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The Potential of Feeding Goats Sun Dried Rumen Contents with or without Bacterial Inoculums as Replacement for Berseem Clover and the Effects on Milk Production and Animal Health

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ABSTRACT

Upgrading the nutritive value of sun dried Rumen Contents (RC) by enzymatic treatments and additives can make it a valuable feed resource for ruminants. The objective of this study was to determine the feeding value of partial replacement of Berseem Clover (BC) by treated RC with a mixture of exogenous enzymes (ZADO® or ZAD®) from anaerobic bacteria in the ration of early lactating Baladi goats. Twelve lactating Baladi goats weighed 26±0.5 kg in the first week of lactation were randomly assigned among four experimental treatments using 4×4 Latin square design to be fed four rations. 60% Concentrate Feed Mixture (CFM)+40% BC (Control); 60% CFM+20% BC+20% DRC (T_1); 60% CFM+20% BC+20% DRC treated with compound ZAD (T_2); 60% CFM+20% BC+20% DRC treated with ZAD compound+20 g compound ZADO /head/d fed directly before feeding (T_3). The period of this trial divided into four experimental periods each of 30 days. Results showed that T_3 and T_2 groups recorded higher values of digestibility coefficients compared with control and T_1 group. Groups contained DRC recorded higher values ($p>0.05$) of ruminal pH and non Protein Nitrogen (NPN) than the control. The treated groups (T_2, T_3) showed higher ($p<0.05$) values for rumen liquor ammonia, NPN and total volatile fatty acids (TVFA's) ($p>0.05$) compared with untreated group (T_1). Results showed insignificant differences for blood serum total proteins, globulins, urea, Creatinine, Serum aspartate aminotransferase (AST), Alanin aminotransferase (ALT) and glucose. Biological treated groups (T_3 and T_2) increased ($p>0.05$) daily milk yield, 4%fat corrected milk (4% FCM), fat, Total Solids (TS), Solids Not Fat (SNF) and lactose yields compared with T_1 group. It could be concluded that feeding goats on rations containing DRC treated with ZADO and/or ZAD compounds as a partial substitute of berseem improved the performance of lactating goats without any adverse effect on animals' health.

Key words: Rumen contents, berseem clover, biological treatments, enzymes, milk

INTRODUCTION

Egypt is suffering from a wide gap between animal's requirements and available feeds which estimated to be around 4.79 million tons of total digestible nutrients per year (El-Ashry, 2007). By-products can play an important role to minimize this gap. For many years, slaughterhouses wastes caused many disposal problems. Ruminants can be an alternative method of Rumen

Contents (RC) disposal. RC are the undigested mass in the rumen of slaughtered animals. The annual production of RC in Egypt during the year 2004 was about 32909.4 tons (Agriculture Economic and Statistics Institute, 2005). These large quantities of RC contain many nutrients that can be utilized in feeding of animals without any toxicity problems. The risk of infection with bacteria, viruses or parasites for livestock consuming the preserved RC after a storage period for 4 weeks was poorly noted (McCaskey *et al*., 1996). RC are not commonly fed to animals because of its low palatability and digestibility. However, these problems may be overcome by some treatments.

Researches founded that supplementing animal diets with fibrolytic enzymes can improve feeds utilization and animal performance by enhancing fiber degradation *in vitro*, *in situ* and *in vivo* (Gado *et al*., 2009); increasing feed intake and digestion rate and/or extent of digestion (Gado and Salem, 2008; Krueger *et al*., 2008). Moreover, fibrolytic enzymes affect hydrolytic activity in the rumen to reduce gut fill and enhance feed intake (Adesogan, 2005). It also enhances microbial colonization of feed and rumen microbial protein synthesis by increasing numbers of ruminal fibrolytic microbes (Morgavi *et al*., 2000; Nsereko *et al*., 2000) to increase rate of degradation of fiber in the rumen (Yang *et al*., 1999; Giraldo *et al*., 2008).

