Nutritional Impact for the Whole Replacement of Concentrate Feed Mixture by Dried Sugar Beet Pulp on Growth Performance and Carcass Characteristics of Ossimi Sheep

Hamed A.A Omer[1], Soha S. Abdel-Magid[1], Alaa Y. El-Badawi[1], Ibrahim M. Awadalla[1], Mamdouh I. Mohamed[1] and Mona S. Zaki[2]

[1]Animal Production Department, National Research Center, Dokki, Giza, Egypt
[2]Hydrobiology Department, National Research Center, Dokki, Giza, Egypt
dr_mona_zaki@yhaoo.co.uk, hamedomer2000@yahoo.com

Abstract: Fourteen Ossimi lambs (Egyptian sheep breed) with an average weight 30.20 ±1.54 kg aged 5-6 months were divided into two equal groups, seven animals each to evaluate the growth performance and carcass characteristics on two types of rations. The 1st ration (control) was based on concentrate feed mixture (CFM) composed mainly of grains, while the 2nd one was based on 90% dried sugar beet pulp (SBP) plus 10% soybean meal as a fibrous concentrate. Both rations were offered at 3% of body weight with *ad lib* amounts of clover hay in a feeding experiment lasted 56 days. The results showed that both experimental feed mixtures were iso-caloric-iso-nitrogenous, while higher significant (P<0.01) differences were recorded for CF, NDF and hemicellulose contents of SBP mixture than common CFM. Daily feed intake expressed as % of body weight, TDNI or DCPI were significantly decreased (P<0.05) with SBP mixture. Inclusion of SBP in the feed mixture at 90% significantly (P<0.05) improved CF digestibility but decreased (P<0.05) EE digestibility in comparison to control mixture, while other nutrients digestion coefficients showed comparable values for the two experimental rations. N. balance expressed relative to N-Intake or digestible-N was significantly (P<0.05) improved with lower (P<0.05) urinary N loss for sheep fed SBP feed mixture. Inclusion SBP in sheep ration significantly (P<0.05) decreased ammonia nitrogen concentration, while, it significantly (P<0.05) increased total volatile fatty acids concentration, however it had no significant effect on pH value compared to control ration (CFM).Incorporation SBP in sheep ration had no significant effect on all parameters of blood plasma except for triglyceride, cholesterol, urea and uric acid. Also, noticed that inclusion SBP in sheep diet significantly (P<0.05) decreased blood plasma of triglyceride, cholesterol, urea and uric acid compared to control ration (CFM). Other blood plasma parameters were in the same range for the two tested rations. Dietary treatment had no significant effect (P>0.05) on final body weight, total body weight gain, and average daily gain. Inclusion of SBP in sheep ration significantly improved (P>0.05) feed conversion ratio (kg intake of DM, TDN and DCP/ kg gain). Carcass characteristic physical and chemical body composition were not significantly influenced by replacing CFM with SBP in sheep ration. However, dressing percentage calculated relative to fasted body weight was significantly (P<0.05) lower for sheep fed SBP, while dressing % calculated relative to empty weight showed comparable values (54.11 for CFM and 54.87% for SBP). Replacing CFM with SBP supplemented with 10% SBM in sheep ration led to decrease total daily feeding cost by45.03% in comparison with the control diet. Meanwhile, daily profit above feeding cost was improved by 18.4%. Feed cost LE/ kg gain was improved by 38.07% compared to control ration. The present study indicated that feeding lambs on concentrate mixture contained 90% SBP + 10% soybean meal instead of common CFM (based on grains) was safe and economically feasable, while the lower daily feed intake of rations containing high level of SBP is a nutritional problem particularly with long-term feeding practices.

[Hamed A.A Omer, Soha S. Abdel-Magid, Alaa Y. El-Badawi, Ibrahim M. Awadalla, Mamdouh I. Mohamed and Mona S. Zaki. **Nutritional Impact for the Whole Replacement of Concentrate Feed Mixture by Dried Sugar Beet Pulp on Growth Performance and Carcass Characteristics of Ossimi Sheep.** *Life Sci J* 2013; 10(4): 1987-1999]. (ISSN: 1097-8135). http://www.lifesciencesite.com. 263

Keywords: Sugar beet pulp, sheep, growth performance, digestion coefficients, blood constituents, carcass characteristics, economic evaluation.

1. Introduction

One of the crucial aims in livestock feeding is to promote the use of local feeds and by products in order to decrease feeding costs **(Lanza*et al.,* 2001).** The goal of feeding concentrate feed mixture to growing lambs is to achieve maximum growth rates, better feed to-gain conversion and best carcass characteristics, leading to optimum profit opportunities **(Bodas*et al.,* 2007).**

Agricultural by-products have a high nutritive potential, and when properly utilized can contribute to better and cheaper feeding of livestock **(Israilides*et al.,* 1979)**. In Egypt the annual amount of sugar beet pulp that produced as a by-product of sugar beet industry as about 161 491 ton

(**Agricultural Statistic, 2003; El-Badawi*et al.*, 2003; Abedo 2006** and **El-Badawi and El-Kady 2006)**. Sugar beet pulp (SBP) is the solid vegetable matter thatremains after sugar extracted from sliced sugar beets; it comprises 6% of the weight of beet root **(Kjaergaard, 1984)**. Dried beet pulp is a carbohydrate rich by-product usually used as a partial source of energy in the rations of livestock **(Castle *et al.,* 1966)**. The protein content of sugar beet pulp is considered low compared with the requirements of most ruminants and monogastric animals which are even higher **(Israilides*et al.*, 1994)**. Sugar beet pulp is of a high fiber content and deficient in fat, phosphorus, carotene and certain B-vitamins which have been reported as a reason for even lower availability of the nutrient in SBP **(Morrison, 1959)**. Beet pulp exhibited a relatively low functional specific gravity and a higher capacity to hold water more than other non-forage fiber sources **(Mohamed *et al.,* 2000)**. Reducing of particle size of SBP by grinding or pelleting resulted in an increased rate of passage of particulate matter from the rumen, a decrease in the digestibility of OM, and an increase in voluntary intake **(Clark and Armentano 1997)**. Sugar beet pulp normally enters the feeding system as one of the following three products which differ only in DM content; wet pulp (6-12 % DM), pressed pulp (18-30 % DM) and dried pulp (87-92 % DM) **(Harland, 1993)**. Sugar beet pulp containing in average 9% CP, 0.5% EE, 6% sucrose, 4% soluble ash, 3% insoluble ash, suggesting that the variations in chemical composition of beet pulp arise because of international and regional effects such as seed varieties, soil condition, fertilizer usage and harvesting date **(Broughton *et al.,* 1995)**. Sugar beet pulp is especially rich in polysaccharides, mainly pectic substances (15-25 %). Beet pectins differ from other pectins (apple or citrus) by their high rhamnose contents, by the presence of acetyl groups linked to the D-galacturonic acid and by the presence of ferulic acid (0.5-1.0 %), one of the major phenolic acids of plant cell wall **(Baciu and Jordening, 2004)**. Including SBP in diets of both ewes and lambs has nutritional and economic benefits and that it is a safer and potentially more effective feed than rolled barley **(Crawshaw 1992)**. Similar conclusion was also mentioned by **El-Badawy *et al.,* (2003** and **2006)** on growing Egyptian sheep.

The main objectives of the this work was to study the effect of complete replacement of concentrate feed mixture (grains based feed) with sugar beet pulp (fibrous feed) in sheep rations and its effect nutrient digestion coefficients, nutritive value, nitrogen utilization, growth performance, blood constituents, carcass characteristics and economical evaluation.

