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Productive Performance of Lactating Buffaloes Fed Ration Containing Sugar Beet Tops and Corn Silages

Research Article

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ABSTRACT

Sixteen multiparous lactating buffaloes after 8 weeks of calving and weighing 500 to 600 kg were used in a complete switch-back design with four groups. Buffaloes in the first group were fed the control ration (R1) consisted of DM basis of 60% concentrate feed mixture (CFM)+20% rice straw (RS)+20% berseem hay (BH), while in the other groups the rations consisted of DM basis of 40% CFM+20% RS+40% sugar beet tops silage (SBTS) and corn silage (CS) in different ratios; 2:1 (R2), 1:1 (R3) and 1:2 (R4), respectively. The digestibility coefficients of DM, OM, CF, EE and NFE, TDN value and the intake of DM and TDN increased significantly (P<0.05) with increasing the level of corn silage, however, CP digestibility, DCP value and CP and DCP intake increased (P<0.05) with increasing level of sugar beet tops silage in the rations. The pH value and NH_3-N concentration increased (P<0.05) with increasing level of sugar beet tops silage, however, TVFA's concentration increased (P<0.05) with increasing level of corn silage in the rations. Buffaloes fed R3 recorded the highest (P<0.05) milk and 7% FCM yield, however, those fed R1, had the lowest yield. The percentages of fat, lactose and TS increased (P<0.05) with increasing the level of corn silage, however, the percentages of protein, SNF and ash increased (P<0.05) with increasing the level of sugar beet tops silage in rations. Animals fed R3 showed the lowest amounts of DM and TDN required per kg 7% FCM and R4 the lowest amounts of CP and DCP required per kg 7% FCM, however, those fed R1 revealed the highest amounts (P<0.05).

KEY WORDS digestibility, economic efficiency, feed conversion, milk yield and composition, rumen activity.

INTRODUCTION

In Egypt, the total planted area of sugar beet was about 167 thousand feddans (feddan=0.42 hectare) (Agriculture Economics, 2006). Sugar beet tops can be used for livestock feed, which sheep and cattle ranchers allow grazing of beet fields in the fall to utilize tops. Cattle and sheep also will eat small beets left in the field after harvest but producers of grazing livestock in harvested fields should be aware of the risk of livestock choking on small beets (Cattanach *et al.* 1991).

Cattanach *et al.* (1991) also demonstrated that beet tops (leaves and petioles) can be used as silage. Sugar beets that produce about 15 tons/feddan of roots and 4 tons/feddan of TDN in the tops. Tops are an excellent source of protein, vitamin A, and carbohydrates. Beet top silage is best fed in combination with other feeds. So, ensiling of sugar beet tops may contribute in solving some problems concerning resources' shortage of animal feeding, especially in summer season and to minimize the pollution. It may offer a reduction of feed cost and minimize quantities of the expensive concentrate feedstuffs used in animal feeding (Mohiel-Din *et al*. 2000; Bendary *et al*. 2000). The TDN values of sugar beet tops silage ranged from 45.66% (Bendary *et al*. 1992) to 61.65% (Eweedah *et al*. 1999) and DCP value from 6.00% (Kripal *et al*. 1975) to 12.05% (Eweedah *et al*. 1999). In Egypt, the total planted area of corn crop is about one million feddans and about 25% of this area is used as silage (Agriculture Economics, 2006). The average yield of fresh corn crop is 18.55 ton on wet basis, 5.43 ton DM, 3.45 ton TDN and 367.16 kg DCP per feddan. Moreover, it may offer a significant reduction of feed cost as well as reduction of using concentrate feed mixture for lactating cows (Mahmoud *et al*. 1992) or replacing fresh berseem in ration of lactating cows (Ahmed *et al*. 2003). The objective of this study was to investigate the effect of feeding sugar beet tops and corn silages at different ratios on nutrients digestibility, rumen activity, milk production, feed conversion and economic efficiency of lactating buffaloes.

