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Response of lactating Zaraibi goats fed with berseem and/or triticale forage on milk production, feed utilization and economic efficiency

M. E. El-Kholany, W.M.A. Sadek*, M. A. Aboul-Omran, H. R. Behery, G.I. El-Emam, T.H. El-Sawah, A.A. Mehany and Ayman Al-Mwafy

Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Cairo, Egypt

*Corresponding author

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ABSTRACT

Twenty eight female Zaraibi goats in 2nd, 3rd and 4th season of lactation with average body weight of 33.0 kg were divided randomly into 4 groups (7 does in each) to study the effect of substitution of berseem forage by triticale forage in diets of lactating Zaraibi goats on their performances for milk yield and composition. In addition, twelve Rahmani rams average body weight of 50 kg were used to evaluate the feeding value of tested diets. Half the crude protein (CP) requirements of lactating goats were covered from concentrate feed mixture (CFM) while other 50% of CP was covered from triticale forage in the first group (G₁), mixture forage (50% triticale- 50% berseem) in the second group (G₂), mixture forage (70% triticale- 30% berseem) in the third group (G₃), and berseem forage in (G₄). The obtained results showed that the dry matter (DM) percent of triticale was higher than berseem (16.50 vs. 13.98). Moreover, the ether extract (EE) and nitrogen free extract (NFE) were higher while CP and ash were lower in triticale forage than berseem. But, crude fiber (CF) was nearly similar in both forages. The daily dry mater intake (DMI) as g/ kg $w^{0.75}$ and body weight (BW) tended to increase with mixture forage G₂ (99.10 and 4.07, respectively) compared with G₃(98.75 and 4.06, respectively) and G₄ (95.27 and 3.91, respectively) and G₁ (91.79 and 3.77, respectively). Ammonia-N (NH₃-N) level and pH values tended to decrease in the rumen of Rahmani sheep fed triticale forage (G₁) compared with other forages (G₂, G₃, and G₄). Rumen volatile fatty acids (TVFA's) concentrations as well as microbial protein (MP) were higher with 50% triticale - 50% berseem than with other rations. The digestion coefficients of OM, CF and NFE were significantly improved with G₂ and G₃ compared with G₁ and G₄. The CP, DM and OM digestibility recorded the lowest values (P<0.05) with triticale forage. The total digestible nutrients (TDN) showed the higher estimates (P<0.05) with the mixture rations (G₂ and G₃), while digestible crude protein (DCP) was significantly higher with increasing berseem in the rations. Whereas, serum protein, albumin, globulin, urea-N and glucose did not significantly differed among the tested diets. Concerning milk production, the obtained data indicated that milk yield of Zaraibi goats was significantly (P<0.05) higher with mixture forage (1.350 kg/ h/ d) G₂ and (1.310 kg/h/d) G₃ compared with the other groups (1.230 and 1.260 for G₁ and G₄, respectively). The effect of experimental treatments on milk fat percentage was significant (P<0.05). While, other milk contain and milk quality parameters (such as pH value and acidity %) were not significant. Accordingly, it could be concluded that using mixture forage (triticale and berseem) in feeding Zaraibi goats has positive effect on feeding value, milk yield and milk composition as well as feed utilization efficiency. Triticale forage could be safety use in feeding Zaraibi goats as it is or mixed with berseem.

Introduction

Triticale is a relatively new cereal crop could be used simultaneously for forage and grain product, it could be grazed one or two times during the early stages of growth (prior to joining) and later to allow to produce grain yield Garico Delmoral (1992). Even though, triticale was developed as a food grain, it has more potential as a feed for farm animals Hill and Utley (1989) and Zobell et al. (1992). In a recent study, Abdel-Galil and Soliman (2002) concluded that the obtained data suggested that, although triticale (as the first man-made cereal) was produced mainly as a cereal crop it could be used as a double purpose crop, giving the grower the alternatives to have either green forage only or green forage plus grain yield. When triticale used as forage crop, it has been found to have higher forage potential and protein content than oats and higher forage and silage yields than wheat, rye and barley Varughese et al. (1987). In another study on Rahmani rams, Haggag et al. (2002) observed that the digestion coefficients of most nutrients and feeding values were better than with rations mixed with berseem than both triticale or berseem forage alone.