ZADO® and ZAD® are commercial exogenous enzyme mixtures which prepared from anaerobic bacterium. It has been shown to improve ruminal fermentation, N balance and nutrients digestibility, as well as milk yield of cows fed diets containing Egyptian by-product feeds (Gado *et al*., 2007). They also improve live body weight gain and feed conversion of wheat straw in sheep and goats (Gado and Salem, 2008).

A commercial exogenous enzyme mixture (ZADO®) activity starts immediately after feeding it to the animals. It works on the microflora directly which reaches its peak after 48 h from feeding. The main action will be on the rumen kinetics and the improvements on overall performance of the microflora effectiveness on utilizing the feed ingredients that usually reflects on the animal performance of either milk or meat production (Gado *et al*., 2007).

The objective of the present study was to evaluate the feasibility to use rumen content with or without different exogenous enzyme mixtures (ZAD® or ZADO®) on feed intake, digestibility, ruminal fermentation and milk production and composition for producing Egyptian Baladi goats.

MATERIALS AND METHODS

The present investigation was conducted to study the probability of replacing berseem clover with rumen contents and the effect of biological treatments by using ZAD and ZADO compounds on the chemical composition, nutritive value, rumen fermentation, milk yield and composition and some blood parameters of lactating Baladi goats.

The study was carried out at a private farm in Om-Dinar, Embaba, Giza Province during the period of Sep. 2007 to Feb. 2008.

Enzymes and treatments: ZAD® and ZADO® enzymes are bio-tech products prepared from natural sources to elevate the level of cellulolytic enzymes from anaerobic bacteria. ZADO® enzyme is similar as ZAD® but contains much higher enzymes per gram fed. ZADO® powder directly fed to animals before feeding. The enzyme products were made from natural sources of anaerobic ruminal bacteria including 7.1 unit g^{-1} of cellulase, 2.3 unit g^{-1} of xylanase, 61.5 unit g^{-1} of α-amylase and 29.2 unit g^{-1} of proteases according to Gado (1997).

Fresh RC (including rumen liquor) was obtained from local slaughter houses in tanks (120 L), without any blood contamination to prevent any ethical problems. The collected materials were spread on a plastic sheet in layers of about 5-10 cm and shuffled upside down twice daily to complete the sun drying for 14 days. The sun dried RC were collected in bags of about 30 kg each till using.

After collection of all dried RC amount needed, fresh water was added to the dried RC till the moisture level reached about 65-70%. The wet RC were inoculated with ZAD® (2 liter/ton dried RC) and then put in plastic bags. The plastic bags were compressed well to spare anaerobic conditions and left for 30 days in a moderate temperature.

Animals, feeding and experimental design: Twelve Baladi goats, averaging 26±0.5 kg of body weight were blocked by parity (lactation number and expected kidding date) and divided into 4 groups of 3 goats each. All goats were vaccinated for common infectious diseases and were dewormed (Albendazole 10 mg kg^{-1} body weight) before the experimental period. The goats were housed in tie stalls with free access to water. Four diets were formulated with 40:60 forage: Concentrates ratio to meet the nutrients requirements of goats (3% of body weight, changed continuously according to animal weight changes). The forage part of diets consisted of 100% Berseem Clover (BC) for control and 50% BC of other experimental diets. The remaining 50% consisted of untreated RC (T_1) or ZAD® treated RC (T_2) or T_2 plus 20 g ZADO®/goat/d orally fed directly before feeding (T_3). Diets were offered twice daily at 08:00 and 16:00 h in equal portions. Composition of the experimental diets are shown in Table 1.

The experimental periods (n = 4) consisted of 27 d for diets adaptation and 3 day for data collection in 4×4 Latin square design with interval period of 30 day. Feed intake and milk yield were measured on the last seven days of each period. Goats (n = 12) were hand milked twice daily at 09:00 and 21:00 h and daily milk samples were pooled by portions according to milk yield at each milking.