MATERIALS AND METHODS

Making silage

Sugar beet tops were collected from sugar beet fields at the harvesting time and wilted for 48 hours to diminish the moisture content to about 65-70% before ensiling. Whole corn plants *single cross 10* was harvested at dough stage of maturity, chopped into 1-1.5 cm of length. Wilted sugar beet tops and chopped corn were ensiled between feed toughs, where 30 cm layer of rice straw spread on the ground as bed to absorb seepage and to prevent contamination with dusts. Molasses was added for sugar beet tops every layer at a level of 5% of fresh weight basis to increase the activity of silage fermentation. Also, ground limestone (sodium carbonate) was added at 2 kg per tone of sugar beet tops to compensatory calcium binding with oxalate. The material was compressed by heavy drum filled with sand, then covered with plastic sheet, hard pressed with 30 cm of soil layer and ensiled for eight weeks.

Experimental animals and design

Sixteen multiparous lactating buffaloes after 8 weeks of calving and weighing 500 to 600 kg were used in a complete switch-back design (4×4) with four groups and three successive experimented periods. Each periods consisted of 28 days, the first 14 days of each period were considered a transition period followed by 14 days as test period, as described by Lucas (1956).

Experimental rations and management

Buffaloes in the first group were fed the control ration (R1) consisted of DM basis of 60% concentrate feed mixture (CFM)+20% rice straw (RS)+20% berseem hay (BH), while in the other groups the fed rations consisted of DM basis of 40% CFM+20% RS+40% sugar beet tops silage (SBTS) and corn silage (CS) in different ratios, 2:1 (R2), 1:1 (R3) and 1:2 (R4), respectively. Concentrate feed mixture consisted of 35% undecorticated cotton seed cake, 20% wheat bran, 24% yellow corn, 10% rice bran, 5% line seed cake, 3% molasses, 2% limestone and 1% common salt. Lactating buffaloes were individually fed to cover the recommended requirements according to Animal Production Research Institute (1997) for lactating buffaloes. Rations were recalculated every two weeks based on milk yield and body weight of animals. Concentrate feed mixture was offered two times daily at 8 am. and 4 pm, berseem hay once daily at 11 am and rice straw was given two times at 9 am and 5 pm sugar beet tops and corn silages once daily at 10 am. Buffaloes were allowed to drink water three times a day at 7 am and 1 and 7 pm and were kept under the routine veterinary supervision through the whole feeding trial.

Digestibility trials

Four digestibility trials were conducted during the 2nd period of feeding trial with 4 animals from each group to determine nutrients digestibility coefficients and nutritive values of the experimental rations using acid insoluble ash (AIA) as a natural marker (Van Keulen and Young, 1977). Samples of feces were taken from the rectum of each animal twice daily with 12 hours interval during the collection period. Samples of tested feedstuffs were taken in the beginning, middle and the end of collection period. The samples of feedstuffs and feces were composted and representative samples were analyzed according to AOAC (1995).

Rumen liquor samples

Rumen liquor samples were collected 3 hours after the morning feeding from buffaloes during the 2nd period of feeding trial using a stomach tube and filtered through double layers of cheese cloth. The pH value was determined directly using Orian 680 digital pH meter. The concentration of total VFA's was determined in rumen liquor samples by steam distillation method (Warner, 1964) using markham micro-distillation apparatus. The concentration of NH_3-N was determined using saturated solution of magnesium oxide distillation according to the method of AOAC (1995).

Milk yield and samples

Individual morning and evening milk yield of lactating buffaloes were recorded daily and corrected for 7% fat content (FCM) using the formula of 7% FCM= 0.265×milk yield (kg)+10.5×fat yield (kg) as per the method of Raafat and Saleh (1962). Milk samples from consecutive evening and morning milking were taken on the 4th week of each period and mixed in proportion to yield. Milk fat, protein, lactose and total solids were determined using Milko-Scan 133B Foss Electric (Foss Electric, Denmark).

Feed conversion
Feed conversion was calculated as the amounts of DM, TDN (kg) and DCP (mg) required to produce 1 kg 7% FCM.