Therefore, this work was aimed to using of triticale forage in feeding small ruminants to determine it's effect on digestibility, feeding values, some blood and rumen parameters and economical efficiency.

Materials and methods

This study was conducted at El-Serw Experimental Research Station belongs to Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt. Zaraibi does, averaged 35.0 kg live body weight, were divided into three feeding treatments (7 does each). The experiments began two weeks after weaning (during mid-lactation) and until the seventh month of lactation (at mating). Each group was housed in a semi-roofed barn (4×3×5 meters). Animals were weighed at the beginning of the experimental and biweekly. All groups were fed on restricted amount of concentrate feed mixture (CFM), to cover 50% of the requirements recommended by NRC (1981) for lactating goats. Yet, a combination of different forages was fed *ad-libitum*. Accordingly rations tested were, CFM+ 100% triticale (G₁), CFM + 50% triticale +

50% berseem (G₂), CFM + 70% triticale + 30% berseem (G₃) and CFM + 100% berseem (G₄).

The triticale and berseem were cultivated in El-Serw Experimental Stations. Triticale and berseem were obtained from the 3rd cut. Concentrate feed mixture (CFM) contained, undecortecated cotton meal (25%), yellow corn (43%), wheat bran (25%), molasses (3.5%), Limestone (2%), common salt (1.0%) and minerals mixture (0.5%). The chemical composition was estimated for the tested ingredients are shown in Table 1. Water was available all times. Diets were offered twice daily at 8.0 am and 3 pm.

Ruminal fluid samples were taken from rams using stomach tube before feeding (0 time) and at 2, 4 and 6 hrs post-feeding at the end of digestibility trails. The samples were filtered through 3 layers of gauze and directed to the determination of pH-value. Ammonia nitrogen (NH₃-N) concentration was measured according to Conway (1957) method whereas total volatile fatty acids (VFA's) according to the technique by Warner (1964); and microbial protein level was estimated by the methods of Shultz and Shultz (1970).

Milk yield was recorded daily for each doe. Representative milk samples (about 0.5% of the total milk produced) were taken biweekly for each doe at both milking. Samples were composed and analyzed for chemical composition of total solids, fat. Protein and ash as well as pH and acidity (Ling, 1963); while lactose content was assessed as described by Barnett and Abdel-Tawab (1957).

Blood plasma was separated by centrifugation at 4000 rpm for 10 minutes, then frozen at -20°C until analysis for total protein (TP), albumin (AL), urea-N, glucose and creatinine using kits and the methods reported by Biochemistry (Biomerieux) laboratory reagents and products. Serum total globulin (GL) was calculated by differences (TP-AL).

In addition, four digestibility trails were conducted using rams to evaluate the nutritive values of the tested diets. Samples of feed and feces were analyzed according to A.O.A.C. (1995).

Data were statistically analyzed using SAS (2003). The significant differences among were assigned according to Duncan (1955).

Results and discussion

Chemical composition of forages

The chemical composition of feed ingredients is presented in Table 1. The dry matter of triticale was higher than berseem (16.50% vs. 13.85%). Moreover, the EE and NFE were higher while CP and ash were lower in triticale forage than berseem. But, CF was nearly similar in both forages as shown in Table 1. Nearly similar chemical composition was obtained by Haggag

et al. (2002) who reported that triticale forage contained 10.90% CP, 2.60 EE, 29.80% CF, 46.94% NFE and 9.25% ash. In this respect, Gabra and Sherif (1985) founded that triticale contained 10.75 %CP, 2.86 % EE, 28.65% CF and 43.62 % NFE, but ash was higher than that obtained herein (14.12 vs. 8.70%). Abdel-Galil and Soliman (2002) studied chemical composition of 5 triticale species and observed that ash content ranged from 7.6 to 9.6% in the 3rd cut of triticale, while it ranged from 15.6 to 16.8% and from 10.4 to 11.8% in the first and second cut, respectively.