2. Materials and Methods

The present study was carried out at the Sheep and Goats experimental station in El-Nubaria, Provence 120 km North Western Cairo city belongs to the Animal Production Department, National Research Center, Dokki, Giza, Egypt.

Animals and feeds

Fourteen growing male Ossimi (native breed) lambs, aged 5-6 months old with an average live weight of 30.20 ± 1.54 kg, were divided randomly into two equal groups (seven animals each) to study the effect of using sugar beet pulp plus 10% soybean meal (SBP) instead of concentrate feed mixture (CFM) on growth performance and carcass characteristics of Ossimi sheep.

The feeding trial lasted 56 days and lambs of two groups were offered the two mixtures at 3% of body weight while clover hay was offered *ad lib*.

Experimental animals were housed in individual semi-open pens and fed the experimental rations that cover the requirements of total digestible nutrients and protein for growing sheep according to the **NRC (1985)**. Daily amounts of experimental mixtures were adjusted every 2 weeks according to body weight changes. Diets were offered twice daily in two equal portions at 800 and 1400 hours, while feed residues were daily collected, sun dried and weekly weighed. Fresh water was freely available at all times in plastic containers. Individual body weight change was weekly recorded before the morning meal.

At the end of the feeding experiment four representative animals were slaughtered and the three animals from each group selected randomly were used to determine nutrient digestion coefficients, nutritive values and nitrogen utilization of two experimental rations. The nutritive values expressed as total digestible nutrients (TDN) and digestible crude protein (DCP) of experimental rations was calculated according to **Abou-Raya (1967)**.

At the end of the digestibility trial rumen fluid samples were collected from 6 animals (three animals from each group) 3 hours post feeding via a stomach tube and strained through four layers of cheesecloth to study the effect of dietary treatments on some ruminal fermentations parameters (pH, ammonia nitrogen (NH_3–N) and total volatile fatty acid (TVFA's) concentrations.

Blood samples were also collected from the left jugular vein in heparinized test tubes and centrifuged at 5.000 rpm for 15 minutes. Plasma was kept frozen at –20 °C for subsequent analysis of total protein, albumin, glucose, triglyceride, cholesterol, AST, ALT, Alkaline phosphatase, urea, uric acid and creatinine.

The slaughter technique

Perioser to slaughter process, animals were fasted for 12 hrs and weighed to record the fasting body weight (FBW). After slaughtering and bleeding, slaughtered animals were skinned, dressed out and the hot carcass weight was recorded. Weight of gastro-intestinal tract (GIT) content was calculated as the difference between full and empty GIT to estimate the empty body weight (EBW). Edible offals heart, liver, spleen, defatted kidneys and testicles) and non edible offals (lungs and trachea, clean empty GIT and visceral fat) were separately weighed and recorded for each slaughtered animal. Trimming including head, hide, four legs, blood and GIT contents were separately weighed and individually recorded. Each carcass was spletted into four quarters (two hind and two fore quarters). Knife separable fat was recorded as the sum weight of tail fat, kidney and visceral fat. The whole carcass was deboned and the physical body composition (meat, fat and bone) was individually recorded.

Body composition

The three best ribs (9^{th}, 10^{th} and 11^{th}) of each slaughtered animal were separated and weighed. Each rib was deboned and dissected into lean meat and fat. Fresh lean meat and fat of the three ribs for each animal were mixed, minced, oven dried at 60C° for 48 hrs, weighed and kept in polyethylene bags under -4 C° until chemical analysis to determine body composition.

Analytical methods

Representative samples of experimental feeds, feces, and urine were analyzed according to **A.O.A.C (2000)** methods. Neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) were also determined for experimental feeds according to **Goering and Van Soest (1970)** and **Van Soest*et al.* (1991)**. NDF and ADF were expressed, inclusive of residual ash. Ruminal pH was immediately determined using digital pH meter. Ruminal TVFA's concentrations were determined by steam distillation according to **Kromann*et al.* (1967)**. Ammonia concentration was determined using the micro diffusion method according to **Conway (1962).**

Plasma total protein was determined as described (**Witt and Trendelenburg, 1982)**; albumin **(Tietz, 1986);** triglycerides **(Fossati and Principe, 1982)**; cholesterol **(Allain *et al.*, 1974)**; alanine aminotransferase (ALT) or (GPT) and aspartate aminotransferase (AST) or (GOT) were determined according to **(Reitman and Frankel, 1957)**; Alkaline phosphatase **(Beliefield and Goldberg, 1971)**; urea **(Patton and Crouch, 1977)**; uric acid **(Kaplan and Pesce, 1989)** and creatinine **(Husdan, 1968)**.

Calculations

Gross energy (kcal/ kg DM), (GE) was calculated according to **Blaxter (1968)**, where, each g of CP= 5.65 kcal; each g of EE= 9.4 kcal and each g of CF & NFE = 4.15 kcal.

Economic evaluation

Economic evaluation was done using the relationship between feed costs (local market price of ingredients) and sheep live body weight gain. Economic evaluation was calculated as follows:

The cost for 1-kg gain = total cost (Egyptian pound (LE)) of feed intake/ total gain (kilogram).

Statistical Analysis

Collected data were subjected to T. test according to Statistical Analysis System of general linear models of **SAS, 1998** for PC.

3. Results and Discussion

Feed ingredients and chemical composition of experimental feeds

Feed ingredient and chemical composition of experimental feed mixtures and clover hay are shown in Table (1).

Both experimental feed mixture (CFM or SBP + 10% SBM) had similar values for DM, OM, CP, cellulose, ADL, ash and calculated gross energy. Higher significant ($P<0.01$) differences were recorded for CF, NDF and hemicelluloses of SBP than CFM, while the later was significantly ($P<0.05$) higher in NFE and EE. Chemical composition is pointing out to that experimental mixtures were iso-caloric-iso-nitrogenous but different in its content of CF and fiber fractions particularly NDF

Chemical analysis of sugar beet pulp was in the same trend with those obtained by **Iconomou *et al.* (1998)** and **Abedo (2006)** for SBP produced in Egypt.

Daily feed intake

Daily feed intake of animals fed experimental rations is illustrated in Table (2). The results of daily feed intake cleared that dietary treatment had significant effect ($P<0.05$) on daily feed intake. It was obvious, that feeding SBP mixture contained 90% pulp significantly ($P<0.05$) decreased total feed intake of growing sheep.

Incorporation sugar beet pulp in sheep rations significantly ($P<0.05$) decrease feed intake of concentrate mixture, hay, dry matter intake (CFM) that expressed as % of body weight, total dry matter intake (TDMI), total digestible nutrient intake (TDNI) and digestible crude protein intake (DCPI) compared to control ration.

These results were in agreement with those obtained **Olfaz*et al.* (2005**) who found that dry matter intake of the control group were higher ($P<0.01$) than that of the 0.40 SBP and 0.60 SBP groups of growing male Karayaka sheep. **Bodas*et al.* (2007)** noted that inclusion SBP in cereal-based diets for fattening lambs has no positive effects on feed intake or animal performance. Also, they decided that average concentrate intake was 9% lower in lambs fed SBP concentrate than those in the control group. **Murray *et al.* (2008)** recorded that total DMI was similar for all diets (17.5 g/kg live weight/ day) when they fed Welsh-cross pony equids on diets contained sugar beet pulp substituted at 0, 100, 200 and 300 g/ kg DM of lucerne silage. **Abedo (2006)** indicated that total dry matter intake were not significantly different among different rations. Also, **Mohamed (2005)** noted that no significant difference in feed intake among lambs that fed diets contained 0% (control), 20, 30 and 40% biologically treated SBP. On the other hand **Zaza (2005)** noticed no significant difference in feed intake of rabbit when fed diets contained 10 and 15% biologically treated SBP compared with control animals.