Economic efficiency
Economic efficiency expressed as the daily feed cost, price of daily weight gain, feed cost per kg gain and the ratio between the price of daily weight gain and daily feed cost. The price of one ton was 1600 LE for concentrate feed mixture, 700 LE for berseem hay, 75 LE for rice straw, 80 LE for sugar beet tops silage and 150 LE for corn silage. While, the price of one kg 4% FCM was 3 LE according to prices of year 2009 [$=5.75 LE (Egyptian Pound)].

Statistical analysis
The data were subjected to statistical analysis according to Lucas (1956). Statistical model was as follows:

$$Y_{ijk} = U + T_i + E_{ik}$$

Where; Y_{ijk}=the observation ik; U=Overall mean; T_i=Treatments; E_{ik}=Experimental error associated with i and k observations assumed to be randomly distributed.

The Duncan multiple range tests were used to compare differences between the means (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition of feedstuffs and experimental rations
Chemical composition of tested feedstuffs and experimental rations are shown in Table 1 and it reveals' that the contents of CP and ash are high and OM, CF and NFE contents are lower in sugar beet tops silage compared with corn silage (14.78, 19.62, 80.38, 12.80 and 50.25 vs. 7.85 and 6.70, 93.30, 23.85 and 58.32%, respectively). So, the contents of CP and ash in experimental rations increased with increasing proportion of sugar beet tops silage, but the contents of OM, CF and NFE increased with increasing the proportion of corn silage. These results are consistent with those obtained by Bendary *et al.* (2000) for sugar beet tops silage and Ahmed *et al.* (2003) for corn silage.

Digestibility coefficients and nutritive values
Digestibility coefficients and nutritive values of experimental rations by lactating buffaloes are presented in Table 2. The digestibility coefficients of DM, OM, CF, EE, NFE and TDN value increased (P<0.05) with increasing the level of corn silage in the rations, which R4 showed the highest values. However, CP digestibility and DCP value increased (P<0.05) with increasing the level of sugar beet tops silage in the rations. Control ration recorded the highest CP digestibility and DCP value. Variations in nutrients digestibility may be attributed to the differences in chemical composition of tested feedstuffs and experimental rations. These results are in agreement with those obtained by Mahmoud *et al.* (1992) and Ahmed *et al.* (2003) who found the digestibility of DM, OM and NFE and TDN value increased with elevating the level of corn silage in the rations. Bendary *et al.* (2000) reported that the digestibility of CP and DCP value were higher with sugar beet tops silage.

Average daily feed intake
Feed intake by lactating buffaloes fed different tested rations are shown in Table 3. Buffaloes fed the control ration showed the highest (P<0.05) intake of DM, CP and DCP, while those fed R4 had the highest (P<0.05) TDN intake. The intake of DM and TDN increased (P<0.05) with increasing the level of corn silage, however, the intake of CP and DCP increased (P<0.05) with increasing the level of sugar beet tops silage in the rations. The variations in feed intake may be attributed to differences in the palatability of different feedstuffs by animals. The lower DM intake with sugar beet tops silage may be attributed to its laxative effect. These results are in agreement with those obtained by Mahmoud *et al.* (1992) and Ahmed *et al.* (2003) who found that DM and TDN intake by cows increased with increasing the level of corn silage in the ration. Bendary *et al.* (2000) indicated that feeding dairy cows on ration containing sugar beet tops silage reduced the intake of DM and TDN.

Rumen activity
Rumen liquor parameters are presented in Table 3 and it reveals that pH value and NH_3-N concentration decreased (P<0.05), however, TVFA's concentration increased (P<0.05) with increasing the level of corn silage and decreasing the level of sugar beet tops silage in the rations.
This result may be due to the degradation of protein to ammonia and carbohydrates fermented to TVFA's in the rumen. Ruminal microorganisms utilize more NH_3-N when more energy sources are fermented (Hungate, 1966). Russell and Dombrowski (1980) reported that ruminal total VFA production was closely related to ruminal pH, which can be considered as an important regulator of microbial yield. Baker (1990) found that feeding silage high in NH_3-N concentration was associated with high ruminal NH_3-N concentration. He also reported that ruminal total VFA concentration decreased with feeding sugar beet tops silage. Van Soest (1983) stated that the optimum pH value for gr-