Table 1. Chemical analysis % (on dry matter basis) of tested rations.

Feed mixture	DM	Chemical analysis% (on DM basis)					
		OM	CF	CP	EE	NFE	Ash
Concentrate feed mixture (CFM)	91.5	93.85	15.80	14.30	3.20	60.55	6.15
100% triticale (G ₁)	16.50	91.30	29.80	10.80	2.55	48.15	8.70
50% triticale + 50% berseem (G ₂)	14.90	90.35	28.30	12.25	2.35	47.45	9.65
70% triticale + 30% berseem (G ₃)	15.40	90.85	28.90	11.65	2.42	47.88	9.15
100% berseem (G ₄)	13.85	87.95	28.95	14.15	1.95	42.90	12.05

Feed intake and water consumption

The average daily feed intake of lactating Zaraibi goats is summarized in Table 2. The total DM intake as (g/h/d) or (g/kgw^{0.75}) tended to increase with G₂ and G₃ (mixture forages) compared to G₁ (triticale) and G₄ (berseem). The differences between G₁, triticale and G₄ (berseem) were not significant. Similarly results were reported by Gabra and Sherif (1995) who noticed that daily feed intake was significantly higher with sheep fed mixture forage (50% triticale- 50% berseem) than

fed triticale or berseem forage alone. Similar results were observed by Shehata et al. (2001), Ahmed et al. (2001) and Ibrahim et al., (2012) with using of mixture silages in small ruminants rations.

Concerning water consumption, does consumed the least amount of water when fed on mixture forage (4.01 l/h/ d or 278 ml / kg w 0.75) while recorded the highest consumption when fed triticale forage (4.27 l/h/d or 296 ml/kg w 0.75) as shown in Table 2.

Table 2. Average daily feed intake and water consumption by lactating goats fed the experimental rations.

Parameters	Groups			
	G ₁	G ₂	G ₃	G ₄
Daily DM intake (g/h) during experimental period				
CFM	650	660	665	640
Forages	720	765	755	680
Total DM intake	1370	1425	1420	1320
DM intake, % of BW	3.90 ^b	4.07 ^a	4.06 ^a	3.77 ^b
DM intake, g/kg w ^{0.75}	95.27 ^b	99.10 ^a	98.75 ^a	91.79 ^b
Roughage: concentrate R/C ratio	52.55: 47.45	53.70: 46.30	53.17:46.83	51.50:48.50
Daily water consumption				
L/ head/ day	4.27	4.01	4.23	4.15
ml/ kg BW	122	115	120	118
ml/ kg w ^{0.75}	296	278	294	288
ml/ g DM intake	3.11	2.80	2.97	3.14

a-b: Means in the same row followed by different letters differ significantly at (P<0.05).

Ruminal fermentation parameters

The pH values, ammonia-N (NH₃-N), total volatile fatty acids (TVFA's) and microbial protein in the rumen of sheep were presented in Table 3. Both ammonia-N and pH values were tended decreased with increasing triticale in sheep rations. Ammonia-N concentration (after feeding) was higher by about 7.14% with berseem

rations (G₄) compared with triticale forage (G₁) but the differences were not significant. Moreover, ruminal ammonia-N concentration was greatly higher post-feeding than before feeding and that maximum values of NH₃-N in the rumen were reached at 4 hrs post-feeding then decreased with all dietary treatments. Similar results were observed by Ahmed (1999) and Zeid et al. (2009).

Table 3. Rumen fermentation parameters of Rahmani sheep fed the experimental rations contained triticale and/or berseem.