Rouzbehan *et al.* (1994) and **Mandebvu and Galbraith (1999)** showed that feed intake was negatively affected when barley was partly substituted by SBP in the concentrate fed to lambs.

El-Badawi and El-Kady (2006) believed that the high water holding capacity of dry SBP due to the existence of pectic substances, methyl and carboxyl groups in its molecular structure might be the reason of its better digestion. Inclusion of SBP in feeding of ruminants delays rate of passage outside the rumen **(El-Badawi*et al.*, 2003)** and increased methanogenic bacterial count, Lactobacilli and Streptococci and enzymatic yield of polygalacturonase and pectin esterase **(El-Badawi*et al.*, 2001)**. In the same time, they have to pay attention that such high water absorptive capacity could eliminate feed intake by ruminants when SBP was fed as a sole ration **(El-Badawi*et al.*, 2001)**.

Hall *et al.* (1998) recorded that Sugar beet pulp has a relatively high content of soluble and insoluble neutral detergent fiber, but it can be considered an energy concentrate because both soluble and insoluble NDF are highly digestible.

Table 1. Feed ingredients and chemical composition of experimental feeds

Item	Experimental feed mixture, %		Clover hay
	CFM	SBP + SBM	
Ground yellow corn	35	-	
Sugar beet pulp	-	86	
Sunflower meal	20	-	
Undecortecated cotton seed meal	5	-	
Soybean meal	-	10	
Wheat bran	25	-	
Rice bran	11	-	
Lime stone	2	2	
Sodium chloride	1.5	1.5	
Vitamins & Minerals mixture	0.5	0.5	
Chemical composition, % (DM basis)			
Dry matter (DM)	90.60	90.34	89.70
Organic matter (OM)	93.63	93.65	86.64
Crude protein (CP)	14.01	13.86	13.25
Crude fiber (CF)	13.18[B]	19.62[A]	32.09
Ether extract (EE)	2.72[a]	0.94[b]	2.86
Nitrogen-free extract (NFE)	63.72_a	59.23[b]	38.44
Ash	6.37	6.35	13.36
Gross energy (kcal/ kg DM)	4239	4144	3944
Cell wall constituents			
Neural detergent fiber (NDF)	40.91[B]	48.53[A]	38.47
Acid detergent fiber (ADF)	30.07	28.65	20.50
Acid detergent lignin(ADL)	3.67	3.06	11.25
Hemicellulose	10.84[B]	19.88[A]	17.97
Cellulose	26.40	25.59	9.25

Hemicellulose = NDF – ADF. Cellulose = ADF – ADL.

Table 2. Daily feed intake of the experimental group animals

Item	Experimental rations		SEM	Sig.
	CFM	SBP+SBM		
Intake of concentrate mixture, kg	1.017[a]	0.835[b]	0.044	0.024
Intake of hay, kg	0.633[a]	0.433[b]	0.052	0.035
Average body weight*, kg	35.81	35.37	1.80	0.070
Dry matter intake (CFM) of body weight, %	2.84[a]	2.36[b]	0.120	0.030
Concentrate mixture: roughage ratio	1.61	1.93	0.091	0.071
Total dry matter intake (TDMI), kg	1.650[a]	1.268[b]	0.095	0.028
Total digestible nutrient intake (TDNI), kg	1.021[a]	0.740[b]	0.065	0.013
Digestible crude protein intake (DCPI), kg	0.145[a]	0.107[b]	0.009	0.018

a and b: Means in the same row having different supper scripts differ significantly (P<0.05).
* Average body weight = {initial weight + final weight}/ 2.

Nutrient digestion coefficients and nutritive values of experimental rations

Nutrient digestion coefficients and nutritive values are presented in Table (3). The results showed that dietary treatment had no effect on all nutrient digestibilities coefficient except for CF and EE digestibilities. Inclusion SBP in sheep ration insignificant (P>0.05) improved DM and OM digestibilities, while, it significantly (P<0.05) increased CF digestibilities, but, it significantly (P<0.05) decreased EE digestibility. Dietary treatment had no effect on nutritive values (TDN and DCP).

Table 3. Nutrient digestion coefficients and nutritive values of experimental rations

Item	Experimental rations		SEM
	CFM	SBP+SBM	
Digestion coefficients			
Dry matter (DM)	74.56	76.49	1.92
Organic matter (OM)	76.87	78.66	1.73
Crude protein (CP)	62.61	61.09	1.64
Crude fiber (CF)	53.66[b]	59.08[a]	2.33
Nitrogen-free extract (NFE)	64.50	61.92	4.79
Ether extract (EE)	80.27[a]	74.02[b]	1.19
Nutritive values			
Total digestible nutrient (TDN)	61.85	58.39	1.28
Digestible crude protein (DCP)	8.77	8.46	0.18

a and b: Means in the same row having different supper scripts differ significantly (P<0.05).
SEM: Standard error of the mean.

Incorporation SBP in sheep ration insignificantly (P>0.05) decreased TDN and DCP values in comparison with the control ration (CFM). These results were in agreement with those obtained by **Abedo (2006)** and **Murray *et al.* (2008)** who cleared that digestibility of DM, OM, CP, EE and NFE were not significantly differed when sheep fed rations contained 0, 25 or 50% untreated SBP. **Bhattacharya *et al.* (1975)** reported that TDN, DE and ME values did not show any differences when 50 or 100% of the yellow corn was replaced by SBP in sheep rations. **Mohsen *et al.* (1999)** and **Ali *et al.* (2000)** noticed that DCP values were not influenced by increasing level of SBP in sheep or goats rations.

Saleh *et al.* (2001) found that CF digestibility increased (P<0.01), and EE digestibility decreased when yellow corn was replaced by SBP at 50 and 100% in lamb rations. **El-Badawi *et al.* (2003)** reported that digestion coefficients of OM, CP, EE, CF and NFE were comparable with replacing corn by SBP at 25, 50 and 75% in sheep ration. TDN and DCP values were insignificantly different among tested rations.

Mousa (2011) replaced concentrate feed mixture with fodder beet roots at 0, 35, 50 and 65%. He noticed that digestibility coefficients of dry matter, organic matter, ether extract and nitrogen free extract were not significantly affected by any level of replacement while the digestibility of crude protein and crude fiber were significantly decreased as the fodder beet roots in diets increased. The same trend was recorded for digestible crude protein (DCP).

Okab *et al.* (2012) showed that inclusion of untreated sugar beet pulp at the level of 50 % in

Barki lamb diets negatively affected diet digestibility coefficients of crude protein, crude fiber, and ether extract. **Mojtahedi and Mesgaran (2011)** noted that total tract apparent digestibility of DM increased quadratically with increasing the proportion of SBP in the diet, but crude protein digestibility were similar among treatments.

