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Response of Lactating Zaraibi Goats to Diets Containing Sesbania and Kochia Silages as a New and High Source of Protein

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Abstract

This work was carried out on lactating goats to investigate the effect of replacing concentrate feed mixture (CFM) protein by some types of silages on milk production, feed conversion efficiency and some metabolic parameters as well as economic efficiency. Twenty eight dairy Zaraibi goats were divided into 4 groups (7 does each). Treatments tested were 40% CFM + 60% maize silage (G1), 30% CFM + 70% mixture silage (50% maize + 50% sesbania) (G2), 30% CFM +70% mixture silage (50% maize +50% kochia) (G3) and 30% CFM +70% mixture silage (50% sesbania + 50% kochia) (G4). The feeding trails lasted 16 weeks. In addition, twelve adult Zaraibi males (each 3 males were fed one of the tested 4 diets) were used in digestion trails to evaluate the feeding values of the experimental rations. The obtained results showed that the contents of crude protein (CP), acid detergent fiber (ADF) and cellulose were decreased with maize silage compared with the other types of silage mixtures. Meanwhile, the highest values of ether extract (EE), nitrogen free extract (NFE) and hemicellulose were recorded with maize silage. The minerals analysis indicated also that Ca, Mg, K and Mn contents were higher, while Zn and Cu were markedly lower in maize silage than the three silage mixtures. The obtained data indicated that the digestion coefficients of all nutrients and DCP were decreased with control group (G1) compared with the three tested rations and differences were significant in DCP only. Ruminal pH values were not significantly affected by treatments. While ammonia–N and microbial protein concentrations tended to be higher with silage mixtures compared with control group and the differences were significant at 3 and 6 hrs post-feeding. Also, ruminal TVF's concentrations post–feeding were significantly affected by tested rations and the highest values were recorded with G2. Concerning blood profile, the obtained data showed that the tested rations positively affected some hematological parameters such as Hb, RBC's, MCHC and lymphocytes. Moreover, serum globulin, total protein and phosphorus were higher, while ALT activity was lower in all tested groups than the control group. As for milk production, the results indicated that the highest yield was recorded with G2 followed by G3 then G4, while the lowest with G1 and the differences were significant. It is interesting to note a negative relationship between SCC and milk yield. The effect of experimental rations on milk constituents and milk quality

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(pH and acidity) was not significant. Moreover, the feed conversion efficiency, based on DM and TDN, was better with the three tested rations compared with the control. In addition, the economic efficiency was noticeably higher by 33.73, 29.76 and 27.78with the three tested rations (G2, G3 and G4, respectively) compared with the control. Accordingly, it could be concluded that replacement of up to 10% of CFM-protein by some types of silage mixtures has some positive effect on metabolic parameters which reflected on dairy goat's performance and economic efficiency.

Introduction

The shortage in animal feeding stuffs in Egypt is main constraint for any further increase in animal population. There are about 12 million animal units and the fresh forage area is about 3 million Fadden (4200 m^2) (Hanafy et al., 2013). According to national policy, the cultivated area with clover must be decrease to increase the cultivated area with wheat to satisfy human demands. Several studies (Tag El-Din,1991; Shehata et al., 2001; Maged et al., 2014) indicated that wild plants as kochia could be used as a good quality forage for ruminants because of its high content of crude protein and feeding values, especially when harvested during earlier growth stage. Moreover, Fahmy and Afaf (2000) reported that both sheep and goats were in a good nutritional status when fed on *Kochia indica* diets and it could be highly recommended to use *Kochia indica* hay, particularly during the summer season as good quality roughage instead of berseem (clover) hay.

Moreover, Soliman et al. (1997) and El-Kholany (2004) stated that the value of CP digestibility and DCP were higher with sesbania (forage or silage) rations compared with teosinte or whole corn plants. Recent studies indicated that *Sesbania sesban* in different forms (forage, silage or seeds) had positive effects on farm animal's performance as reported by Ahmed et al. (2009), Ibrahim et al. (2012) and El-Kholany et al. (2016), respectively. Therefore, the main objective of the present study was to recognize the effect of substitution of concentrate feed mixture (CFM) with some types of silage mixtures (sesbania and / or kochia) on milk yield and its composition, feeding values, feed conversion and economic efficiency of Zaraibi goats. Some rumen parameters and blood profile were also evaluated.

