pipe to soil potential for box 4

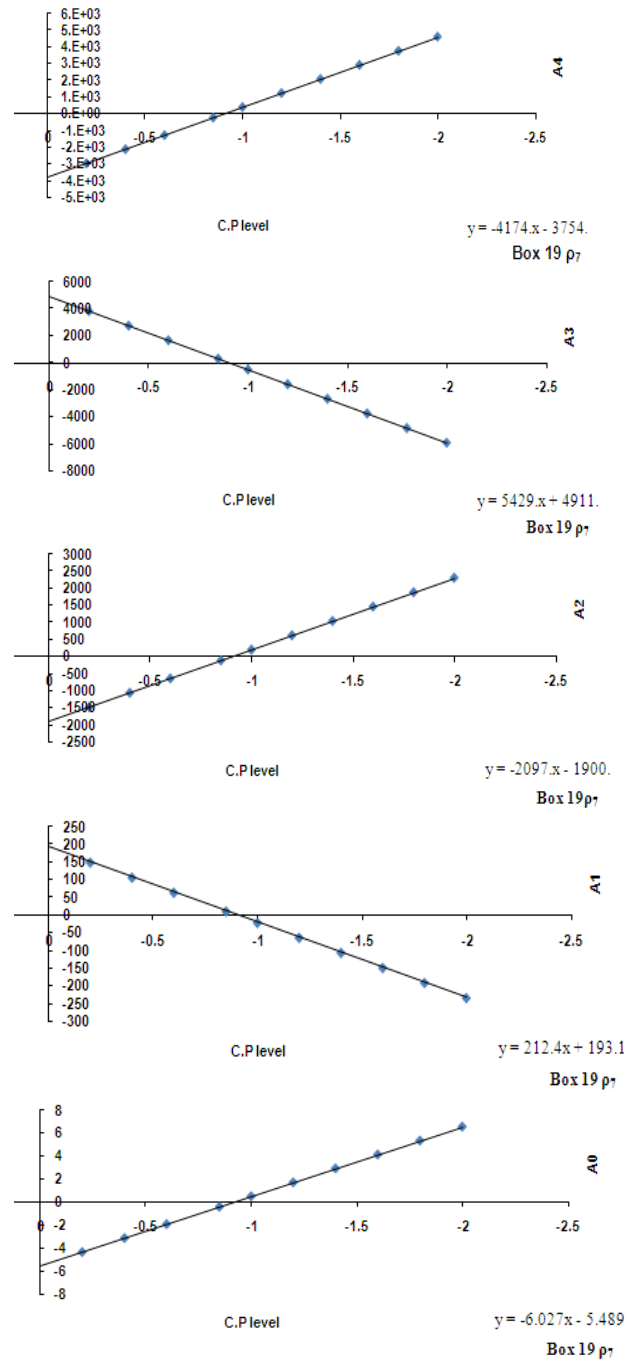


Figure 17: The protection current print constants against pipe to soil potential for box 4

Table 13: Error table between theoretical and experimental values of pipe to soil potential for all boxes under test during humidity change

Resistivity	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
Box No.	1	4	9	10	13	18	19	24	27	28
Av. Error	H	± 10 %	± 15 %	± 35 %	H	± 35 %	± 5 %	H	± 10 %	H

Table 14: Comparison between theoretical and experimental values of pipe to soil potential of box 4 during humidity change

Box	Electrical Parameters			PH	H %	Pipe to Soil Potential		Error %
	V _{P-PE}	C _{P-PE}	I			Theoretical	Experimental	
	Volt	nF	mA			V _{HC} - Volt	V _{HC} - Volt	
4	0.1480	-0.570	0.0002	7.0	45%	-0.476829528	-0.4910	2.8860432
4	-0.2710	-0.570	0.4000	7.0	45%	-0.557774389	-0.5640	1.103831794
4	-3.7100	-0.570	5.1000	7.0	45%	-1.509352292	-1.3700	-10.17170015
4	-6.3900	-0.570	8.6000	7.0	45%	-2.217974135	-2.1110	-5.067462573
4	-9.3800	-0.570	11.1000	7.0	45%	-2.724132594	-2.6400	-3.186840686
4	-11.4400	-0.570	13.0000	7.0	45%	-3.108813023	-3.0000	-3.627100771
4	0.1000	45.600	0.0010	6.9	80%	-0.663867462	-0.5190	-27.91280574
4	-0.2050	45.600	0.3300	6.9	80%	-0.690445272	-0.5520	-25.08066515
4	-4.2800	45.600	7.9000	6.9	80%	-1.301977249	-1.3400	2.837518756
4	-6.3700	45.600	11.2200	6.9	80%	-1.570178856	-1.7000	7.636537911
4	-10.1500	45.600	15.9000	6.9	80%	-1.948246181	-2.2600	13.79441678
4	0.1930	70.000	0.0033	6.5	85%	-0.664663193	-0.6020	-10.40916827
4	-0.2140	70.000	0.1530	6.5	85%	-0.676743878	-0.8800	23.09728664
4	-2.9500	70.000	16.0000	6.5	85%	-1.955585621	-1.7800	-9.864360757
4	-4.9000	70.000	29.6000	6.5	85%	-3.053096047	-2.5500	-19.72925675
4	-6.8000	70.000	40.0000	6.5	85%	-3.892368726	-3.2300	-20.5067717
4	-8.5500	70.000	47.8000	6.5	85%	-4.521823235	-3.7700	-19.94226087

Table 15: Comparison between theoretical and experimental values of pipe to soil potential of box 19 during humidity change

Box	Electrical Parameters			PH	H %	Pipe to Soil Potential		Error %
	V _{P-PE}	C _{P-PE}	I			Theoretical	Experimental	
	Volt	nF	mA			V _{HC} - Volt	V _{HC} - Volt	
19	0.1276	8.000	-0.0002	7.0	55%	-0.591185741	-0.5520	-7.098866132
19	-0.2490	8.000	0.3000	7.0	55%	-0.6986547	-0.6230	-12.14361155
19	-3.6500	8.000	3.0000	7.0	55%	-1.665230946	-1.4060	-18.43747837
19	-6.3200	8.000	5.2000	7.0	55%	-2.452811591	-2.0600	-19.06852382
19	-9.3000	8.000	7.7000	7.0	55%	-3.347789596	-2.8400	-17.87991536
19	0.0340	13.900	-0.0008	6.5	75%	-0.68121396	-0.6650	-2.438189508
19	-0.1920	13.900	0.1900	6.5	75%	-0.694328432	-0.6950	0.096628523
19	-4.0000	13.900	9.1000	6.5	75%	-1.306749508	-1.2500	-4.539960668
19	-6.6300	13.900	15.7000	6.5	75%	-1.76039475	-1.7300	-1.756921981
19	-9.8300	13.900	24.5000	6.5	75%	-2.365255073	-2.2800	-3.73925758
19	0.2700	72.000	0.0062	5.3	96%	-0.75561634	-0.7070	-6.876427114
19	-0.4400	72.000	0.1506	5.3	96%	-0.761007335	-0.7370	-3.25744026
19	-3.1300	72.000	14.0000	5.3	96%	-1.278057518	-1.2900	0.925773821
19	-4.7500	72.000	24.7000	5.3	96%	-1.677528755	-1.7000	1.321837922
19	-6.6900	72.000	35.8000	5.3	96%	-2.091933497	-2.0800	-0.573725824
19	-8.2000	72.000	46.2000	5.3	96%	-2.480204607	-2.4400	-1.647729778
19	-1.0700	72.000	57.4000	5.3	96%	-2.898342724	-2.8000	-3.512240159

D. The General Equation Of The Pipe To Soil Potential At All Humidity Conditions By The Use Of Both Soil Factor and Stray Potential Of The Pipe-Soil-Earthing Grid System

10. Analysis

As we said before, the print A's of the stray potential of the pipe segment to the earthing grid could be obtained from the general equation of the stray potential (5) and easily we can construct the

print of the stray potential A's table for all boxes under test at pipe to soil potential, by the use of Cu/CuSO₄ half cell, from -0.2V up to -2V as per table 7 as an example. The question now is: is it possible to rearrange the table results such that to be as stray potential A's for each box against the pipe to soil potential? This is as per tables 16 & 17 as an example for the stray potential A's against pipe to soil potential for boxes 10 & 13 respectively. What would be the results for all boxes under test?

Table 16: Stray potential print constants of box10 at pipe to soil potential equal to -0.2 volt to -2 volt

Box 10 ρ ₄										
	-0.2	-0.4	-0.6	-0.85	-1	-1.2	-1.4	-1.6	-1.8	-2
A_{4V}	2.43E+04	22128	20006	17354	15762	13640	11518	9395.4	7273.2	5151
A_{3V}	-1.32E+04	-12146	-11131	-9862.3	-9100.9	-8085.8	-7070.7	-6055.6	-5040.4	-4025.3
A_{2V}	2.37E+03	2224.1	2082.5	1905.4	1799.2	1657.6	1515.9	1374.3	1232.7	1091
A_{1V}	-1.56E+02	-152.17	-148.12	-143.05	-140.02	-135.97	-131.91	-127.86	-123.81	-119.76
A_{0V}	3.64E+00	3.3314	3.0217	2.6345	2.4023	2.0926	1.7828	1.4731	1.1634	0.8537
error	0	0	0	0	0	0	0	0	0	0

Table 17: Stray potential print constants of box 13 at pipe to soil potential equal to -0.2 volt to -2 volt

Box 13 ρ ₅										
	-0.2	-0.4	-0.6	-0.85	-1	-1.2	-1.4	-1.6	-1.8	-2
A_{4V}	-2.52E+04	-17108	-8993.3	1149.5	7235.1	15349	23464	31578	39692	47806
A_{3V}	8.50E+03	4654	806.87	-4002.1	-6887.5	-10735	-14582	-18429	-22276	-26123
A_{2V}	-2.73E+02	293.88	860.87	1569.6	1994.9	2561.9	3128.8	3695.8	4262.8	4829.8
A_{1V}	-8.76E+01	-115.06	-142.47	-176.73	-197.29	-224.7	-252.11	-279.52	-306.93	-334.45
A_{0V}	2.14E+00	2.2143	2.2855	2.3745	2.4278	2.499	2.5702	2.6413	2.7125	2.7837
error	0	0	0	0	0	0	0	0	0	0

10.1 A_{0V} print constant

The stray potential from the pipe segment to the earthing grid, A_{0V} print constant is linearly proportional to the pipe to soil potential V_{H-C} measured by Cu/CuSO₄ half cell. Figures 18 & 19 show boxes 10 & 13 as an example and the correlation between them is governed by equation 23 for all boxes under test as follow:

$$A_{0V} = B_{1A0V} V_{H-C} + B_{0A0V} \tag{23}$$

10.2 A_{1V} print constant

The stray potential from the pipe segment to the earthing grid, A_{1V} print constant is linearly

proportional to the pipe to soil potential V_{H-C} measured by Cu/CuSO₄ half cell. Figures 18 & 19

show boxes 10 & 13 as an example and the correlation between them is governed by equation 24 as follow:

$$A_{1V} = B_{1A1V} V_{H-C} + B_{0A1V} \tag{24}$$

10.3 A_{2V} print constant

The stray potential from the pipe segment to the earthing grid, A_{2V} print constant is linearly proportional to the pipe to soil potential V_{H-C} measured by Cu/CuSO₄ half cell. Figures 18 & 19 show boxes 10 & 13 as an example and the

correlation between them is governed by equation 25 as follow:

$$A_{2V} = B_{1A2V} V_{H-C} + B_{0A2V} \tag{25}$$

10.4 A_{3V} print constant

The stray potential from the pipe segment to the earthing grid, A_{3V} print constant is linearly proportional to the pipe to soil potential V_{H-C} measured by Cu/CuSO₄ half cell. Figures 18 & 19 show boxes 10 & 13 as an example and the correlation between them is governed by equation 26 as follow:

$$A_{3V} = B_{1A3V} V_{H-C} + B_{0A3V} \tag{26}$$

10.5 A_{4V} print constant

The stray potential from the pipe segment to the earthing grid, A_{4V} print constant is linearly proportional to the pipe to soil potential V_{H-C} measured by Cu/CuSO₄ half cell. Figures 18 & 19 show boxes 10 & 13 as an example and the correlation between them is governed by equation 27 as follow:

$$A_{4V} = B_{1A4V} V_{H-C} + B_{0A4V} \tag{27}$$

Table 18 shows the result table of protection current print constants (A's) in terms of pipe to soil potential for all boxes under test

Table 18: Stray potential print constants (A's) in terms of pipe to soil potential for all boxes under test

		ρ ₁	ρ ₂	ρ ₃	ρ ₄	ρ ₅	ρ ₆	ρ ₇	ρ ₈	ρ ₉	ρ ₁₀
		Box 1	Box 4	Box 9	Box 10	Box 13	Box 18	Box 19	Box 24	Box 27	Box 28
A _{0V}	B _{1A0V}	2.19E+00	1.567	0.911	1.548	-0.355	-2.09E+00	-7.671	2.437	-2.635	1.1
	B _{0A0V}	4.80E+00	0.724	2.688	3.95	2.072	2.88E+00	0.632	-0.117	2.302	2.535
	error	0%	0	0	0	0	3%	0	0	1%	0%
A _{1V}	B _{1A1V}	-468.88	-8.6912	141.17	-20.257	137.08	1660.1	237.32	28.372	135.56	82.588
	B _{0A1V}	-1421.8	-45.09	-308.35	160.27	-60.217	-978.29	-3.0607	59.6	-67.017	-250.82
	error	0	0	0	0	0	0	0	0	1%	0
A _{2V}	B _{1A2V}	58664	865.2	-3960	708.1	-2834	-13567	-1225	-857.8	-493.2	-2781
	B _{0A2V}	14164	1020	13609	2507	-840	95891	-115.2	-961.4	747.3	10114
	error	0	± 70%	0	0	0	0	0	0	0	0
A _{3V}	B _{1A3V}	-2.00E+06	-7698	41703	-5075	19236	4.00E+06	2301	5996	428.4	55331
	B _{0A3V}	-5.00E+06	-8402	-18786	-14176	12348	-4.00E+06	424.3	5158	-2400	-14698
	error	±10%	0	0	0	0	±5%	0	0	±1%	0
A _{4V}	B _{1A4V}	2.00E+07	0	-99143	10611	-40571	-3.00E+07	-1424	0	129	-36192
	B _{0A4V}	5.00E+07	0	83364	26373	-33336	4.00E+07	-349.5	0	2335	66349
	error	10%		0	0	0	3%	0		1%	20%

10.6 The deduction of the general equation of the pipe to soil potential

We have the stray potential general equation from equation 5 as follow:

$$V_{Str.} = A_{4V} X^4 + A_{3V} X^3 + A_{2V} X^2 + A_{1V} X + A_{0V} \tag{5}$$

By substituting the values of A's from equations 23,

24, 25, 26 and 27 in equation 5, the general equation of the pipe to soil potential will equal to equation 28 as follow:

$$V_{H-C} = \frac{V_{Stray} \cdot [B_{0A4V} X^4 + B_{0A3V} X^3 + B_{0A2V} X^2 + B_{0A1V} X + B_{0A0V}]}{[B_{1A4V} X^4 + B_{1A3V} X^3 + B_{1A2V} X^2 + B_{1A1V} X + B_{1A0V}]} \tag{28}$$

Where:

V_{H-C}: The equivalent value of the pipe to soil potential in volt measured by Cu/CuSO₄ half cell.

V_{Str.}: Stray potential of the pipe segment in Volt.

X: Segmental soil factor in $\Omega.m\%$.

B's: New print constants of pipe-soil-earth system
Table 19 shows the error for all boxes under test while

tables 20 & 21 are showing the detailed comparison between the pipe to soil potential obtained by equation 28 and the pipe to soil potential obtained by direct measurement by the use of Cu/CuSO₄ half cell

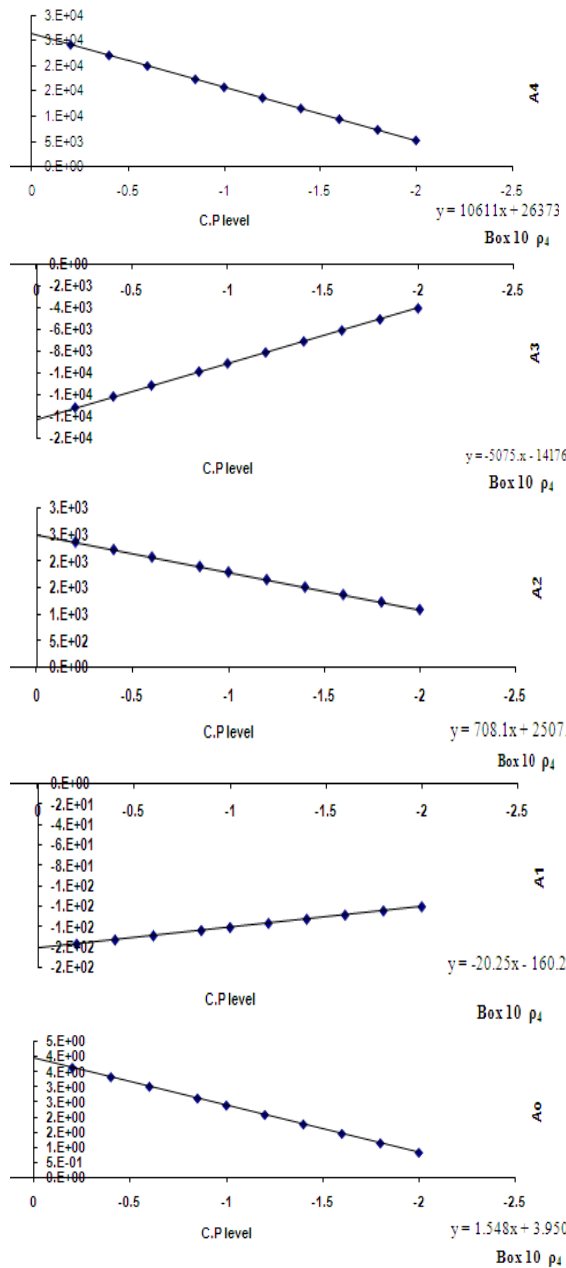


Figure 18: The stray potential print constants against pipe to soil potential for box 10