El-Badawi and El-Kady (2006) evaluated the effect of feeding ration containing 50% (w/w) feed sugar beet pulp sprayed with urea solution 30 g/ kg of sugar beet pulp (USBP) to replace the common concentrate feed mixture (CFM) on nutrient digestibility and nutritive values by sheep. They noted that digestibility of CP and EE were decreased with ration containing 50% USBP; CF digestibility was extremely higher than that of the traditional feed mixture. Dietary nutritive value expressed in terms of TDN was higher by about 5% for the 50% USBP mixture than control however differences of both TDN and DCP between the two mixtures did not attain any significance. In similar trend **Eweedah *et al.* (1999)** on Merino lambs found that both CP and EE digestibilities were significantly decreased by feeding rations contained SBP in replacement of grains or concentrate mixtures. It was noted earlier, that the CP of SBP is poorly digested by ruminants **(Metwally and Stern, 1988)**. The lower dietary EE digestibility was mentioned to be regarded to the high water holding capacity of dry sugar beet pulp which could prevent the enzymatic hydrolysis of dietary fat in the rumen media **(Mohamed *et al.*, 2000)**. Mean while **Mansfield *et al.* (1994)** noted that crude fiber content of SBP could be digested as effectively as NFE fraction in rations of Holstein cows

Dietary nitrogen utilization by animals of experimental groups

Dietary nitrogen utilization by animals of experimental groups is illustrated in Table (4). Data showed that N-balance was positive for two experiment groups and N-balance was insignificantly improved (P>0.05) when SBP introduced in sheep ration compared to control ration (CFM).

N. balance expressed relative to N-Intake or digestible-N was significantly (P<0.05) improved with lower (P<0.05) urinary N loss for sheep fed SBP feed mixture.

Table 4. Dietary nitrogen utilization by animals of experimental groups

Item	Experimental rations		SEM
	CFM	SBP+SBM	
Nitrogen intake (NI), g	37.28	28.32	-
Fecal nitrogen (FN), g	13.94	11.02	-
Digested nitrogen (DN), g	23.34	17.30	-
Urinary nitrogen (UN), g	17.86[a]	12.38[b]	0.92
Total nitrogen excretion, g	31.80	23.40	-
Nitrogen balance (NB), g	5.48	4.92	-
N- balance of NI, %	14.70[b]	17.37[a]	1.00
N- balance of DN, %	23.48[b]	28.44[a]	1.43

a and b: Means in the same row having different supper scripts differ significantly (P<0.05).
SEM: Standard error of mean.

These results were in agreement with those found by **Mousa (2011)** who noted that all animals were in positive N-balance when feed mixture replaced with fodder beet roots at 0, 35, 50 and 65%. **Abedo (2006)** showed that the nitrogen balance was significantly (P<0.01) decreased for animals fed ration contained 25 or 50% biological treated SBP compared with the control and the rations contained untreated SBP. **Mohamed (2005)** reported that sheep fed diet that contained 30% biologically treated SBP had (P<0.05) higher nitrogen balance than control (0% SBP) and animals fed on 20 or 40% of concentrate feed mixture. **El-Badawi *et al.* (2003)** found that dietary nitrogen utilization (%N-balance of N-intake) was obviously higher (P<0.05) with feed mixtures containing 50 and 75% SBP.

Generally, the superiority in nitrogen retention due to a specific ration is affected by several factors such as possible production of microbial protein synthesis, increasing presence of fermentable energy **(Hagemeister *et al.*, 1981)**, differences in availability of fermentable energy **(Tagari *et al.*, 1976)**, variability in nitrogen that might escape fermentation from the rumen, an increased utilization of ammonia in the rumen **(Holzer *et al.*, 1986)** and the effect of free fats in protein synthesis **(Sutton *et al.*, 1983)**. Inclusion untreated sugar beet pulp at the level of 50 % in Barki lamb diets negatively affected nitrogen utilization **(Okab *et al.*, 2012)**.

Ruminal fermentation parameters for animals fed experimental rations

Ruminal fermentation parameters for animals fed experimental rations are presented in Table (5) cleared that inclusion SBP in sheep ration significantly (P<0.05) decreased ammonia nitrogen concentration, while, it significantly (P<0.05) increased total volatile fatty acids concentration, however it had no significant effect on pH value compared to control ration (CFM).The results of ruminal fermentations clear that increasing TVFA's might be related to the more utilization of dietary energy and positive fermentation in the rumen. **Abedo (2006)** noted that pH values at 3hrs post feeding was significantly (P<0.01) decreased for sheep fed rations contained 50% untreated and biological treated SBP.

Table (5) Ruminal fermentation parameters for animals fed experimental rations

Item	Experimental rations		SEM
	CFM	SBP+SBM	
pH value	6.67	6.71	0.03
NH_3-N (mg/dl).	27.08^a	22.14^b	0.67
TVFA's (meq/ dl).	9.03^b	10.47^a	0.14

a and b: Means in the same row having different supper scripts differ significantly (P<0.05).
SEM: Standard error of the mean. NH_3-N: Ammonia nitrogen concentration.
TVFA's: Total volatile fatty acids.

Also, **Mohamed (2005)** found that pH was significantly lower for sheep fed diets contained 30 and 40% biologically treated SBP than that fed diets contained 20% or fed control diet at zero and 3 hrs post feeding, but no difference was recorded at 6 hrs. **Abedo (2006)** noticed that ammonia nitrogen concentration was significantly (P<0.01) lower for animals fed rations that contained 25 and 50% untreated SBP than the control group. Also, **Abedo (2006)** recorded that TVFA’s was decreased for sheep fed rations contained untreated and biologically treated sugar beet pulp compared with control animals. Also, **Mohamed (2005)** reported that TVFA’sconcentration was decreased for goats fed biological treated cotton stalks and for sheep fed biologically treated SBP compared with control animals, respectively. **Silva and Ørskov (1988)** reported that feeding SBP might encourage growth of cellulolytic and hemicellulolytic microorganisms and this, in turn, should increase the extent of forage digestion. On the other hand, there was a good efficiency in ruminal protein synthesis when a non-protein nitrogen source was in feeds containing rapidly fermentable carbohydrates **(Lanza *et al.*, 2001)**. Therefore, use of SBP may have increased ruminal protein synthesis. This may be a good reason for protein saving and environmental protection with less ruminant manure (nitrogen) pollution, since the groups using SBP had a lower protein consumption due to DM intake **(Olfaz *et al.* 2005).**

Bodas *et al.* (2007) found that inclusion of SBP in cereal based diets for fattening lambs seems to enhance the ruminal environment and prevent ruminal acidosis. Also they reported that ruminal pH was significantly (P<0.05) lower in lambs fed on the control concentrate compared to concentrate with SBP. A significant decrease (P<0.05) in total volatile fatty acid's concentration occurred when SBP was included in the concentrate, no significant differences (P<0.05) were observed in ammonia-N concentration.

It is known that SBP has a high water holding capacity and, hence, water intake may have been greater in lambs fed SBP than control concentrate, with a possible depressing effect on feed intake **(Rouzbehan *et al.*, 1994)**. **Bodas *et al.*, (2007)** reported that although water intake was not measured in their study, the lower TVFA's concentration and in the rumen of SBP-fed animals could be partly due to a dilution effect as result of a higher water intake. However, the differences in ruminal volatile fatty acid's concentrations between treatments could be also related to changes in fermentation pattern. In fact, ruminal pH increased when barley was substituted with SBP in the concentrate, which can be also attributed to a slower fermentation rate **(Ben-Ghedalia *et al.*, 1989).**

The reduction of ammonia nitrogen in the rumen liquor appears to be the result of increased incorporation of ammonia nitrogen into microbial protein and it was considered as a direct result to stimulated microbial activity. While, increasing TVFA's might be related to the more utilization of dietary energy and positive fermentation in the rumen. Addition of more fermentable carbohydrate to ruminant rations causes a decrease in rumen ammonia **(Tagari *et al.*, 1964)** probably due to a greater uptake of ammonia by rumen microorganisms in support of enhanced microbial growth. The rate of TVFA's production may in this situation exceed the rate of TVFA's absorption through the rumen epithelium and TVFA's concentration in the rumen juice is increased **(Van't Klooster, 1986)**.