Table 1 Chemical composition of feedstuffs and experimental rations used in feeding buffaloes

Item	DM%	Composition of DM%					
		OM	CP	CF	EE	NFE	Ash
Feedstuffs							
Concentrate feed mixture	91.20	91.60	16.25	12.45	3.20	59.70	8.40
Berseem Hay	90.50	87.40	13.30	25.40	2.60	46.10	12.60
Sugar beet tops silage	25.60	80.38	14.78	12.80	2.55	50.25	19.62
Corn silage	28.35	93.30	8.15	23.85	2.98	58.32	6.70
Rice straw	90.85	83.25	2.55	32.50	1.55	46.65	16.75
Calculated composition of experimental rations							
R1 (control)	91.99	89.09	12.92	19.05	2.75	54.37	10.91
R2	45.80	86.73	12.26	17.71	2.27	54.50	13.27
R3	46.61	88.03	11.60	18.81	2.44	55.18	11.97
R4	47.45	89.32	10.93	19.92	2.61	55.86	10.68

R1: 60% CFM+20% RS+20% BH (Control). R2: 40% CFM+20% RS+40% SBTS and CS (2:1).
R3: 40% CFM+20% RS+40% SBTS and CS (1:1). R4: 40% CFM+20% RS+40% SBTS and CS (1:2).

Table 2 Digestibility coefficients and nutritive values by buffaloes fed different experimental rations*

Item	Experimental rations				±SEM
	R1	R2	R3	R4	
Digestibility coefficients (%)					
DM	67.22[b]	67.78[ab]	68.48[ab]	69.58[a]	0.39
OM	68.23[b]	68.82[ab]	69.53[ab]	70.74[a]	0.41
CP	63.81[b]	67.79[a]	66.11[b]	64.74[b]	0.53
CF	60.91[c]	61.98[bc]	63.03[ab]	64.37[a]	0.60
EE	73.95[b]	74.85[ab]	75.24[ab]	76.06[a]	0.37
NFE	71.20[b]	73.35[a]	75.03[a]	76.89[a]	0.76
Nutritive values (%)					
TDN	63.13[c]	63.08[c]	65.05[b]	67.32[a]	0.53
DCP	8.24[a]	8.31[a]	7.67[b]	7.08[c]	0.15

R1: 60% CFM+20% RS+20% BH (Control). R2: 40% CFM+20% RS+40% SBTS and CS (2:1).
R3: 40% CFM+20% RS+40% SBTS and CS (1:1). R4: 40% CFM+20% RS+40% SBTS and CS (1:2).
[*] The means in the same row that have at least one common letter, do not have significant difference (P>0.05).

owth of cellulytic microorganisms was 6.7 and the range for normal condition was about ±0.5 pH degrees.

Average daily milk yield

Results in Table 4 revealed that milk and 7% FCM yield of buffaloes fed tested rations (R2-4) were higher (P<0.05) compared with those fed R1 (control ration). Buffaloes fed R3 contained sugar beet tops and corn silages (1:1) recorded the highest (P<0.05) milk and 7% FCM yield, however, those fed R1 (control ration) had the lowest yield (11.25 and 9.96 vs. 9.16 and 7.85 kg/day respectively). The higher milk yield recorded by buffaloes fed R3 may be due to suitable TDN and DCP contents (Table 2) as well as ruminal TVFA's concentration (Table 3). These results showed that using sugar beet tops and corn silages in feeding of lactating buffaloes surprisingly replaced berseem hay and rice straw as a source of roughage and which saved a part of high expensive concentrate feed mixture (20%) as well as increasing milk production. These results are in agreement with those obtained by Mahmoud *et al.* (1992) and Ahmed *et al.* (2003) who found that milk yield of Friesian cows increased with increasing the level of corn silage in the ration. Bendary *et al.* (1996) and Bendary *et al.* (2000) reported significant increase in milk and 4% FCM yield with Friesian cows fed rations containing sugar beet tops silage.