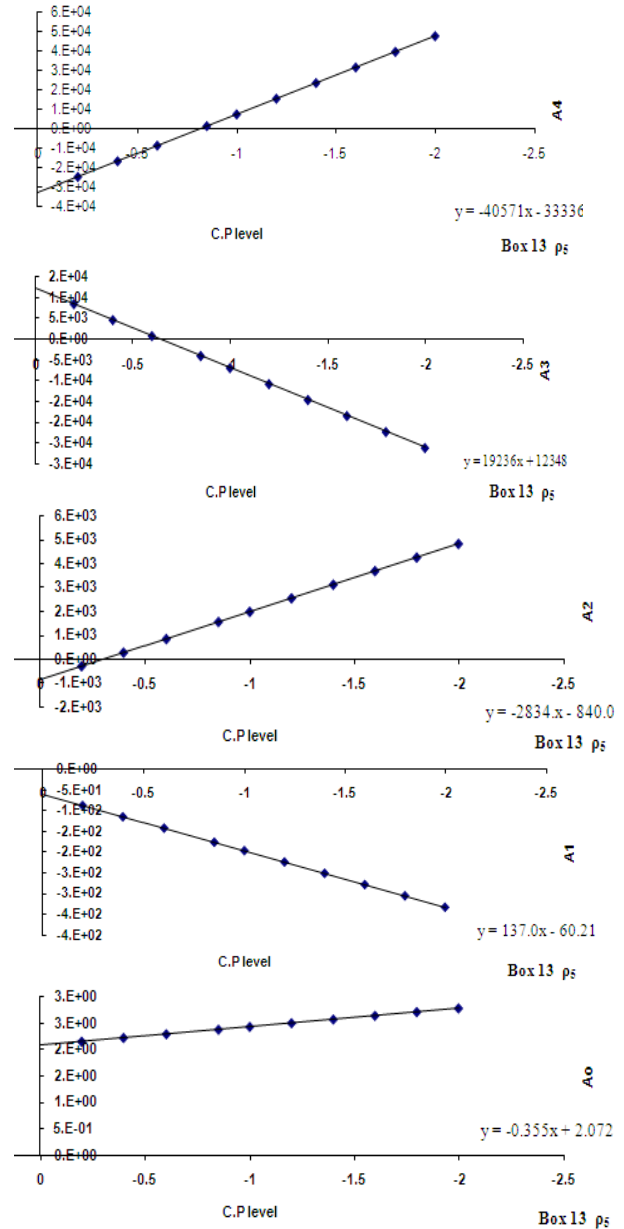


Figure 19: The stray potential print constants against pipe to soil potential for box 13

Table 19: Error table between theoretical and experimental values of pipe to soil potential for all boxes under test

Resistivity	ρ_1	ρ_2	ρ_3	ρ_4	ρ_5	ρ_6	ρ_7	ρ_8	ρ_9	ρ_{10}
Box No.	1	4	9	10	13	18	19	24	27	28
Av. Error	H	$\pm 5\%$	$\pm 40\%$	$\pm 5\%$	$\pm 5\%$	H	$\pm 5\%$	$\pm 40\%$	$\pm 5\%$	$\pm 5\%$

Table 20: Comparison between theoretical and experimental values of pipe to soil potential of box 10

Box	Electrical Parameters			pH	H %	Pipe to Soil Potential		Error %
	V _{P-PE} Volt	C _{P-PE} nF	I mA			Theoretical V _{HC} - Volt	Experimental V _{HC} - Volt	
	10	0.49	0.172			0.0015	7.8	
10	-0.461	0.172	0.0060	7.8	10%	-0.9620273	-0.9600	0.2107321
10	-4.33	0.172	0.0175	7.8	10%	-3.595012572	-3.6000	-0.1387319
10	-5.07	0.172	0.0220	7.8	10%	-4.098607584	-4.1400	-1.0099141
10	-8.06	0.172	0.0335	7.8	10%	-6.133403645	-6.1000	0.5446184
10	0.2723	7.900	0.0046	7.7	18%	-0.182218469	-0.3063	-68.094926
10	-0.1923	7.900	0.1000	7.7	18%	-0.431641808	-0.4550	-5.4114757
10	-4.37	7.900	1.2600	7.7	18%	-2.674465499	-2.4960	6.6729408
10	-6.79	7.900	1.9600	7.7	18%	-3.973657238	-3.8500	3.1119251
10	-9.38	7.900	2.7500	7.7	18%	-5.364114513	-5.3500	0.2631285
10	-10.5	7.900	3.1400	7.7	18%	-5.965393335	-6.1300	-2.7593598
10	0.21	33.400	0.0023	7.0	65%	-0.43028885	-0.5010	-16.433414
10	-0.315	33.400	0.5000	7.0	65%	-0.657031363	-0.6600	-0.4518258
10	-3.38	33.400	5.5400	7.0	65%	-1.980775742	-1.8600	6.0973961
10	-6.1	33.400	11.2100	7.0	65%	-3.1555179	-3.2000	-1.4096608
10	-9.5	33.400	17.0000	7.0	65%	-4.623945597	-4.6500	-0.5634669
10	0.145	49.600	0.0018	6.5	88%	-0.432519024	-0.5380	-24.387592
10	-0.29	49.600	0.1850	6.5	88%	-0.615311165	-0.6400	-4.0124146
10	-3.93	49.600	10.6000	6.5	88%	-2.144882184	-1.9900	7.2210112
10	-6.31	49.600	17.6000	6.5	88%	-3.144986311	-3.0900	1.74838
10	-9.6	49.600	30.0000	6.5	88%	-4.527483193	-4.6500	-2.7060687
10	0.244	89.000	0.0048	6.0	100%	-0.564233649	-0.6350	-12.542029
10	-0.006	89.000	0.1530	6.0	100%	-0.656040154	-0.6700	-2.1278951
10	-3.56	89.000	18.8000	6.0	100%	-1.961161418	-1.9000	3.1186325
10	-5.42	89.000	34.2000	6.0	100%	-2.64420181	-2.5300	4.3189521
10	-6.72	89.000	44.0000	6.0	100%	-3.121595632	-3.1800	-1.870978
10	-8.45	89.000	55.0000	6.0	100%	-3.756896641	-3.8400	-2.2120214

Table 21: Comparison between theoretical and experimental values of pipe to soil potential of box 13

Box	Electrical Parameters			pH	H %	Pipe to Soil Potential		Error %
	V _{P-PE} Volt	C _{P-PE} nF	I mA			Theoretical V _{HC} - Volt	Experimental V _{HC} - Volt	
	13	0.145	0.000			0.0019	7.3	
13	-0.705	0.000	0.0067	7.3	6%	-1.163633299	-1.1390	2.1169297
13	-4.06	0.000	0.0224	7.3	6%	-3.759507649	-3.9000	-3.736988
13	-4.9	0.000	0.0275	7.3	6%	-4.409443403	-4.4100	-0.0126228
13	-7.13	0.000	0.0394	7.3	6%	-6.134868083	-6.0700	1.0573672
13	0.2796	8.700	0.0044	7.6	10%	0.315257985	-0.2900	191.98815
13	-2.575	8.700	0.0800	7.6	10%	-1.358426955	-0.4860	64.223325
13	-3.81	8.700	0.7000	7.6	10%	-2.082521715	-2.1100	-1.3194717
13	-5.66	8.700	1.0100	7.6	10%	-3.167198076	-3.2220	-1.7302967
13	-8.49	8.700	1.5900	7.6	10%	-4.826459752	-4.8500	-0.4877332
13	-10.79	8.700	2.0200	7.6	10%	-6.174976309	-6.3600	-2.9963466
13	0.288	31.900	0.0024	6.9	80%	-0.441743481	-0.4960	-12.282359

Table 21 Cont.								
Box	Electrical Parameters					Pipe to Soil Potential		
	V_{P-PE}	C_{P-PE}	I	pH	H	Theoretical	Experimental	Error
	Volt	nF	mA		%	V_{HC} - Volt	V_{HC} - Volt	%
13	-0.211	31.900	0.9200	6.9	80%	-0.670961813	-0.6590	1.782786
13	-3.77	31.900	10.8000	6.9	80%	-2.305807595	-2.2900	0.6855557
13	-6.44	31.900	18.8000	6.9	80%	-3.532286449	-3.7100	-5.0311195
13	-9.11	31.900	27.4000	6.9	80%	-4.758765302	-4.8600	-2.1273312
13	0.146	109.200	0.0019	5.2	100%	-0.648122287	-0.6880	-6.1528069
13	-0.244	109.200	1.0800	5.2	100%	-0.793995223	-0.7700	3.0220866
13	-3.4	109.200	30.0000	5.2	100%	-1.974443905	-2.0000	-1.2943439
13	-6	109.200	56.0000	5.2	100%	-2.946930144	-3.0400	-3.1581969
13	-9.5	109.200	85.0000	5.2	100%	-4.256046236	-4.3200	-1.5026567
13	0.133	243.000	0.0014	5.0	100%	-0.660302144	-0.7010	-6.1635202
13	-0.14	243.000	0.1870	5.0	100%	-0.761080019	-0.7840	-3.0115074
13	-2.87	243.000	19.1000	5.0	100%	-1.768858767	-1.7500	1.0661545
13	-4.6	243.000	60.5000	5.0	100%	-2.407487791	-2.4200	-0.5197206
13	-6.3	243.000	87.0000	5.0	100%	-3.035042323	-3.0800	-1.4812867
13	-7.55	243.000	108.0000	5.0	100%	-3.496479478	-3.6000	-2.9607073

11. Conclusion

The behavior of the electrical parameters of the pipe-soil-earth system during the change of the electrochemical properties of the soil could be plotted in electrical parameters PRINT which will be always valid in all times as the pipe-soil system is maintained and without any external interference. Once the system is changed by replacement another pipe with different dimension and/or the replacement of the soil, there will be another new electrical parameters PRINT for the new pipe-soil-earth system. Also, the buried pipe line segment with soil surrounding medium could be simulated electrically by an electric circuit where the system is subjected to the law: (charge = capacitance \times volt) between the pipe surface and the remote earth. This is where each of circuit electric parameter could be obtained by an equation as a function of the measured electrochemical properties of the soil (soil factor), 4th degree polynomial at room temperature but the A's constants are different for each electric quantity. The constants of each equation (A's) considered to be as a PRINT of such pipe-soil-earth system and valid until pipe and/or soil is changed with of course new print values. For buried bare pipe segments in different kind of soils at different cathodic protection level, the PRINTS of the electrolytic stray capacitor between pipe & earth, the stray potential across the stray capacitance, surface charge and the protection current of the cathodic protection system passed through the pipe segment were obtained in terms of the new parameter, the soil factor. The useful of these prints is to obtain complete electrical data correlated with many cathodic protection levels which help, after

complete erection of the pipeline, in defining the c.p level (pipe to soil potential) of any pipe line segment through it's length by measuring the protection current and calculating the soil factor at the pipe segment from direct field measurements. Not only has that but also to define the most suitable route of the pipe line, before the erection process, which generates the minimum surface charge. The error of electric parameters equations reduced to be less than $\pm 5\%$. The most important advantage of such electrical analogue circuit of pipe segment-soil-earth system is the possibility to simulate a complete pipeline – soil system by an electric circuit and to convert both the corrosion and cathodic protection problems of the pipeline to an electric problem. This will help in corrosion monitoring and the maintenance of c.p systems. The most important result is that: the pipe to soil potential of any buried pipeline could be obtained segmental along its route without the need of any test points. This is by the use of the new electric concept of pipe-soil-earth system.

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First and foremost, thanks to GOD the most kind, the most merciful and to whom any success is related.

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Prognostic Value Of Expression Of Survivin And Ki67 In Head And Neck Squamous Cell Carcinoma Treated By Chemoradiotherapy

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Abstract: Aim of the work: to evaluate prognostic value of expression of survivin and ki67 in head and neck squamous cell carcinoma treated by chemoradiotherapy. **Patients and Methods:** Between Jan. 2005 and Dec. 2009, all patients who were treated with primary chemoradiotherapy with curative intent for squamous cell carcinoma of the head and neck (SCCHN) at our department of clinical oncology. All initial pretreatment specimens were examined for expression of survivin and ki67 using immunohistochemical staining. **Results:** One hundred and fifty four patients were eligible for this study. Survivin expression was low in 107 (69.5%) and high in 47cases (30.5%). According to immunoreactive score (IRS), the staining was negative in 78 (50.7%), weak in 28 (18.2%), moderate in 22 (14.3%) and strong in 26 (16.9%) cases. Nuclear staining of Ki-67 was positive in 72 tumors (46.8%) and negative in 82 tumors (53.2%). The median follow-up was 19.5 months (range: 3 - 55 months). There were 114 local treatment failures (74%) and 86 deaths (55.8%), of which 72deaths (83.7%) were caused by disease. High survivin expression was correlated significantly with higher disease free survival and overall survival. Patients with high survivin expression in their tumors had a median disease free survival of 32 months compared with 16 months for patients with low expression tumors ($P = 0.007$). The median overall survival of patients with high survivin expression was 36 months versus 24 months for those with low survivin expression, ($P = 0.04$). The expression of Ki-67 significantly correlated with tumor grade but it was not significantly correlated with either disease free survival, ($P = 0.5$) or overall survival, ($P = 0.7$). **Conclusion:** the present study demonstrated that high survivin expression predicts better local control and superior overall survival in advanced HNSCC treated with radiochemotherapy. Survivin might be used as a stratification marker to define HNSCC patients, who would potentially benefit from radiochemotherapy. Further investigation is necessary to clarify and understand the roles of survivin in patients with HNSCC.

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1. Introduction

Head and neck squamous cell carcinoma (HNSCC) is the fifth most common cancer in men.[1] Over 70% of head and neck cancer patients present with advanced stage III and IV disease. Concomitant chemoradiation (CCRT) leads to improved local control (LC) and overall survival (OS) in advanced head and neck cancer compared with conventional radiotherapy,[1-4] making this modality the most suitable curative treatment option in these patients currently. However, CCRT is not effective in all patients, and when unsuccessful, patients suffer its potential side effects and toxicities. Therefore, the identification of new prognostic factors is so crucial that the appropriate therapy can be tailored better for individual patients,[5].

Studies in the literature have examined the prognostic significance of various biomarkers, including cell cycle regulators, members of the proapoptotic family, angiogenesis markers, and

proliferation markers in head and neck squamous cell cancer with mixed results ,[6-9].

Survivin is one of the most cancer-specific biomarkers identified to date. It belongs to the apoptosis inhibitor gene family. It inhibits apoptosis either by directly or indirectly interfering with caspase-3 and caspase-7 function and caspase-9 processing [10]. Furthermore, survivin enhances cell proliferation and promotes angiogenesis. Survivin is expressed during embryonic and fetal development but is undetectable in terminally differentiated normal adult tissue. However, it is re-expressed in transformed cell lines and several human cancer cells at a frequency of 34-100% [11]. Although high expression of survivin in cancer cells is a common phenomenon, which is supposed to be critically involved in tumor progression by inhibition of apoptosis, the reason for this abundant protein expression remained unclear and the relevance of survivin for the clinical course of HNSCC still has to be defined.

Ki-67 is a nuclear antigen expressed mainly in the S and M phases of the cell cycle, and it has been used for estimating the growth fraction in many studies investigating various tumor types [12].

The aim of his study is to evaluate prognostic value of expression of survivin and ki67 in head and neck squamous cell carcinoma treated by chemoradiotherapy.

2. Materials and Methods

This is a retrospective study that enrolled all patients who were treated with primary chemoradiotherapy with curative intent for squamous cell carcinoma of the head and neck (SCCHN) at our department of clinical oncology, Assiut University, between Jan. 2005 and Dec. 2009. Eligible patients have to have pathologically proven SCCHN without evidence of distant metastases, ≥ 18 years old and ECOG P.S. of < 2 . All patients should undergo a full endoscopic examination and CT scan of the head and neck before initial treatment, 1-2 months after completion of chemoradiotherapy & on recurrence. Patients treated with chemotherapy alone, brachytherapy or surgeries for the primary tumor were excluded.

Clinical data retrieved from patient charts included gender, age, tobacco use, tumor site, and clinical T and N classifications according to the TNM system by AJCC (AJCC 2002), [13], reevaluation after finishing treatment course, any recurrence or distant metastases during the period of follow up.

Chemotherapy: The chemotherapy regimen consisting of cisplatin 20 mg/m² once weekly during radiotherapy. All patients received adequate hydration and serotonin antagonist against emesis during cisplatin administration. Full blood count examination was performed weekly. If the white blood cell count was lower than $3.0 \times 10^9/l$, the platelet count below $100 \times 10^9 /l$, or hemoglobin less than 10 g/dl, the subsequent chemotherapy dose was delayed for one week, without interruption of radiotherapy.

Radiation Therapy:

Pre-treatment CT of the head and neck was done to assess the extent of the primary tumor, as well as the neck nodes. The treatment volume included the primary tumor site and the neck nodes above the clavicle. The patients were treated with 6 MV photons. The fractional daily dose was 2 Gray (Gy) with a planned total dose of 60 Gy. This was delivered using a 6-MV linear accelerator or Cobalt-60 at a dose fraction of 2 Gy per day five times a week, without any intended gaps, up to a dose of 60–66 Gy (depending on TNM classification; T1 and T2 tumors and negative nodes were treated with a dose of 60 Gy, while patients with T3, T4 and/or positive

nodes were treated with a dose of 66 Gy). Reproducibility of head and neck positioning was achieved by using a fixation device (Orfit mask; MEDTEC Inc Orange City, Iowa, USA). The treatment volume included the primary tumour site plus adequate margins and the neck nodes at risk. Usually, parallel-opposed fields were used to irradiate the primary tumour and the upper neck. A separate, anterior supraclavicular field was used to irradiate the lower neck and supraclavicular fossa. The spinal cord was protected after 40 Gy. The prescribed dose was 50 Gy to the clinically negative neck and 60–66 Gy to the gross target volume and positive neck nodes.

Histopathology

All histology slides from initial pretreatment biopsies were reviewed by two authors (Refaiy A M. and Elosaily GM.) to confirm the diagnoses. Tumors were graded as well differentiated (Grade 1), moderately differentiated (Grade 2), or poorly differentiated (Grade 3).

A representative block was selected for each patient. Unstained sections were cut for routine staining with hematoxylin and eosin and for immunohistochemistry.

Immunohistochemistry

Four micron Paraffin sections were cut and mounted on coated slides with polylysine and stained for survivin and Ki immunohistochemistry according to manufacturer's protocol. Tissue sections were deparaffinized, rehydrated in graded alcohol, and transferred to phosphate buffered saline (PBS; PH 7.6). The slides were rinsed twice with PBS, and then endogenous peroxidase was blocked by the use of 3% hydrogen peroxide in methanol for 5 minutes.

After three times wash with PBS, antigen retrieval was done by using microwave at 700W for 15 min in citrate buffer. After cooling the slides were washed three times with PBS. The slides were incubated for 18 h (overnight) at 4 C with primary antibody for survivin (mouse monoclonal antibody Ab1) and Ki 67 (rabbit polyclonal antibody Ab4), Thermo scientific CA, USA, at dilution of 1:100 and 1: 200 respectively. The slides were then rinsed three times with PBS and incubated for 10 min. with the biotinylated goat antipolyvalent (Thermo Scientific, CA,USA) at room temperature. After further rinsing with PBS, the slides were incubated for 10 min. with Streptavidin peroxidase (Thermo Scientific, Ca, USA) at room temperature. The slides were again washed three times with PBS, and diaminobenzidine was applied for 5 min at room temperature. Finally, the slides were rinsed in D.W., counterstained with Mayer's hematoxylin, dehydrated and mounted. Positive control sections for survivin were from human placenta and for Ki 67

were from lymph node with reactive hyperplasia. Specificity of staining was checked on negative control slides by omitting the primary antibody.

Expression of survivin was determined in the nucleus and in the cytoplasm by assessing semi-quantitatively the percentage of marked tumor cells and the staining intensity. The percentage of positive cells was rated as follows: 1, 1-10% positive cells; 2, 11-50%; 3, 51-80%; and 4, > 80% positive cells. Staining intensity was scored as 1, weak; 2, moderate, and 3, intensive. Scores for percentage of positive cells and scores for expression intensities were multiplied to calculate an immunoreactivity score (IRS) [14]; 0-2 = no staining; 3-4 = weak staining; 6-8 = moderate staining; 9-12 = strong staining. For statistical analyses, “none” and “weak” staining were combined and counted as “low expression” whereas “moderate” and “strong” staining were grouped together and scored as “high expression.”