It should be noted that, TVFA's concentration in the rumen is governed by several factors such as dry matter digestibility, rate of absorption, rumen pH, transportation of the digesta from the rumen to the other parts of the digestive tract and the microbial population in the rumen and their activities **(Allam *et al.*, 1984)**. Increasing of ruminal TVFA's concentration is an indicator for betterutilization of dietary carbohydrate was noticed by (**Fadel *et al.*, 1987).** Also, **Briggs et *al.* (1957)** observed that an increasing in ruminal TVFA's concentration caused a reduction in ruminal pH value.

Ruminal pH is one of the most important factors affecting the fermentation and influences its functions. It varies in a regular manner depending on the nature of the diet and on the time it is measured after feeding and reflects changes of organic acids quantities in the ingesta. The level of NH_3-N and TVFA's as end products of fermentation and breakdown of dietary protein, have been used as parameters of ruminal activity by **Abou-Akkada and Osman (1967)**.

Blood plasma constituents of the experimental groups

Data of Table (6) showed that inclusion SBP in sheep ration had no significant effect on all parameters of blood plasma except for triglyceride, cholesterol, urea and uric acid.Inclusion of SBP in sheep diet significantly (P<0.05) decreased plod plasma of triglyceride, cholesterol, urea and uric acid compared to control ration (CFM). On the other hand the other blood plasma parameters were in the same range for two tested rations. These results are in agreement was those obtained by **Bodas *et al.* (2007)** who noticed that there were no significant (P>0.05) differences between control and SBP groups in any of the blood biochemical parameters studied. The absence of effects on blood parameters could be due to the short duration of the fattening period, probably insufficient to exhibit metabolic acidosis.

Kaneko (1989) and **Abedo (2006)** stated that blood parameters included; total protein, albumin, globulin, A: G ratio, glucose, Alanine aminotransferase (ALT), Aspartate aminotransferase (AST), alkaline phosphates, and creatinine were not significantly differed among sheep groups fed different rations contained untreated or treated SBP and were within the normal range.

Zaza (2005) reported no significant differences in blood proteins, GPT and GOT of rabbits fed diets that contained biologically treated SBP. While urea nitrogen and glucose were (P<0.05) increased, but the cholesterol value was decreased with feeding treated sugar beet pulp. **Gurbuz and Coskun (2011)** found no difference in plasma glucose, cholesterol and triglyceride (P>0.05) when they replaced oats with dried sugar beet pulp at levels of 0, 12.5, 25 and 37.5% in horse diets.

Table 6. Blood plasma constituents of the experimental groups

Item	Experimental rations		SEM
	CFM	SBP+SBM	
Total protein (g/dl)	7.02	6.90	0.08
Albumin (g/dl)	3.11	3.12	0.03
Globulin (g/dl)	3.91	3.78	0.05
Triglyceride (mg/dl)	46.13^a	38.20^b	1.36
Cholesterol (mg/dl)	18.36^a	15.11^b	0.79
Liver function:			
AST (U/I)	25.33	24.89	1.36
ALT (U/I)	48.06	47.85	0.45
Kidneys function:			
Alkaline phosphatase (U/I)	70.26	71.18	1.44
Urea (mg/dl)	30.15^a	22.35^b	1.56
Uric acid (mg/dl)	0.08^a	0.05^b	0.01
Createnine (mg/dl)	1.14	1.15	0.03

a and b: Means in the same row having different supper scripts differ significantly (P<0.05).
SEM: Standard error of the mean.

Growth performance of the experimental groups

Growth performance of the experimental group animals is presented in Fig (1) and Table (7). The results showed that dietary treatment had no significant effect (P>0.05) on final body weight, total body weight gain, average daily gain. Inclusion SBP in sheep ration significantly improved (P<0.05) feed conversion ratio (kg intake of DM, TDN and DCP/ kg gain). Bodas*et al.* (2007) noted that inclusion SBP in cereal-based diets for fattening lambs has no positive effects on animal performance. Also, they decided that ADG was 19% lower in lambs fed SBP concentrate than those in the control group. Feed: gain conversion was 12% higher in lambs fed concentrate with SBP than in the control group.

Olfaz *et al.* (2005) found that DM conversion of the control group were higher (P<0.01) than that of the 0.40 SBP and 0.60 SBP groups of growing male Karayaka sheep.

Rouzbehan *et al.* (1994) and **Mandebvu and Galbraith (1999)** showed that ADG and feed conversion ratio were negatively affected when barley was partly substituted by SBP in the concentrate fed to lambs.

The reduction in ADG in lambs fed the SBP can be fairly attributed to the lower feed intake than those fed CFM. However, some other factors should also be considered such as type of substrates, high water absorptive capacity and lower phosphorous and B-vitamins contents of SBP. **(Morrison, 1959; Mohamed 2005** and **Bodas *et al*,. 2007)**.

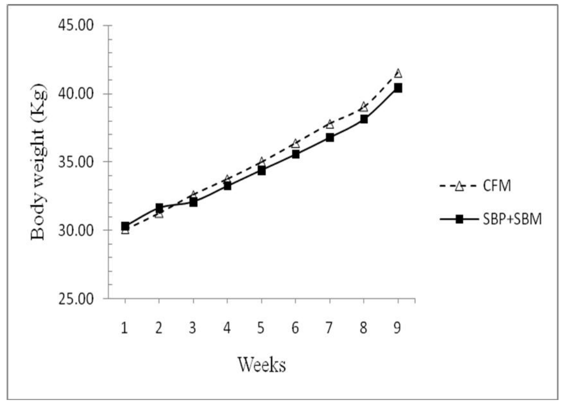

Fig. (1): Body weight development of lambs fed experimental rations.

Table 7. Growth performance of the experimental animals

Item	Experimental rations		SEM
	CFM	SBP+SBM	
Initial weight, kg	30.09	30.31	1.54
Final body weight, kg	41.53	40.43	2.10
Total body weight gain, kg	11.44	10.12	0.76
Duration period	56 days		
Average daily gain, g	204	181	13.58
Feed conversion (kg intake/ kg gain) of:			
DM	8.09[b]	7.06[a]	0.35
TDN	5.00[b]	4.09[a]	0.32
DCP	0.71[b]	0.59[a]	0.05

a and b: Means in the same row having different supper scripts differ significantly (P<0.05).
SEM: Standard error of mean.

On the other hand, **El-Badawi and El-Kady (2006)** noted that inclusion of sugar beet pulp sprayed with urea solution 30 g/ kg of sugar beet pulp (USBP) at 50% of the common CFM increased average daily gain by nearly 30%. Consequently feed conversion in terms of kg DM or TDN per kg gain was significantly (P<0.05) better for the group fed 50% USBP.

Inclusion of untreated sugar beet pulp at the level of 50 % in Barki lamb diets negatively affected average daily gain and feed conversion **(Okab *et al.*, 2012)**.

On the other hand, **Abedo (2006)** recorded that feed conversion as kg feed/ kg gain was significantly (P<0.01) different between group lambs fed rations contained untreated or treated SBP. While, **Mohamed (2005)** found that feed conversion were not significant difference for lambs fed diets contained biological treated SBP compared to those fed control diet.

Carcass characteristics of the experimental groups

Carcass characteristics of the experimental groups are illustrated in Table (8). Results showed that carcass characteristic was not significantly influenced by replacing CFM with SBP in sheep ration. However, dressing percentage calculated relative to fasted body weight was significantly (P<0.05) lower for sheep fed SBP, while dressing % calculated relative to empty weight showed comparable values (54.11 for CFM and 54.87% for SBP).

