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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

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ABSTRACT

This study was carried out to evaluate the effect of feeding different levels of fodder beet roots in replacement of Concentrate Feed Mixture (CFM) on the nutritive values, productive performance and economical efficiency of ewes and dairy goats. Four rations were evaluated during the first. The control ration consisted of CFM and rice straw. Three tested rations were formulated so that 35, 50 and 65% of CFM were replaced by fodder beet roots. In the second trial, ration 3 which showed the highest feeding value and had the highest possible replacement without negative effects was compared with the control ration in a feeding trial. 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). All animals were in positive N-balance. There were no significant effects on birth weight, weaning weight and daily weight gain of kids or lambs due to feeding their dams on fodder beet. Dairy goats and ewes fed on fodder beet roots produced more milk than the control by about 12.09 and 24.38%, respectively. Therefore, replacement of fodder beet roots up to 50% from CFM in dairy goats and ewes diets improved milk yield, productive performance, economical efficiency, decreased feed cost and can participate in solving the problem of feed stuffs shortage in North Sinai.

Key words: Fodder beet, dairy goats, ewes, milk production, economic efficiency, productive performance

INTRODUCTION

Food shortage is becoming critical, particularly in the developing countries, due to the over-increasing population. In Egypt in general and new reclaimed desert lands in particular, there is a great shortage in animal feed stuffs particularly during summer season and early autumn (Yousef, 2005). In recent years, the price of energy sources had dramatically increased with the increase demand for animals feeding. The increases of feed prices encouraged nutritionists to search for cheaper high energy feed ingredients (Suliman and Moustafa, 2008). Many attempts have been made to introduce unconventional new forages, especially for the summer season when animals are under-fed (Gabra and Gad, 1999). New reclaimed lands have a large potential in expanding animal production through forage cultivation. In the low land regions of Europe, hay and fodder beet are common components of the basal diets for dairy cows during winter (Collomb *et al.,* 2004).

Fodder beet when grown under suitable conditions, can produce almost 21 ton dry matter h^{-1} (DAF, 1998) compared with 13-15 ton DM h^{-1} from four harvests of grass. Approximately 75% of fodder beet DM is present in the roots (DAF, 1998).

In Egypt, the TDN and Digestible Crude Protein (DCP) values of fodder beet roots were higher than those of Berseem Hay (BH) or Sugar Beet Pulp (SBP) as reported by Helal *et al.* (1998). The obtained TDN and DCP values for fodder beet roots were 75.94 and 7.83%, respectively. The corresponding values for BH and SBP were 50.4, 6.6, 72.1 and 5.7%. Gabra and Gad (1999) reported that the average yield/feddan of fodder 117% TDN (4.44 vs 3.81 ton/F) and 57% DCP (0.46 vs 0.80 ton) compared to the values of one feddan of berseem.

Fodder beet is an important winter forage crop. It is very promising in North Sinai because it is tolerant to high soil salinity and somewhat low water requirement. It's total yield, above and under the ground, can directly be used in animal feeding or may be processed as silage. The roots can also be stored in the soil for a period of time without being greatly damaged, thus used when needed. Therefore, cultivation may help in overcoming the problem of animal feeding shortage in summer season (El-Sarag, 2004; El-Kassas, 2008).

Under North Sinai conditions, the average yields of feddan fodder beet roots were 8.77, 5.7 and 4.3 ton DM when irrigated every 3, 5 and 7 days, respectively (El-Kassas, 2008).

Fodder beet roots could be successfully used a good source of energy for animal feeding (Gabra and Gad, 1999; Eriksson *et al.*, 2004), sheep (Gabra *et al.*, 1993; Gabra and Gad, 1999; Hartnell *et al.*, 2005; Nkosi and Ratsaka, 2010), lactating dairy cows (Gabra *et al.*, 1992; Fisher *et al.*, 1994; Muller *et al.*, 1994; De Brabander *et al.*, 1995, 1999; Phipps *et al.*, 1995; Birkenmaier *et al.*, 1996; Deininger *et al.*, 1996; Ferris *et al.*, 2003; Mogensen and Kristensen, 2003; Collomb *et al.*, 2004; Keogh *et al.*, 2009) beef cattle (Maloney and Kiely, 1999) and fattening bulls (Fiems *et al.*, 1992) and a good quality silage (Maloney and Kiely, 1999; Eriksson *et al.*, 2004) and biogas production (Klocke *et al.*, 2007; Scherer *et al.*, 2009).

Several studies were carried out in Egypt to evaluate and use fodder beet roots in animal feeding (Gabra *et al.*, 1992, 1993; Gabra and Gad, 1999).