Ki 67 evaluation was done by counting number of positive nuclei in 1000 tumor cells and the percentage was calculated as ki 67 labelling index.

The endpoints were disease free survival and overall survival. Local treatment failure was defined as either presence of neoplasm after radiotherapy or the appearance of local recurrence at the irradiated site confirmed by histology.

Statistical analysis

Data were recorded on specialized forms and all statistical tests were performed using SPSS version 16 for windows (SPSS Inc, Chicago, IL, USA) and Microsoft Excell (Realmond, W.A, USA) software. Descriptive analysis (e.g., mean, standard deviation, frequencies, percentage) were calculated and analysis was performed using the student's t-test and Fisher ExactT- Test. A multivariate analysis using the Cox regression model [14] was then performed on all variables with significant prognostic influence in univariate analysis ($P < 0.05$). The survival curves were made using the Kaplan-Meier method and comparison was with the log rank test.

3. Results:

One hundred and fifty four patients were eligible for this study. They were composed of 93 men (60.4%) and 31 women (39.6%) with a mean age at the time of diagnosis of 54 years (range, 21–80 years). The site of the primary tumor was the larynx in 64 patients (41.6%), oropharynx and oral cavity in 27 patients (17.5%), the hypopharynx in 52 patients (33.8%), and the nasopharynx 11 (7.1%) (Table 1). The majority of patients had advanced T-stage tumors (71% T3–T4) and enlarged L.N. (63.3% N1–N3).

Immunostaining

The immunostaining for survivin was prevalently cytoplasmic with sporadic prominent nuclear staining. So, we recorded the specimens as positive without considering the intracellular localization of the signal (cytoplasmic or nuclear). No survivin expression was detected in adjacent normal tissues. Survivin expression in the cytoplasm of tumor cells and / or nucleus by immunohistochemistry was low in 107 (69.5%) and high in 47 cases (30.5%); (Table.1). According to immunoreactive score (IRS), the staining was negative in 78 (50.7%), weak in 28 (18.2%), moderate in 22 (14.3%) and strong in 26 (16.9%) cases (Fig 1, 2).

Based on a 20% threshold value, nuclear staining of Ki-67 was positive in 72 tumors (46.8%) i.e. having high proliferation rate (Fig 3, 4) and negative in 82 tumors (53.2%) i.e. with low proliferation rate.

Clinical outcome and survivin expression

The follow-up ranged from 3 months to 55 months (median, 20.5 months). There were 114 local treatment failures (74%) and 86 deaths (55.8%), of which 72 deaths (83.7%) were caused by disease.

High survivin expression was correlated significantly with higher disease free survival and overall survival (Fig.5). Patients with high survivin expression in their tumors had a median disease free survival of 32 ± 3.62 (95% CI, 18.927–43.073) compared with 16 ± 1.1 (95% CI, 13.912–18.088) for patients with low expression tumors ($P = 0.007$). The median overall survival of patients with high survivin expression was 36 ± 1.81 months (95% CI, 32.45–39.55) months, versus 24 ± 3.47 months (95% CI, 18.18–31.82) for those with low survivin expression. This difference of survival rates was statistically significant ($P = 0.04$). The expression of Ki-67 was not significantly correlated with either disease free survival 19 ± 5.3 months (95% CI, 8.618–29.382) for patients with negative ki67 vs. 17 ± 1.7 months (95% CI, 14.712 - 19.288) for positive ki67 ($P = 0.5$) or overall survival 26 ± 4.4 months (95% CI, 13.285 - 40.715) for patients with negative ki67 vs. 20 ± 5.3 months (95% CI, 11.615 - 42.366) for positive ki67, ($P = 0.729$), (Fig.6).

Analysis of Subgroups

Both univariate and multivariate analyses showed no significant correlation between survivin expression and age, sex, histological grade, tumour stage, or the presence of lymph node metastasis (Table 2). Ki67 correlated significantly with age and tumor grade but did not correlate with other factors (Table 3).

Table 1: Patients characteristics

		Frequency (N=154)	Percent
Sex	Male	93	60.4
	Female	61	39.6
Age (years)	Mean \pm SD	53.99 \pm 14.07	
	Median	54	
	Min - Max	21-80	
Site	Larynx	64	41.6
	Nasopharynx	11	7.1
	oral cavity	23	14.9
	Oropharynx	4	2.6
	Hypopharynx	52	33.8
T	1	6	3.9
	2	38	24.7
	3	69	44.8
	4	41	26.2
L.N	0	56	36.4
	1	47	30.5
	2	45	29.2
	3	6	3.9
Grade	1	51	33.1
	2	73	47.4
	3	30	19.5
Response	CR	83	53.9
	PR	38	24.7
	NR	28	18.2
	PD	5	3.2
Survivin	Low	107	69.5
	High	47	30.5
Ki67	Negative	82	53.2
	Positive	72	46.8

Table 2: correlation of survivin with patients characteristics

		Survivin I				P-value
		Low		High		
		N	%	N	%	
sex	Male	65	60.7	28	59.6	0.5
	Female	42	39.3	19	40.4	
Age (years)		53.57 \pm 14.3		56.35 \pm 12.68		0.3
Site	Larynx	36	33.6	28	59.6	0.06
	Nasopharynx	7	6.5	4	8.5	
	Oro-pharynx/oral cavity	21	19.6	6	12.8	

		Survivin1				P-value
		Low		High		
		N	%	N	%	
	Male	65	60.7	28	59.6	0.34
	Hypo-pharynx	43	40.2	9	19.1	
T	1	2	1.9	0	0.0	
	2	14	13.1	8	17.0	
	3	51	47.7	28	59.6	
	4	40	37.4	11	23.4	
L.N	0	50	46.7	31	66.0	0.06
	1	20	18.7	2	4.3	
	2	35	32.7	10	21.3	
	3	2	1.9	4	8.5	
Grade	1	25	23.4	6	12.8	0.06
	2	68	63.6	25	53.2	
	3	14	13.1	16	34.0	

Table 3: correlation of ki67 with patients characteristics

		Ki67				P-value
		Negative		positive		
		N	%	N	%	
sex	Male	54	65.9	39	54.2	0.13
	Female	28	34.1	33	45.8	
Age (years)		59.38 ± 13.789		49.49 ± 12.902		0.002
	Larynx	36	43.9	28	38.9	0.3
	Nasopharynx	3	3.7	8	11.1	
	Oro-pharynx/oral cavity	13	15.9	14	19.4	
	Hypo-pharynx	30	36.6	22	30.6	
T	1	2	2.4	0	0.0	0.08
	2	14	17.1	8	11.1	
	3	33	40.2	46	63.9	
	4	33	40.2	18	25.0	
L.N	0	32	39.0	49	68.1	0.06
	1	14	17.1	8	11.1	
	2	30	36.6	15	20.8	
	3	6	7.3	0	0.0	
Grade	1	28	34.1	3	4.2	0.000
	2	50	61.0	43	59.7	
	3	4	4.9	26	36.1	

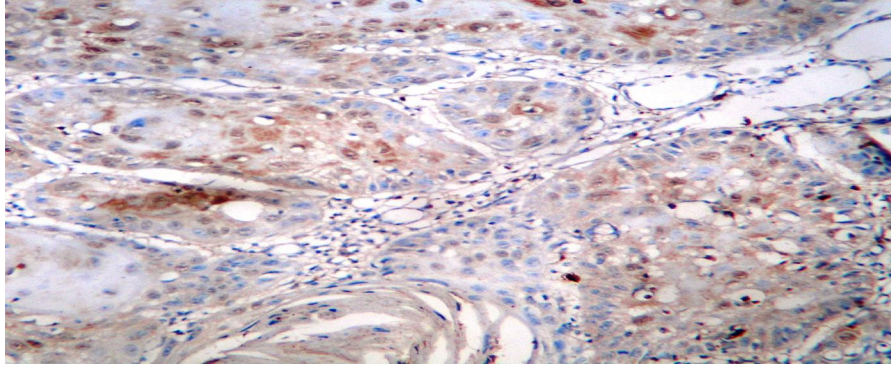


Fig 1: Moderate survivin expression in moderately differentiated SCC (x200)

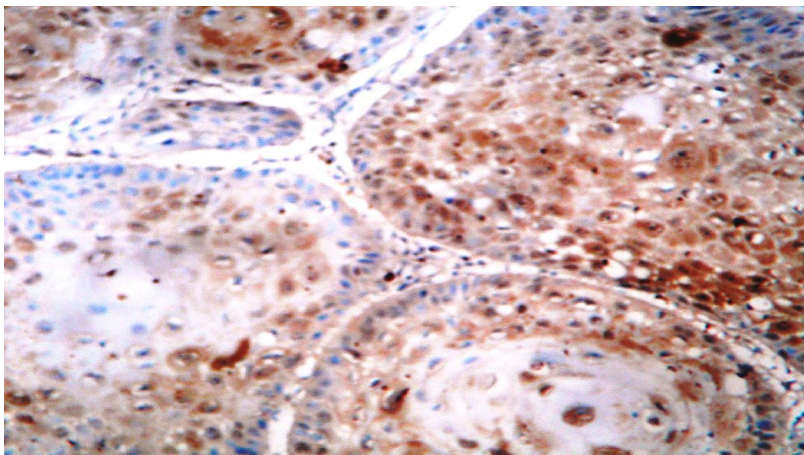


Fig 2: Strong survivin expression in well differentiated SCC (x200)

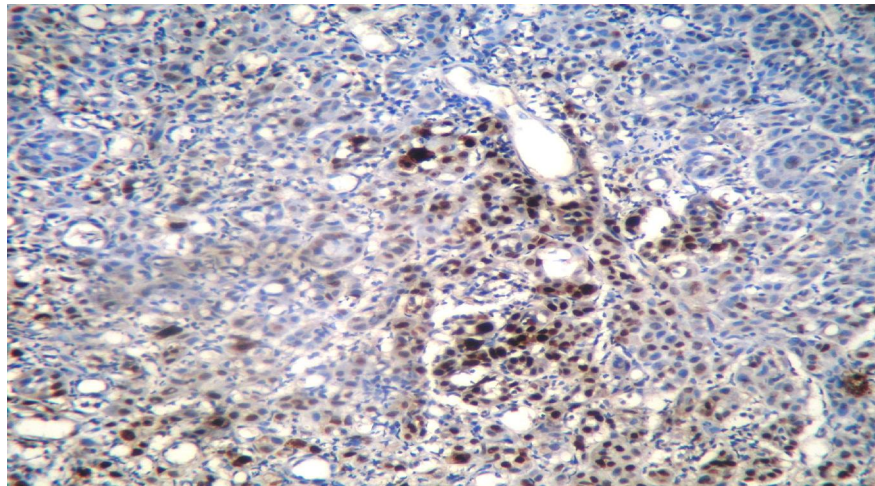


Fig 3: Ki67 immunohistochemical expression in moderately differentiated squamous cell carcinoma showing brown nuclear staining (x100)

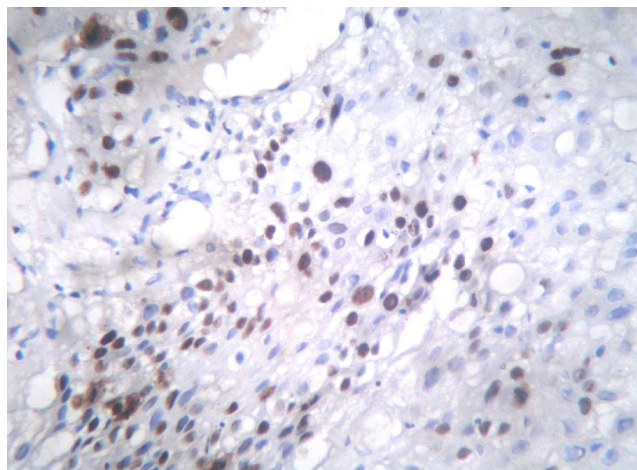


Fig 4: Ki67 expression in moderately differentiated SCC higher power view (x200)

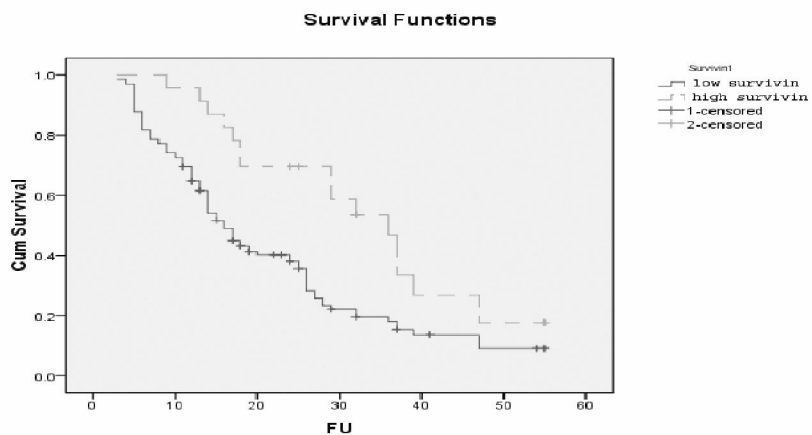


Fig.5A. correlation of survivin with disease free survival.

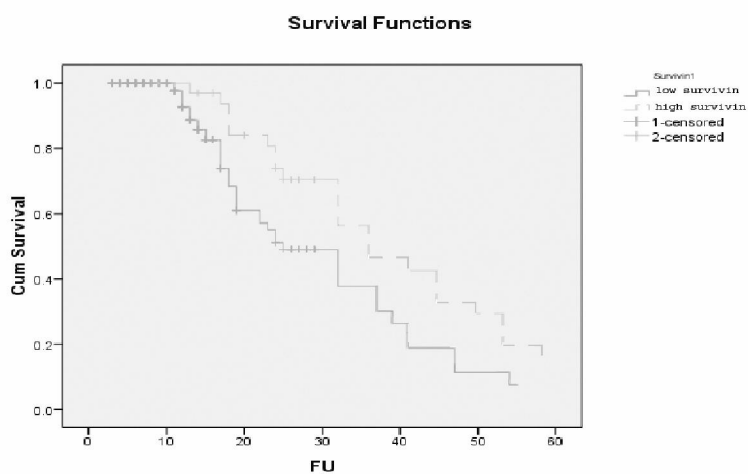


Fig.5B: correlation of survivin with overall survival

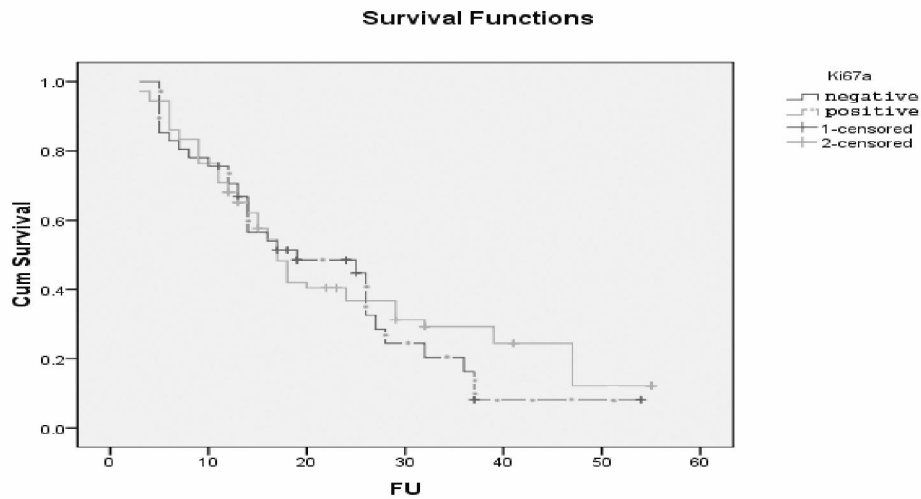


Fig.6 A: correlation of ki67 with disease free survival

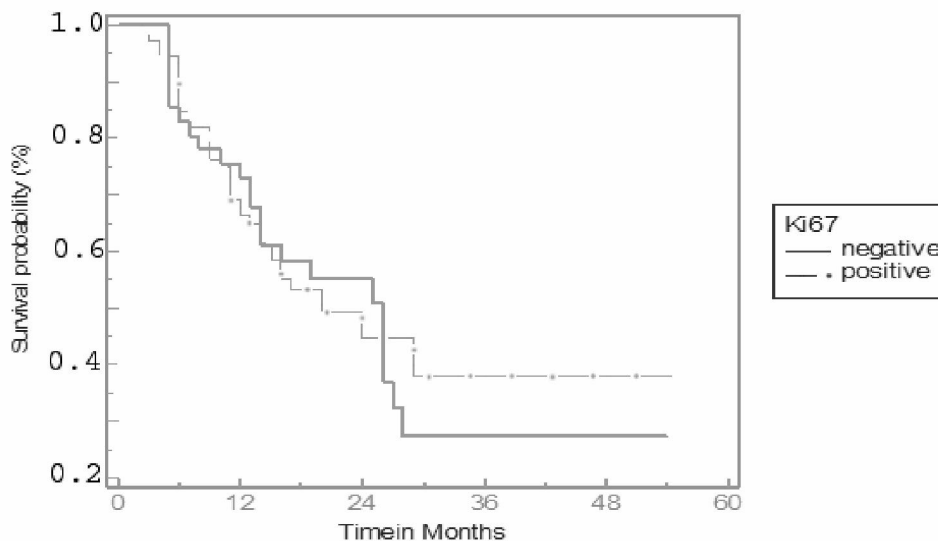


Fig.6 B: correlation of ki67 with overall survival.

4. Discussion

The aim of the present study was to delineate prognostic value of expression of survivin and ki67 in head and neck squamous cell carcinoma treated by chemoradiotherapy.

Khan et al. [15] reported that Survivin is expressed in a varying proportion of cells, and in majority of patients it was localized in cytoplasm in oral squamous cell carcinoma. Others [16,17] demonstrated nuclear subcellular survivin localization. However Engels et al. [18] suggested that the difference between cytoplasmic and nuclear survivin is an indicator for survivin activity in tumor cells.

The clinical implications for subcellular localization of survivin expression remains controversial. Among the 19 publications relevant to survivin localization in nuclei or cytoplasm in various cancer tissues reviewed by Li et al. [19], 9 publications showed that survivin expression in cancer cell nuclei was an unfavorable prognostic marker, whereas 5 publications proposed the opposing notion that nuclear survivin expression represented a favorable prognostic marker. Similarly, overall survivin expression, its discrete intracellular localization, and its implication as a prognostic marker were also analyzed in several HNSCC studies, albeit with opposing results [16,20,15].

In the present study, high survivin expression in HNSCC was associated with favorable patients' outcome. Consistent with our data are those reported by Freier et al [19] who found that high survivin expression was an independent predictor of increased 5- and 10-year overall survival of patients with oral squamous cell carcinoma (OSCC). Within a subgroup of patients, who received radiation therapy, they also found that high survivin expression was the only predictor of favorable 3-, 5- and 10-year overall survival in a multivariate cox regression analysis including UICC stage and age as covariables [21]. Also, recent studies in several different tumor entities like breast carcinoma, [22] colon carcinoma, [23] osteosarcoma [24] and transitional bladder cancer [25] showed similar results of high survivin expression predicting increased overall survival of the patients.