These results in agreement with those recorded by **Olfaz *et al.* (2005)** who noted that no significant differences were observed for carcass weight and dressing percentage for growing male Karayaka sheep which fed commercial feed (60%) and roughage (40%) and sugar beet pulp (SBP) replaced 40 or 60% of grass hay. Also, they concluded that grass hay can be replaced by 60% of SBP in the growing diet for Karayaka rams without a reduction in meat quality.

Table 8. Carcass characteristics of the experimental group animals

Item	Experimental rations		SEM
	CFM	SBP+SBM	
No. of slaughtered animals	4	4	-
Fasted body weight (FSW), kg	40.00	39.50	1.38
Empty body weight (EBW), kg	35.30	33.35	1.27
Hot carcass weight, kg	19.10	18.30	0.92
Dressing of FBW, %	47.75[a]	40.33[b]	1.06
Dressing of EBW, %	54.11	54.87	1.16
Dissected carcass traits, kg:			
Fore quarters	10.50	9.79	0.24
Hind quarters	6.65	6.40	0.18
Tail	1.45[b]	2.11[a]	0.04
Edible offals, kg:			
Heart	0.18	0.17	0.05
Liver	0.57	0.55	0.06
Spleen	0.05	0.05	0.002
Kidneys with fat	0.21	0.20	0.07
Testicles	0.20	0.22	0.06
Total edible offals	1.21	1.19	0.03
Carcass + edible offals of EBW, %	57.54	58.44	1.32
Non edible offals, kg:			
Lungs and trachea	0.70	0.68	0.04
Clean empty GIT	3.60	3.75	0.12
Viscera	0.10	0.13	0.04
Trimming and external offals, kg			
Head	2.25	2.10	0.04
Four legs	0.95	1.00	0.02
Hide	5.90	4.85	0.19
Blood	1.50	1.35	0.13
GIT contents	4.70	6.15	0.33
Total non-edible, external offals and trimmings, kg	19.70	20.01	0.11
Non-edible + trimmings of FBW, %	49.25	50.66	1.16
GIT contents of FBW, %	11.75[b]	15.57[a]	1.03

a and b: Means in the same row having different supper scripts differ significantly (P<0.05).
SEM: Standard error of the mean.
Empty body weight (EBW) = Slaughter weight - digestive tract content weight.

Bodas *et al.* (2007) demonstrated that there were no significant differences (P>0.05) between treatments in weight of the empty gastrointestinal tract, total gut or rumen contents. Also, there was a tendency (P<0.09) for statistically significance in differences between SBP and control groups in weight of the empty for stomachs. **El-Badawi and El-Kady (2006)** studied the effect of sprayed sugar beet pulp with urea solution 30 g/ kg of sugar beet pulp (USBP) to replace the common concentrate feed mixture (CFM) on carcass traits. They reported that empty body weight, warm carcass weight and dressing percentage were much better for lambs fed 50% USBP rations, however yields of edible and non edible offal's were slightly higher for lambs fed the CFM, while the percentage of bone was much lower (P<0.05) for lambs fed 50% USBP ration. Protein and fat contents of carcass were higher for lambs fed 50% USBP ration. **Mandebvu and Galbraith (1999)** replaced barley with increasing quantities of molassed sugar beet pulp (MSBP) to provide diets containing 0, 25, 50 and 75% of the maximum quantity of barley. They found that hot and cold carcass was reduced linearly with increasing provision of MSBP in the diet.

Dissected carcass components and chemical composition of *longissimus dorsi* muscle for slaughtered animals

Data of Table (9) showed that dietary treatment had no significant effect on carcass components and chemical composition of *longissimus dorsi* muscle.

Physical and chemical body composition was not significantly influenced by replacing CFM with SBP in sheep ration.

Also, dietary treatments had no significant effect (P>0.05) on Knife separable fat. (Table 10).

Table 9. Dissected carcass components and chemical composition of *longissimus dorsi* muscle for slaughtered animals

Item	Experimental rations		SEM
	CFM	SBP+SBM	
Carcass components, %			
Bone	19.10	19.25	0.11
Lean	52.60	52.88	0.19
Fat	29.30	27.87	0.14
Longissimus dorsi muscle composition, %			
Dry matter	41.20	39.91	0.22
Crude protein	16.60	16.49	0.18
Ether extract	18.65	19.03	0.20
Ash	5.95	5.58	0.07

SEM: Standard error mean.

Table 10. Knife separable fat of slaughtered animals fed experimental rations

Item	Experimental rations		SEM
	CFM	SBP+SBM	
Tail fat, kg	1.95	2.10	0.03
Kidney fat, kg	0.06	0.07	0.001
Visceral fat, kg	0.10	0.13	0.02
Total separable fat, kg	2.11	2.30	0.02

SEM: Standard error mean.

Table 11. Economic evaluation of the experimental rations

Item	Experimental rations	
	CFM	SBP+SBM
Daily feed intake (fresh), kg of		
Concentrate feed mixture (CFM)	1.123	---
Sugar beet pulp + 10% soybean meal (SBP + SBM)	---	0.924
Clover hay (CH)	0.706	0.483
Daily feeding cost, LE[1]	3.42	1.88
Average daily gain, kg	0.204	0.181
Value of daily gain, LE[2]	7.34	6.52
Daily profit above feeding cost, LE	3.92	4.64
Relative economical efficiency[3]	100	118.4
Feed cost LE/ kg gain	16.76	10.38

[1] Based on value of year 2013 where value of one kg of CFM= 2.10 LE; one kg of SBP + SBM= 1.25 LE and one kg of BH =1.50 LE

[2] Value of one kg live body weight equals 36 LE (2013).

LE: Egyptian pound equals 0.15 American dollars approximately.

[3] Assuming that the relative economic efficiency of control diet equals 100.

No significant effect of sugar beet pulp incorporation into the diet on fat firmness was observed **(Normand *et al.*, 2001; Kinsella and L'Estrange, 1980)**. The lack of firmness of subcutaneous fat may be partly due to the high levels of energy intake and to the high growth rates in both groups **(Busboom *et al.*, 1981)**.

Economic evaluation of the experimental rations

Economic efficiency was represented by daily profit over feed cost. The costs were based on average values of year 2013 for feeds and live body weight. Feeding costs and profit above feeding costs are shown in Table (11). Replacing CFM with SBP supplemented with 10% SBM in sheep ration lead to decrease total daily feeding costs of experimental rations by 45.03% in comparison with the control diet.

Meanwhile, daily profit above feeding cost was improved by 18.4% when sheep fed ration contained SPB compared to the control diet (CFM). Feed cost

LE/ kg gain was improved by 38.07% compared to control ration. Relative economical efficiency was improved by 18.4% in comparison with the control diet. These results were in agreement with those obtained by **Mohamed (2005)**; **Abedo (2006)** and **Mousa (2011)** who found that the lowest feeding cost and the highest profit were recorded for lambs fed diets contained biological treated SBP, especially when fed on level of 40% from concentrate feed mixture.

4. Conclusion

It could be concluded that replacement concentrate feed mixture by sugar beet pulp supplemented with 10% soybean meal can be recommended for rations of growing sheep with no adverse effect on their performance, digestion processes, carcass characteristics and blood constituents. Also, incorporation of sugar beet pulp in sheep ration could lead to formulate cheap rations and consequently decreased the feeding cost.