Table 1: Composition of experimental diets

	Diets[1]			
Item	C	T_1	T_2	T_3
Ingredient (%)				
Cotton seed cake	18.00	18.00	18.00	18.00
Wheat bran	12.00	12.00	12.00	12.00
Yellow corn	27.60	27.60	27.60	27.60
Limestone	1.20	1.20	1.20	1.20
Salt	0.60	0.60	0.60	0.60
Mineral and vitamin mixture[2]	0.60	0.60	0.60	0.60
Berseem clover (BC)	40.00	20.00	20.00	20.00
Untreated RC	0.00	20.00	0.00	0.00
Enzymes treated RC	0.00	0.00	20.00	20.00
Composition (Mcal kg^{-1})[3]				
DE	2.73	2.69	2.80	2.85
ME	2.31	2.27	2.38	2.43
NE_L	1.40	1.38	1.44	1.46

[1]C: 60% CFM+40% BC, T1: 60% CFM+20% RC+20% BC, T2: 60% CFM+20% ZAD® treated RC+20% BC, T3: 60% CFM+20% ZAD® treated RC+20% BC+20 g ZADO®/head/d. [2]Contained, per kg: 4.5% Ca, 2.5% P, 6.6% Na, 1.5% Mg, 1.2% K, 0.11% S, 1,372 mg of Fe, 1,032 mg of Mn, 1,500 mg of Zn, 247 mg of Cu, 16 mg of I, 16 mg of Co, 10 mg of Se, 185,000 IU of vitamin A, 32,500 IU of vitamin D3 and 900 IU of vitamin E. [3]Calculated according to NRC (2001)

Ruminal fermentation, blood chemistry and total tract nutrients utilization: Grabbed fecal samples were collected 4 times daily during the last 3 d of each period at 08:00, 12:00, 16:00 and 20:00 h. Samples were dried at 60°C in a forced-air oven for 48 h and pooled by goat within each period. Acid Insoluble Ash (AIA) was applied as internal marker according to Ferret *et al.* (1999). Digestibility coefficients calculated according to Ferret *et al.* (1999).

On the last day of the experimental period a 100 mL of rumen liquor sample was obtained via a stomach tube introduced into the ruminal ventral sac after 0, 3, 6 h of feeding. Collected digest were mixed and filtered through 4 layers of cheesecloth. Rumen liquor pH was immediately determined by using a hand-held pH electrode (model M90, Corning Inc., Corning, NY). Strained rumen liquor was stored in glass bottles (45 mL) with few drops of toluene and paraffin oil just to cover the surface and stored at -20°C for ammonia N and total volatile fatty acids (TVFA's) analysis.

On the last day of the experimental period, a 10 mL of blood from each animal was collected into a clean dried tube from the jugular vein after 4 h after feeding. Blood samples were centrifuged at 4000 rpm for 20 min. The blood serum was separated into a clean dried glass vials and frozen till analysis.

Chemical analysis: Dried samples (feeds, orts, feces) were ground through a Wiley mill (Arthur H. Thomas, Philadelphia, PA, USA) using a 1 mm screen. Samples of feed, orts and feces were analyzed for Dry Matter (DM) (930.15), Crude Protein (CP) (954.01), Ether Extract (EE) (920.39), Crude Fiber (CF) (962.09) and ash (942.05) (AOAC, 1995) while Nitrogen Free Extract (NFE) was calculated by difference. Milk samples were analyzed for fat, true protein and lactose using infrared spectrophotometry (Foss 120 Milko-Scan, Foss Electric, Hillerød, Denmark). Digital pH meter with a glass electrode was used for the pH measurements.

Samples of ruminal fluid were analyzed for TVFA's according to Warner (1964). Ammonia N, was analyzed as described by AOAC (1995).

Serum samples were analyzed using specific kits obtained from *Stanbio* Laboratory, USA. Total protein (Cannon *et al.*, 1974), albumin (Doumas *et al.*, 1971), serum aspartate Aminotransferase (AST) and Alanin aminotransferase (ALT) activity (Reitman and Frankel, 1957), urea, creatinine (Henary, 1974), glucose (Siest *et al.*, 1981) and total lipids (Postma and Stroes, 1968).