Materials and methods

This study was conducted at the Animal Production Research Station, El-Serw, belonging to Animal Production Research Institute, Agricultural Research Center, Egypt. Twenty eight Zaraibidoes were selected from El-Serw Station herd, and weighing on average 31.95 ±0.432Kg. The animals were divided according to their body weight into 4 similar groups (7each). Each group was housed in semi–roofed yard (4×3×5 m).The animals were weighted at the beginning then biweekly. Zaraibi goats were fed for 3 weeks as a transitional period on the experimental rations before the start of the experimental work.

Lactating Zaraibi goats were offered their requirements of CFM and the tested silages (S) according to NRC (1981) allowances of dairy goats. Feeding the four tested experimental rations lasted for 16weeks. Accordingly, rations tested were, 40% CFM+60% maize silage (control, G1),30%CFM+70% maize–sesbania (G2), 30%CFM+70% maize–kochia silage (G3) and 30% CFM +70%sesbania–kochia silage (G4).Maize was cultivated in salt affected soil in El-Serw Experimental Station. But, *Kochia indica* and *Sesbania sesban* were collected from ridge and canals from the same farm. These silages were made after chopping, where moisture content at ensilaging time averaged 70%. Silage mixture of 50% sesbania plus 50% kochia (G4) was prepared by adding 5% molasses, on fresh-weight basis. The used CFM contained undecorticated cotton seed meal (25%), yellow corn (43%), wheat bran (25%), molasses (3.5%), limestone (2%), common salt (1%) and minerals mixture (0.5%).

The chemical composition of CFM and different types of silages are presented in Table 1.Water was available at all times and drinked water was measured for each group (ml/day).Diets were offered twice daily at 8.0 am and 4.0 pm and any refused amounts were daily recorded. Rumen fluid samples were taken from 3 animals of each experimental group using stomach tube before feeding (0 times) and at 3 and 6 hrs post-feeding at the end of digestibility trails period. The samples were filtered through 3 layers of gauze and immediately subjected to the determination of pH value by pH meter. Ammonia nitrogen (NH_3-N) concentration was measured according to the method of Conway (1957). Microbial protein was determined according to Schultz and Schultz (1970); whereas, total volatile fatty acids (VFAs) were determined according to the technique described by Warner (1964). Blood samples were

collected from jugular vein once before feeding (from 3 animals/group) at the end of feeding trail period. The whole blood was immediately directed to hematological estimations. Another blood samples were centrifuged at 4000 rpm for 20 min and part of separated serum was directed to enzymes activity determination, while the other part was stored frozen at -20°C till the biochemical analysis. Commercial kits were used for colorimetric biochemical determinations. The daily milk yield was recorded for each goat.

Representative milk samples (about 0.5% of the total milk produced) were taken once biweekly from each goat, from the morning and evening milking of the same day. Then, the samples were analyzed for total solids (TS), fat, protein, solid non-fat (SNF) and ash as well as pH and acidity according to Ling (1963) procedures, while milk lactose was calculated by differences. The economic efficiency was calculated as ratio between output (price of milk yield) and cost of feed consumed according to the local price during the study. In addition, four digestibility trails were conducted using 12 adult Zaraibi bucks to evaluate the feeding values of the tested diets. Samples of feeds and faces were analyzed according to A.O.A.C (1995). Data were statistically analyzed using SAS (2003). The significant differences among means were assigned using Duncan multiple rang test methods (Duncan, 1955).