This study aimed to evaluate partial replacement of CFM by fodder beet roots in rations of small ruminants (ewes and does) on the digestibility coefficients and nutritive values, milk yield and milk composition and growth performance of their lambs or kids.

MATERIALS AND METHODS

This study was carried out in the farm Animal Production of Department, Faculty of Environmental Agricultural Sciences, El-Arish, Suez Canal University. The climatic characteristics of this region is semi-arid (Long. 33.75 E., Lat. 31.27 N.) with an average annual rainfall of about 94mm and average ambient temperature of about 20.47°C (average 10 years from 2000 to 2009) (CLAC, 2008).

The experimental work of this study was divided into two successive trials. During the first trial, digestibility and nitrogen balance trials were conducted before the commencement of the feeding trial to evaluate the experimental diets. Three Awassi ram lambs were used for each group. Animals were kept in individual metabolic cages. Each trial lasted 21, 14 days as a preliminary period followed by 7 days for total fecal and urine collection. The control ration (TI) was a basal diet consisting of CFM and rice straw to cover their nutritional requirements according to NRC (1985). Three tested rations (2nd, 3rd and 4th rations) were formulated so that 35, 50 and 65% of CFM was replaced by fodder beet roots. They were offered *ad lib.* plus 100 g rice straw/head/day In the second trial, ration 3 which showed the highest feeding value and had the highest possible replacement without negative effects was chosen and compared with the control ration in a feeding trial conducted using 10 ewe lambs and 10 doe goats which were divided into two similar groups of 5 animals per species.

Fodder beet roots were chopped to about 2-3 cm length. The CFM was offered twice a day in almost two equal portions at 8.00 a.m and 4.00 p.m whereas rice straw was offered at 9.00 a.m while fodder beet roots were offered at 10.00 a.m. Refusals were collected just before offering the next day feed. Mineral and vitamins blocks were fixed among cages to enable animals for licking when ever they require and fresh water was available at all time.

Samples of the experimental ingredients and fodder beet roots were taken for chemical analysis at the beginning of the collection period of the digestibility trials and the chemical composition of the consumed rations were calculated. During the collection period, total daily excreted feces were weighed then samples of 10% of the total daily collection period were dried in an oven at 65°C for 48 h. At the end of the collection period, dried fecal samples of each ram lamb were mixed, ground and kept in plastic vials for laboratorial analysis.

Urine volume was daily measured then 5% representative samples were collected and used for determination of daily urinary N.

Productive performance: In the second trial, ten ewe lambs and 10 doe goats, with an average live body weight of 38.2 and 36.5 kg, respectively were used in the 2nd trial. Ewe lambs and does were divided into two groups of 5 animals for each species one week prior to the expected date of parturition. The control group (T1) was fed a basal diet consisting of CFM and rice straw to cover their nutritional requirements according to NRC (1985 and 1981). While the second group (G2) was fed the tested ration (T3 of the first trial in which fodder beet roots replaced 50% of CFM) *ad lib.* plus 100 g rice straw of each animal/day. Lambs and kids born from the two groups suckled their dams for one month and were then fed on barley till weaning (14 weeks). Fresh water was available at all time. The animals of each group were fed and housed in a 6×10 m^2 semi-open shaded pens. All ewes and does delivered single lambs or kids.

Daily milk yield for each ewe lambs or does were measured individually twice/day (every 12 h) by suckling lambs or kids, once every two weeks until 8 weeks of suckling. After 8 weeks from lactation, the daily milk yield for each ewe or doe was measured by hand milking twice until the end of the suckling period. The lambs or kids were separated from their dams at 16.00 p.m prior to the day of measuring, lambs or kids were weighed immediately before and after suckling and hand milking of the residual milk in the udder. The differences between the lambs or kids weights were recorded before and after each suckling were added together with the residual milk denoting milk yield (Mousa, 1996).

Averages of daily milk yield and total milk yield during the suckling period and lambs or kids weaning weights were recorded. Milk samples form consecutive morning and evening milking were taken monthly during the experimental period in the end of the 2nd and 3rd month of lactation period and stored at-20°C for analysis. Milk samples were analyzed for percentage of fat, protein, lactose, Total Solids (TS) and ash by milk SCAN 133 BNF OSS Electric, Denmark.

Lambs or kids were weighed after parturition and every two weeks until the end of suckling period.

Data were subjected to statistical analysis by the computer program of SAS (1996) using the General Linear Models (GLM). Differences among treatment means were tested for significance ($p<0.05$) using Duncans multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The dry and feed units yield as TDN and DCP of fodder beet roots (ton/feddan) are presented in Table 1. Regarding the yields of fodder beet roots, dry matter, TDN, SV and DCP under North Sinai conditions were higher than those obtained by Gabra and Gad (1999) being, 5.59,4.44,4.15 and 0.46, respectively .The average yield of fodder beet roots, represents 98.56% DM , 121.6% TDN and 59.6% DCP compared to the values of one feddan of berseem.