Milk composition

Milk compositions of buffaloes are affected by feeding rations containing sugar beet tops and corn silages and are shown in Table 4. There were significant differences (P<0.05) in milk composition among the different groups. The percentages of fat, lactose and TS increased (P<0.05), however, the percentages of protein, SNF and ash decreased (P<0.05) with increasing the level of corn silage and decreasing the level of sugar beet tops silage in the rations. Increasing fat percentage with increasing the level of corn silage may be due to the higher fermentation of its fiber into volatile fatty acids in rumen (Table 3) which was subsequently converted to fat in milk. Also, protein and lactose contents increased in similar trends to increasing DCP and TDN intake (Table 3). These results are consistent with those obtained by Bendary *et al.* (2000) and Ahmed *et al.* (2003).

Feed conversion

There were significant differences (P<0.05) in feed conversion among buffaloes fed the different experimental rations as shown in Table 5. Feed conversion improved by feeding rations containing sugar beet tops and corn silages. Animals fed R3 showed the lowest (P<0.05) DM and TDN/kg 7% FCM and R4 the lowest CP and DCP/kg 7 % FCM, howev-

Table 3 Average daily feed intake and rumen activity of buffaloes fed different experimental rations*

Item	Experimental rations				±SEM
	R1	R2	R3	R4	
Feed intake (kg/head/day)					
Concentrate feed mixture[1]	10.87	6.93	7.03	7.14	
Berseem hay[1]	3.65	-	-	-	
Rice straw[1]	3.64	3.48	3.53	3.59	
Sugar beet tops silage[1]	-	18.83	12.52	6.36	
Corn stover silage[1]	-	5.58	11.31	17.24	
DM	16.52[a]	15.81[c]	16.03[bc]	16.29[ab]	0.09
TDN	10.43[b]	9.97[c]	10.43[b]	10.97[a]	0.12
CP	2.13[a]	1.94[b]	1.86[c]	1.78[d]	0.04
DCP	1.36[a]	1.31[b]	1.23[c]	1.15[d]	0.03
Rumen activity					
pH value	6.72[a]	6.65[ab]	6.52[bc]	6.41[c]	0.02
TVFA's (meq/100 ML)	14.95[d]	16.35[c]	17.20[b]	18.85[a]	0.40
NH_3-N (mg/100 mL)	23.65[b]	25.30[a]	21.84[c]	19.75[d]	0.53

R1: 60% CFM+20% RS+20% BH (Control). R2: 40% CFM+20% RS+40% SBTS and CS (2:1).
R3: 40% CFM+20% RS+40% SBTS and CS (1:1). R4: 40% CFM+20% RS+40% SBTS and CS (1:2).
[*] The means in the same row that have at least one common letter, do not have significant difference (P>0.05).
[1] As fed.

Table 4 Milk yield and composition of buffaloes fed different experimental rations*

Item	Experimental rations				±SEM
	R1	R2	R3	R4	
Milk yield (kg/day)	9.16^{b}	9.78^{ab}	11.25^{a}	10.63^{a}	0.39
7% FCM (kg/day)	7.85^{b}	8.66^{ab}	10.10^{a}	9.73^{a}	0.39
Milk composition %					
Fat	5.64^{b}	5.90^{ab}	6.02^{ab}	6.18^{a}	0.08
Protein	3.54^{ab}	3.69^{a}	3.52^{ab}	3.34^{b}	0.05
Lactose	5.42^{b}	5.56^{ab}	5.65^{ab}	5.78^{a}	0.05
SNF	9.66^{b}	9.98^{a}	9.89^{ab}	9.83^{ab}	0.08
TS	15.30^{ab}	15.88^{b}	15.91^{ab}	16.01^{a}	0.13
Ash	0.70^{c}	0.73^{a}	0.72^{ab}	0.71^{bc}	0.004

R1: 60% CFM+20% RS+20% BH (Control). R2: 40% CFM+20% RS+40% SBTS and CS (2:1).
R3: 40% CFM+20% RS+40% SBTS and CS (1:1). R4: 40% CFM+20% RS+40% SBTS and CS (1:2).
*The means in the same row that have at least one common letter, do not have significant difference (P>0.05).

er, those fed upon the control ration (R1) the highest DM, TDN, CP and DCP/kg 7% FCM. These results are in accordance with those obtained by Bendary *et al.* (2000) and Ahmed *et al.* (2003) who found that better feed efficiency attained by feeding Friesian cows in ration containing sugar beet tops or corn silages.