Results and discussion

Chemical composition of the experimental diets

The chemical composition of the tested silages (S) are presented in Table 1. It could be observed that CP, ADF and cellulose were higher with sesbania/kochia silage mixture (S4) compared with the other silages, especially maize silage, while the contents of EE and NFE seemed to be in an inverse trend among the silage types. Meanwhile, the highest values of NDF and hemicellulose were recorded with maize silage (S1), but the lowest values were detected with maize/kochia silage mixture (S3). Moreover, the CF and OM were higher with maize/sesbania silage (S2) than the other silages.

The minerals analysis presented in Table2 indicated that concentrations of Ca, Mg, K and Mn were higher in maize silage than the other three silage mixtures. On the contrary, the levels of both Zn and Cu were markedly decreased with maize silage compared with the other silages as shown in Table 2.The chemical composition obtained from this study was nearly similar to that obtained by Ahmed et al. (2002), Shehata et al. (2006) and Bakr (2013) for maize silage, El-Kholany (2004) for maize and/or sesbania silage and Shehata et al. (2001) for teosinte and /or kochia silage.

Table 1. Dry matter, chemical composition and fiber fractions (% DM basis) of the studied silages.

Chemical composition	Silages				CFM
	S1	S2	S3	S4	
DM	30.51	30.75	29.97	30.51	90.33
OM	90.00	90.65	87.50	87.00	92.05
CP	10.65	15.03	13.51	17.17	15.91
CF	27.83	29.11	27.00	28.65	14.95
EE	3.03	2.77	2.61	2.29	3.55
NFE	48.49	43.74	44.38	38.89	57.64
Ash	10.00	9.35	12.50	13.00	7.95
Fiber fractions*					
NDF	59.39	58.5	57.11	58.01	41.75
ADF	35.01	37.13	38.55	39.11	15.21
ADL	6.71	6.5	7.01	6.91	4.3
Hemicellulose	24.38	21.37	18.56	18.9	26.54
Cellulose	28.3	30.63	31.54	32.2	10.91

* NDF: Neutral detergent fibers, ADL: Acid detergent lignin.

Table 2. Levels of some macroelements and microelements in the tested silages.

Items	Silages				CFM
	S1	S2	S3	S4	
Macroelements,%					
Ca	1.95	1.61	1.59	1.25	0.81
P	0.33	0.35	0.27	0.29	0.92
Mg	0.41	0.38	0.36	0.36	0.41
Na	0.07	0.08	0.07	0.08	0.50
K	2.95	2.71	2.78	2.52	0.61
Microelements,ppm					
Zn	11.50	29.50	32.30	49.70	21.00
Cu	2.50	4.90	4.10	5.30	4.00
Mn	43.70	41.30	37.50	35.10	61.00
Fe	115.30	127.10	113.30	125.00	47.00

Fermentative characteristics of the silages

The different silages had good physical characteristics expressed as pleasant aroma, natural color and pleasing taste. Data in Table 3 represent the pH values, lactic acid, acetic acid, propionic acid, isobutyric acid and butyric acid concentrations. The silage pH values and butyric, lactic and acetic acid concentrations ranged from 3.95 to 4.09, 0.12 to 0. 17, 1.95 to 2.09 and 0.95 to 1. 11%, respectively. The total VFAs ranged from 1.57 to 1.71%. The values of silage quality obtained herein are more close to those recorded by El-Kholany (2004), being 4.25 for pH, 1.88% lactic acid, 0.89% acetic acid,0.16% butyric acid and 1.71% total VFAs concentrations for 50% maize + 50% sesbania silage. Generally, the obtained data from the present study indicated good quality of the tested silages, which is comparable with the results reported by Shehata et al. (2001 and 2003), Ahmed et al. (2002), Bakr (2013), El-Emam et al. (2014) and Maged et al. (2014) with different forages silages.

Table 3. Some quality criteria of different silages tested.