The first trial

Chemical composition of the ingredients and the experimental rations: The chemical composition of the ingredients used to formulate the experimental rations (Table 2) was within the normal ranges published in Egypt (Shalaby *et al.*, 1989a, b; Gabra and Gad, 1999; El-Sarag, 2004; El-Kassas, 2008).

Table 2 shows that Nitrogen Free Extract (NFE) was higher in fodder beet roots than CFM while Crude Protein (CP); Crude Fiber (CF) and ash were lower than CFM. These results are in agreement with those reported by Shalaby *et al.* (1989a), Gabra and Gad (1999), El-Sarag (2004) and El-Kassas (2008).

The nutrient composition indicated that fodder beet roots contained high levels of NFE, therefore it could be considered as a rich source of energy. These results are in agreement with those obtained by Shalaby *et al.* (1989a, b) and Gabra and Gad (1999). The proximate analyses of the experimental rations are presented in Table 2. The control ration (TI) had higher DM% than rations 2, 3 and 4 because of the higher moisture content in fodder beet roots. Ration 4 (65% fodder beet roots) had lower CP and CF contents but higher NFE than the other rations.

However, increasing fodder beet roots replacement level from 35 to 65% instead of CFM of the ration decreased CP and CF contents. These results are reflections of the composition of the two ingredients and their proportions in the ration. Similar trends were reported by Hassounna *et al.* (1988, 1989) and Darwish *et al.* (1989) who found that increasing fodder beet roots level from 21 to 45% of the ration decreased CP and CF%.

Table 1: The yield of fodder beet roots (ton/feddan) under North Sinai conditions compared to berseem

	DM*		TDN**		DCP**	
Feed	Yield	(%)	Yield	(%)	Yield	(%)
Fodder beet roots	6.101	98.56	4.633	121.60	0.477	59.6
Berseem**	6.19	100	3.81	100	0.80	100

DM: Dry matter, TDN: Total digestible nutrients, DCP: Digestible crude protein. *Data cited from El-Kassa (2008). **According to Gabra and Gad (1999)

Table 2: Chemical composition of the ingredients and the calculated chemical composition of the consumed rations (%)

		On DM basis					
Ingredients	DM	OM	CP	EE	CF	NFE	ASH
Concentrate feed mixture (CFM)	89.50	90.09	16.92	2.91	11.70	58.56	9.91
Fodder beet roots	13.52	91.22	9.73	2.85	8.60	70.04	8.78
Rice straw	90.91	81.58	3.36	1.27	35.50	41.45	18.42
Ration 1	89.79	88.31	14.09	2.56	16.67	54.99	11.69
Ration 2	62.48	89.73	13.12	2.74	12.74	61.13	10.27
Ration 3	53.29	89.85	12.23	2.73	12.40	62.49	10.15
Ration 4	43.67	89.99	11.32	2.72	12.01	63.94	10.01

DM: Dry matter, OM: Organic matter. CF: Crude fiber, CP: Crude protein, NFE: Nitrogen free extract, ASH: Ash contents, EE: Ethet extract

Digestibility coefficients: Digestibility coefficients of the experimental rations are presented in Table 3. Insignificant ($p<0.05$) differences were observed among ration 1, 2, 3 and 4 in digestibility coefficients for DM, OM, EE and NFE. On the other hand, increasing fodder beet roots level from 35 to 65% from CFM ration significantly ($p<0.05$) decreased CP and CF from 75.54 to 72.80% and 62.07 to 55.9%, respectively. These results agreed with those obtained by Darwish *et al.* (1989) who reported that increasing fodder beet roots level from 21 to 45% of the ration decreased CP digestibility from 79.29 to 70.79%. Gabra and Gad (1999) found that average digestion coefficients for fodder beet roots of DM, CP, EE, CF and NFE were 76.2, 69.82, 55.27, 50.94 and 82.24%, respectively.

The decrease in CP digestibility may be due to the high content of NPN (about 71% of total N) in fodder beet roots as noted by Castle *et al.* (1961). Moreover, Shalaby *et al.* (1989b) reported that digestion coefficients of DM, OM, CP, EE, CF and NFE for fodder beet roots were 77.5 80.9, 69.3, 53.3, 50.7 and 86.4%, respectively. On the other hand, Hartnell *et al.* (2005) reported that apparent digestibility of DM, OM and DE of fodder beet were each above 80%. While, Muller *et al.* (1994) reported that inclusion of fodder beet roots in diets of lactating cows increased digestibility of DM and energy in the total diet while digestibility of crude fiber remained unchanged.