However, our data are in contrast to recent studies in oral squamous cell carcinoma, [26,27], laryngeal basaloid squamous cell carcinoma [16], and adenoid cystic carcinoma of the head and neck [28] in which high survivin expression was associated with adverse patients' outcome. Similar results of correlating survivin with an unfavorable clinical outcome were reported by previous studies in a variety of cancers, including colorectal cancer [29], breast cancer [30], lung cancer [31], and esophageal cancer [32].

However, in esophageal carcinoma, a tumor entity, which derives from the epithelium of the upper aerodigestive tract just like HNSCC, an association of high mRNA survivin expression and favorable outcome after neoadjuvant radiochemotherapy was recently found [33]. This was corroborated by a previous study, which showed that survivin protein expression correlates with the proliferative index but not the apoptotic index in esophageal carcinoma, which might enhance the responsiveness to induction radiochemotherapy eventually resulting in survivin-dependent superior overall survival [34]. According to our data, one might speculate that increased proliferation activity of the tumor cells induced by high survivin expression makes the tumor cells more liable for radiation-induced cell damage. This could explain the observed increased overall survival of patients with high survivin expression treated by radiochemotherapy. If the assumption of high survivin expression being a predictor of radiation response could be verified in further functional analysis, survivin might be a promising stratification, which should be evaluated in prospective, controlled clinical studies to marker to preselect patients, who would benefit from radiochemotherapy in the clinical management of HNSCC.

In this study, we found a statistically significant correlation between Ki67 expression and

tumor grade but not correlated with other factors. Our results are in agreement with several reports of evidence that Ki67 expression increases with the severity of dysplastic changes in the head and neck squamous cell carcinoma, [35, 36].

In conclusion, the present study demonstrated that high survivin expression predicts better local control and superior overall survival in HNSCC patients treated with radiochemotherapy for an advanced tumor. Survivin might be used as a stratification marker to define HNSCC patients, who would potentially benefit from radiochemotherapy. Further investigation is necessary to clarify and understand the roles of survivin in patients with HNSCC.

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Methods of Distance Education in Agricultural education

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Abstract: According to the information in the development of any society should take half of the world to progress until the necessary coordination and synchronization global developments so as to accept the design structure of a knowledge-based society have a special place for the University and respect the role of education and technology was In designing a model with global standards of dynamism and flexibility at first be necessary to select a sample that the facilities and communications needed for this purpose provide action and then determine optimal cognitive deficiencies than Hammett and weaknesses push. No doubt the experiences of implementing these standards and to develop troubleshooting information using technological tools would be much more economical. That if we develop a range of information from a city university level and conduct more successful we'll be more acceptable was. Because the utilization and application tools and step up the information they've been successful. Therefore the most important first step needed to coordinate and synchronize technology education and educational technology standards and capability in the high user acceptability of the world is also enjoyed.

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Keywords: Distance Education , Agricultural Education

Introduction:

Guidance and therefore move in the direction of society should be education and technology for comprehensive pandemic done. Considering the above definitions and with the knowledge and attitudes towards the third millennium and the desirability and some weaknesses in the achievement of certain standards and dynamic structures in order to achieve a knowledge based society, there is. In the present circumstances to provide our information infrastructure development and integration inevitably link the elements and tools that they are as indicators of technology education and technology education will be remembered. In the new context of combining these two indicators comes to training facilities and a variety of tools that will provide guidance and development in information will be very effective. While the effect of these two indices of body functions and its other fields (favorable to foster new ideas provides. Technologies training web-based technology as one of the most effective learning tools in educational issues have been identified and a total of E-learning as it is referred. . But if the scientific and cultural infrastructure with this technology's Day is not coordinated development of information will be obtained. This weakness caused by lack of growth and development of training required for pandemic knowledge of existing technology is. In many systems of scientific tools and capabilities needed to provide hardware and commissioning are still technological problems resulting from lack of knowledge of poverty and poor education in these centers to be seen.

In other words, the country still in the feasibility assessment and appropriate to make public the necessary training for operation and application of scientific principles and technological tools is has been done and why certain movements and sometimes non-normative point will not be able node an unlock.

The conditions and according to the capacity of developing countries and training facilities required a knowledge-based society feels is felt. If all processes in technology education and technology optimization and standardization of the Hungarian education should go, and appropriate channels that the best option in this area could benefit from state universities is capabilities.

The contract between teacher and learner, whether in a traditional classroom or distance education, requires that the student be taught, assessed, given guidance and, where appropriate, prepared for examinations that may or may not be conducted by the institution. This must be accomplished by two-way communication. Learning may be undertaken either individually or in groups; in either case, it is accomplished in the physical absence of the teacher in distance education. Where distance teaching materials are provided to learners, they are structured in ways that facilitate learning at a distance. Recent rapid development of technology has resulted in systems that are powerful, flexible, and increasingly affordable. The base of available information technology resources is increasing with dramatic speed. Much has been learned about connecting various forms of technology into systems,

so that the ability to link systems is growing. Most distance learning systems are hybrids, combining several technologies, such as satellite, ITFS, microwave, cable, fiber optic, and computer connections.

Educational methods in distance learning:

Today, under the new system replaced the traditional systems of learning and learning week (ie tutoring methods, lectures) are:

- Multimedia courses:

These courses and widely used elements of image, communication, graphics and simulated components, animation and communication elements for guidance and tips, and talk back on course and curriculum issues are held.

- Enhanced communication mechanisms:

The mechanism of any texts simultaneously, and asynchronous audio-visual communications to protect you. This case allows students to practice on topics learned will give.

- Written test:

thus, question and test via a distributed communication network, are corrected and returned. These exams through video conferencing support and runs.

-Virtual Seminar:

thereby different groups of students in different geographical environments linked together makes.

- Collaborative virtual laboratories:

the laboratory of the Group's activities are supported. Workshops such as software engineering.

-Smart academic factors:

academic factors that inform intelligent, support and guidance students pay.

Remote educational tool:

distance learning tools and supplies various uses. These tools in four main courses are:

A - Audio Tools:

Audio tools include training such as two-way interactive telephone, video conference, shortwave radio and a strain of tools such as audio tape and radio.

B - Image tools:

including slides, films, video tapes and video conferences.

C - Data:

computers as electronic data are sent and received. Because the data word description for a wide range of educational tools is used.

Computer applications for distance education are varied and include the following:

- 1- Training to Computer Management.
- 2 - Computer Assisted Instruction.
- 3 - through PCs.

4 - e-mail, telegraph, computer conference and the World Wide Web simultaneously.

D - Print:

The main element of distance education programs, particularly in the exchange and delivery system information tools are considered.

Conclusion:

As the cost of delivering quality education increases, institutions find that limited resources prevent them from building facilities, hiring faculty, or expanding curricula. They are using distance education to maximize resources and are combining their assets with others to produce programming. Distance education is offered internationally, nationally, regionally, and locally over all forms of conferencing technology.

Distance learning is expanding and examples of it are increasing dramatically. Fewer than 10 states were using distance learning in 1987; today, virtually all states have an interest or effort in distance education. Distance learning systems connect the teacher with the students when physical face-to-face interaction is not possible. Telecommunications systems carry instruction, moving information instead of people. The technology at distant locations are important and affect how interaction takes place, what information resources are used, and how effective the system is likely to be.

Technology transports information, not people. Distances between teachers and students are bridged with an array of familiar technology as well as new information age equipment. What sets today's distance education efforts apart from previous efforts is the possibility of an interactive capacity that provides learner and teacher with needed feedback, including the opportunity to dialogue, clarify, or assess. Advances in digital compression technology may greatly expand the number of channels that can be sent over any transmission medium, doubling or even tripling channel capacity. Technologies for learning at a distance are also enlarging our definition of how students learn, where they learn, and who teaches them. No one technology is best for all situations and applications. Different technologies have different capabilities and limitations, and effective implementation will depend on matching technological capabilities to education needs.

Distance education places students and their instructors in separate locations using some form of technology to communicate and interact. The student may be located in the classroom, home, office or learning center. The instructor may be located in a media classroom, studio, office or home.

The student may receive information via satellite, microwave, or fiber optic cable, television

(broadcast, cable or Instructional Television Fixed Services (ITFS), video cassette or disk, telephone - audio conferencing bridge or direct phone line, audio cassette, printed materials - text, study guide, or handout, computer - modem or floppy disk, and compressed video. Recent rapid development of technology has resulted in systems that are powerful, flexible, and increasingly affordable. The base of available information technology resources is increasing with dramatic speed. Much has been learned about connecting various forms of technology into systems, so that the ability to link systems is growing. Most distance learning systems are hybrids, combining several technologies, such as satellite, ITFS, microwave, cable, fiber optic, and computer connections.

Interactivity is accomplished via telephone (one-way video and two-way audio), two-way video or graphics interactivity, two-way computer hookups, two-way audio. Interactivity may be delayed but interaction provided by teacher telephone office hours when students can call or through time with on-site facilitators. Classes with large numbers of students have a limited amount of interactivity. Much of the activity on computer networks is on a delayed basis as well. Possibilities for audio and visual interaction are increasingly wide.

In the earlier days of distance learning, it was most common to see distance learning used for rural students who were at a distance from an educational institution. The student might watch a telecourse on a television stations, read texts, mail in assignments and then travel to the local college to take an exam. This model is still in use, but as the technology has become more sophisticated and the cost of distance learning dropped as equipment prices dropped, the use of distance education has increased.

High front-end costs prevented an early widespread adoption of electronically mediated learning. Distance learning has been aggressively adopted in many areas because it can meet specific educational needs. As the concept of accountability became accepted and laws required certain courses in high school in order for students to be admitted to state colleges, telecommunications was examined as a way to provide student access to the required courses. Many rural school districts could not afford the special teachers to conduct required courses. Distance education met this need by providing courses in schools where teachers were not available or were too costly to provide for a few students. It also fulfilled a need for teacher training and staff development in locations where experts and resources were difficult to obtain. These systems link learner communities with each other and bring a wide array of experts and information to the classroom.

Challenges which faced the early users of distance education are still with us today. If distance education is to play a greater role in improving the quality of education, it will require expanded technology; more linkages between schools, higher education, and the private sector; and more teachers who use technology well. Teachers must be involved in planning the systems, trained to use the tools they provide, and given the flexibility to revise their teaching. Federal and state regulations will need revision to ensure a more flexible and effective use of technology. Connections have been established across geographic, instructional, and institutional boundaries which provide opportunities for collaboration and resource sharing among many groups. In the pooling of students and teachers, distance learning reconfigures the classroom which no longer is bounded by the physical space of the school, district, state or nation.

The key to success in distance learning is the teacher. If the teacher is good, the technology can become almost transparent. No technology can overcome poor teaching which is actually exacerbated in distance education applications. When skilled teachers are involved, enthusiasm, expertise, and creative use of the media can enrich students beyond the four walls of their classroom.

Teachers need training in the system's technical aspects and in the educational applications of the technology. Areas for assistance include the amount of time needed to prepare and teach courses, how to establish and maintain effective communication with students, strategies for adding visual components to audio courses, ways to increase interaction between students and faculty, planning and management of organizational details, and strategies for group cohesion and student motivation.

The interchange of ideas requires different communication methods than in conventional classrooms: information technologies are predominantly visual media, rather than the textual and auditory environment of the conventional classroom, the affective content of mediated messages is muted compared to face-to-face interaction, and complex cognitive content can be conveyed more readily in electronic form because multiple representations of material (e.g., animations, text, verbal descriptions, and visual images) can be presented to give learners many ways of understanding the fundamental concept.

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The Wise, Hero Man and His Characteristics from Nietzsche's Viewpoint

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Abstract: Nietzsche has had an enormous influence on the thoughts of intellectuals and artists. He is a philosopher who is different from others. He wrested the hammer of philosophy and smashed to pieces the idols of one millennial value after another. He regarded himself as another Christ in another era, an era longing for tidings of a different kind, tidings of an abundant and powerful life. Nietzsche's wise and heroic man loves life, possesses ambition and fertility, is abundant with positive energies, and is opposed to all weakness and self-belittlement. He is courageous and adventurous. This short paper focuses on Nietzsche's wise and heroic man and his characteristics. [Muhammad Hossein Mardani Nokandeh. The Wise, Hero Man and His Characteristics from Nietzsche's Viewpoint. Life Science Journal. 2011;8(2):739-745] (ISSN:1097-8135). <http://www.lifesciencesite.com>.

Keywords: Nietzsche; wise man; hero; superman; vitality; passion

1. The wise man and his characteristics

From Nietzsche's point of view, human beings own various natures and temperaments and their energies, gifts, fertility, and will to power are unique (Dast-gheyb, 1998). Only a few can discover their existent energies and transform their potential abilities into actual ones, since most people lack vital, abundant energy, or sufficient power and ambition to achieve their objectives (Razavi, 2002). In fact, Nietzsche emphasizes the unlikeness and inequality of human beings and strongly dissents from proponents of equality and those preaching the equality and similarity of individuals (Nietzsche, 1900). To separate, rank, and evaluate individuals (from nations), he refers to the fertility of nature (the grade of each being's consistency with vitality and instinct) and the power of spirituality (the power of creation, insight, and construction) and, with his metaphorical language, determines their "superiority" and "wisdom" (Jaspers, 2004). In short, one can describe the temporal and spiritual characteristics of Nietzsche's powerful, fertile, and wise man in several ways. He adores life and, like Dionysus, is abundant with vitality. In other words, a lively man answers, "Yes!" to his time (Blackham, 1952), and accepts the good and evil of his fate (Cuppitt 1988), since the follower of *The Gay Science* knows that life is a crucible for setting the hallmark for human beings. The opposite, tragic process of life (i.e. the biological examination), sets the fertility and self-control of the existence of every individual (Fooladvand, 2004). He enjoys the power to will, ambition, or a particular energy (Ashori, 1973), since he, himself, has a strong connection to the powers of vitality and life (Daybreak, 1881). In other words, a strong-hearted man will not repress his instincts and natural desires, but strive to express, guide, and cause his nature to

flourish and flow (Nietzsche, 1900). He favors ambition, fertility, and an ascending life and, as a result, can transform his potential power into an actual power and realize his wants to "become what he is" (Razavi, 2002). He is possessed of passion (Fooladvand, 2008) and has, essentially, a Dionysian nature (Nietzsche, 1886). As a result, he is passionate and self-opposite and pays more attention to the whisper of passion than the call of reason (Magee, 1978). However, this lover's abundant passion is different from transient excitement and emanates from an inner fire (Cuppitt, 1988). Furthermore, he, like Dionysus, is disobedient, fearless, and adventurous (Winchester, 1995) He is a disciple of knowledge, spirituality, and construction, and one could even consider him a Gnostic or clear-sighted man, due to his zeal for knowing and his interest in discovering (i.e. the faculty of seeing or insight) the truths of the revealed world (Nietzsche, 1900). In a sense, through superabundance of imagination and thought and creative substance, this clear-sighted free-thinker steps into the glorious realm of the land of visions with the faculty of insight and imagination in which the world is concretized and objectivity transforms into mentality. Surely, this discoverer of the land of visions is a gallant person with self-control and superabundant thought, energy of imagination, and creativity (Farhadpoor, 2001). As such, the Nietzschean true man (Nietzsche, 2003) is both the result of an abundance of vitality and ambition and the fruit of superabundance of oppositeness, passion, spirituality, and fertility. Like Don Juan Castaneda, he searches for other horizons and undergoes strange experiences. He fearlessly welcomes his fate and boisterous time (Mc Daniel, 2000), is continuously in an unbalanced position or unusual circumstances, and, as a result, constantly

feels duality, disintegration, and other disasters of personality and dissolution (Razavi, 2002). Nietzsche writes, "...sometimes the idea runs through my head that I am living an extremely dangerous life, for I am one of those machines that can explode" (Pirooz, 2001). Yes, Nietzsche is one of the tragic, wise men (Pirooz, 2001) and belongs to a race in which the superabundance of their beings accompanied by events puts them on the edge of the cliffs of ecstasy and delirium (Ansell- Pearson, 1994). As the labyrinthine of cognition looks for adventure, the wise gallant knows well that "craziness is a danger in the way of men of wisdom" (Ashoori, 2002).

Nietzsche regards humankind as the greatest fruit of evolution, and emphasizes that evolution does not end with humankind. This does not mean that another being greater than humankind will be created, but, rather, that the human will evolve within himself until overcoming himself. Nietzsche intended to return humankind to its original innocence (the innocence before laying down moral principles) and, to do so, one should overcome morality that is the source of good and evil, and overcome his humanity, which is different than morality in origin. Where he reaffirms, "human being is a being who should overcome himself," or one "should go beyond his good and evil," he is pointing out the passing of humankind from the era of morality.

Nietzsche believes that the Superman is a new man who has overcome his humanity and has surpassed all good and evil. He is proud, free, light-hearted, calm, strong both physically and mentally, and the greatest yes-sayer. The Superman is generous not for the sake of helping the poor and needy, but because it is required by his nature. His generosity is no weakness. It is a power. His generosity and power are like sunrays that shine on high and low places, land and sea, villages and deserts alike. He does good for people not for the sake of doing good as he is not desperate for it, but to fulfill his nature. Moreover, he enjoys gaiety and the spirit of dancing and healthiness.

2. Rearing the hero and the superman

Explicating the concept of the "Superman" and rearing the Hero were some of Nietzsche's most brilliant goals. From his perspective, the Superman or Hero is first one who is self-sufficient, self-reliant, and independent of any other beings. Second, his major characteristics must represent power, strength, and ambition.

2.1. Conditions for Rearing the Hero

To rear the Hero, Nietzsche believes, "self-confidence is the strongest cramp, the most severe whip, and the most powerful wing." Heidegger

explains this situation as "saying yes to oneself"—the expression adapted from Nietzsche himself—and asserts, "The heroic souls are those who, in the most tragic situations, say 'yes' to themselves and enjoy suffering pain and agony. The soul of the Hero is the embodiment of paradoxes and uncertainties." This embodiment of paradoxes and uncertainties means the spiritual and mental preparations to accept the metamorphosis in thoughts and beliefs, which are the requirements for the Hero souls. For Nietzsche, the principle of equality is opposite to the goal of ethics. Equality causes a kind of monotony and psychological inertia. In *The Will to Power*, Nietzsche proposes that "... the concept of the 'equal value of men before God' is extraordinarily harmful; one forbade actions and attitudes that were in themselves among the prerogatives of the strongly constituted—as if they were in themselves unworthy of men."

The Hero possesses the lion-will: "Hungry, fierce, lonesome, God-forsaken: so doth the lion-will wish itself. Free from the happiness of slaves, redeemed from Deities and adorations, fearless and fear-inspiring, grand and lonesome: so is the will of the conscientious." Humankind must make use of all its resources and powers to rear the Hero. In this regard, Nietzsche says, "I love him who laboreth and inventeth, that he may build the house for the Superman, and prepare for him earth, animal, and plant: for thus seeketh he his own down-going." Then, he adds, "I love those who do not first seek a reason beyond the stars for going down and being sacrifices, but sacrifice themselves to the earth that the earth of the Superman may hereafter arrive." This down-going and victimization results in the over-going of man in the form of the Hero. Thus, this down-going is the same as over-going: "I love those that know not how to live except as down-goers, for they are the over-goers."