Items	Silages			
	S1	S2	S3	S4
pH value	3.95	4.03	4.05	4.09
Lactic acid, %	2.09	2.01	1.97	1.95
VFA's fraction,%:				
Acetic acid,	1.11	1.03	0.99	0.95
Butyric acid,	0.12	0.13	0.15	0.17
Propionic acid,	0.21	0.25	0.27	0.29
Isobutyric acid,	0.23	0.28	0.30	0.33
Total VFA's	1.67	1.69	1.71	1.74

Digestion and feeding values

The obtained data in Table 4 indicated that values of all digestion coefficients and digestible crude protein (DCP) tended to decrease with control group (G1) compared with the other 3 tested rations and the differences were significant in DCP only. Moreover, the highest values of TDN were observed with G2 (65.01%) then G1 and G3 (63.92 and 63.45%, respectively) and lastly, G4 (63.31%). Similar results were observed by Shehata et al. (2001) and Ibrahim et al. (2012) with goats and sheep fed rations containing kochia and sesbania silages, respectively. El-Kholany (2004) found that digestion coefficients (DM, OM, CF, CP and EE) and feeding values (TDN and DCP) of maize–sesbania mixture was higher than both of maize and sesbania silages when singly tested.

Table 4. Digestion coefficients and feeding values (%) of the testes experimental rations fed to Zaraibi bucks.

Items	Groups				SE
	G1	G2	G3	G4	
Digestion coefficients					
DM	64.70	65.84	66.79	66.33	0.437
OM	67.06	68.18	68.25	68.57	0.397
CP	70.75	72.24	72.17	72.20	0.409
CF	61.03	62.14	61.94	62.58	0.545
EE	76.95	78.08	78.02	77.91	0.326
NFE	68.27	69.40	69.56	69.64	0.564
Feeding values					
TDN	63.92	65.01	63.45	63.31	0.384
DCP	8.82^{d}	11.05^{b}	10.26^{c}	12.12^{a}	0.366

Mean in the same row with different superscripts differ significantly at $p<0.05$

Ruminal parameters

Results of pH values (Table 5) indicated that maximum values were recorded at 0 time with all groups without significant differences among treatments, and then gradually decreased to the minimum values at 3 hrs post feeding and thereafter tended to increase again at 6 hrs post feeding with all groups. Similar trends were observed by Ahmed and El-Kholany (2012) and Ibrahim et al. (2012) with Zaraibi goats and Rahmani sheep, respectively. At the same time, ruminal ammonia–N concentration was greatly higher post-feeding than before feeding and the maximum values of NH_3-N in the rumen were reached at 3 hrs post-feeding then decreased with all groups without noticeable differences among the tested experimental diets before feeding. At 3 and 6 hrs post feeding, ruminal NH_3-N concentration was significantly higher in the rumen of goats fed silage mixtures (G2, G3 and G4) than those fed maize silage.

The high content of ruminal ammonia-N concentration in the other 3 tested groups may be due to the high content of CP in silage mixture (Table1). Similar results were observed by Ahmed et al. (2001), Shehata et al. (2006) and Ibrahim et al. (2012) with Zaraibi goats fedrations containing kochia, reed and sesbania silages, respectively. In this respect, El-Kholany (2004) found that the NH_3-N was higher in the rumen of goats fed sesbania silage (SS)and silage mixture (sesbania + maize) than those fed maize silage only and this may be attributed to high content of CP in sesbania silage and high protein degradability of sesbania protein as reported by Khalili and Varvikko (1992). Data of ruminal total VFAs concentrations presented in Table 5 revealed the highest values post feeding (3 and 6 hrs) with G2 (12.35 and 11.42mEq/100ml, respectively), while the lowest values were detected with G4 (11.50 and 10.62mEq/100ml, respectively) and the differences were significant at 3 and 6 hours. Similar results were observed by El-Kholany (2004), who observed that the highest values of ruminal total VFAs were recorded with silage mixture (maize +sesbania) at all hours, and then maize silage and the lowest values were detected with sesbania silage group. Moreover, the highest value of total VFAs concentrations was at 3 hours post-feeding which was reflected on lowering pH values (Table5) at that time as reported by Shehata et al. (2006) and Ahmed et al. (2013) with Zaraibi goats.