In addition, Ferris *et al.* (2003) reported that fodder beet inclusion increased the digestibility of DM, GE and OM ($p<0.05$) while decreasing the digestibility of NDF ($p<0.05$) for dairy cows. Also, Nkosi and Ratsaka (2010) found that digestion coefficients of DM, OM, CP and CF for dietary inclusion of discarded beet root were 90.1, 90.8, 87.8 and 81.6, respectively for South African Dorper lambs.

On the other hand, El-Badawi and El-Kady (2006) found that digestibility of both CP and EE decreased with feeding a mixture containing 50% (w/w) 3% ureated sugar beet pulp while CF digestibility was extremely higher than that of the traditional feed mixture for growing sheep. Also, Eweedah *et al.* (1999) found that both CP and EE digestibilities were significantly decreased by feeding Merino lambs rations containing sugar beet pulp in replacement of grains or concentrate mixture.

Feeding values: Table 3 illustrates the nutritive value expressed as total digestible nutrients (TDN%) and digestible crude protein DCP% of the experimental diets. The highest TDN% value was that of ration 3. Total digestible nutrients TDN% in ration 3 (67.36) was higher than other rations, ration 1 (65.39%), ration 2 (66.69%) and ration 4 (66.44%)

Darwish *et al.* (1989) reported that fodder beet roots could be included at a level of 49% on DE basis for calves. Also, Shalaby *et al.* (1989b) reported that TDN% for fodder beet roots was 73.4.

The DCP% values of the experimental rations are shown in Table 3 the DCP% of the ration 1 (10.72) was significantly ($p<0.05$) higher than the other rations 2 (9.91), 3 (8.98) and 4 (8.24).

The high DCP% value of ration 1 (control) may be due to increased CFM in ration 1 than other rations and high level of CP.

The TDN and DCP values of fodder beet roots were higher than those of berseem hay or sugar beet pulp reported by Helal *et al.* (1998).

Gabra *et al.* (1993) found that TDN and DCP for the fresh fodder beet roots were 77.91 and 7.81%, respectively. Also, Gabra and Gad (1999) reported that TDN and DCP values for fodder beet roots were 75.94 and 7.33, respectively.

Table 3: Digestion coefficients and nutritive values of the experimental rations

	Experimental rations			
Items	1	2	3	4
Digestion coefficients (%)				
DM	69.16±0.45	70.06±1.54	69.94±0.75	69.74±1.06
OM	72.27±0.71	71.36±0.80	72.31±0.58	71.97±0.59
CP	76.15±0.71[a]	75.54±1.08[ab]	73.41±0.20[bc]	72.80±0.56[c]
EE	63.43±1.30	63.96±0.78	65.80±1.67	64.85±1.10
CF	64.25±0.32[a]	62.07±0.50[b]	61.16±0.70[b]	55.90±0.53[c]
NFE	73.29±0.70	74.90±0.77	75.16±0.19	74.32±0.75
Nutritive values (%)				
TDN	65.39±0.52	66.69±0.30	67.36±0.49	66.44±0.85
DCP	10.73±0.10[a]	9.91±0.14[b]	8.98±0.02[c]	8.24±0.06[d]

DM: Dry matter, OM: Organic matter, CP: Crude protein, CF: Crude fiber, NFE: Nitrogen free extract, TDN: Total digestible nutrients, DCP: Digestible crude protein. EE: Ethet extract, *Data cited from El-Kassa (2008). **According to Gabra and Gad (1999), [a,b and c]Means bearing different superscripts within the same row differ significantly (p<0.05)

Nitrogen balance: Results of the N-balance are presented in Table 4. Generally, all animals receiving the four tested rations were in positive N balance. Animals fed ration 1 (control) had more (p>0.05) N-intake than other rations. The values were 24.22, 20.61, 18.71 and 17.11 g/h/d for rations 1, 2, 3 and 4, respectively. The same trend was recorded for fecal N, N digested and urinary N. Animals fed the control diet had more (p>0.05) N-balance than other rations.

Animals fed ration 2 and 3 (replacing 35 and 50% of CFM by fodder beet roots) had more (p>0.05) N-balance than rations 4 (replacing 65% of CFM by fodder beet roots).

When the N-balance was expressed as a percentage of NI, it was found that N-balance of the rations 2 (36.50), 1 (35.72), 4 (35.59) were higher than ration 3 (34.86). When N-balance was calculated as a percentage of N-D, it was found that the N-balance of rations 3 was highest (52.13%), followed by ration 2 (50.59%) and ration 4 (49.37%) while ration 1 was lowest (49.25%).