Economic efficiency

Economic efficiency is illustrated in Table 5 which reveals significant differences (P<0.05) in economic efficiency among different groups. Buffaloes fed on the control ration (R1) showed the highest average daily feed cost and feed cost/kg 7% FCM and the lowest price of 7% FCM yield and economic efficiency (P<0.05). However, buffaloes fed on R3 contained sugar beet tops and corn silages (1:1) the lowest feed cost/kg 7% FCM and the highest price of 7% FCM yield and economic efficiency (P<0.05). These results may be due to the reduction of the quantity of highly expen-

Table 5 Feed conversion and economic efficiency of buffaloes fed different experimental rations*

Item	Experimental rations				±SEM
	R1	R2	R3	R4	
Feed conversion					
DM kg / kg 7% FCM	2.11^{a}	1.83^{b}	1.59^{c}	1.67^{c}	0.06
TDN kg / kg 7% FCM	1.33^{a}	1.15^{b}	1.03^{c}	1.13^{b}	0.03
CP g/kg 7% FCM	272.16^{a}	223.88^{b}	184.18^{c}	183.11^{c}	11.08
DCP g / kg 7% FCM	173.63^{a}	151.76^{b}	121.74^{c}	118.53^{c}	6.87
Economic efficiency					
Average daily feed cost (LE)	20.22^{a}	13.67^{d}	14.21^{c}	14.80^{b}	0.79
Feed cost (LE)/ kg 7% FCM	2.58^{a}	1.58^{b}	1.41^{c}	1.52^{b}	0.14
Price of kg 7% FCM (LE)	23.55^{c}	25.98^{b}	30.30^{a}	29.19^{a}	0.84
Economic efficiency	1.16^{c}	1.90^{b}	2.13^{a}	1.97^{b}	0.11

R1: 60% CFM+20% RS+20% BH (Control). R2: 40% CFM+20% RS+40% SBTS and CS (2:1).
R3: 40% CFM+20% RS+40% SBTS and CS (1:1). R4: 40% CFM+20% RS+40% SBTS and CS (1:2).
*The means in the same row that have at least one common letter, do not have significant difference (P>0.05).

sive concentrate feed mixture and also replacing highly expensive berseem hay, as well as, increasing milk yield with feeding rations containing sugar beet tops and corn silages. These results are in accordance with those obtained by Bendary *et al*. (1996) and Bendary *et al*. (2000) who found that cows fed on sugar beet tops silage along with concentrate were the most economic milk producers compared with cows fed on traditional summer ration. Feeding lactating cows on ration containing corn silage reduced daily feed cost and improved economic efficiency (Mahmoud *et al*. 1992; Ahmed *et al*. 2003). El-Nahas *et al*. (2009) found that feeding growing calves rations containing sugar beet tops silage improved economic efficiency.

CONCLUSION

Sugar beet tops and corn silages as sources of roughage is more efficient especially to replace berseem hay and to save a part of concentrate feed mixture. Using sugar beet tops and corn silages (1:1) in the rations of lactating buffaloes improve milk production, feed conversion and economic efficiency.

REFERENCES

Agriculture Economics. (2006). Agricultural Economics, part 1 pull. By Agriculture Research Center, Ministry of Agriculture, Egypt.

Ahmed B.M.; Taie H.T., Bendary M.M. and Abdel-Lateif K.F. (2003). Influence of dietary corn silage on digestibility, performance and economical efficiency of dairy cattle. *Egypt. J. Nutr. Feed*. **6**, 587-594.

Animal Production Research Institute. (1997). Animal Nutrition Scientifically and Practically. 1st Ed. Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Dokki, Giza, Egypt.