As regard to microbial protein, the obtained results indicated that ruminal microbial protein content was not significantly differed among the 4 silage groups at zero time, while there was significant ($p<0.05$) lower value with maize silage group than of mixture silages post feeding, especially at 6 hrs (Table 5). The highest values of microbial protein content (at all hours) were recorded with G2 then G3 followed by G4, while G1 recorded the lowest values. Similar results were observed by Soliman et al. (1997) and Ibrahim et al. (2012) who found that microbial protein content was higher with silage mixture (legume + grass) compared with legume or grass alone.

Table 5. Effect of the experiment rations on rumen pH value, ammonia-N, volatile fatty acids' concentrations and microbial protein content in Zaraibi bucks rumen.

Items	Hours	Groups				SE
		G1	G2	G3	G4	
pH value	0	7.03	7.08	7.05	6.98	0.026
	3	6.60	6.65	6.57	6.55	0.021
	6	6.78	6.83	6.75	6.70	0.028
Ammonia-N(mg/100 ml)	0	16.33	16.60	16.47	17.10	0.216
	3	21.03^{c}	22.33^{bc}	21.87^{ab}	22.93^{a}	0.240
	6	20.00^{b}	21.47^{a}	21.27^{a}	21.87^{a}	0.262
Total VFA's (m Eq/100ml)	0	9.13	9.03	9.05	8.97	0.042
	3	12.02^{a}	12.35^{a}	12.17^{a}	11.50^{b}	0.104
	6	11.07^{b}	11.42^{a}	11.20ab	10.62^{c}	0.092
Microbial protein(g/100 ml)	0	0.340	0.360	0.350	0.347	0.010
	3	0.513^{b}	0.587^{a}	0.577^{ab}	0.573^{ab}	0.012
	6	0.433^{b}	0.513^{a}	0.507^{a}	0.493^{a}	0.012

Mean in the same row with different superscripts differ significantly at $p<0.05$

Blood profile

Data of hematological parameters of lacting Zaraibi does fed different experimental rations during mid-lactation period is presented in Table 6. The obtained results indicated that most hematological parameters were not markedly affect by the tested rations. The values of Hband RBCs tented to decrease in control group compared with the silage mixture groups (G2, G3and G4). Similarly, the highest value of MCHC % (34.25) was recorded with G2 then G3 (34.22), followed by G4 (33.79) and lastly G1 which recorded the lowest value (32.73).

Moreover, the effect of tested rations on lymphocytes and platelets counts were significant and the highest values were recorded with G3 (maize – kochia) as shown in Table 6. Similar results were observed by Ahmed et al. (2001), Ibrahim et al. (2012) and Maged et al. (2014) as a result of using both sesbania and kochia in a silage mixture (legume–grass) in goats' rations. Data of biochemical parameters of dairy Zaraibi goats fed tested rations is presented in Table 7. Values of some serum blood parameters explained that there were no significant differences among the four rations for albumin, creatinine, glucose, cholesterol and activities of serum AST and ALT. While serum total protein and globulin of control group was significantly decreased (6.53 and 3.03 g/dl, respectively) than the other groups. Also, both total protein and globulin were significantly higher with G4 (7.17 and 3.43 g/dl, respectively) compared with G3 (6.77 and 3.17 g/dl, respectively).Moreover, the highest value of serum calcium was recorded with G3 (10.87 mg/dl) and lowest value (10.40mg/dl) was detected with G2 and differences were significant. On the contrary, serum phosphorus recorded the highest value (5.97mg/dl) with G2, followed by G3 (5.80mg/dl), then G4 (5.50mg/dl) and lastly G1 (5.43mg/dl) and the differences were not significant. This increase in serum phosphorus in G2 may be attributed to the high content of phosphorus (0.35%) in maize–sesbania silage (S2) compared with the other different types of silages (Table 2). Kaneko (1989) cited that the normal physiological range of blood phosphorus is 5.0 to 7.3 mg/dl.