The second trial

Body weight of the dams and born offsprings: Body weights of the dams in both groups of both species at parturition were nearly similar (Table 5). The changes in live body weights of the does or ewes from parturition until the end of the suckling period indicated slight gains in live body weight. However, the differences between the two treatments were not significant (p<0.05). These results agreed with those obtained by Mousa (1999).

Productive performance of does and ewes: The body weights of the kids or lambs at birth and weaning are presented in Table 6. The birth weight, weaning weight and daily gain of kids and lambs were not significantly affected by the two experimental rations during the suckling period. Similar results were obtained by Abd El Gawad (1996) who reported that the feeding level of dams did not significantly affect birth weight for Rahmani ewes.

Similar birth weights were recorded for Barki and Zaraibi kids (Mohamed, 1990), Sinai kids (El-Gayar, 1994) but were lower than those were reported by El-Shabrawy (2006) for Zaraibi kids.

Similar birth weights were recorded for Rahmani lambs (Abd El Gawad, 1996) but were lower than those of Awassi lambs in North Sinai (Mousa,1999, 2001) and lower than those reported for Awassi lambs in Iraq (Al-Jalili *et al.*, 2006). Then variations among different studies are most probably being due to different parities of dams.

Table 4: Nitrogen balance of lambs fed the experimental rations

	Experimental rations			
Items	1	2	3	4
N-Intake (g/h/d)	24.22±0.07[a]	20.61±0.14[b]	18.71±0.06[c]	17.11±0.10[d]
Fecal-N (g/h/d)	6.64±0.33[a]	5.74±0.26 [ab]	5.20±0.71[b]	4.77±0.20[b]
N-digested (g/h/d)	17.57±0.38[a]	14.86±0.12[b]	13.50±0.18[c]	12.33±0.13[d]
Urinary-N (g/h/d)	8.92±0.33[a]	7.35±0.27[b]	6.55±0.19[bc]	6.25±0.14[c]
N-balance (g/h/d)	8.65±0.14[a]	7.52±0.21[b]	6.95±0.22[c]	6.09±0.04[d]
NB/NI×100	35.72±0.49	36.50±1.14	34.86±0.33	35.59±0.39
NB/ND×100	49.25±0.94	50.59±1.59	52.13±1.77	49.37±0.69

[a,b and c] Means bearing different superscripts within the same row differ significantly (p>0.05)

Table 5: Live body weight of the dairy goats and ewes during suckling period as influenced by feeding beet roots (X±SE)

	Does		Ewes	
Items	Control	Fodder beet root	Control	Fodder beet root
Live body weight after				
Parturition (kg)	30.62±1.12	31.12±0.75	31.12±0.48	32.10±1.00
During suckling				
1st month	27.88±1.36	29.87±1.23	30.25±0.75	30.78±0.97
2nd month	30.75±0.96	31.87±0.83	32.00±0.79	31.10±1.10
3rd month	32.60±0.95	33.01±0.72	33.25±0.78	32.00±1.03

All differences between the two rations for each species were not significant (p>0.05)

Table 6: Productive performance of does and ewe lambs as affected feeding fodder beet (× SE)

	Does		Ewe lambs	
Items	Control	Treatment	Control	Treatment
No. born	5 (2♂+3♀)	5 (2♂+3♀)	5 (2♂+3♀)	5 (2♂+3♀)
Birth weight (kg)	2.07±0.15	2.15±0.10	2.88±0.09	2.96±0.08
Weaning weight (kg)	10.74±0.29	11.15±0.22	14.05±1.05	14.11±0.72
Weaning age (day)	84	84	87	87
Total gain (kg)	8.67	9.00	11.17±1.01	11.15±0.66
Average daily gain (g)	103.21±3.82	107.13±3.11	128.39±11.80	127.13±6.79
Total milk yield (kg)	88.33±4.22	99.01±4.67	45.07±0.94[b]	56.06±3.78[a]
Lactation period (day)	84	84	87	87
Average milk yield (g)	1050.0±49.56	1180.0±55.74	518.0±5.54[b]	644.3±30.3[a]

[a,b]Means bearing different superscripts within the same row differ significantly (p>0.05)

Weaning weight of kids of ration 2 (replacing 50% of CFM by fodder beet roots) tended to heavier than kids of control ration. While weaning weight of lambs for control and treated groups were similar, being 14.05 and 14.11 kg, respectively.

Milk yield and composition: Data of total milk yield, average milk yield are presented in Table 6. Total milk yield and average milk yield tended to increase with replacing CFM by fodder beet roots in the tested ration but the differences between the control ration and treatment ration for does was not significant but significant for ewes. Similar results obtained by Collomb *et al.* (2004).