Parameters	Hrs.	Groups			
		G ₁	G ₂	G ₃	G ₄
pH value	0	6.92±0.09	6.96±0.09	7.0±0.11	7.06±0.09
	2	6.45±0.05	6.60±0.04	6.56±0.03	6.65±0.05
	4	6.31±0.04	6.46±0.03	6.42±0.03	6.55±0.03
	6	6.62±0.03	6.66±0.04	6.64±0.03	6.73±0.03
NH ₃ -N (mg / 100 ml)	0	16.75±0.80	17.09±0.27	16.98±0.70	17.30±1.22
	2	26.15±0.91	27.10±0.81	27.10±1.21	28.70±1.12
	4	27.30±0.43	29.11±0.85	28.27±0.57	29.86±0.46
	6	25.30±1.40	26.50±0.83	26.03±0.42	27.33±0.41
Total VFA's (meq / 100 ml)	4	11.92±0.32 ^b	13.11±0.32 ^a	13.00±0.34 ^a	11.5±0.31 ^b
Microbial protein (g / 100 ml)	4	0.395±0.01 ^b	0.525±0.02 ^a	0.513±0.01 ^a	0.492±0.01 ^a

a-b : Means in the same row followed by different letters differ significantly at (P<0.05).

Rumen TVF's concentrations were high (P<0.05) in the rumen of rams fed mixture forages (G₂ and G₃) compared to other rations (G₁ and G₄). Whereas, microbial protein was significantly higher in the rumen of sheep fed berseem (G₄) and their mixture (G₂ and G₃) than that fed triticale alone (G₁) and the highest values were recorded with the mixture forages contained 50 and 70% Table 3. Similar results were recorded by Soliman et al. (1997) with legume (Sesbania) and grass (Teosinte) and their mixtures, El-Kholany (2004) and Ibrahim et al. (2012) with using of

mixture forage (or silage) in goats and sheep rations.

Digestion coefficients and feeding values

The digestibility of most nutrients Table 4 was higher with mixture forages (G₂ and G₃) than the other rations (G₁ and G₄). The digestion coefficients of OM, CF and NFE were significantly higher with sheep fed G₂ (50% triticale - 50% berseem) and G₃ (70% triticale - 30% berseem) than that fed G₁ (triticale) and G₄ (berseem).

Table 4. Digestion coefficients and nutritive values of the experimental rations fed to Rahmani sheep.

Parameters	Groups			
	G ₁	G ₂	G ₃	G ₄
Digestion coefficients				
DM	67.70±0.22 ^c	72.04±0.42 ^a	71.40±0.35 ^{ab}	70.36±0.42 ^b
OM	71.37±0.45 ^c	74.90±0.36 ^a	74.25±0.22 ^a	72.76±0.51 ^b
CF	65.12±0.65 ^b	67.66±0.21 ^a	67.24±0.26 ^a	65.35±0.26 ^b
CP	71.93±1.05 ^b	77.83±0.33 ^a	76.91±0.06 ^a	77.90±0.80 ^a
EE	75.53±0.31 ^a	76.70±0.60 ^a	76.36±0.12 ^a	74.03±0.37 ^b
NFE	75.20±0.24 ^b	78.65±0.51 ^a	78.03±0.24 ^a	75.75±0.60 ^b
Nutritive values				
TDN	67.20±0.42 ^b	70.45±0.37 ^a	70.36±0.20 ^a	67.65±0.48 ^b
DCP	7.80±0.12 ^b	9.45±0.04 ^b	8.93±0.01 ^c	10.75±0.11 ^a

a-b: Means in the same row followed by different letters differ significantly at (P<0.05).

The DM, OM and CP digestibility's were significantly decreased with G₁ (triticale) compared with G₄ (berseem). But, the differences in CF and NFE digestibility values between triticale and berseem were not significant. Moreover, it was noticed that the higher value of CP digestibility was with G₄ (77.90%) followed by G₂ (77.83%) then G₃ (76.91%) and finally G₁ (71.93%). Therefore, DCP was recorded the highest value ($P < 0.05$) with G₄ (10.75) while the lowest value was recorded with G₁ (7.80). Whereas, the TDN was significantly higher with sheep fed mixture forage (G₂ and G₃) than those fed triticale (G₁) or berseem (G₄) forage alone.