References

1. A.O.A.C., 2000. Official Methods of Analysis, 17th ed. Association of Official Analytical Chemists, Washington, DC, USA.
2. Abedo, A.A.A., 2006. A study on the use of sugar beet pulp in the feed mixtures for ruminants. Ph. D Thesis. Agric. Sc., (Animal Nutrition), Department of Animal Production, Faculty of Agriculture, Ain Shams University.
3. Abou-Akkada, A. R. and H.E. Osman, 1967. The use of ruminal ammonia and blood urea as an index of the nutritive value of proteins in some feedstuffs. J. Agric. Sci., 69: 25-31.
4. Abou-Raya, A.K., 1967. Animal and Poultry Nutrition. 1st Edit. Pub. Dar El-Maarif, Cairo (Arabic text book).
5. Agricultural Statistics, 2003. Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Arab Republic of Egypt.
6. Ali, M.F., K. Mohsen, M.I. Bassiouni and M.M.E. Khalafalla, 2000. The influence of using dried sugar beet pulp on sheep performance. J. Agric. Res. Tanta Univ., 26: 132.
7. Allain, C.C., L.S. Poon, C.S. Chan, W. Richmond and P.C. Fu, 1974. Enzymatic determination of total serum cholesterol. Clin. Chem., 20: 470 – 475.
8. Allam, S.M., A.K. Abou-Raya, E.A. Gihad and T.M. El-Bedawy, 1984. Nutritional studies by sheep and goats fed NoaH treated straw. 1st Egyptian British conference on Animal and Poultry Production, Zagazig, 11-13 Sep. P. 53.
9. Baciu, I.E. and H.J. Jordening, 2004. Kinetics of galacturonic acid release from sugar beet pulp. Enzyme and Microb. Tech. 34:505.
10. Beliefield, A. and D.M. Goldberg, 1971. Estimation of serum alkaline phosphatase. Enzyme. 12: 561.
11. Ben-Ghedalia, D., E. Yosef, J. Miron and Y. Est, 1989. The effects of starch and pectin-rich diets on quantitative aspects of digestion in sheep. Anim. Feed Sci. Technol. 24: 289–298.
12. Bhattacharya, A.N., T.M. Khan and M. Uwayjan, 1975. Dried beet pulp as a sole source of energy in beef and sheep rations. J. Anim. Sci., 41: 616.
13. Blaxter, K.L., 1968. The energy metabolism of ruminants. 2nd ed. Charles Thomas Publisher. Spring field. Illinois, U.S.A.
14. Bodas, R., F.J. Giraldez, S. Lopez, A.B. Rodrıguez, A.R. Mantecon, 2007. Inclusion of sugar beet pulp in cereal-based diets for fattening lambs. Small Ruminant Research 71: 250–254.
15. Briggs, P.K., J.P. Hogan and R.L. Reid, 1957. The effect of volatile fatty acids, lactic acid and ammonia on ruminal pH in sheep. Aust. J. Agric. Res., 8: 674.
16. Broughton, N.W., C.C. Dalton, G.C. Jones and E.L. Williams, 1995. Addeding value to sugar beet pulp. International Sugar Journal. 97: 57.
17. Busboom, J.R., G.J. Miller, R.A. Field, J.D. Crouse, M.L. Riley, G.E. Nelms and C.L. Ferrell, 1981. Characteristics of fat from heavy ram and wether lambs, J. Anim. Sci., 52: 83–92.
18. Castle, M.E., A.D. Drysdale and J.N. Watson, 1966. The effect of feeding dried sugar beet pulp on the intake and production of diary cows. J. Dairy Res. 33: 123.
19. Clark, P.W. and L.E. Armentano, 1997. Influence of particle size on the effectiveness of beet pulp fiber. J. Dairy Sci., 80: 898.
20. Conway, E.R., 1962. Micro diffusion Analysis and Volumetric Error. (5thEd.). Crosby Lockwood and sons Ltd., London.
21. Crawshaw, R., 1992. Sheep and sugar beet pulp. British Sugar Beet Review. 60: 16.
22. El-Badawi, A.Y., R.I. El-Kady, T.M. El-Bedawy and M.Z. Sedik, 2001. Inclusion of sugar beet pulp in ruminant diets. 2. Changes of rumen fermentation, microbial count and enzymatic activity associated with feeding different levels of ureated sugar beet pulp in rations of growing sheep. Egypt. J. Nutr. Feeds, 4: 113–24
23. El-Badawi, A.Y., M.H.M. Yacout and H.E.M. Kamel, 2003. Effect of replacing corn with sugar beet pulp on ruminal degradation kinetics and utilization efficiency of rations by growing sheep. Egypt. J. Nutr. Feeds, 6: 1349–1363.
24. El-Badawi, A.Y. and R.I. El-Kady, 2006. Effect of partial replacement of concentrates with sugar beet pulp on performance, carcass characteristics and energy utilization of growing sheep. International Journal of Agriculture & Biology, 8 (3): 344-348.
25. Eweedah, N.M., S.A. Mahmoud, G. El-Santiel and M.F. Ali, 1999. Utilization of sugar beet by-products in feeding ruminants. 1- Digestibility, rumen fermentation and nutritive value. Egypt. J. Nutr. Feeds, 1: 121–30.
26. Fadel, J. G., D.U. Den and D.H. Robinson, 1987. Effect of nitrogen, energy supplementation on intake and digestion of oat straw by non lactating ruminant dairy cows. J. Agric. Sci., 106: 503.
27. Fossati, P and L. Principe, 1982. Clin. Chem. 28, 2077.
28. Goering, H.K. and P.J. Van Soest, 1970. Forage fiber analyses (Apparatus, Reagents, Procedures and some applications). USDA, Agr. Hand. Book 379.
29. Gurbuz, E. and B. Coskun, 2011. Effect of dried sugar beet pulp on some blood parameters and heart rate in exercised horses. Kafkas Univ. Vet. Fak Derg, 17 (2): 191-195.
30. Hagemeister, H., W. Lipping and W.K. Kaufimann, 1981. Microbial protein synthesis and digestion in the high yielding dairy cow. In Recent Advances in Animal Nutrition. Hresign, PP. 67. Butterworth, London.
31. Hall, M.B., A.N. Pell and L.E. Chase, 1998. Characteristics of neutral detergent-soluble fiber fermentation by mixed ruminal microbes. Anim. Feed Sci. Technol. 70: 23–39.
32. Harland, J.I., 1993. By-products of sugar beet pulp crop. In. D.A. Cooke and R.K. Scott (Ed). The Sugar Beet Crop. Pp 619-647.
33. Holzer, Z., D. Levy and V. Samule, 1986. Interactions between supplementary nitrogen source and ration energy density on performance and nitrogen utilization in growing and fattening male cattle. Animal. Production 42: 19.
34. Husdan, H., 1968. Chemical determination of creatinine with deproteinization. Clin. Chem., 14:222.
35. Iconomou, D., K. Kandylis, C. Israilides, P. Nikokyris, 1998. Protein enhancement of sugar beet pulp by fermentation and estimation of protein degradability in the rumen of sheep. Small Ruminant Research 27: 55-61.