AOAC. (1995). Association of Official Analytical Chemists. Official Methods of Analysis, 15th Ed. Washington, DC.

Baker A.A. (1990). Feeding of goats on underutilized resources. M. Sc. Thesis, Faculty of Veterinary Medical, Zagazig University, Egypt.

Bendary M.M., Mahmoud A.M., Koriet I.S. and Mahmoud E.M. (1992). Nutritional studies on using sugar beet tops in animal feeding. 2-Chemical composition and nutritive values of sugar beet tops silage made by different methods. *Menofiya. J. Agric. Res*. **17**, 109.

Bendary M.M., Mohamed M.M., Ghanem G.H.A and Abou-Selim I.A. (1996). Nutritional studies on using sugar beet tops in animal feeding. 5-Performance of lactating Friesian cows fed dried sugar beet tops and its silage. *Egypt. J. Anim. Prod*. **33**, 199-210.

Bendary M.M., El-Ayouty S.A., Farrage F.H.H., Mohiel-Din A.M.A. and Khalil F.F.M. (2000). Productive performance of lactating cows fed rations containing different forms of sugar beet tops and berseem silage. Proceeding of Conference of Animal Production, In the 21th Century, 18-20 April, Sakha, Egypt, Pp. 255-265.

Cattanach A.W., Dexter A.G. and Oplinger E.S. (1991). Alternative Field Crops Manual. Sugar beets. http://www.hort.purdue.edu/newcrop/afcm/sugarbeet.html.

Duncan D.B. (1955). Multiple range and F-test. *Biometrics*, **11**, 1-42.

El-Nahas H.M., Shakweer I.M.E., Gaafar H.M.A. and Abou-Aiana R.M. (2009). Productive performance and semen physical characteristics of Friesian calves fed different proportions of sugar beet tops and corn stover silages. *Egypt. J. Nutr. Feed*. **12**, 193-204.

Eweedah N.M., Mahmoud S.A., El-Santiel G.E. and Ali M.F. (1999). Utilization of sugar beet by-products in feeding ruminant. 1-Digestibility, rumen fermentation and nutritive value. *Egypt. J. Nutr. Feed*. **2**, 121-129.

Hungate R.E. (1966). The Rumen and its Microbes. Academic Press. New York and London.

Kripals S., Sagar V., Gupta P.G. and Randhir S. (1975). Studies on the utilization of sugar beet leaves in the ration of sheep. *Nutr. Abstr. Rev*. **48**, 190.

Lucas H.L. (1956). Switch back trials for more than two treatments. *J. Dairy Sci*. **39**, 146-154.

Mahmoud A.M., Bendary M.M., Harfoush M.A. and Ramadan G.A. (1992). Effect of feeding lactating cows corn silage on milk production compared with traditional summer and winter rations. *J. Agric. Sci. Mansoura Uni*. **17**, 2904-2916.

Mohiel-Din A.M.A., Bendary M.M., El-Ayouty S.A., Farrage F.H.H. and Khalil F.F.M. (2000). Nutritional values of sugar beet tops (dried or silage) and berseem silage. Proceeding of Conference of Animal Production, In the 21th Century, 18-20 April, Sakha, Egypt, Pp. 245-254.

Raafat M.A. and Saleh M.E. (1962). Efficiency of feed utilization with buffaloes and dairy cattle. Proceedings of the Sector Animal Production Conference (March 3-10), Cairo, Egypt.

Russell J.B. and Dombrowski D.B. (1980). Effect of pH on the efficiency of growth by pure culture of ruminal bacteria in continuous culture. *Appl. Environ. Microbiol*. **39**, 604-615.

Van Keulen J. and Young P.A. (1977). Evaluation of acid insoluble ash as a natural marker in ruminant digestibility studies. *J. Anim. Sci*. **44,** 282-287.

Van Soest P.J. (1983). Nutritional Ecology of the Ruminant. O and B books, Corvallis OR.

Warner A.C.I. (1964). Production of volatile fatty acids in the rumen, method of measurements. *Nutr Abstr. Rev*. **34**, 339.