Nietzsche, in all his writings, speaks of the "will to power," whereas, in the discussion of rearing the Hero or raising the Superman, he moves beyond that and speaks of the "will to danger," saying, the Hero steps beyond the will to power and risks moving toward the will to danger. The sign of the Hero and Superman and "and the bright sign of standing over life is the will to danger. Of course, life essentially means being in danger. Not only this, but also life is like the instinctive search for the life that has elevated to a higher power degree, with the danger of living." Now, Nietzsche, in Germany's framework of traditional thinking, looks positively to war:

In *Thus Spake Zarathustra*, Nietzsche has designated one whole chapter of the first part

to war and warriors, in which, to warriors he addresses, “Ye shall love peace as a means to new wars--and the short peace more than the long... war and courage have done more great things than charity. Not your sympathy, but your bravery hath hitherto saved the victims... Man shall be trained for war, and woman for the recreation of the warrior: all else is folly.”

Nietzsche highly recommends war as a remedy for retardation of nations. War is a purifying power, a treatment for nations that grow weak and humble. If these nations are to continue to live, war can be a prescribed remedy. The national responsibility needs treatment as much as the individual responsibility does. For Nietzsche, the concept of heroism has two theoretical and applied elements, the theoretical part of which applies to philosophy, and the philosopher as the Hero.

The philosopher, as we free spirits understand him—as the man of the greatest responsibility, who has the conscience for the general development of mankind—will use religion for his disciplining and educating work, just as he will use the contemporary political and economic conditions.

The values of the Hero’s life cannot be assessed and measured by standards of ordinary life. He moves beyond the existing values. His life is, in essence, beyond movement. In this regard, Nietzsche declares:

The motives of the Superman’s acts are indescribably various and baffling. For instance, a word like ‘pity’ illustrates nothing, whatever it may be. The paramount principle is this feeling: ‘who am I?’ Who is the other in relation with me? The value of judgments is constantly at work.

To love is one of the indispensable qualities of Heroes. To perform beyond conventional values is “heroism” and this quality is reinforced by the power of love in the Hero and “What is done out of love always takes place beyond good and evil.” The Hero, in the theoretical scope, is the philosopher himself, and the philosopher, to attain his sublime objectives, must take the first steps according to conventional criteria. In other words, one cannot reach Hero status overnight, but should begin with what is easily accessible.

It may be necessary for the education of the real philosopher that he himself should have once stood upon all those steps upon which his servants, the scientific workers of philosophy, remain standing, and must remain standing he himself must perhaps have been critic, and dogmatist, and historian, and besides, poet, and collector, and traveler, and riddlereader, and moralist, and seer, and ‘free spirit,’ and almost everything, in order to traverse the whole range of human values and estimations, and that he may be able with a variety of eyes and consciences to look from a height to any distance, from a depth up to any height, from a nook into any expanse. But all these are only preliminary conditions for his task; this task itself demands something else—it requires him to create values.

The heroic life, philosophical thought, and values creation, are all risks. Living outside of common norms requires that one stake one’s body and soul and forget all about peace and quiet. One who is made of life keeps up with society and one who wishes to create values must pass this stage. It is in a dangerous life and “in the period of great dangers that philosophers are created—when the wheel of time spins fast, philosophers and artists replace the lost myths.” Nietzsche describes this life as dangerous and one that jeopardizes oneself in the position of “declaration of war on factions”:

A declaration of war on factions is necessary from the supermen’s side! Wherever there are some middle-class who work together to accomplish nobility are used for the purposes of ‘people’ and ‘females’ and work in the direction of public poll and the dominance of the debased. But, we should take revenge and bring the whole issue—which began with Christianity in Europe—to light and judgment.

The essence of all qualities and characteristics of the philosopher as the Hero is power. Of course, this is in the first grade of spiritual power that provides us with the possibility of thinking about great criteria and “What determines rank, sets off rank, is only quanta of power, and nothing else.” Finally, quoting from his favorite hero Zarathustra, Nietzsche says, “I teach you the Superman.”

2.2. The Ultimate Goal of the Hero’s Existence

Nietzsche declares the modern age as the historical end of metaphysics. As divinity is the symbol of that period, the modern age is the end of divinity; hence he states his famous maxim "God is dead." The thought of rearing the Hero and Superman is a substitute for divinity. In this regard, Heidegger says, "The Superman is a plan to substitute for a god who has died. Therefore, the death of God necessitates the creation of the Superman. Nietzsche, in *Thus Spake Zarathustra*, states, 'Dead are all the Gods. Now do we desire the Superman to live? Let this be our final will at the great noontide!' Regarding the replacement of Superman for God, Nietzsche reiterates, "Once did people say God, when they looked out upon distant seas; now however, have I taught you to say, Superman."

Substituting the Superman for God is for nothing but legislation and setting values. Henceforth, humankind itself bears the responsibility for its affairs and making its own legislations. Preparation for becoming the legislators of the future, the masters of the earth, at least our children. Basic concern with marriages. "Therefore, O my brethren, a new nobility is needed, which shall be the adversary of all populace and potentate rule, and shall inscribe anew the word "noble" on new tables. The Superman is the meaning of the earth. Let your will say: The Superman shall be the meaning of the earth! I conjure you, my brethren, remain true to the earth and believe not those who speak unto you of super earthly hopes! According to one of Jaspers' interpretations, one of Nietzsche's prime motives in defying divinity and declaring its termination is a release from the "fear of death." One of man's psychological problems is the fear of death and Nietzsche associates this with the divinity concept:

Nietzsche is one of a series of thinkers who wish to overcome every form of death because it is existentially ruinous and a sign of an existence which is not self-based. However, it seems that Nietzsche's ultimate goal (i.e. the creation of the Superman) is by far more original than man's independence, his ruling, his self-basedness, and his fear of death. From his perspective, to create a genius (i.e. the Superman or Hero) is the goal of culture that, in turn, is the goal of life. Literally, life cannot be lived without goals. In particular, a life without divinity seems meaningless and goalless. Therefore, certain goals must be set. This goal is the plantation and growing the prettiest flower of humankind - the genius who has a noble and genuine mind and is a noble man, which has been described as Superman in Nietzsche's latest thoughts. From Nietzsche's point of view, recognizing the probability of the Superman plan is the perfectness of life. He says, "I love him who liveth in order to know,

and seeketh to know in order that the Superman may hereafter live."

Man must constantly fight to rear the Hero, the genius, and the Superman. To rear the Superman, short peace and a long war is better than long-lasting peace.

Your enemy shall ye seek; your war shall ye wage, and for the sake of your thoughts! And if your thoughts succumb, your uprightness shall still shout triumph thereby! Ye shall love peace as a means to new wars--and the short peace more than the long. You I advise not to work, but to fight. You I advise not to peace, but to victory. Let your work be a fight, let your peace be a victory!

Despite the shortsightedness and narrow-mindedness, this war is not for bloodshed and this Hero is not like Hitler. By contrast, this war is a sacred one for setting high human values and for releasing man from superstitions like weakness, tyranny, humiliation, and nothingness. It is a war of all human instincts against all inhuman ones.

2.3. The Hero's Potential Deviations

Rearing the Hero and the Superman may be vulnerable to various threats, the most mortal of which are scientism, motherly affection, slavish moralities, and the wickedness and platitude of quasi-heroes. The dangers that beset the evolution of the philosopher are, in fact, so manifold nowadays, that one might doubt whether this fruit could still come to maturity. The extent and towering structure of the sciences have increased enormously, and therewith also the probability that the philosopher will grow tired even as a learner, or will attach himself somewhere and 'specialize' so that he will no longer attain to his elevation, that is to say, to his superspection, his circumspection. The other danger is motherly compassion, which is offensively and bitterly expressed about women. Nonetheless, one should not consider this anti-feminist as these qualities take the form of compassion for women and that is why they are labeled "effeminate."

And finally, woman! One-half of mankind is weak, typically sick, changeable, inconstant—woman needs strength in order to cleave to it; she needs a religion of weakness that glorifies being weak, loving, and being humble as divine: or better, she makes the strong weak—she rules when she succeeds in overcoming the strong. Woman has always conspired with the types of decadence, the priests, against the

"powerful," the "strong," the men. Woman brings the children to the cult of piety, pity, love—the mother represents altruism convincingly.

The Superman plan may be exposed to other dangers, as well. J. P. Stern suggests, "In recent Nietzscheism periods, nothing more than Hitler's life and deeds have been the embodiment of the will to power. Even if we presume (although there are evidences to prove this) that the truth goes beyond what was imaginable for Nietzsche."

2.4. Characteristics of the Hero

If the traditional disciplining becomes dominated and the ordinary values overwhelm, the Hero, then, will be imperiled by degeneration and everydayness. Manliness will be replaced by weakness and perseverance by pity and then, "So much kindness, so much weakness do I see. So much justice and pity, so much weakness. Round, fair, and considerate are they to one another, as grains of sand are round, fair, and considerate to grains of sand. Modestly to embrace a small happiness--that do they call submission, and at the same time they peer modestly after a new small happiness. In their hearts they want simply one thing most of all: that no one hurt them. Thus do they anticipate every one's wishes and do well unto every one. That, however, is *cowardice*, though it be called 'virtue.'"

Imposed weakness may penetrate the man's psyche in different ways and jeopardize the Hero. As Nietzsche says, "Weakness as a task: weakening the desires, the feelings of pleasure and displeasure, the will to power, to a sense of pride, to want to have and have more; weakening as meekness; weakening as faith; weakening as aversion and shame in the face of everything natural, as negation of life, as sickness and habitual weakness--weakening as the renunciation of revenge, of resistance, of enmity and wrath."

Realizing the Nietzsche's Hero inevitably leads to race purification and superiority. Nietzsche points out this issue in places in his writings and, as mentioned before, Nietzsche does not believe in equality. Regarding the relationship between equality and race superiority, he says, "Requiring equal rights is against racism." Elsewhere he says, "There is only nobility of birth, only nobility of blood." He encourages people to move toward superiority. He says, "Blessed remote period when a people said to itself: I will be *master* over peoples! For, my brethren, the best shall rule, the best also willeth to rule and where the teaching is different, there the best is lacking!" To avoid these imposed weaknesses, the Hero must take risks. Thus, taking risks is the vital

characteristic of the Hero. By doing so, he will be safe from the dangers of degeneration and routineness. Moreover, by breaking with tradition and mythical ages, the Hero paves the way for creation, creativity, and accomplishing heroism.

The Hero does not look for emotional influences. The embarrassment for emotional influences is one of the distinct signs of the Hero. The underlying sign of the Hero is taking risks and heroic living's primary motivation is living dangerously! This is the secret of the most fruitful harvest of entity.

Another quality of the Hero is his practicality, especially his military-like practicality. From Nietzsche's viewpoint, martial jobs are the best jobs. However he does not mean to favor Hitler, here. His much-adored figure is Napoleon. In his view, "the highest human beings, such as Caesar, Napoleon" should be the flag-holders of life. Also, he says, "I am thinking, e. g., of Napoleon and Bismarck. The rivalry with strong and unintelligent wills, which is the greatest obstacle, is small. Who doesn't topple these 'objective' gentlemen with weak wills, like Rancle or Renan!" By comparing the Hero to such martial leaders as Napoleon and Caesar, Nietzsche does not intend to wage war and cause bloodshed. The point is a practical power and creativity.

One who creates persistently is a "Mother-Man," in the broad meaning of the word. One who know only the pregnancies and the deliveries of his own soul, who does not have time to think about himself or his work, one who compares himself to others, and applies his taste but easily forgets it, releases or does not use it. Yet, he may finally create works beyond his own understanding and critical mind in such a way that, afterward, his ideas and opinions may seem stupid to himself. Nietzsche illuminates his courageous heroic soul through a comparison where relationships between soldiers and commanders are more nobler than the ones between workers and masters.

Every military civilization is, at least until today, far better than those called "industrial." With their present forms, these are the most degenerated types of life ever. Law is a requirement for industrial civilization. We wish to live and we should sell ourselves, but we humiliate one who abuses this inevitable situation and buys the worker. It is a strange thing to obey powerful people who create fear or even fright.

The Hero is independent, needless of others, self-reliant, responsible for his own work and life, and free from restraints imposed by others. He is a "Superman, proud and free, happy, and calm, strong in both physical and mental terms, and the greatest yes-sayer of life. He is the real Dionysus. He even says yes to death, as he says yes to life like what he

is.” Such a being, as the noble type of man, considers himself as the establisher of values. He does not need others’ approval. He judges himself: what harms me is a harm by itself. He knows that it is only himself who attaches value to all things. He is the creator of values. In other words, the good are noble by origin and from the aristocracy. They create values and their own moralities. To make readers appreciate the behavior of freedom, Nietzsche says, “Use your own feet to ascend! Do not allow others to ascend you! Do not sit upon the heads and shoulders of the strangers.” Again he expresses the same theme with another interpretation: “O! Nobler men! Learn to place yourself upon your own appropriate feet.” Man’s freedom or slavery are in direct contact with his power or weakness and man’s power can be measured by his freedom. The more powerful, the freer and the weaker, the more useful. “Man’s power, or, in other words, his weakness can be assessed by the amount of faith by which he needs to grow or by the number of recourses he relies on and, due to that, he does not want others to resort to them.” The freedom and independence of the Heroes—or philosophers, theoretically speaking, —are the source of controlling, governing, and legislating.

The real philosophers, however, are commanders and law-givers; they say: ‘Thus shall it be!’ They determine first the Whither and the Why of mankind, and thereby set aside the previous labor of all philosophical workers, and all subjugators of the past—they grasp at the future with a creative hand, and whatever is and was, becomes for them thereby a means, an instrument, and a hammer. Their ‘knowing’ is creating, their creating is a law-giving, their will to truth is—will to power.

This is why philosophers are neither scientists, nor artists, nor the pious, nor divine men. They are, however, the powerful free-standing beyond all values and criteria and they can be called “the highest” when it comes to categorization. The philosophical life of the Hero and the Superman requires dispensing with traditional rules and regulations. This, in turn, necessitates a deeper understanding of the world. Ignoring the appearance of rules, customs, and ordinary mottoes of life can penetrate into the depth of the world. Perhaps, with perseverance in doing so, the moment promised by Nietzsche arrives and the “conviction” of the philosopher becomes actualized. In this regard, Nietzsche says, “There is a point in every philosophy at which the ‘conviction’ of the philosopher appears on the scene.”

Among historic figures people like Napoleon and Cyrus came close to the Nietzschean ideal Hero in character. They were the embodiment of autocracy, self-assurance, self-containment, personality independence, and freedom of conventions. “Such men as Napoleon must come again and again and confirm the belief in the autocracy of the individual.”

From Nietzsche’s perspective, the relationship between the Superman and man is like that of man and the ape and this is to bring the position of freedom into focus: “What is the ape to man? A laughingstock, a thing of shame. And just the same shall man be to the Superman: a laughingstock, a thing of shame.” In another comparison, he likens man to a “polluted stream,” and Superman to a “sea.” This is the sea that can tolerate the pollution of the river, “Verily, a polluted stream is man. One must be a sea, to receive a polluted stream without becoming impure. Lo, I teach you the Superman: he is that sea; in him can your great contempt be submerged.” Nonetheless, merely because Nietzsche has chosen Napoleon, one should not assume that he only admires physical strength. His ambition is not only a powerful beast, but a man with the highest mental maturity and of course physical excellence. Thus, with utmost certainty, Nietzsche says, “Humankind must surpass himself, as the Greeks did. He should not recourse to non-materialistic imaginations. ... The goal is a noble culture with the whole body not only with mind.” Nietzsche describes the free, heroic Superman thus:

To redeem what is past, and to transform every "It was" into "Thus would I have it!"-- that only do I call redemption! Will--so is the emancipator and joy-bringer called: thus have I taught you, my friends! But now learn this likewise: the Will itself is still a prisoner. Willing emancipateth: but what is that called which still putteth the emancipator in chains? "It was": thus is the Will's teeth-gnashing and lonestomest tribulation called. Impotent towards what hath been done--it is a malicious spectator of all that is past. Not backward can the Will will; that it cannot break time and time's desire--that is the Will's lonestomest tribulation. Willing emancipateth: what doth willing itself devise in order to get free from its tribulation and mock at its prison?

3. Conclusion

Nietzsche is a super-ambitious philosopher who ascends mountains and pinnacles and loathes descents to low places. He denounces whatever leads

to self-betittlement or baseness. Great characteristics, manners, and thoughts become great men. Likewise, sordid manners and debased thoughts suit low, mean human beings - called "the flies of the market-place" by Nietzsche.

Thus, Nietzsche, despising the "ceremonial clowns," the mean, and the "flies of the market-place," searches for a wise, original, superman who stands above all moral and religious values and principles, who has overcome his humanity, and who has reached the pinnacle of human evolution. It is a wise man who is unattainable, but should be either found or made.

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Feminism and Power in Islamic Republic of Iran

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Abstract: Feminism and women's movements has been in to concern during the last years in Iran. But there isn't any comprehensive and coherent understanding about it among Iranian intellectuals' minds due to its deconstructive aspect of this theory. Since feminism thesis relies on Foucault's theory of discourse and power relation analysis, this article is trying to represent the reply to this question that how Iranian elites have perceived feminism in Islamic Republic of Iran by applying the concepts of Foucault's discourse theory such as discourse, power/knowledge and gender. From the view of Foucault's, in any negotiation the knowledge power will produce its own correlated thus the current negotiation in Islamic Republic of Iran (Islamic, construction, reforms and fundamentalism) have formulated the feminism knowledge in intellectuals' mind under the shadow of dominant power relation considering the fact which has been produced pertaining to women(gender) in discussed discourses. Consequently, what as feminism in Islamic Republic of Iran has been generated by Iranian intellectuals is strictly affected by the frame of power in this period, so acquires features and characteristics which will distinguish it from its own western model.

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1. Introduction

Debatable theory of feminism is the fruit of western notion in modern period. In regard to the diversity of theories, it can be defined in a general definition as well: "feminism as a social and conceptual movement in its widest definition is endeavoring to raise women situation as a group of community."(Moshirzade, 1385:15). Since more than two centuries of women movements, we face yet with difficulty in definition and explanation of feminism theories and these deficiencies will arise more when we intend to survey this theory according to south developing communities with conditional texture of coherent culture and religion.

Despite three decades after Islamic revolution in Iran and the entry of women in different political, social, economical... arenas and women' movement activities, feminism has still been regarded as an awkward label.