36. Israilides, C.J., G.A. Grant and V.W. Han, 1979. Acid hydrolysis of grass straw for yeast fermentation. Devel. Int. Microbiol., 20: 603.
37. Israilides, C.J., D.I. Conomou, K. Kandylis and P. Nikokyris, 1994. Fermentability of sugar beet pulp and its acceptability in mice. Bioresource Tech. 47: 97.
38. Kaneko, J.J., 1989. Clinical Biochemistry of Domestic Animals. 4thedition. Academic press, Inc.
39. Kinsella A.J. and J.L. L'Estrange, 1980. The performance of lambs fed indoors on concentrate diets based on whole barley or mollassed beet pulp with or without supplementation with monensin sodium, Anim. Prod. 30: 483.
40. Kaplan, L.A. and A.J. Pesce, 1989. Clinical Chemistry, Theory, Analysis and Correlation. C.V. Mosby Company.
41. Kjaergaard, L., 1984. Examples of bio-technological utilization of beet pulp and bagasse. Sugar Technol. Rev., 10: 183.
42. Kromann, R.P., J.H. Meyer and W.J. Stielau, 1967. Steam distillation of volatile fatty acids in rumen digesta. Journal of Dairy Science 50:73.
43. Lanza, M., A. Priolo, L. Biondi, M. Bella and H.B. Salem, 2001. Replacement of cereal grains by orange pulp and carob pulp in faba bean-based diets fed to lambs: effects on growth performance and meat quality. Animal Research, 50 (1): 21–30.
44. Mandebvu, P. and H. Galbraith, 1999. Effect of sodium bicarbonate supplementation and variation in the proportion of barley and sugar beet pulp on growth performance and rumen, blood and carcass characteristics of young entire male lambs. Anim. Feed Sci. Technol., 82: 37–49.
45. Mansfield, H.R., M.D. Stern and D.E. Otterby, 1994. Effect of beet pulp and animal by-products on milk yield and *in vitro* fermentation by rumen microorganisms. J. Dairy Sci., 77: 205–216.
46. Metwally, H.M. and M.D. Stern, 1988. Effects of dietary carbohydrates and protein sources on ruminal fermentation and protein supply to the small intestine of dairy cattle. J. Anim. Sci., 66: 95–99.
47. Mohamed, S.A., T.M. Mohamed and A.Y. El-Badawi, 2000. Impact of enzymatic hydrolysis of polysaccharidies in sugar beet pulp on cell.-wall constituents and *in vitro* dry matter disappearance. Arab Univ. J. Agric. Sci., 8: 425–37.
48. Mohamed, Sh. H., 2005. Biological treatment of sugar beet pulp and its use in sheep ration. M. Sc. Thesis. Fac. of Agric., Cairo Univ.
49. Mohsen, M.K., M.F. Ali and M.I. Bassiouni, 1999. The effect of partial replacing concentrate mixture by dried sugar beet pulp on performance of growing Angora goats. Egypt. J. Nutr. and Feeds (Special Issue) 2: 309.
50. Mojtahedi, M. and M.D. Mesgaran, 2011. Effects of the inclusion of dried molassed sugar beet pulp in a low-forage diet on the digestive process and blood biochemical parameters of Holstein steers. Livestock Science 141: 95–103.
51. Morrison, F.B., 1959. Feeds and Feeding. 22nd edition The Morrison Publishing Company, Clinton, Iowa, USA.
52. Mousa, M.R.M., 2011. Effect of partial replacement of dietary concentrate feed mixture by fodder beet roots on productive performance of ewes and doe goats under the conditions of North Sinai. Asian Journal of Animal Sciences, 5: 228-242.
53. Murray, J.A.M.D., A. Longland, P.M. Hastie, M.M. Colyerb and C. Dunnett, 2008. The nutritive value of sugar beet pulp-substituted lucerne for equids. Animal Feed Science and Technology, 140: 110–124.
54. Normand, J., M. Theriez, P. Bas. V. Berthelot, B. Aurousseau and D. Sauvant, 2001. Effect of the type of concentrate, cereals vs. sugar beet pulp, on rumen fermentation, plasma concentration of methylmalonate and quality of subcutaneous adipose tissue of intensively reared lambs. Anim. Res. 50: 275–288.
55. N.R.C., 1985. Nutrient requirements of domestic animals. Nutrient requirements of sheep. National Academy of Sciences, Washington. D.C.
56. Okab, A.B. M.A. Ayoub, E.M. Samara, K.A. Abdoun, A.A. Al-Haidary, A.A. Koriem and A.A. Hassan, 2012. Improvement of growth and nitrogen utilization in sheep using sugar beet pulp treated with *Trichoderma reeseior* urea. Trop Anim Health Prod, DOI 10.1007/s11250-012-0116-2 Published on line 13 March 2012.
57. Olfaz, M., N. Ocak, G. Erener, M.A. Cam and A.V. Garipoglu, 2005. Growth, carcass and meat characteristics of Karayaka growing rams fed sugar beet pulp, partially substituting for grass hay as forage. Meat Science 70: 7–14.
58. Patton, C.J. and S.R. Crouch, 1977. Spectrophotomattic and kinetics investigation of the Berthelot reaction for the determination of ammonia. Anal. Chem. 49: 464.
59. Reitman, S. and S. Frankel, 1957. Calorimetric method for the determination of serum glutamic oxaloacetic and glutamic pyruvate transaminase. An. J. Clin. Path., 28:56.
60. Rouzbehan, Y., H. Galbraith, J.A. Rooke and J.G. Perrott, 1994. A note on the effects of dietary inclusion of a yeast culture on growth and ruminal metabolism of lambs given diets containing unground pelleted molassed dried sugar-beet pulp and barley in various pro-portions. Anim. Prod. 59, 147–150.
61. Saleh, M.S., N.M. Eweedah, M.F. Ali and M.K. Mohsen, 2001. Comparison between dried sugar beet pulp and yellow corn as a source of energy with berseem in ration of growing lambs. Egypt. J. Nutr. and Feeds (Special Issue).4: 231.
62. S.A.S., 1998. Statistical Analysis System. SAS Users Guide. Version 6. 12 Ed. Basics SAS Institute Inc., Cary, NC, USA.
63. Silva, A.T. and E.R. Ørskov, 1988. The effect of five different supplements on the degradation of straw in sheep given untreated barley straw. Animal Feed Science and Technology, 19 (3): 289–298.
64. Sutton, J.D, R. Mc Allan Knight, A.B. and R.H. Smith, 1983. Digestion and synthesis in the rumen of sheep given diets supplemented with free and protected oils. Birth Journal of Nutrition 49: 419.
65. Tagari, H., Y. Driori, L. Ascarelli and A. Bondi, 1964. The influence of level of protein and starch in rations for sheep on utilization of protein. Br. J. Nutr. 18: 333.
66. Tagari, H., D. Lery, Z.H. Oizer and D. Jlan, 1976. Poultry litter for intensive beef production. Anim. Prod. 23: 317.
67. Tietz, N.W., 1986. A method for the rapid determination of albumin of blood plasma. P.589 in Textbook of Clinical Chemistry. W.B. Saunders Company, Philadelphia.
68. Van Soest, P.J., J.B. Robertson and B.A. Lewis, 1991. Methods for dietary fiber, neutral detergent fiber and non starch polysaccharides in relation to animal performance. Journal of dairy Science 74: 3583–3597.
69. Van'tKlooster, A.T., 1986. Pathological aspects of rumen fermentation. In: New developments and future perspectives in research on rumen function (Neimann–Sorensen, A., Ed). Commission of the European Communities, Luxembourg, 259 – 276.
70. Witt, I. and C. Trendelenburg, 1982. A method for the rapid determination of total protein plasma. J. Clin. Biochem.20: 235.
71. Zaza, G.H.M., 2005. Effect of incorporation of biologically treated sugar beet pulp as non-conventional feedstuffs in the diets of growing rabbits. The 4th Inter. Conference on Rabbits Prod. In hot climates. Sharm El-Sheikh, Egypt.

11/2/2013