Calculations and statistical analysis: Fat corrected milk (4% FCM) was calculated according to Gaines (1928). Digestible Energy (DE) (MCal kg^{-1}), Metabolizable Energy (ME) (MCal kg^{-1}) and NEL (MCal kg^{-1}) were calculated according to NRC (2001).

All data except ruminal parameters were analyzed as a 4×4 Latin square using PROC MIXED of the SAS/STAT® software (SAS Institute 2001, Version 8.02, SAS Institute Inc., Cary, NC, USA). The statistical model included the effect of goat as random with period and treatment as fixed effects.

Data of VFA's, Ammonia N, were analyzed as repeated measurements across time by using PROC MIXED of the SAS/STAT® software (SAS Institute 2001, Version 8.02, SAS Institute Inc., Cary, NC, USA) with the following model:

$$Y_{ijkl} = \mu+T_i+A_j\ (T_i)+S_k+(T*S)_{ik}+E_{ijkl}$$

where, Y expressed the every observation of the jth animal in the kth sampling time given ith treatment, T (1-4) expressed the treatments effect, A (T) expressed the animal within treatments,

S (1-3) expressed the sampling time effect, T*S expressed the interaction between the treatments and sampling times and E expressed the experimental error.

Differences between means were determined using Duncan's multiple range test (Duncan, 1955). Significance was declared at $p<0.05$.

RESULTS AND DISCUSSION

Chemical composition of the experimental ingredients and rations: The average values of DM, OM, CP, EE, CF and NFE of the different experimental ingredients and rations are shown in Table 2. Generally, the ration contained untreated RC (T_1) had the highest values of ash, CF and EE but recorded the lowest values of CP and NFE. The biological treatments of RC slightly increased OM, CP and NFE while decreased ash, CF and EE compared with untreated RC (T_1) (Table 2).

Dry matter intake: Goats fed diets contained either treated or untreated RC consumed nearly similar amount of total DM (Table 3). while control animals consumed more ($p<0.05$) roughage. This may be due to that rations contained RC have higher CF contents and/or due to that BC is more palatable than RC. These results are consistent with Khattab *et al.* (2006) who fed RC and reported similar DM intake results.

Enzymes supplementations reported slight increase ($p>0.05$) in roughage intake compared with untreated RC. Other reports have shown an increase in DM intake with the same enzymes mixture (Gado *et al.*, 2007; Gado and Salem, 2008).

Nutrients digestibility: The treatment with ZADO® recorded the highest values for all nutrients digestibility followed by ZAD® treatment then control group in comparison with RC group (T_1) which recorded the lowest values. ZAD® and ZADO® positively influenced all nutrients digestibility through the total tract than both untreated RC and control diets (Table 3).

Generally, all nutrients digestibility positively increased with enzymes supplementation. Other reports have also shown an increase in digestibility with fibrolytic enzymes (Gado and Salem, 2008; Hristov *et al.*, 2008). Exogenous fibrolytic enzymes would be expected to increase fiber digestion

Table 2: Chemical composition of dietary ingredients and experimental rations (% on DM basis)

Item	DM	OM	Ash	CP	CF	EE	NFE
Ingredient							
CFM[1]	88.79	88.06	11.94	16.10	9.13	3.44	59.39
BC	16.88	90.71	9.29	9.51	29.98	4.51	46.71
Dried RC	89.39	85.47	14.53	8.47	34.10	7.55	35.35
Enzymes treated RC	91.10	86.18	13.82	9.13	31.26	7.44	38.35
Experimental rations[2] (calculated)							
Control	60.03	89.12	10.88	13.46	17.47	3.87	54.32
T_1	74.53	88.07	11.93	13.26	18.29	4.47	52.05
T_2	74.87	88.22	11.78	13.39	17.73	4.45	52.65
T_3	74.87	88.22	11.78	13.39	17.73	4.45	52.65

[1]CFM: 30% un-decorticated cotton seed cake, 20% wheat bran, 47% yellow corn, 2% limestone and 1% salt. [2]C: 60% CFM+40% BC, T_1: 60% CFM+20%, RC+20% BC, T2: 60% CFM+20% ZAD® treated RC+20% BC, T3: 60% CFM+20% ZAD® treated RC+20% BC+20 g ZADO®/head/d