We confront with a variety spectrum of votes in Iran which are somehow contradicting each other and would not follow the linear and evolutionary process. What are the effective factors in formation of intellectuals' mentality? Since Sarah Mills believes that feminism theory is strictly relied upon Foucault's discourse theory (Mills, 1382:99). The focus on methodology is based on Foucault interpretation of discourse. In this article the focal point focuses on understanding the feminism knowledge in the frame of power relations (social-political structures) from the view point of Iranian intellectuals in Islamic Republic of Iran. As Foucault considers the power as partial and trivial in all over the society, we also

frame the power relationship in Islamic Republic of Iran in four arenas: political, economical, social and cultural, but since the power relationship pertaining to women is considered, from each above mentioned areas an appropriate one due to women's problems has been chosen for investigation, in cultural area: higher education , social area: family, political area: elections and finally in economical area: employment, in order to understand how the exerted power relations in these areas have formed the gender and as the alleged words of Foucault that knowledge power will produce its own correlated we also are following this knowledge formation which is feminism among Iranian elites since they are the conversational means in the community. The study of above arenas necessitates perceiving social textures which are active in those areas. So, regarding the political-social structures of Islamic Republic of Iran we have made the distinction four discourses which are as the follows:

- 1- Islamic discourse (1357-1367)
- 2- Construction discourse (1367-1376)
- 3- Reforms discourse (1376 - 1384)
- 4- Fundamentalist discourse (1384 till now)

In these four discourses we would survey the political, social and even legal structures affecting Iranian intellectuals mentality in order to understand that how feminism and gender in particular have been conceived in Islamic Republic of Iran's period and to achieve this goal in different discourses we would use the works of enlighteners who have written in this field and the activists who have taken the step in

development and progress of feminism and women's rights in this country.

2. Definition of concepts

The concept of discourse and its critical analysis has been associated with Foucault. His scopes in context of knowledge, power, discourse, culture and society has ranked him alongside of European thinkers. He negates the correlation among rationality, freedom and improvement in his works and tries to prove that the new forms of power and knowledge will provide the field of progress and growth of sovereignty. Many Foucault's exegetes would refer to works before 1970s (paleontology period) and the works after it (decent biology period) as two separate course in his notions. Foucault, however, has reconstructed his previous works in the light of his next interests. The concepts which have been documented from Foucault's intellectual series are the fruit of these periods. Foucault's discourse theory has been formed in his paleontology studies. He represents a trihedral definition of speech act, and sometimes considers it as a common field of all words and statements, sometimes a set of specific and distinct statements and sometimes as logic deeds which indicates a set of statements. The first definition refers to all real applications of routine written and speech language. The second defines the formulation and or specific areas such as racism, feminism discourse and... and finally the third definition returns to politic-social structures which determine the conditions and rules of speech and statements. In fact, discourse is that common and general area in which the language is formulated and applied in specific forms. The discourse is a determinant of area in which knowledge is constructed and reconstructed. (Zeymaran, 1382:33). One of the most useful ways of reflection in discourse is to be considered not as a set of symptoms or a piece of text, but "procedures" which formulate the alleged topics and objects systematically. Thus, discourse is something which produces something else (part of speech, concept, effect). (Foucault, 1972:49) In the regard of discourse as an effective object, it is important to monitor truth, power and knowledge factors, so because of these elements the discourse is influential. Foucault believes: "truth belongs to this world and it is rooted in the universe due to the requirements and compulsions. Each real regime has general policy of its own truth and those are the types of discourse which that community nourishes and imposes them to play the role of truth. The mechanisms and evidences which enable a person to distinguish the real propositions from fake ones and their proving ways of each one: the techniques and formalities which

have become valuable due to obtaining truth: the medal and rate of those who are obligated to say something which is considered to be true." Mills, 1382:28). So the truth is what the communities should act for its production, not as represented in transcendental style. Thus, Foucault is not bounded in which discourse is the representative of fact or the reality. The notion in Foucaultian style provides this possibility of understanding how meaning is being produced, but not subject to the will of unique man-oriented individual, not as a linguistic structure and not in such a way as socio-economic relations has been triggered, but through a range of power-knowledge systems which organizes the context. The conditions can create the possibility of different actions and is rooted in the core of the social entities. Foucault believes that power and knowledge are interlinked in the discourse. Discourses are the practices of knowledge composing, those are something more than the ways of notion and meaningfulness, and those are shaping the body nature, conscious and unconscious mind and subjects' sense of life who desire to rule over them (azdanlou, 1374:48). From the viewpoint of Foucault, the power of knowledge makes its correlated, but his desired power is not possessed by state, dominant class and or ruling person, on the contrary power is a strategy: power is neither entity nor a structure but a "complex strategic situation" and "plurality of relations among forces", and indeed power for its establishment requires a large number of resistance points. According to Foucault analysis, power is exerted only on released individuals and their actions and induces them to choose from different options. So the constant relationship of power with struggle, resistance and freedom is the condition for its existence. But wherever disobedience and resistance came to an end, the relation of power would be terminated. Thus Foucault has allowed an important distinction between power and violence. (Refer to Foucault, 1384). Exerting power necessarily activates knowledge devices and provides the areas in which knowledge is being formulated, from the standpoint of Foucault, this is the relation of power and knowledge which promote subjectivity and objectivity to human beings as an individual and make into forms of knowledge threads. But Foucault attitude to the power is a type of which accordingly power would dominate all the community simultaneously as an integrated whole. in this type of power, there is no intellectual and autonomous subject which has taken the control of power, but this is the power which generates the subject and what returns back to it. This is the power which brings the social entities under its umbrella and determines the practices of their notions and speeches. (Soltani,

1387:17). We should delve into deeds micro level to conceive power in its activity and routine performance, namely that level of politic technologies in which our deeds are shaped. Power is not restricted to politic entities. Power plays a direct productive role which derives from lower section, is multi directional, and acts from down and up and vice versa. (Same: 312). Given to the central issue of feminism in this article, it is necessary to take a look at the concept of feminism from the standpoint of Foucault. In his opinion, the gender is an incidental system of speeches, behaviors and themes which presently surrounds people in the core of power and discourse relations. In other words, the gender is a strategy for management, production and supervision on humans' body and their social relations. Namely, the gender acts as a leverage to dominate human existence. Foucault discussed the gender in exact historical meaning; it is not a basic tentative biological phenomenon, but a historical product. (Jahandide, 1383:18). This paper follows to recognize Iranian intellectuals' concept about feminism. As we initially pointed out feminism definition so our intent about intellectual has to be determined. Intellectual in terms of Edward Said is an individual with specific common role in society, who is capable and talented in resembling, visualization and clear expression of a message, a view, an idea, philosophy or opinion to or for a group of people. This role is so difficult and the enlightener can not play it unless through this percept and sense of which his/her task is to induce disturbing questions and encounter with traditionalism and dogmatism and not to provoke them (Said, 1382:30) and this was the definition by Edward Said which became a basis for intellectuals in Islamic Republic of Iran.

3. Power relations in Islamic Republic of Iran

The desired power of Michel Foucault is a partial and scattered power which includes social relations thoroughly and exists in all decision making, actions and ...

Since the aim is to understand this power relations in Islamic Republic of Iran, so for more in depth survey according to Foucault thesis about discourse as a set of social-political structures which determines the conditions and rules of texts and speeches we have distinguished four discourses in 30 years life time of Islamic Republic of Iran and we would study the power relation in four areas of elections, employment, higher education and family and in each state we will discuss about women.

A- Islamic discourse (1357-1367)

B-Construction discourse (1368-1376)

C-Reforms discourse (1376-1384)

D-Fundamentalism discourse (1384- present)

A- Islamic discourse (1357-1367)

Prior to Islamic revolution's victory in 1357, Pahlavism hegemonic discourse, aimed to deconstruction and had lost its unity of discourse field, till on 22 Bahman 1357 which was completely overthrown and Islamic revolution led by Imam Khomeini succeeded, as the name of this popular movement describes "Islamic Revolution" the main reason of people for this revolution was establishing a government with the essence of Islam. What we nominate as Islamic discourse encircles two discourses of revolutionary and war. The dominant discourse of years 1357-1359 was the revolutionary speech. The years of debate swirl for power, nationalist movements, Islamic and leftist which during the early years of revolution victory and the same year of 1357 were living in a metaphorical air according to the theory of LacLau and Mouffe's discourse analysis (See, Gheyranlu: 21-36) demanded for running the society based on their own ideologies the next day of revolution victory. But some of groups' aims and ideologies were not aligned with revolutionary goals and ideals. This was Islamic and religious groups among the impressive forces in the victory of Islamic revolution which could take the power through a large social base, rejecting and excluding other movements. (Bashiriye, 1382:43).

The war speech was the dominant discourse of years 1359-1367, because as Imam Khomeini had stated: this was not a war between two countries but the war of blasphemy against Islam and the battle of right and wrong (Imam Khomeini, 1378:223). The burst out of imposed war against Iran made a significant role in considering the discourse as Islamic. After removal of liberal and leftist otherness, gradually othering among Islamic groups was highlighted. This eventually led to originate right and left wings in the country. Right-wing has the tendency toward "aristocracy, bazaar-traditional" and left-wing had the trend of "petty equity, radical-traditional". The difference point of these two Islam-oriented factions was over political concepts rather than political ones. Traditional right believed in private property and lack of control over domestic and foreign trade and the traditional leftists was rather than rival the advocate of state-owned economy, anti-imperialism and U.S opposition. The definition of Islamic community in this period is a provincial society and Islamic hard core of supreme leader. This sacred entity as an internal mechanism is far more than the power relations and can release theocracy government from deviation and neither any other have the exponent and competence beyond this entity. Any consideration about Islam in this period is a juridical and theological one, and religious ritual and

appearances are paid more attention and establishment of religious reign is possible only through enforcing the religious commandments. When the imposed war begun which Iran's economy was in the threshold of implementing the plans and programs in case of self-sufficiency and reduction to oil dependency which allocated a part of country budget to defensive affairs, and a large number of human and other resources were consumed in war affairs, war could have an impressive and deterrent impact on Iran development process.(for more details see Dejpasand and Raoufi:1389). After understanding the Islamic discourse now we review the power relations about women in the areas of election, employment, higher education and family.

Elections: despite the legal platforms for political participation of women in elections, there are in practice some restrictions and barriers on the path of this partnership particularly in the field of women's select ability. By the approval of election bill of state and provincial associations on October 1341, the women's political laws and their right to participate in elections for the first time was granted. But due to the pressure of some religious people for the reason of being pretext it was cancelled on 8th Aban of the same year, then another single article about women participation in elections approved on 1343 was adopted and this right was granted. What is considered here about political participation in particular is the right of women select ability in presidential elections. When the franchise will be effective in which the characteristics of generality, equality and freedom of choice have been into consideration. Although some limitations such as nationality, age, abuse history are the logic reasons for the lack of right for elector and to be selected, but the discrimination in public participation merely for the reason of gender does not seem to be justifiable. Regarding the select ability of women in presidential elections, Article 115 of IRI constitution has been controversial since its very beginning of approval, and always at the threshold of presidential elections the discussions, comments and interpretations arise to the peak but eventually never take place. At the beginning, Article 115 of constitution in its first initial draft has been as the follows:

"The president should be Iranian-born, Iranian nationality, has the country's official religion and being its promoter, faithful to the principles of IRI , man, a good record, trustworthiness and piety." (The detailed discussion of parliament about the final review of IRI constitutions, 1364:1766). In relation to the principles of Ayatollah Montazreri's reasoning as the head of Assembly of Experts, the draft of constitution in terms of women's incumbency for presidency are, the huge responsibility and its

disproportion with women's specific features. Mrs. Gorji the only female representative, the member of Assembly of Experts as the oppose of presidential male select ability in response would observed: " when the most people should vote, if against sharia, would have not participated in voting and should be approved by the leader too, given that there is not provincial and it is a demonstrative and power of attorney and if in case of competency, namely the trustworthiness, piety, good record and faithful to Islamic principles, they can meet the features, because a woman can be capable of being faithful, trustworthy and piety and her political power is assigned by Islam." (Same, 1770) "The president should be selected from among the religious and political figures which obtain the following conditions: Iranian-born, Iranian nationality, director and resourceful, a good history of trustworthiness, piety, faithful and believer to IRI principles and country's official religion."(Same, 1796) This principle was reviewed without any discussion by Assembly of Experts members and the constitution was share voted and approved by the session chairman. Assembly of Experts for Constitution representatives by setting the term of "religious and political men" represented in brief the issue of women presence, and they kept open the discussion about this case till the future by more in depth theoretical arguments and providing the social bases which this task should be settled down. Due to the lack of women's expressing dissatisfaction about mentioned principle in that cross section of time, holding four presidential elections during Islamic discourse and the review of this elections candidates reveal that the issue of taking the responsibility of presidential post in that period basically has not been in to consideration for the women.

Employment: with regard to economic employment necessity and women's participation in economic activities in our county, yet the desirable and admissible balance in this area between men and women in different activities have not been yet achieved. The unavoidable circumstances of Iran-Iraq war like a huge tide led many of country's activities and investments toward the advance of defensive goals. A surge which would not left any areas for women's economic participation. Change in product sectors, economic problems, the widespread influence of dominant view of society over the appropriate role of women drove them out from economic activities areas. Although, there hasn't been any changes in labor laws pertained to women but the prevailing notion in war period was the role of motherhood and partnership is more deserving and the house is a proper space for them and the public area should be assigned for men, consequently, in

this period the share of housewives from total women of age 10 years and above remained unchanged. (69%) while the share of employed women had a decline process. In this era the share of active women from total women of age 10 years and above declined from 12/9 percentage to 8/2, also the share of employed women from country's total employed people declined from 13/8 percentage to 8/9. In explanation of such a decline it can not be confined just to the factors of downturn or increasing the number of female students while the effects of discriminatory policies of statesmen in this roll back is appropriately visible. (Shaditalab: 1386, 36) It has been proved that after revolution the positions and socio-political opportunities which have been granted to women, due to its lack of a strong belief context was challengeable and women were excluded from many decision making and management levels. During this epoch, judge women were forefronts. Because it was announced that women have no right to judge on bahman 22nd 1357. under the influence and domination of this type of radical vision and concept which had been visualized in a group of current policymakers, women's most favorable extensive training programs in many fields were halted and eventually the man and women's natural division of labor which is a completely different idea against women's social participation was reinforced and female anti-employment beliefs and ideas could find to raise and progress in more suitable environment. The absence of measure over population control and shutting down of family welfare centers affiliated to women's organization training them contraception practices added more problems, closing of public kindergarten became a burden and in total, some events occurred which shifted the flow of women employment to anti-employment and the programs of creating appropriate opportunities for employment were closed. (Kar, 1384:103). In this era the experts have classified social barriers which had banned the women path in the case of economic participation as the follows:" encouragement of women to earlier redemption and retirement- inspiring and drawing the women who were interested in doing successful and basic social activities to marginal and auxiliary affairs- using the mass media to show women as the creatures within the house which had a direct impact in providing the conditions which reinforced women to adopt it. Part-time job for women-separation of men and women in workplace, and sometime transferring women from technical and specialized jobs which they were responsible besides men to simple and non-professional occupations, moreover, another strategy was adopted which avoid the assignment of any management positions to women. It was argued

that women are not responsible for providing family subsistence and any upgrade in administrative system belongs to man. As a result women were not allowed to grow more than the restricted level of expert in the administrative structure and basically they became a mere executors rather than decision maker.(Kar,1384:152) therefore, women employment is marginal in this discourse and more focus on supportive, educational roles which can be interpreted within the frame of motherhood and partnership.

Higher education: after the revolution victory, due to the dominant atmosphere on universities, all the country's universities for awhile were closed.(1359-1362) and in order to organize the cultural affairs of schools and universities, purpose of islamization and the unity between seminary and university the Revolution Culture Staff was established by Imam Khomeini's decree. The measures taken during Cultural Revolution as one of its goals were considered as a part of fighting program against western culture in Iran. During this period according to the current perspective the content of many textbooks and scientific books were reviewed. The views of so-called liberal and left were eliminated from the university through the different practices; these programs yielded a great impact on cultural and scientific structures, so many of intellectuals and enlighteners left Iran. Though new universities were established in towns aiming at increasing the access to higher education facilities for town's inhabitant, but university research in many fields were limited and after the cultural revolution, the number of researcher's papers in prestigious scientific journal significantly decreased. Based on drafted constitution in the years of after revolution, the task of government is to prepare primary education facilities for all which this led to increase the number of schools and teachers in the first decade of revolution,, providing the educational facilities even in remote villages along with family especially fathers' new interpretation of educational system and Islamic consideration, caused dramatically the fading of cultural barriers on the way of female education. Consequently, girls almost throughout Iran could accede to elementary schools and even in rural areas more than 50% of girls enrolled in schools. In the first decade after revolution despite the war conditions, the attempt of the entire system for expanding the educational facilities and progression of urban and rural girls at least to primary school level caused significant changes along side with qualitative changes.

In this period, the expansion of girls education in primary and secondary levels, the policy of higher education by the development of public universities

capacity and establishment of private university provided the area for girls' more progressive awareness, but there have been attempts for separating the universities simultaneously or girls classes done and determination of courses which according to job definition was suitable for women. In such a way, that in 1363 the choice of 91 out of 169 available courses which mostly were in technical and engineer field was not possible for girls, moreover, according to the law adopted in 1364, the possibility of further education in abroad for unmarried girls was restricted (Karname Haghghi,1384:88)

Family: the revision of family laws systematically was implemented on 1364 and ultimately family protection law was ratified and in 1353 made some changes for more conformity with women's profit in family. Significant changes then in family laws implemented after Islamic revolution which the most important was the Family Protection Act in 1353 which took place after dramatic changes in family laws. Family after revolution is considered as fundamental unit of Islamic society and women are nominated by Imam Khomeini as the pillars of nation which have to be a stronghold of spirituality and virtue. The law attempted to create a homogenous relation between Islamic family and nation through the defensive manner of special series relations on one hand to strengthen the control of men over women in the family, on the other hand promoted the position of women as the active citizens. Imam Khomeini believed that Pahlavi's Family Protection Act was based on foreign resources and tendencies and ascribed it non-religious which hurt the family and caused family life to collapse. Thus, Family Protection Act was abolished and referred back to the set of civil law in 1315. This meant those women's all short-run prudential supports about divorce, marriage, child custody and abortion which ever existed were cancelled since then; the religious traditional laws superseded the current family laws. During these years, the number of married female at the age of less than 14 reached to 112,000 people which consisted 2/4 percent of total married female. Although this contribution is negligible but, besides the negative impact on female education, provided the field of fertility and number of children increase rate, the issue which its inducing effect on society as a whole caused that Iran faced with a population explosion which its consequences are revealed in later periods.

B- Construction discourse (1368-1376)

In late 1360s the occurred massive changes around the country led to formation of speech within Islamic discourse. Due to the long term war of attrition, bombardment attack on economic centers by Iraq, the

increased number of martyrs, injured and missing people, and economic sanction and ... this speech intended to end the war and reconstruct the country.

Iran entered a new stage by the end of war and approval of resolution, the stage which was far more different than the war period. The first diversity of current period to the previous one was the specific attention to economic problems and the attempt to resolving the country's economy. Low product activity had no result except the expansion of poverty and corruption in society and because of expropriations and nationalizations, private investment in product sector moved back and even state-owned economy did not yet grow. Rationed and coupon terminated in sharing the poverty and followed by brokerage and corruption spread. Just one economic and social peace could heal the tired and painful mind of Iranian nation. The relatively intellectual slogans, such as privatization, economic structure reform, preparation for foreign investment and free trade zones, press expanding and other issues like "less child, better life and ... Imam Khomeini passed by following the disease on 14th Khordad 1368 and based on revised constitution, Mr. Khamenei was introduced as the new leader. Mr. Hashemi Rafsanjani as the president of Iran assigned the economic development in his own top priority. He in second period presidency due to the frustration and critiques done about economic adjustment program released the economic stabilization program to the parliament. In the middle of 70s Mr. hashemi's state economic programs had widespread consequences which in total led to the growth of reform movement. Between the years of 1368-1376 there have been major structural changes like demographic revolution, generation gap, cultural similarities of rural and urban populations, increasing literacy rate in the community, consumerism promotion and classification gap in the country which had been rooted in previous discourse (Islamic). These evolutions played a major role in meaningfulness and making valuable and in this era the values of Islamic discourse lacked its own required performance and the necessity for new values was in air. (Rabiei, 1378, 40)

Elections: we have witnessed in holding two presidential elections by the end of war and the beginning of reconstruction era. But in this period there is no evidence based on women's presence and or their demand in select ability stage for this position.