The improvement in digestion coefficients of most nutrients and nutritive value (TDN) with mixture forage may be due to the positive effect between the two forages and the better condition of the rumen fermentation. The average TDN of the treatments in this study were in agreement with those mentioned by Ibrahim et al. (1978), Gabra (1984) and Soliman et al. (1997) with mixture forages (legume with grass). Moreover, Gabra and Sherif (1985) observed that DCP was higher with increasing berseem in sheep rations and the lowest value was recorded with triticale forage alone as reported in the study.

Blood parameters

The results in Table 5 indicated that all measured blood constituents of goats (protein, albumin, globulin, urea-N, glucose and creatinine) were not significantly affected by inclusion of triticale in tested diets indicating no adverse effects either on

blood components or animal health, in general, that could occur as a result of such treatment.

Generally, the obtained results indicated that blood components measured showed slight differences due to the source of forages, while all levels were within the normal ranges which had been reported by Kaneko (1989) for healthy goats and on line with the finding of Haggag et al. (2002) who used triticale and berseem forage and their mixture in small ruminants rations.

Milk production and its quality

Data presented in Table 6 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 (1.350 kg) was recorded with G₂, followed by (1.230 kg) and the differences were significant as shown in Table 6.

The superiority of productive performance for lactating goats with mixtures forages, especially G₂, may be due to 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.

Table 5. Effect of feeding experimental rations on some blood serum parameters.

Parameters	Groups			
	G ₁	G ₂	G ₃	G ₄
Total protein (g/100ml)	6.45±0.07	6.43±0.08	6.41±0.02	6.57±0.06
Albumin (A) (g/100 ml)	3.62±0.06	3.61±0.06	3.50±0.35	3.58±0.03
Globulin (G) (g/100 ml)	2.83±0.10	2.82±0.02	2.91±0.07	2.99±0.03
A/G ratio	1.28±0.06	1.27±0.02	1.20±0.05	1.20±0.02
Urea-N (mg/100 ml)	17.75±0.80	18.40±0.50	18.22±0.82	19.10±0.69
Glucose (mg/100 ml)	60.12±1.75	62.00±1.13	60.63±1.80	59.97±1.43
Creatinine (mg/100ml)	1.40±0.05	1.42±0.03	1.52±0.06	1.50±0.04

Table 6. Effect of feeding experimental rations on milk production and its quality of dairy Zaraibi goats.

Parameters	Groups			
	G ₁	G ₂	G ₃	G ₄
Average milk yield (k/h)	1.230±0.01 ^b	1.350±0.02 ^a	1.310±0.02 ^{ab}	1.260±0.02 ^{ab}
Milk composition				
Fat (%)	4.05±0.04 ^a	4.21±0.03 ^a	4.20±0.03 ^a	3.97±0.05 ^b
Protein (%)	3.00±0.03	3.06±0.03	3.01±0.03	3.03±0.03
Lactose (%)	4.58±0.03	4.47±0.02	4.45±0.02	4.59±0.03
Total solids (%)	12.34±0.09	12.46±0.07	12.38±0.09	12.31±0.08
SNF (%)	8.29±0.04	8.25±0.04	8.18±0.04	8.34±0.04
Ash (%)	0.71±0.04	0.72±0.003	0.72±0.004	0.72±0.004
Somatic cell count, (SCC)× 10 ³	478±7.98 ^b	443±5.93 ^c	469±7.94 ^b	489±8.25 ^a
pH value	6.67±0.03	6.62±0.02	6.63±0.02	6.66±0.02
Acidity (%)	0.16±0.002	0.16±0.002	0.16±0.002	0.17±0.003

a-b-c: Means in the same row followed by different letters differ significantly at (P<0.05).

Milk fat percentage was significantly (P<0.05) lower with G₄ (3.97) compared with the others as shown in Table 6. The positive effect of triticale forage and their mixture with berseem on milk fat % may be due to the clear increase in ether extract (EE) digestibility and high content of EE in triticale forage. But the effect of the tested experimental rations on other milk contents (protein, lactose, total solids, solids non fat and ash) were not significant (P<0.05) and the obtained values of milk constituents were within the normal range given by Ahmed (1999), El-Kholany (2004) and Ibrahim et al (2012) for Zaraibi goat.