Generally, the obtained data showed that most serum parameters were slightly differed among the tested groups, though some differences were significant; all values were within the normal ranges as reported by Kaneko (1989), Abdelhamid et al. (1999 and 2004) and Maged et al. (2017) for healthy goats and in line with the finding of El-Kholany (2004), Ibrahim et al. (2012) and Maged et al. (2014) when they used some wild plants such as sesbania or kochia in feeding both goats and sheep.

Table 6. Effect of feeding experimental rations on blood hematological parameters of dairy goats.

Items	Groups				SE
	G1	G2	G3	G4	
Hemoglobin (Hb), g/dl	10.48	10.87	10.67	10.83	0.247
Red blood cell (RBC's)×10^6/ul	12.03	12.3	12.23	12.17	0.121
Hematocrite (Hct), %	32.03	31.70	31.13	32.00	0.503
Mean corpuscular value(MCV), fl	21.83	22.87	22.60	22.16	0.299
Mean corpuscular hemoglobin(MCH), pg	8.17	8.47	8.33	8.26	0.084
Mean corpuscular hemoglobin conc. (MCHC), %	32.73	34.25	34.22	33.79	0.392
White blood cells (WBC's)×10^3/ul	10.47	9.90	10.00	9.83	0.24
Granules, %	50.60	50.30	48.60	50.30	0.595
Lymphocytes, %	42.40^b	43.33^b	45.47^a	43.00^b	0.412
Monocytes, %	7.00	6.37	6.07	6.70	0.39
Plateletes (×10^3/ul)	720^b	741^{ab}	765^a	739^{ab}	11.0

Mean in the same row with different superscripts differ significantly at $p<0.05$

Table 7. Effect of feeding experimental rations on serum biochemical parameters of dairy goats.

Items	Groups				SE
	G1	G2	G3	G4	
Total protein , g/dl	6.53^c	7.03^{ab}	6.77^{bc}	7.17^a	0.084
Albumin , g/dl	3.50	3.63	3.60	3.73	0.045
Globulin, g/dl	3.03^c	3.40^{ab}	3.17^{bc}	3.43^a	0.06
Creatinine, mg/dl	0.78	0.81	0.79	0.77	0.018
Glucose, mg/dl	72.67	74.00	73.33	72.00	0.67
Cholesterol, mg/dl	65.67	62.33	64.00	67.00	2.794
Asparate aminotransferase (AST), u/l	22.00	20.33	20.67	19.33	0.657
Alanine aminotransferase (ALT), u/l	46.00	42.33	45.67	48.00	1.505
Calcium, mg/dl	10.70^{ab}	10.40^b	10.87^a	10.63^{ab}	0.073
Phosphorus, mg/dl	5.43^b	5.97^a	5.80^{ab}	5.50^{ab}	0.09

Mean in the same row with different superscripts differ significantly at $p<0.05$

Milk production and its quality

Data presented in Table 8 show the effect of the tested rations on average milk yield and its composition and milk quality as well. The obtained results indicated that average daily milk yield of Zaraibi goats was significantly higher with G2 compared with G1. The highest yield (1.350Kg) was recorded with G2, followed by G3 (1.310 kg), then G4 (1.273 kg), while the lowest with G1 (1.230kg) and the differences were significant as shown in Table 8. The superiority of productive performance for lactating goats with mixtures silages, especially G2, may be due to the positive associative effect between the two forages and the better condition of rumen fermentation as reported by Soliman et al. (1997), Ahmed et al. (2001 and 2013) and Ibrahim et al. (2012) as well as blood profile as reported in the present study. El-Kholany (2004) found that milk yield was significantly higher by lactating goats fed silage mixture (50% maize-50% sesbania) than that fed maize or sesbania silage alone. Concerning milk composition (Table 8), the obtained data indicated that differences in milk composition among the four rations were not significant, where it ranged from 3.98 to 4.05% for fat, 3.01to 3.07% for protein, 4.60 to 4.64% for lactose and 12.31 to 12.47% for total solids. Similar results were observed with Gabr et al. (1999) and El-Kholany (2004) with mixture of forage and silage, respectively. Ahmed et al. (2001) observed that the effects of substitution of teosinte (grass) with kochia (legume) in silages on all milk components were not significant. Somatic cell count (SCC) was significantly affected by the tested experimental rations (Table 8). The highest value (489000) of SCC was recorded with G1, followed by G4