Table 3: Effects of treatments on DM intake (g/day) and total tract Diet digestibility (g kg^{-1})

	Diets[1]					
Item	C	T_1	T_2	T_3	SEM	p-value
Intake (g day^{-1})						
DMI	880.17	856.75	860.58	862.92	9.97	0.2112
DMI-concentrates	529.58	528.00	528.75	529.17	6.01	0.6294
DMI-roughage	350.56^{a}	328.75^{b}	331.83^{b}	333.75^{b}	5.66	0.0254
Nutrient utilization (g kg^{-1})						
DM	665.70	661.10	669.70	681.20	10.88	0.3142
OM	663.70^{ab}	652.80^{b}	668.80^{ab}	687.50^{a}	10.35	0.2103
CP	718.70^{ab}	698.00^{b}	732.00^{a}	735.10^{a}	9.33	0.0350
CF	655.30^{ab}	644.10^{b}	678.50^{a}	682.00^{a}	11.75	0.0563
EE	681.50^{ab}	663.90^{b}	686.60^{ab}	699.80^{a}	9.09	0.2328
NFE	643.50^{b}	641.50^{b}	662.50^{ab}	678.00^{a}	11.82	0.0733

[1]C: 60% CFM+40% BC, T_1: 60%CFM+20% RC+20% BC, T_2: 60% CFM+20% ZAD® treated RC+20% BC, T3: 60% CFM+20% ZAD® treated RC+20% BC+20 g ZADO®/head/d. Each value was obtained from 12 animals. Means with different superscripts in the same row are significant ($p<0.05$)

by many mechanisms. Increasing the rate of ruminal digestion of the potentially digestible fiber (Yang *et al*., 1999), reducing digest viscosity (Hristov *et al*., 2000) alterations in ruminal fermentation (Nsereko *et al*., 2002). It also enhance attachment and colonization to the plant cell wall by ruminal microorganisms (Nsereko *et al*., 2000; Wang *et al*., 2001) and/or by synergism with enzymes in rumen fluid (Morgavi *et al*., 2000). However, increased fiber digestion is unlikely the result of supplemental enzyme activity alone because the contribution of added exogenous enzymes to total ruminal activity is relatively small (Beauchemin *et al*., 2001). Morgavi *et al*. (2000) demonstrated synergism between exogenous enzymes and ruminal enzymes such that the net combined hydrolytic effect in the rumen was much greater than that estimated from individual enzyme activities. Wang *et al*. (2001) reported that enzyme supplementation increased numbers of non-fibrolytic and fibrolytic bacteria in a batch culture system with rumen fluid. Stimulation of rumen microbial numbers by the use of enzymes could result in higher microbial biomass which would provide more total polysaccharidase activity to digest feedstuffs. Consistent with this hypothesis (Yang *et al*., 1999) reported that enzyme supplementation of dairy cow diets increased feed digestion in the rumen and flow of microbial protein from the rumen.

Ruminal fermentation: Groups contained RC (T_1, T_2, T_3) slightly increased ($p>0.05$) ruminal pH compared with control group (Table 4). Enzymes treated rations (T_2, T_3) increased ruminal TVFA's and ammonia-N compared with untreated RC group (Table 4).

All ruminal fermentation parameters (Table 4) suggested that enzymes supplementation improved ruminal fermentation specially fibers fermentation. The increase in ruminal pH for rations contained RC is in agreement with Khattab *et al*. (2006) This may be due to the relatively high content of fiber for these rations (Table 1). Results of TVFA's suggested that the anaerobic fermentation of enzymes treated materials was more efficient and yielded more TVFA's than that of un-supplemented one (T_1). This may be due to the increases of digestibility of OM (Table 3) in both T_3 and T_2 treatments. The results are in agreement with Khattab *et al*. (2006) and Abd-El-Tawab *et al*. (2008). Increased ammonia N concentration in animals fed the enzyme supplemented diet supports its capability to enhance rumen protein degradation, probably because