Somatic cell count (SCC) was significantly affected by the tested experimental rations (Table,6). The highest value (489000) of SCC was recorded with G₄, followed by G₁ (478000), then G₃ (469000) and

lastly. The lowest value (443000) was recorded with G₂ and the differences were significant. It is interesting to not a negative relationship between SCC and milk yield. In this respect, Baro et al. (1994), Bedo et al. (1995) and Ahmed et al. (2008a) found that SCC correlated negatively with milk yield, But, the differences in same 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).

Economic efficiency

Data of average feed intake and average milk yield during the experimental period as well as feed conversion efficiency of the dairy Zaraibi goats are summarized in Table 7.

Table 7. Feed and economic efficiency for lactating Zaraibi goats fed different experimental rations.

Items	Groups			
	G ₁	G ₂	G ₃	G ₄
Daily feed intake (g/h)				
CFM (g/h/d)	650	660	665	640
Forage	720	765	755	680
Total DM intake (g/h)	1370	1425	1420	1320
DM intake (g/kg BW)	3.91	4.07	4.06	3.77
DM intake (g/kg w 0.75)	95.27	99.10	98.75	91.79
CP intake (g/h/d)	172.0	189.0	184.0	187.0
Average milk yield (g/h/d)	1230	1350	1310	1260
Feed conversion efficiency				
Kg DM / kg milk	1.11	1.01	1.08	1.05
Kg CP/ kg milk	0.139	0.140	0.140	0.148
Economic efficiency				
Cost of consumed (L. E./h)	2.48	2.57	2.58	2.50
Price of milk produced (L.E./L)	4.31	4.73	4.59	4.41
Feed cost / kg milk. L.E.	2.02	1.90	1.97	1.98
Economic efficiency (%)	1.74	1.84	1.78	1.76

*The prevailing prices / ton at time of study are 3600 L.E., berseem forage cost 300L.E., triticale 200 L.E., and 1 ton of berseem forage/ triticale forage cost 250 L.E., while 1 kg milk 3.5 L.E.

The data indicated that the average milk yield recorded the highest value (1.350 kg/h / d) with G₂ followed by G₃ (1.31 kg/ h / d) and (1.260 kg/ h/d) with G₄ and lastly G₁ which recorded the lowest value (1.230 kg /h / d), and the differences were significant. Thus, the feed conversion calculated as DM and CP (intake / milk yield) was better in G₂ (1.01 and 0.140, respectively) and G₃ (1.08 and 0.140, respectively) compared with G₁ (1.11 and 0.139, respectively). Similar results were observed by El-Kholany (2004) and Ahmed (2013) using mixture of silages for Zaraibi goats. However, the obtained values of feed conversion are within the normal range given by Gabr et al. (1999). In the other study, Shehata et al. (2006) found that the feed conversion efficiency of Zaraibi goats ranged from 1.17 to 1.28 kg milk / kg DM intake.

Data in Table 7 indicated that the highest total feed cost (LE/h) along the feeding period was observed for G₃ (2.58) compared with other groups (2.57, 2.50 and 2.48 for G₂, G₄ and G₁, respectively). Therefore, the highest total feed cost / kg milk (LE) was observed for G₁ (2.02) and the lowest values were for G₂, G₃ and G₄ (1.90, 1.97 and 1.98, respectively), due to the highest daily milk yield as well as the lowest of feed consumption in the two groups (forage mixture).

Conclusion

It could be concluded that using mixture forage (triticale with berseem) in feeding Zaraibi goats had a positive effect on improving the feeding value, milk yield, and milk composition as well as feed utilization efficiency. Moreover, no remarkable any adverse of feed triticale on blood or rumen parameters and digestion coefficient. So, Triticale forage could be suitable for feeding goats as it is or as a mixture with berseem.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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