The present results indicated that feeding does or ewes on the tested ration (replacing 50% of CFM by fodder beet roots) increased total milk yield and average milk yield by 12.10, 12.38 and 24.38 and 24.38%, respectively compared with control ration. These results may be due to the inclusion of fodder beet roots in ration that had higher DMI and TDNI than the control. Similar results were reported on dairy goats by Abd El-Rahman *et al.* (2003). Niazi *et al.* (2000) reported that fodder beet is used as a valuable source of food for cattle, due to its higher water and sugar content which increased milk production and was considered as a suitable forage for dairy cows.

Gabra *et al.* (1992) found that replacement of 40% of a concentrate feed mixture with fodder beet roots resulted in increasing feeding value, daily feed intake and milk yield. When fodder beet was ensiled together with whole maize crop, it positively affected milk yield and fat content whereas protein content remained unchanged (De Brabander *et al.*, 1995). Phipps *et al.* (1995) incorporated fodder beet into a forage mixture for dairy cow fed diets based on grass silage. Their results showed that maize silage, brewer's grains and fodder beet all produced similar increase in milk yield.

However, these obtained results are in agreement with those reported by Fisher *et al.* (1994) and Phipps *et al.* (1995) although positive milk yield response to the inclusion of fodder beet was observed by Phipps *et al.* (1995) also Fisher *et al.* (1994) reported that the fodder beet tended to increase milk yield. Also, Ferris *et al.* (2003) reported that the inclusion of fodder beet had no significant effect on milk yield ($p<0.05$).

On the other hand, milk yield decreased linearly with increasing fodder beets on average up to 4 kg DM/cow/d. for German simmental×Red Holstein Friesian cows (Birkenmaier *et al.*, 1996). While, Mogensen and Kristensen (2003) found that the supplement of fodder beets compared to barley resulted in milk reduction which could be expected because of the lower energy supply.

The total milk yield of Awassi ewes in the present study is similar to that of Sohagi ewes Kassab *et al.* (2009) but lower than those reported for Awassi ewes in North Sinai by Mousa (1999) and Mousa and Shetaewi (2002). Such variability may be due to the different parities of ewes. Further explanations were reported by Abd El-Karim (1981) and Latif *et al.* (1988) who reported that many factors may affect milk yield such as breed of ewes, number of suckled lambs, feeding level and parity of ewes.

Also, the average daily milk, yield for does in the present study are similar to those of Desert Barki (Haider, 1994), Zaraibi does in mid-lactation (El-Shabrawy *et al.*, 2004; Shehata *et al.*, 2006) but lower than those reported for Egyptian-Nubian goats (Mousa, 1996) and Zaraibi goats (El-Shabrawy, 2006).

The daily milk yield of Awassi ewes and does reached the peak at the 2nd week of lactation (Table 7) then gradually decreased till the end of lactation. In this respect, Mousa (1999) reported that daily milk of Awassi ewes reached the peak at 2nd week of lactation in control and treatment 3 and the 4th week of lactation in treatment 2. Also, Kassab *et al.* (2009) found that lactation reached the peak at the 2nd week of lactation for Sohagi ewes. Similar results were obtained by Hayder (2004), Hamdon (2005) and El-Medany (2005) for different sheep breeds.

Data of milk composition for does and ewes are shown in Table 8. The percentages of fat, protein, lactose, solids not fat and total solids for ewe lambs in morning and evening milk were not significantly different among control ration and treatment ration. These results agreed with those obtained by Collomb *et al.* (2004). Similarly, Moustafa *et al.* (2008) reported insignificant differences among treatments for milk protein, total solids and solids not fat content of Egyptian lactating buffaloes fed ration containing olive pulp compared to the control animals. El-Kassas *et al.* (2005) and Talha *et al.* (2005) also reported that milk composition with respect to

Table 7: Average milk yield (g) at weekly intervals for does and ewe lambs as affected by feeding fodder beet roots (×±SE)

	Does		Ewes	
Items	Control	Treatment	Control	Treatment
Week of lactation				
2	1325.0±75.0	1555.0±113.8	722.5±35.67	770.0±51.0
4	1225.0±47.8[b]	1555.0±91.40[a]	632.5±22.86	730.0±56.3
6	1110.0±42.7[b]	1392.5±51.40[a]	577.5±17.97	692.0±34.98
8	932.5±82.39	1095.0±100.7	460.0±16.88	639.0±18.05
10	765.0±105.3	872.5±116.3	422.5±11.08	545.0±30.03
12	615.0±121.5	632.5±106.5	315.0±13.23	455.0±39.17
Lactation period (day)	84	84	87	87
Total milk yield (kg)	88.33±4.22	99.01±4.67	45.07±0.94[b]	56.06±3.78[a]
Daily milk yield (g)	1050.0±49.56	1180.0±55.74	518.0±5.54[b]	644.3±30.3[a]