Table 4: Effect of treatments on rumen parameters

	Diets[1]					
Parameter	C	T_1	T_2	T_3	SEM	p-value
pH	6.34	6.45	6.43	6.42	0.08	<0.001
TVFA's (m.eq dL^{-1})	10.67	10.30	10.83	10.84	0.47	<0.001
Ammonia-N (mg dL^{-1})	25.82^{b}	24.68^{b}	28.96^{a}	27.08^{ab}	0.93	<0.001

[1]C: 60% CFM+40% BC, T1: 60% CFM+20% RC+20% BC, T2: 60% CFM+20% ZAD® treated November 10, 2011RC+20% BC, T3: 60% CFM+20% ZAD® treated RC+20% BC+20g ZADO®/head/d. Each value was obtained from 12 animals. Means with different superscripts in the same row are significant ($p<0.05$)

it contained protease enzymes. However, increased protein degradation may also reflect the more neutral rumen pH with enzyme addition, thereby increasing ruminal bacterial colonization of feed particles (Yang *et al*., 1999; Morgavi *et al*., 2000; Nsereko *et al*., 2000). However, Colombatto *et al*. (2007) worked with an enzyme product rich in xylanolytic activity and concluded that exogenous enzymes had higher activity close to pH neutrality and that the hypothesis that exogenous enzymes have an effect on digestion when pH values were not optimal for fiber degradation is not supported. Results of ruminal ammonia N are in line with those reported by Khattab *et al*. (2006).

Blood biochemical parameters: The results of blood serum biochemical parameters of the different experimental animal (Table 5) did not indicate any significant differences among the dietary groups except those of albumin and total lipids. The total lipids contents in the serum of goats fed untreated RC was decreased ($p<0.05$) compared with treated RC (Table 5).

Serum total protein reflects the nutritional status of the animal and it has a positive correlation with dietary protein (Kumar *et al*., 1980). The results of serum total proteins are parallel with values of CP content in the experimental rations (Table 1). The decrease ($p<0.05$) of serum albumin for untreated RC group may be due to the lowest CP digestibility of this group (Table 3). These results are in a good agreement with those obtained by Gado *et al*. (2006). The increase of serum urea for control and RC treated groups is in a good agreement with Gado *et al*. (2006) who found that serum urea concentration was increased with ZAD® treatments compared with control. Serum AST and ALT activity were in normal range (Reitman and Frankel, 1957) which is a good indicator for normal liver cells activity. Gado *et al*. (2006) found that AST and ALT activities were not affected by ZAD® treatments. The concentrations of urea and creatinine suggest that experimental animals were not in a catabolism situation and kidney function was not adversely affected by treatments.

Milk yield and milk components: Partial replacement of BC by untreated RC decreased ($p>0.05$) milk yield and 4% FCM, However, the biological treated rations (ZADO® and ZAD®) increased ($p>0.05$) milk yield and 4% FCM compared with untreated RC ration (T_1) (Table 6). The diets contained RC (T_1, T_2, T_3) positively influenced fat content compared with control. ZADO® treated RC increased ($p<0.05$) all milk components compared with T_1. No effects of supplementation on milk pH were noted.

The most important finding in the present study is that milk production increased by enzymes supplementation (T_3, T_2) compared with untreated one (T_1). ZADO® treated group recorded the highest 4% FCM yield followed by control and (T_2) compared with (T_1) group that recorded the

Table 5: Effect of treatments on blood serum metabolites

	Diets[1]					
Parameter	C	T_1	T_2	T_3	SEM	p-value
Total protein (g dL^{-1})	6.88	6.66	6.76	6.84	0.14	0.819
Albumin (g dL^{-1})	3.43^{ab}	3.24^{b}	3.40^{ab}	3.63^{a}	0.11	0.222
Urea (mg dL^{-1})	43.17	37.96	42.32	41.71	2.34	0.699
Creatinine (mg dL^{-1})	1.26	1.18	1.20	1.18	0.06	0.404
AST (units mL^{-1})	61.83	68.17	63.17	66.75	4.00	0.115
ALT (units mL^{-1})	18.88	17.50	18.88	18.71	1.75	0.659
Glucose (mg dL^{-1})	78.00	74.61	75.28	78.17	2.28	0.743
Total lipids (mg dL^{-1})	247.50^{ab}	211.50^{b}	265.90^{a}	273.40^{a}	16.55	0.034