(477000), then G3 (469000), and lastly, the lowest value (443000) was recorded with (G2) and the differences were significant. It is interesting to note a negative relationship between SCC and milk yield. In this respect, Baro et al. (1994), Bedo et al. (1995) and Ahmed et al. (2008a) also found that SCC correlated negatively with milk yield. But, the differences in some milk quality such as pH value and acidity among the different tested groups were not significant and the obtained values were within the normal ranges given by Shehata et al. (2006), Ahmed et al. (2008b) and Maged et al. (2017).

Table 8. Effect of feeding experimental rations on milk production and its quality of dairy Zaraibi goats.

Items	Groups				SE
	G1	G2	G3	G4	
Average daily milk yield, kg/h	1.230^{b}	1.350^{a}	1.310^{ab}	1.259^{ab}	0.0179
Milk constituents, %					
Fat	4.01	4.05	4.03	3.98	0.316
Protein	3.03	3.07	3.02	3.01	0.021
Lactose	4.61	4.64	4.63	4.60	0.020
Ash	0.70	0.72	0.72	0.72	0.004
Total solids	12.34	12.47	12.39	12.31	0.071
Solids nonfat (SNF)	8.34	8.42	8.37	8.33	0.042
Milk quality					
pH value	6.65	6.63	6.65	6.67	0.007
Acidity,%	0.17	0.16	0.16	0.16	0.001
SCC, $\times 10^3$	489^{a}	443^{c}	469^{b}	477^{b}	3.730

Mean in the same row with different superscripts differ significantly at $p < 0.05$

Feed conversion rate

The average daily DM intake of Zaraibi does is summarized in Table 9. The total DM intake as g/kg $w^{0.75}$ and %BW tended to increase with G2 (86.88and 3.66, respectively) compared with the other groups. The increased roughages intake (silage) gave positive evidence that silage was of good quality. The present values are in accordance with those obtained by Ibrahim *et al*. (2008). El-Kholany (2004) found that the DM intake was higher (1271.2 g/h) by lactating goats fed silage mixture (50% maize +50% sesbania) than that fed maize or sesbania silages (1230.4 and 1195.8 g/h, respectively).

Concerning water consumption, the obtained data indicated that the differences in water consumption among treatments were noticeable as shown in Table 9. The values of water consumption was higher with the three tested rations (4597, 4615 and 4701 ml /h for G2, G3 and G4, respectively) compared with the control group (3785 ml/h). The same trend was observed also when related to metabolic body mass (Table 9). The corresponding values of water consumption when related to dry matter intake was 3.27, 3.95, 4.01 and 4.15 ml/g DM, respectively. Similar results were observed by Shehata et al. (2001); Ahmed et al. (2001) and El-Kholany (2004) on Zaraibi goats. They found that the values of water consumption were noticeably higher by Zaraibi goats fed kochia-S or sesbania-S and their mixture with teosinte and maize, respectively and this mostly due to halophytic effect of wild plants as observed also in the present study as a result of using kochia and sesbania as wild plants.

Generally, the present estimates of water consumption are nearly similar to those obtained by Abdelhamid et al. (2011) on lactating Zaraibi goats during the early lactation period (ranged from 3.87 to 4.43 l/h and from 183 to 210 ml/kg $w^{0.82}$). The feed conversion bases on DM, TDN and DCP by Zaraibi goats are summarized in Table9. The obtained results indicated that feed conversion calculated as dry matter intake/milk yield was better with G2 (0.863), then G3 (0.878), followed by G4 (0.901) and lastly G1 (0.940). Similarly, the values of feed conversion based on total digestible nutrient (TDN) were better with the 3 tested rations (0.561, 0.557 and 0.570 for G2, G3 and G4, respectively) compared with the control (0.601). On the contrary, the values of feed conversion expressed as DCP intake/kg milk yield was better in does received maize silage alone diet (0.083) compared with other rations (Table 9). The same trend was observed by El-Kholany (2004) who found that the values of feed conversion to milk, when based on DM and TDN intakes, were better (0.978 and 0.634, respectively) with