[a, b]Mean with in different superscripts within the same row for each species differ significantly (p<0.05)

Table 8: Effect of feeding fodder beet roots on milk composition of dairy goats and ewes

	Dairy goats		Ewes	
Items	Control	Treatment	Control	Treatment
Average milk yield at morning	579	649.5	298.40	367.20
Suckling period (day)	84	84	87.00	87.00
Morning milk				
Milk protein (%)	3.31±0.09	3.66±0.23	4.84±0.21	4.81±0.10
Milk fat (%)	2.90±0.25	2.75±0.16	4.40±0.31	4.28±0.36
Milk lactose (%)	4.28±0.10[b]	4.74±0.16[a]	5.31±0.25	5.46±0.16
Solids not fat (%)	8.19±0.15[b]	9.02±0.32[a]	10.75±0.13	10.88±0.17
Total solids	11.09±0.35	11.77±0.40	15.15±0.031	15.15±0.36
Average milk at evening (9)	471	530.5	219.60	277.10
Evening milk				
Milk protein (%)	3.35±0.07[b]	3.62±0.07[a]	5.21±0.16	4.83±0.09
Milk fat (%)	3.04±0.13	2.76±0.17	5.22±0.32	4.86±0.35
Milk lactose (%)	4.31±0.08[b]	4.92±0.18[a]	5.42±0.14	5.40±0.08
Solids not fat (%)	8.26±0.13[b]	9.16±0.19[a]	11.23±0.24	10.75±0.09
Total solids	11.30±0.22[b]	11.92±0.15[a]	16.46±0.35	15.68±0.37

[a,b]Means bearing different superscripts within the same row for each species are significantly different (p<0.05)

percentages of fat, protein, lactose, total solids and ash were not significantly different among ewes fed rations containing canola or peanut hulls, respectively.

Milk composition with respect to percentages of protein, fat and total solids for does in the morning milk were not significantly different among the two rations while milk lactose and solids not fat were higher ($p>0.05$) for does fed fodder beet roots than control ration. The composition of evening milk revealed that milk fat was not significantly different among the two rations. In contrast, milk protein, lactose, solids not fat and total solids% of does fed fodder beet roots was significantly ($p>0.05$) higher than those fed the control ration. It is noted that milk fat content is higher in control ration for does and ewes than treatment ration. Results obtained in milk composition revealed that, milk content (%) of protein, lactose, solids not fat and total solids were higher in do feed fodder beet roots than does control. These significant differences could be fairly attributed to the higher DMI and TDNI from the tested diet containing fodder beet roots (50%

replacement of CFM) than from the control diet. Similar results were reported on dairy goats by Abd El-Rahman *et al.* (2003).

In general, milk composition of doe's milk obtained in the present study (percentages of protein, lactose and solids not fat) are similar to those obtained by El-Shabrawy *et al.* (2004) for Zaraibi goats. On the other hand, Collomb *et al.* (2004) reported that milk yield and milk composition of cows were not significantly affected when the control diet (hay *ad libitum* and 15 kg fodder beet) was supplemented with either 1 kg ground rape seed, 1 or 1.4 kg ground linseed, or 1 or 1.4 kg ground sun flower seed.

Fisher *et al.* (1994) reported that fodder beet tented to increase milk composition and yield of constituents but the effect was statistically significant for milk protein only ($p<0.01$).

Birkenmaier *et al.* (1996) reported that the milk composition was scarcely influenced, the fat content increased a little, the mean alteration of protein and lactose content were below 0.1 percentage points.

Mogensen and Kristensen (2003) reported that the supplementing fodder beets did not affect milk composition compared to the total mixed ration with barley for dairy cows. Ferris *et al.* (2003) reported that milk fat content was unaffected by the level of concentrate or by the inclusion of fodder beet ($p<0.05$) whereas milk protein content showed a significant increase with increasing levels of concentrate supplementation and inclusion of fodder beet in the diet ($p<0.01$). Also, Keogh *et al.* (2009) reported that cows offered fodder beet pre-partum had greater milk solids and fat corrected milk yield in the first 35 days of lactation than those offered Kale and grass silage pre-partum.