[1]C: 60% CFM+40% BC, T1: 60% CFM+20% RC+20% BC; T2: 60% CFM+20% ZAD® treated RC+20%BC; T3: 60% CFM+20% ZAD® treated RC+20% BC+20g ZADO®/head/d. Each value was obtained from 12 animals. Means with different superscripts in the same row are significant ($p<0.05$)

Table 6: Effect of treatments on milk yield and composition.

	Diets[1]					
Item	C	T_1	T_2	T_3	SEM	p-value
Yield g/h/day						
Milk	821.60	771.00	807.50	813.40	40.55	0.001
4% FCM[2]	755.10	715.90	754.60	773.70	37.20	0.014
Milk composition (%)						
Fat	3.470^{c}	3.54^{bc}	3.57^{b}	3.70^{a}	0.093	<0.001
CP	3.470^{ab}	3.43^{b}	3.53^{ab}	3.58^{a}	0.210	<0.001
Lactose	4.270^{a}	4.13^{b}	4.19^{ab}	4.26^{a}	0.06	<0.001
TS	11.94^{b}	11.83^{b}	12.00^{b}	12.24^{a}	0.200	<0.001
pH value	6.500	6.52	6.53	6.53	0.02	0.421
Milk efficiency[3]	0.860	0.84	0.88	0.90	0.045	0.012

[1]C: 60% CFM+40% BC, T1: 60%CFM+20%RC+20% BC, T2: 60% CFM+20% ZAD® treated RC+20%BC, T3: 60% CFM+20% ZAD® treated RC+20% BC+20g ZADO®/head/d. [2]Calculated according to Gaines (1928). [3]calculated as FCM/DMI. Each value was obtained from 12 animals. Means with different superscripts in the same row are significant ($P<0.05$). FCM, Fat corrected milk; CP, Crude protein; TS: Total solids

lowest value. These results are positively correlated with the corresponding increase in nutrients digestibility (Table 3). Also, milk fat, total solids, total protein and lactose percent were increased ($p<0.05$) with ZADO® and ($p>0.05$) with ZAD® compared with untreated group (T_1).

The nutrients digestibility and ruminal fermentation activity suggested that increased milk production was due to feeding enzymes. The increase in milk fat content of the treated RC groups (T_3, T_2) compared with untreated RC (T_1) may be related to the increase of fiber digestibility of these groups (Table 3). These results are consistent with those of Gado *et al.* (2009) who used the same enzyme mixtures.

Studies on enzyme supplementation to dairy cow diets have shown milk yields improvement (Lewis *et al.*, 1999), probably due to increased digestibility (Yang *et al.*, 1999), as well as alteration of acetic/propionic acid ratio in the rumen (Giraldo *et al.*, 2008) which increased energy available for milk production (Lewis *et al.*, 1999; Yang *et al.*, 1999). Results also showed that ZADO® and ZAD® slightly increased ($p>0.05$) milk efficiency (FCM/DMI) compared with control and RC groups (Table 6).

CONCLUSION

This study discussed a very important points which have a very important Implications. The economic importance of this work is that it used a very cheap materials with very simple and cheap treatments which will positively affects the economic efficiency of diets. The environmental implication of this work is the utilization of materials (rumen contents) which cause many disposal problems specially in Egypt where it throw in rivers and canals.

Under the conditions of the present study, Replacing 50% of berseem clover in rations of Baladi lactating goats with untreated sun dried rumen contents (DM basis) decreased all nutrients digestibility, feed intake and feed efficiency in term, decline the performance of lactating goats. Feeding ration containing sun dried rumen contents treated with ZADO and ZAD compounds improved the performance of lactating goats without any adverse effect on animals' health. More research is needed to determine the optimal share level and essential pretreatments and the long-term effects of feeding RC to dairy goats.

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