silage mixture (50% maize+50%sesbania) compared with maize silage alone (1.017 and 0.655,respectively), but when based on DCP intake, the best was with maize silage (0.087) compared with maize+sesbania silage (0.109).The obtained values of feed conversion are within the normal range given by Shehata et al.(2006), Ibrahim et al. (2008), El-Kholany et al. (2016) and Maged et al. (2017).

Table 9. Average daily feed intake and feed conversion ratio by lactating goats as affected by experimental rations.

Items	Groups			
	G1	G2	G3	G4
Daily feed intake* during the experimental period:				
CFM, g/h	455	340	339	339
Silage, g/h	701	825	811	795
Total DM intake, g/h	1156	1165	1150	1134
DM intake , %BW	3.60	3.66	3.59	3.57
DM intake, g/Kgw$^{0.75}$	85.63	86.88	85.50	84.69
Roughage (Silages), %	60.64	70.81	70.52	70.11
TDN intake, g/h/d	738.92	757.37	729.68	717.94
DCP intake, g/h/d	101.96	128.73	117.99	137.44
Milk yield, Kg/h/d	1.230^{b}	1.350^{a}	1.310^{ab}	1.259^{ab}
Feed conversion ratio:				
Kg DM/Kg milk	0.940	0.863	0.878	0.901
Kg TDN/Kg milk	0.601	0.561	0.557	0.570
Kg DCP/Kg milk	0.083	0.095	0.090	0.109
Daily water consumption*:				
ml/head/head	3785	4597	4615	4701
ml/Kg w$^{0.82}$	220	269	269	276
ml//g DM intake	3.27	3.95	4.01	4.15

*Group feeding; Mean in the same row with different superscripts differ significantly at $p<0.05$

Economic efficiency

Data in Table 10indicated that the highest total feed cost (LE/h) along the feeding period was observed for G1(2.804) compared with other groups (2.302, 2.305 and 2.247 for G2, G3 and G4,respectively). The corresponding values of price of milk yield were (7.073, 7.763, 7.533and 7.239 LE/h for G1, G2, G3 and G4, respectively). Therefore, the highest total feed cost/kg milk (LE) was observed for G1 (2.28)and the lowest values were for G2,G3 and G4 (1.705, 1.760 and 1.785, respectively), due to the highest daily milk yield as well as the lowest price of feed consumption in the three groups (silage mixtures).

Accordingly, the economic efficiency was noticeably higher (3.37, 3.27 and 3.22) with the three tested rations (G2,G3 and G4, respectively) compared with the control group (G1, 2.52). This positive effect of sesbania or kochia on economic efficiency was observed also by Ahmed et al. (2001 and 2009) and Ibrahim et al. (2008) with lactating Zaraibi goats.

Table 10. Economic efficiency for lactating Zaraibi goats fed different experimental rations.

Items	Groups			
	G1	G2	G3	G3
Daily feed intake (as fed):				
CFM/h	503.7	376.4	375.3	375.3
Silages/h	2225	2683	2706	2606
Cost of consumed feed, LE/h	2.804	2.302	2.305	2.247
Daily milk yield, kg/h	1.230	1.350	1.310	1.259
Price of milk yield, LE/h	7.073	7.763	7.533	7.239
Feed cost /kg milk, LE/h	2.280	1.705	1.760	1.785
Economic efficiency, %	2.52	3.37	3.27	3.22

The prevailing prices / ton, at time of study are 3800 LE – CFM, 400 LE-S1, 325 LE-S2, 325 LE-S3, 315 LE-S4 and 5750 LE-milk

Conflict of interest statement

Authors declare that they have no conflict of interest.

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