Employment: state implemented new policies in the frame of first development plan aimed at reducing the public sector dimensions and encouraging investment in private sector during the second decade of revolution, a reconstruction era which are the reflection of some adjustments which has been taken

place in ideological interpretations of system and has had widespread impact on women's lives such as shift of population policy from a national retrospective to a family-based policy which was followed by stabilizing the population's growth rate. The government interest in removal of structural obstacles in deployment of women's workforce in different fields of community caused to establish women's office in presidential entity and the similar offices in all ministries and governmental organizations for consulting about women affairs. President also issued a circular for women appointment in managerial positions. Thus the negative growth of previous era shifted to a positive growth. The ration of employed women to total country's employed increased from 9% in 1365 to 12/1 in 1375 and the number of employed women increased to a figure of more than 2million people. The ratio of housewives to total women at the age of 10 and above decreased from 69% to 10% which had been stagnant for a decade. During the reconstruction era, the employment of women in industry sector which had the most decrement occurred during the war, showed a rapid increase process and the number of employed women in this section is nearly being tripled. Again the share of employed women in industry sector which had decreased from 52/7 % to 21/6% reached to 23% in 1357. (Bagherian, 1389:87) the reforms entered the banking system in order to provide the possibility of women presence in economic activities. Central bank has prioritized grant facility for household employee women. Agricultural and Tejarat banks have promoted special programs in product and service sectors for rural and employer women respectively (Shaditalab, 1375:80). Although women employment has had a positive trend, but women's share in management of state-owned organization, though to all attempted efforts, has not improved according to their expectations and in recent years has been remained about 3%. As the result the educated and more work experience women have mentioned top discriminative variables in creating women employment problems and their dissatisfaction as follows: 1- Inequality of opportunities for getting job 2- Inequality of opportunities in making suggestions and critics 3- Disregarding women's ideas in decision making process. 4- Providing higher job opportunities for men. (Shaditalab, 1377:283)

Higher education: the positive change taken place in Islamic discourse in the case of girl education and particularly primary education has been resumed in construction discourse. So we observed girls' enrollment rate enhancing in all educational levels. This issue in the recent years of construction period became a matter of competition of girls and boys for

entering the university, because the student in the early years of revolution now were ready to enter country's higher education system and in this contestation the girls surpassed boys. So the ratio of female to male candidates in the entrance exam has been increased more than 10% since 1368-1376. Unfortunately, in this era despite of dramatic growth of women presence in country's scientific arenas, they are not allowed yet to study in some courses. So that according to studies done in academic year of 1369-70 women are unable to study in 55/55% of technical and mathematical sciences, 28/1357 of human sciences, in 23/35% of experimental sciences and 5/26% of art , it means they have legal prohibition. (Jarollahi, 1372:6)

Family: the changes of rules and regulations in the field of family have been initiated from the last years of 50s which still is continuing. A major part of these changes are due to family laws revision in a more relaxed atmosphere and the study of the outcome of Islamic discourse changes in the family which its stability significance as the most important social unity has been consistently and repeatedly in to consideration of the statesmen. In addition to reform of marriage laws, the reform in the case of divorce laws has been necessitated to prevent its increasing process. Moreover the above mentioned, the researches show the elapsing patriarchal era in Iran. (Alagha, 1376:327). It can be concluded that the power-sharing structure in the family is transforming, most importantly the youths and educated people are more adherent to participatory decision making in the family. Thus this education improvement has caused the decrement in exclusive power of men.

C-Reform discourse (1376-1384)

2nd of khordad 1376 is the formal entry of this discourse to the country's political, cultural, social and economical areas. The election held on 2nd khordad 1376 is the stage of confrontation between two conflicting discourse models. A victorious model filled with new concepts, boundaries and the modern cultural, social and political horizons. (Gholamreza Kashi, 1379:7) Here is an example model which for a long time has been in the sideline of the dominant and formal discourse, and by the domination of right wing discourse on power sources could not afford, as it was expected to attend in political arena and for this reason has been drawn back to the margin and intellectual circles. The major part of reform discourse, which we are recalling, has been formulated during the elections, namely the interval between 7th Bahman 1375(Khatami's candidacy) till 2nd Khordad 1376, indeed the main basis of this discourse have been rooted in this period and the superstructure of this discourse was laid the

foundation in Khatami's presidency era. Population growth, increment of young troops of society, promotion of awareness in this class, communication expansion, disregarding the political development and lack of inflation inhibition caused the formation of new demands in the society. The demands up until now have not been explicitly considered. Of course, the other factors such as freedom of speech, civil society and in one word the democracy have been impressive in exposure on new demands. The left wing had been marginalized after the war end and the beginning of construction period and this was a big opportunity for reconsidering this wing's votes and thoughts. The usual presidency election model changed by the arrival of leftwing particularly Khatami to the political conflicts area who was one of the well known political figures in elections and was considered as coming president. He along with several other rivals participated in the arena and all political forces did their best in encouraging people in attending more in polling places on Election Day. The art of Khatami was applying a new indication which has been proposed in constitution law but has been neglected. Since the beginning of Islamic revolution till 1376 in political discourses arena the privilege was granted to Islamic and its peripheral indications while Khatami's applied indication was republican instead. He applied law, people, freedom, civil society in his speeches and slogans, discussing the issues which constructed the concept of republicanism and people as the core and fundamental of this concept. The indication kept silent and constantly has been defined and surrounded by the shade of Islamic indication. Khatami revived this indication but never isolated it from the Islamic sense, but tried to provide an opportunity to display itself and since the concept of religious democracy has been formed. The main reason of people's interest to this discourse was due to its legislator's democratic notions content which was in connection with religion and reflected the desires and ideas of different social groups. This election could drive governmental legitimacy from charismatic and traditional authority to the legal context in the political arena and led the authoritarian system of government from imperative condition to a democratic one. From political - sociological perspective, the election of 2nd Khordad 1376 and the process of new political discourse formation in Iran, people demands aligned with a part of intellectual elites aimed to rationalize government's authority practices and creating a democratic society. During the reform period, a partial openness was emerged in Iran in the field of media, journalism, information and book publishing. The numerical and quantitative growth of publications in a short-run,

while the dramatic changes in distribution, content, news, articles and reports was associated to more attention to the picture, caricature and layout. The newspapers across the country had become mostly four fold more till early 1379, and newspaper circulation figures increased to unprecedented numbers of 3,000,000 copies per day in Iranian history which was about four fold of newspaper circulation figure in 1375. (Fozi, 1384:1089). The growth of civil entities and non-state organizations was another change in this period, during the reform era, the outline of organizing the public participation has been provided in the field of specialized activities and public works in the frame of non-governmental organizations (NGO) and forums by demission of authority to establishment of these entities and supporting in different fields (Same, 1109). However, we have observed the occurrence of some events in the reform era, such as the arrest and trial of Tehran's mayor, the murders event known as serial murders, university dormitory attack, Berlin Conference and sit of some representative in sixth parliament which were followed may political and oral conflicts.

Elections: there is no women presence in select ability during these two rounds of presidential elections (seventh and eighth). Only Mrs. Azam Taleghani attended in seventh round of presidential elections in 1376 and stated her aim of this symbolic act as the clarification the task of "men" in Article 115 of Constitution. (See, Taleghani, 1376). Abdollah Ramezanzade, the government spokesman at the end of Khatami's presidency in 1384 the second round stated: "we believe that among the female managers of society there are capable people who are the true example of political men for candidacy in presidential elections, Ramezanzade added: this was a critique to Khatami that why he didn't apply women in his cabinet while prior to his presidency, no woman was assigned as the general director or deputy secretary and governor who Khatami tended to choose from them as a minister. (RamezanZade, 1384:90)

Employment: According to Human Development Report 2004, the economic activities of Iranian women consists 30% of total economic activity which in comparison with other countries, Iranian women are ranked at 82nd position. Shojaee (the head of presidential center for women's participation) with above announced news stated: "at present women's capabilities for impressing the policies of country has confronted with tremendous limitations due to the inadequacy of women's presence in decision making structures and macro policy, a few number of women's presence in representation and managements and impossibility to access the required skills for operating in different levels have imposed

them a double oppression.” She added: “up to next 10 years we will face with the excessive phenomenon of single family headed by graduated girls regarding current traditional and gender structure in addition to the graduates’ unemployment crisis, uncertainty of women’s economic situation in the family and community. She accounted for the dependency of community total situation improvement to the progress of women’s conditions and observed:” the rights of social support and development, the empowerment of women would not be achievable without the upheaval in the levels and entities of the society.”(Shojaee, 1384:95). The men and women’s participation rate have been respectively 62% and 12% in 1380, while women’s unemployment rate has been 20% and men’s unemployment rate 13%. The women’s participation rate in labor market according to the predictions of Iran’s fourth economic, social and cultural development plan would be increased from 9/1 in 1375 to 15/2 in 1388. This would impose a huge pressure on labor market. In such case, there should be 232,000 job opportunities created for the reason of women’s sufficient job opportunity which seems to be a hard task. Whereas the new job opportunities occupied by women have been 100,000 in the first plan and 71,000 in second plans. Although the achievement of fourth development plan’s goals pertaining to women’s employment appears to be difficult, but in assumption of achieving the plan’s goals more than 700,000 women who are seeking the job would be employment-deprived.(Falihi, 1381:56) it seems that women’s life in Iranian community is mostly affected by men’s manner, idea and the attitudes, whether as the role of father who makes the control over his daughter’s amount and type of education and marriage, or as her husband whose idea is determinative in further education, range of social activities and her employment or unemployment. The statistics pertaining to women’s cultural and artistic participation in reform discourse like their economic participation statistics are not only disappointing but also shows a fantastic growth. The women publishers’ growth rate between the years of 1376-1379 has been more than 56% and women writers’ growth rate was more than 300 %.(women’s status report, 1384:192)

Higher Education: the gender distribution of volunteers during reformation years has displayed substantial changes, 42% of women in 1362 has been increased to 62% in 1380. This represents the mentioned change in favor of women, because the alleged ratio of men in 1362 was almost 58% which has been decreased to 38% in 1380. This prevailing ratio despite of the tangible reduction in men’s ratio to the total higher education volunteers has been resisted till 1376 and this is used in the favor of

women. It seems that the major increment in the number of candidates should be considered totally due to these factors: 1- higher marriage age 2- women’s desire and tendency to further education 3- social changing attitudes toward women 4- increase choice. (Karname Haghghi, 1384:92)

Family: Women’s Participation Center was established during the eight-year reforms period. The foundation and programs of such center which have been implemented and followed in Khatami’s two-term presidency indicates the women’s place within the reforms discourse. In reforms discourse the boundary between the public and private areas has faded and women’s definition was not aligned with mere wife or motherhood tasks, but it has been more emphasized on the significance of social, political, economical... presence of country’s women and ladies. Although some fundamentalism discourse critics claimed that this discourse was followed by shaking the foundation of family. In this era the most important procedure done by the center of women’s participation about the female situation in family was, the implementation of national plan in surveying the domestic violence against women in 29 provinces of the country which has been done by the cooperation of social affairs of interior ministry. This national plan statistics show that 66% of Iranian women since their common life are being at least once abused. However, the amount and types of domestic violence has a significant, diversity and verity in different provinces of Iran. (Ezazi, 1385:65)

D-Fundamentalism discourse (1384 till now)

The fundamentalism discourse is a kind of discourse which we are currently living in its speech and deed atmosphere and many of our functions are affected by the indications ruling this discourse. Those who once have been the executive arm of conservatives, in ninth presidential elections succeeded in winning their candidate without the support of any party and only in the last few days. Some called this flow as radical right though with a high desires in state economy. Some also called it authoritarian or fundamentalist, but they themselves preferred to be addressed as conservative and social construction, he was the only candidate who never applied democratic slogans in campaign and relied on a revolution in economical and managerial structure. (Mehdizade, 1386) Mahmud Ahmadinejad, in tenth presidential election flow caused a great resentment among some dignified individual and elites. In presidential debates, the moderate and fundamentalist figures like Ayatollah Hashemi Rafsanjani and Ali Akbar Nategh Nouri wouldn’t be deprived from AhmadiNejad penetrating criticism blade. And in the campaign they have been condemned of deviation from the fundamentalist

through different literature of all critics of Ahmadinejad's fundamentalist. In this current section it seems that Iran's political geography can not be analyzed regarding the traditional classification of past two decades. Due to the recent developments, though a part of traditional right flow would confirm Ahmadinejad all actions to survive in political arena, and somehow has become as the follower of new left-wing faction, but much of the traditional right-wing along with precedent flows of system namely modern left and right have found a common unwritten point around a few issues, the understandings with the themes as adopting a non-invasive and participatory approach toward the globe, reducing government policies in the current affairs particularly in economy section, avoiding economical shock therapy, attaining a kind of understanding and unity between the faithful flows of revolution and ...

We must wait and see that new left-wing can span its domination on executive affairs in this new figure or in the confrontation with this great alliance would have to reformulate its own performance. This is a question which the future will reply it. (Mehdizade, 1386)

There are several diversities between this period and the former elections which will highlight ninth and tenth presidential elections here. The diversities which reveal the difference of new-born discourse with the former discourses, such as: 1- wide speculations in order to identify the individuals who participate as the candidates. 2- lack of general aligned consensus on a single candidate among political groups. 3- The numbers of registered and disqualified volunteers. 4- Initial disqualification of candidates and their approval by leader's decree. 5- Organizing candidates' supporters according to social stratifications and fractures. 6- the association of considerable directors in making propaganda movies. 7- vast use of national and new reportage media. 8- Transparency in candidates' programs and providing economical, political and cultural codified plans. 9- Lack of predictability in elections even in the second round and emerging of lesser known figures. 10- Negative positioning and personality destruction of candidates. 11- The serious alloy of electoral fraud. 12- political classification around social gaps in second stage. (See, Mirvahabi, 1388)

According to the survey entitled , the analysis of electoral behaviors case study of ninth presidential elections about the reasons of selecting Mahmud Ahmadinejad by the people in Political Studies Association's site could be represented based on these features: popularity, serving, simple living, challenger contradiction, variety-seeking, fighting corruption, religion-oriented, justice, advertising, non-theocracy and effectiveness. The features which

caused the fundamentalism discourse being changed to people's accessible discourse by its own founder.

Elections: Islamic revolution has embraced ten presidential elections, as prior to our discussion women have been deprived in participating presidential campaign during past 30 years, and Guardian Council with its own unilateral interpretation of Constitution Article 115 has denied women from their most self-evident right for presidential candidature. Since 1376, that Mrs. Azam Taleghani who announced her participation in 7th presidential elections until 8th elections who nearly 50 women have announced their candidature to this arena and till the 9th presidential election more than 100 women have volunteered for presidential post, despite of numerous efforts by women activists, the task of "men" has not yet been clarified. Mehr News Agency in 1383, quoted the alleged news by Gholam Hussain Elham, the spokesman for Guardian Council: "so far there has not been any formal interpretation about this issue by Guardian Council, but it may have had a gender concept (political men) and in Guardian's negotiations the main concern has been focused on the gender, namely male gender (Mehr News Agency 08/08/1388). He in his last comments in case of enrolling the women and Council's view added: The Council comment about women's candidature in presidential elections has several times been announced and about these volunteers it would be notified at the appropriate time. (IRNA 2/24/1384). Due to these available interpretations which are somehow contradicted, women activists are less concerned about the withdrawal of any practical opportunity from them by completely tightened interpretation and the dominant idea ruling over Guardian Council. Thus two of women in 7th parliament tried their best in 9th presidential candidature that were defeated. Mehrangiz Morovati and Rafat Bayat enrolled in presidential elections who their approval were rejected by Guardian Council. Anyway the presence of women in 9th presidential elections did not terminated to these comments but a group of socio-political women activists aggregated in front of Presidential office in Tehran to protest their disqualification of presidency candidature.

Employment: the relative distribution of employed women at the age of 11 and above to the total employees' population in 1385 has been estimated 13/1359% which this has been increased 1/49% considering year of 1375. While, the women's distribution rate, namely the relative distribution of employees' women at the age of 10 and above to the total active women in 1385 has been reported 76/65%. (Naghsh, 1386:8). The percentage of high educated women to the total population has been increased

from 33% in 1375 to 41/78 in 1385 while the share of admitted girls in the universities have been enhanced considering recent years, therefore it is expected that the share of high educated women to the total population would still be increasing in coming years, and at the end of 4th development plan would be reached to 45/6%. Followed by the active population it would also have faced with a fundamental change in 4th development plan and the share of active high educated population to the total active population may have reached from 8/9% in 1375 to 13/82 in 1383. The share of active high educated women to the total active women has been increased from 17/3% in 1375 to 64/40 in 1383. The share of highly educated women employees to the total women in 1383 has been estimated 30/7% (Haghverdi, 1384:17). The comparison of women's employment pattern in three categories of agriculture, industry and services in 1385 all over the country suggests that, during this decade the relative frequency of female employment in agriculture sector is low, in industry sector is high and in services sector has remained fixed. It can be concluded based on statistical data that the women's employment tendency in different sections of economic activity in urban areas has shifted from service to industry sector and in rural areas from agriculture to industry sector. Population distribution of country's female employees during 1385 in economical section, services section (especially, health and education services) industries and mines (especially handicrafts and homemade) and agricultural has been respectively as 44/1, 33/5, 25/4 percent. (Same, 18) The current statistics indicate this fact that women's employment situation due to the past periods particularly during 9th government's policies has been developed, but the statements and performances of some scholars, statesmen and women active in community's decision making positions regarding the available data and figures show a different approach. As Fereshte Sassani the consultant secretary and the general manager of women affairs of ministry of interior observed: "if there are any job opportunities it should be submitted to men, because if they enter the market they can make a family. Anyway an employed woman will never marry with an unemployed man. The community should have a moderate look at women. In administrative field we are not allowed to respect the equality, because the physical ability of men and women are different." Sassani stating that propose of issues pertaining to women's rights has not resolved the problems declared: "proposing women's legal problems is regarded as the ground of more issues, when people become familiar with their own rights would make more problems in the society by requesting individual demands. (Sassani, 1385:89).