Feed intake and economical efficiency: The average of DM intakes for dairy goats and ewes fed the experimental diets are presented in Table 9. The DM intakes (g/head/day) were 1236 and

Table 9: Effect of feeding fodder beet roots on dry matter intake and economical efficiency of does and ewes

	Does		Ewes	
Items	Control	Treatment	Control	Treatment
DM intake (g/h/d)				
Rice straw	268	90	274	90
Fodder beet roots		650		619.1
Concentrate	968	695	927	584
Total DM intake	1236.66 ± 50.28^{b}	1435.83 ± 23.36^{a}	1201.5 ± 54.18	1293.1 ± 24.27
Roughage : concentrate	21.6:78.4	51.6:48.4	22. 8:77.2	55 : 45
The cost of the feed intake (LE)	1.67	1.42	1.60	1.25
Daily TDN intake (g)	808.22 ± 33.01^{b}	966.61 ± 17.65^{a}	785.33 ± 37.61^{b}	871.03 ± 16.41^{a}
Daily DCP intake (g)	132.50 ± 5.08	128.86 ± 2.46	128.74 ± 6.14	116.12 ± 2.16
Feed efficiency				
DMI : milk yield	1.18 ± 0.03	1.21 ± 0.04	2.32 ± 0.02^{a}	2.01 ± 0.07^{b}
TDN: milk yield	0.77 ± 0.03	0.82 ± 0.03	1.51 ± 0.08	1.35 ± 0.02
DCP: milk yield	0.126 ± 0.004	0.109 ± 0.003	0.248 ± 0.01^{a}	0.180 ± 0.01^{b}
Daily milk yield (g)	1050 ± 49.56	1180 ± 55.74	518.0 ± 5.54^{b}	644.3 ± 3.3^{a}
Economical efficiency*	2.20 ± 0.08^{b}	2.91 ± 0.10^{a}	1.29 ± 0.01^{b}	2.06 ± 0.07^{a}
Improvement %	100	132.27	100	159.69

^{a,b}Means bearing different superscripts within the same row for each species are significantly different ($p<0.05$). *The price of CFM, does rice straw, fodder beet roots, milk (goats) and milk (sheep) = 1500, 200, 60, 3500 and 4000 L.E ton^{-1}, respectively

1435 and 1201 and 1293 for does fed and ewes fed the control and tested ration, respectively. The results showed that does and ewes consumed more DM from the tested ration than from the control ration by 16% and 7.66, respectively. The increase in DM intake was significant (p<0.05) only with The intake in terms of TDN was significantly (p<0.05) more for the tested ration than from the control for both species. On the other hand, there were no differences in DCP intakes between both diets within each species. Such finding is in agreement with those reported by Gabra *et al.* (1992) who found that replacement of 40% of a concentrate feed mixture with fodder beet roots resulted in increase feeding value, daily feed intake and milk yield. Also, Gabra and Gad (1999) reported that substituting maize silage and concentrate by fresh fodder beet had a positive effect on dry matter intake.

Fodder beet inclusion in the tested ration (replacing 50% from CFM by fodder beet roots) reduced the feeding costs during the whole period (Table 9). The highest total feed cost along the feeding period was observed for the control diet, being 1.67 L.E. followed by the tested ration (50% fodder beet roots) 1.42 L.E. for does and 1.60 L.E. for the control diet and lowest was 1.25 L.E. of ration 2 (50% fodder beet roots) for ewes, due to the lower price of fodder beet and higher price of CFM.

Economical efficiency (price of milk/cost of consumed feed) illustrated in Table 9 revealed that ration 2 (replacing 50% from CFM by fodder beet roots) had the best economical feed efficiency (2.91) and (2.06) compared to the control ration (2.20) and (1.29) for dairy goats and ewe lambs, respectively.

The same trend was noticed for the improvement% since the values were 100 and 132.27 and 100 and 159.7 for dairy goats and ewe lambs, respectively. The results are in agreement with those reported by El-Kerdawy(1997), Abd El-Galil (2001), Mousa (1999, 2001), Mousa and Abd El-Samee (2002), Abd El-Rahman *et al.* (2003) and Mostafa *et al.* (2003) who found that the feed cost per kg gain was relatively lower than the control when sheep, growing rabbits were fed rations containing 15-40 olive pulp. Also, Mousa and Shetewi (2002), Mousa and El-Shabrawy (2003) and Mousa (2011) reported that the feed cost was relatively lower than control when goats and sheep were fed rations contained 30-40% acacia.

CONCLUSION

In conclusion, results of the present study indicated that feeding sheep and goats on fodder beet roots can maintain animal productivity, to save about 50% of the rations concentrate feed mixture and to increase milk yield and improve it's components. This would lead to encourage sowing fodder beet especially in new reclaimed lands in North Sinai to participate in solving of feed stuffs shortage and the problem of green forage shortage during summer.

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