Representing the plans by parliamentary women like, reduction of working hours, reducing the retirement age, sick permissions may cause women to be satisfied, but seems these proposed plans would have a direct impact on reduction of women's employment chance. The employers would prefer to hire men who are not entitled to receive those benefits, even if any employers are satisfied to hire women, these so called legal benefits would probably be compensated by the reduction of other job benefits, bonus and ... Moreover, 9th government has considered women's benefits in returning to family, and performing the sacred and credited job of housekeeping. Mojtaba samare Hashemi, presidential adviser, in the introduction ceremony of Zohre Teyyebzade Nouri, the new head of women's affairs has stated: "the most sacred and prestigious jobs is housekeeping, while its social status is affected and if a woman spend all her time in nursery and housekeeping, some may criticize." (Same: 36)

Higher education: the most important and controversial action which has been occurred in 9th government was the state's gender categorizing bill to the parliament. Since the most important indicators of academic growth in our country is to being admitted to the entrance examination in recent years we have observed the dramatic increase in girls and women's presence in the universities. So that in 1388 from the total 524,769 admitted people in the entrance exam, there are 328,729 women and 195,977 men, it means that from the admitted people there were 62/7% female and 37/3% male. The increased number of girls in the universities has become the statesmen's concerns which resulted in gender-based rationing bill which restricted the girls' entrance to the universities, this bill aroused many theoretical discussions between parliamentarians and scholars, but women's issues would not confined to this level in higher education of fundamentalist discourse and the other following plan which has been promulgated was gender-based indigenous categorization in the entrance examination, these plans would certainly impact on the reduction of education quality. Women's right activists in Iran have considered gender-based indigenous categorization as the resumption of women's oppression and stay-at-home project. (See, Rahmani, 1387)

Family: The Women's Participation Center was renamed to Presidential Women & Family's Affair during the presidency of Mahmud Ahmadinejad. The main motto of this center was the consolidation of family foundation. Such slogan and title reveal the fundamentalist discourse's change of speech atmosphere. It means that the position, dignity and character of an ideal woman within family and its

existence have been redefined. Many of plans, bills and circulars of this period resemble such a process. The Presidential Women & Family's Affairs Center may follow specific goals for this set of series regarding the constitutions, visions and supreme leader's guidance which these goals are as the follows: increasing women's participation rate in family and society fields, improvement of attitudes, representing a Muslim woman model as a symbol of nobility, chastity, and eventually understanding women's problems and issues in society, family, workplace and following the modification of related laws. Another major pivots which Women & Family's Affairs Center has placed on its agenda in 1384, is the revision of current rules in the family and women areas. But besides of various and somehow useful laws aligned with family's foundation consolidation which has been ratified in the Nation's Home, since the summer of 1386 by offering the family support bill, there occurred many discussions and debates regarding women and family laws in the society and publications were filled with criticism of this bill and led to women's change of attitude toward the fundamentalist state, also a group of women's rights activists met the members of parliament in protest of drafting the anti-family bill. Prior to this meeting there have been frequent sessions by Shirin Ebadi and the review of different proposals from women's spectrum. The variety of different spectra in this meeting was the homogenous voice of protest to women's discriminatory laws (feminist school site-another kind of women's presence in parliament courtyard). It is obvious that restricting women's rights within the family has no result except decrease the sense of security; shake the family foundation and justice mitigation, while protection and observance of women's rights would strengthen family basis, more confidence and affection between the couples and ultimately led to a healthy family and healthier society.

4. The reality of gender

Imam Khomeini as the supreme leader of movement with a specific subtle sense took into consideration the massive force of women in the revolution process and necessitated their participation in the motion and anti-regime movements. Islamic discourse started from Islamic revolution's victory and terminated by the end of war, the period of stabilizing the religious values and indeed revival of religious identity in the society especially about the women, therefore the Islamic revolution aligned the women of middle and lower-class who had fewer fields for emerging and opened for them the realm of socio-political activities. But women's presence and role in the revolution process was interpretable within the frame of the

same metaphorical space of discourse analysis. As the result they lacked organization, plans and operational prospect for achieving their goals, though the leader regarded them as the nation's pillar and the backing of revolution. The reality of woman in Islamic discourse was a subdominant one which has been created by its indications as, power relations, events like Islamic revolution's victory and the imposed war. The significance of woman's role in the society was based on the need in crisis situations like war and... aligned with public interests and national profits. In this period it is more emphasized than before on women's supportive roles. As the result the required knowledge for women's personality growth, creating of mental request in drawing their requests and pursuit of revolution and state would not be formulated and their participation can be investigated in the frame of mass participations. At the end of war and delicately balance of revolutionary ideological traits, we enter a new discourse in which country's economic well-being has relied on the global free economic relations. In this period, suddenly woman changes the position from revolutionary stronghold to a manpower that must develop. If the public sphere belonged to men and woman preferably worked at home and essentially outside in the first discourse, but within the new discourse, the current women's obstacles in entering the public sphere have been removed. If in the former discourse, the Islamic veil was unique model and incompatible in mixing with men, in the recent discourse it came to the point and this was derived from the public sphere which had been opened wide for women rather than the second decade of revolution. The truth which had been drawn from Iranian woman in construction discourse was different than Islamic discourse, because Iranian community, in this era, had left behind the transformative developments such as revolution and war looking for alteration and stabilization of the issues. In this period it was a institutional and organizational approach toward women's problem, actually, we know the mid of 1370s and Hashemi Rafsanjani's first presidential term as the period of women's identification, the period of making hardware and infrastructures for requesting women demands and the first step in this case was taken from the political power and the state arenas, but the establishment of these identification and administrative, judicial and legal organizations in Hashemi Rafsanjani's second presidential term could afford the cause of self-consciousness in women and moved them from the margin toward the core of society. In fact the essence of women in this period according to the previous mentioned stages was a semi-peripheral and that dependent creature now overflowed to the stage of self-consciousness who

endeavored in achieving divergent way and her demands from those social structure planners, and here the fading conventional and traditional boundaries between public and private space flourished. The essence of woman in construction discourse is a drawn of participative woman who has entered the society equipped with self-realization for stating and obtaining her demands and without any concern and apprehension has taken the steps toward the path of public arena. In fundamentalist discourse, women appears to be upper paradoxical and bilinear, because in one hand there is a struggle in returning her to the private stage and family consolidation area and on the other hand the statesmen run with speech on women's passionate social, economic and cultural presence, and would promote them to the vice president operations and ministry positions. In this discourse the fact which we have identically touched was the social presence of woman in the shadow of private arena and again the motherhood and particularly the role as a spouse could dominate her other various and effective roles. In fact, the scale of private arena weighed more and what is seen in the public scale brings to the mind a just dramatic presence.

5. Intellectuals and Feminism

Feminism has been a major issue in intellectual circles during past few years. Many people either woman or man have done the surveys in this scope and following these explorations there have been various classifications based on feminism's different intellectual principles. The most major of classifications in feminism discourse has been diverged into religious and secular divisions. The current article is looking into other aspect of what is called feminism in Iran and has done the survey based on theoretical and practical dimensions.

5. Theoretic feminism

In IRI many individuals (means the enlightened) have argued and debated about feminism and women's movements from the first beginning of revolution's victory. By the investigations done most of these people have attempted from the academic or governmental scope in commenting, decision making and somehow legislation affairs and their major discussions have been mostly focused on theories and theorization and practically have not entered the society general / objective arena and putting the effort into reclaiming rights. These theoretical scope enlighteners have participated in four IRI discourses. Islamic republic carries a vast system of speeches, concepts and symbols in its hasty caravan. The intellectuals, consciously or unconsciously, due to the dispersed and partial power have produced the knowledge in the shadow of this conceptual system

and what they have represented as the feminism is diverse and somehow paradoxical in each knowledge and discourse formulation. So in order to distinguish the notions, theoretical feminism is branched into reformist and conservatism divisions that the theoretical feminism reformist-scope consist two construction and reform discourses and theoretical feminism conservative-scope would oversee the Islamic and fundamentalist discourses.

6. Theoretical feminism conservative-scope

Islamic revolution led by Imam Khomeini provided the ground for women presence particularly those traditional women in the public and society arena who had not the opportunity to emergence due to the values and ruling western dramatic culture of Pahlavi's regime and this opportunity became more spacious by war outburst. Their inevitable entry to this arena was unpredicted and for the reason of emergency. We can conclude according to the analysis of what has been done in Islamic discourse about the women in elections, employment, higher education and family that in this period and discourse it has not been a conscious and demand-oriented presence, so in revolution process none of the women's groups with different intellectual tendencies did not attempt to determine their requests and even yet after the victory of revolution there hasn't been no request for power by any women movements and what reinforced them was the preservation and administration of Islamic values in the society, war outburst and its calamities over the families and the damages remained psychologically, physically, economically and ... deprived the opportunity of thinking about the promotion in the society and advancing their group goals.

Conservative feminism monitors two meaning and concepts of Islamic and fundamentalist discourse, two discourse of having time interval, the first hegemonic discourse formed with premier indication in IRI and fundamentalist discourse, the current situation which after reforms breaking rules by the dominant indication of justice and kindness entered to the state's speech and deed sphere. The collection of meanings and concepts which fundamentalist discourse would convey in its own caravan having the most similarities with Islamic discourse and in one word it is the readout of revolution ideals. In the shadow of Islamic discourse indications and signs, there have been qualified characteristics and features for revolutionary women that due to some moderation have been uncovered till now. The features which will arrange them in conservative fraction, in fundamentalist discourse we would find them mostly in public offices and interpreter of women affairs and even this group constitutes the

intellectuals of fundamentalist feminist, by examination of these thoughts and opinions we would conceive that feminism knowledge has a specific figure in their perspective: Imam Khomeini (Supreme leader), martyr Motahhari (Islamic thinker), Mohammad Fuladi (Thinker), Hojjat Islam Zibae nejad (Thinker and professor), Dr. Bijan Abdulkarimi (professor), Zohre Elahian (representative of 8th Iranian Parliament), Ibrahim Shafiee Sarvestani (Professor), { for more detail information about these intellectuals opinions see, Khomeini 1370,1375,1378, Motahhari 1383,1378,1388, Fuladi,1385, Zibae nejad 1381, Abdulkarimi 1385, Tabatabae 1385}. Nonetheless, they criticize the traditions and regulations but resume the emotional action and privilege the task over the right, for example, in subject matters like divorce, child custody, wergild, obedience to husband and ... a task-oriented criticism necessitates the juridical order should be extracted in accordance with time and space and then what the Muslim jurisconsult renders, it would be considered as the task. They believe religion in the context of ideology and this led to ideological needs and requests which its result would be the sacred ideals and requests and doctrinal opposition to critics and opponents and the tendency toward the conspiracy theory. On the other end the characteristic of ideological view is that women have always preferred other requests to their own real needs, and have privileged the needs of metropolitan government over basic and fundamental own desires and eventually by idealistic and ideological interpretation of so long as "the society wouldn't change to a religious one women's heaven wouldn't be achieved on the earth", put their efforts on transcendence of government's political authority to their own needs. The intellectuals of fundamentalist acquire a denial and at the best critical approach to the feminism theory and women movements. They consider feminism development and its pertaining issues as the colonialism purposes and cultural invasion which deteriorate the woman's dignity and have triggered subversion of family. This group of intellectuals consider these cultural and social problems due to the penetration of feminism notion to Iranian women thoughts by documentation to higher divorce rate, higher marriage age, the increase in woman jobseekers rate, increment of female volunteers in entrance exam and ...

Thus their produced feminism, though the applicable use of feminism word for some of them flourishes as alien and unappealing use, is somehow suffixed with Islamic, Iranian and indigenous. This knowledge put the emphasis on preserving women dignity and expressed that there is no difference between men and women in human rights perspective and set for

division between legal and natural personality of women and has more emphasis on women's motherhood and the role of wife. They prioritize these roles over any other social, economical, political and ... roles and they assume that woman presence within the household is the sense of family members comfort and link many of cultural and value anomalies rooted in women presence in public arena, and at the best of situation they consent to women's preserve chastity and observance of Islamic affairs in case of their attendance in public and community spheres. These intellectuals and their produced knowledge lack the tendency to plan the discussion of exclusively theoretic and academic and basically have no debates over women movements and its history. In fundamentalist discourse the majority regulations ratified by women standing in public office and some of statesmen for the women's welfare have led to the private sector and fading women presence in public sphere. Finally, in this discourse the generated feminism is in apparent contrast with western feminism and its origin, believes that feminism has resulted in hostility between man and woman and Iranian woman in this transition from tradition to modernity has become bewildered, its slogan is individualistic and profit-oriented and Iranian feminists are pursuant of western origin and suffer from the lack of their own plan and program.

7. Practice Feminism: (Practical)

This type of feminism is monitoring the speech and deed of those practically and objectively attempting to acquire women's rights and requests. Their identity and speech are excessively interrelated to the structure of political power. So that it can be predicted that once the political power and hegemonic discourse has been concluded, what class of enlightener would be emerged. This type of feminists who are pragmatic and or from the view point of belief are known as secular would apply concept or symbols in expressing their notion and requests which from the diversity of discourses, the discourses like reforms and overflowed fundamentalist and due to the lack of articulation with privilege indication would be marginalized. Whatsoever, the more vast diversity of discourses, speech, concepts, and the applied symbols by each discourse the less debates in using such intellectuals there would be. Nevertheless, they would make the position in criticizing the current relations. They demonstrate, protest against the lack of adjudication, hold the seminars, do the research and recently have organized different campaigns and sign gathering. In case of a spectrum look at feminism in Iran, in one end there is reformist feminism and on the other end

there would be conservative feminism and pragmatic feminism would be outside of this division, though in the hegemonic period of reforms discourse was in a close position to reform feminism. In fact we have witnessed a type of convergence between reform feminism and pragmatic feminism due to that discourse's socio-political structures and the frame of its ruling power and the most othering pertaining to women affairs would be occurred in fundamentalist discourse. By the study of the theories of intellectuals such as Nushin Ahmadi Khorasani (Journalist and women's rights activist), Mahbube Abbasgholizade (journalist and women's rights activist), Fateme Sadeghi (professor), Parvin Paydar (researcher of women's issues), Marziye Mortazi Langrudi (journalist and women's rights activist), Manjje Najm Iraqi (writer and translator), Nasrin Jazi (Professor), Mehrangiz Kar (researcher and women's rights activist), Faride Mashini (journalist and women's rights activist), Fariba Davudi Mohajer (women's rights activist) {for more detail information about these intellectuals theories see, Ahmadi Khroasani 1385,1387, Abbasgholizade 1379,1383,1385,1379, Sadeghi1384, Paydar 1387,Mortazi Langrudi 1385, Najm Iraqi1382, Jazani 1382,Kar1377, DAvudi Mohajer 1384} we found that practice feminism would consist both theoretical and practical aspects of feminism, though its pragmatism aspect has been always weighed more. As it was mentioned, this type of feminism in reforms discourse have the common points with reformist feminism, from the standpoint of feminism knowledge, this group of women who participated in the state during the reforms discourse played the converter and interface role between the state and the civil society. This knowledge in assigning the solutions to women movement considers the western theories as well and believes that they have induced the knowledge and has provided the better motion; the significant point in this knowledge of women movement would be certainly granted which has a long record dating back to constitutional history. Considering the structures of reforms discourse, its framework of power and the stress which is imposed on vast and grassroots participation in any arenas this knowledge expressed that the creation of women movement is a popular, democratic and lack of leadership because its leadership is diverse and the characteristics of being democratic is the growth of women's N.G.O which play an effective role in achieving their goals. They completely define the goal in challenging with patriarchy and or patriarchal and the difference between men and women are resulted from distinct sociability and formation of gender issue. This will propose the other issues in reaction to fundamentalist discourse. Since the most challenging pertained to

women's issue in this discourse is about family protection bill their major stress would be put on changing law and taking legal action, target-setting in challenge with patriarchal and this induce the fundamentalist feminism to label them as anti-family stigma. Their generated feminism knowledge lacks in certain, defined purposes and plans and they believe that their goals are determined in the process of movement and when the opportunities are made the different factions would become united and the best occasion is prior to election atmosphere and the theories are rooted in this social action. They have no positive attitude toward statesmen for they believe the politicians have misused women in achieving the power and political goals. This has caused the women movements gain a political function, while this movement is endeavoring in making social changes in the favor of women and not getting fair share of political power. The fundamentalist government's performance pertaining to women movement and marginalizing them have led to some restrictions in public sphere for them (such as the detention of women activists, disruption of women communities, banning women's periodicals, sealing women's grassroots organizations) this has driven them to cyberspace, though there have not been left safe due to the filtering. Nowadays, what we witness from the viewpoint of this intellectual faction as women movement is the shift from mass to individual motions in women opposition. While we are moving far beyond the revolution, people pay more attention to their own daily life policies, tired population of policy and politics would keep the distance from collective action. At the end, what we conceive about feminism in Iran has the resultant of theoretic and practice feminism's views and performances in the system of Islamic Republic of Iran. Considering the initial definition which we have represented in this article, it is a social and intellectuals movement which in its broadest meaning is trying to promote women's status as a faction of the society. Feminism knowledge has been derived from the power frame of IRI, this knowledge has attained specific features and characteristics which would distinct it from western feminism model, but the obvious features of Iranian feminism due to ruling socio-political structures are as the follows:

- 1- stress on women's formal employment as the sole way of liberation
- 2- emphasis of confrontation and opposition between men and women
- 3- irrespective to diversity and plurality of women's factions in Iran
- 4- promotion and confirmation a full similarity between men and women

5- disagreement on feminism among some factions

Regarding the overall features which were counted for Iranian feminism knowledge we would understand that in junctures of Islamic Republic of Iran's history the dominant power has been more active in case of cultural structures like publishing books, translation of foreign literature, licensing women's professional periodicals and due to its generative power this cultural force has been very impressive on women's intellectual encounter to a massive amount of literature. So that Iranian women became acquainted with three great flows of feminism and hadn't any opportunity or chance for a successive and distinct learning, understanding and reviewing of western feminism and its effects were an amalgam of these flow's attitudes in emerging Iranian feminism knowledge. So we can not specify Iranian feminism exactly in one motion and different aspect would be observed in review of intellectuals' notion and the performance of activists, but by the study of power frame in Iran and the intellectuals' ideas, the generated feminism knowledge is mainly revisable in the first flow of global feminism, a kind of feminism which stressed on the equality of men and women's rights. After more discussion and extensive revision mentioned in advance, finally we concluded that feminism and women's affairs in Iran have been strictly affected by the power frames in different discourses of Islamic Republic of Iran and since the wisdom would be generated from within the power relations and would be exerted to human subject for converting it to different forms of knowledge. Knowledge and wisdom are the most significant ways and tools of hiding the power. In modern era the power owners would become hidden behind the exerting power system and this is ordinary people who are observable. According to Foucault's theory the enlighteners in theoretic feminism arena and in two dimensions of reformist and fundamentalist, particularly in public offices would launch theory processing and decision making, would be hidden in stabilization of exerting power system mostly flourished in custom and law, and these are practical and pragmatic feminism who are visible and would pay this visibility cost by being arrested, going to jail, deprivation of the social rights and ... and this secretion in stabilizing the power exerting system from the university to the parliament and this visibility of women in the community have led to the deep gaps among the women. While Iranian women after three decades since Islamic revolution's victory have not yet been able to come on consensus for their requests, though in some cross sections there would be convergence between reformist and conservative women, but ultimately this generated power and the

resistance against has produced a kind of knowledge in Iran which has turned women's issues to a political problem. So feminism in its Iranian form, in my opinion, is the feminist struggles based upon the gender awareness, the realization which couldn't yield the identity among women, and hadn't established the correlated power of its feminism knowledge and articulating the indications in the form of hegemonic discourse which has any sing of Iranian and or Islamic feminism.

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