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Research Article
Effect of Partial Replacement of Corn Grains by Date Seeds on Rahmani Ram's Nutrients Digestibility and Nubian Goat's Milk Production

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Abstract

Background and Objectives: Most utilized grains in livestock feeding in Egypt are imported from abroad, therefore searching for alternative feed ingredients to replace of high cost feed grains is very important approach. This research aimed to investigate the effects of partial replacement of corn grains by Powdered Date Seeds (PDS) or PDS+fibrolytic enzymes on the productive performance of Rahmani rams and lactating Nubian goats. **Materials and Methods:** For digestibility trial, three mature Rahmani rams were randomly assigned to the experimental rations [Control (0% PDS), R1 (50% of corn of the control replaced by PDS), R2 (50% of corn of the control replaced by PDS) + 2 g Asperozym kg^{-1} DMI] using 3×3 Latin square design. For lactation trial, twenty seven lactating Nubian goats randomly assigned into three groups of nine animals each to the experimental rations using complete random design. The entire experimental periods for digestibility and lactation trials were 63 days. Rams and goats were fed dry matter according to 4% of their body weight and water was offered freely. Data were statistically analyzed by SAS (Version 8) software. **Results:** Rams fed R1 recorded the lowest values of ruminal fermentation characteristics (except pH) and nutrients digestibility coefficients. No significant differences were found between (R_2) and control rams in all tested ruminal fermentation characteristics (except pH) and all nutrients digestibility coefficients (except CF digestibility). There were no significant differences among all groups in plasma total protein, globulin, urea, ALT, AST and cholesterol concentrations. Milk, 4% FCM and all milk constituents yields (except SNF yield) were higher ($p<0.05$) for control and R2 goats than R1 goats. **Conclusion:** The replacement of 50% of corn grains by enzymatically treated powdered date seeds had no negative effect on rumen fermentation and nutrients digestibility of Rahmani rams, as well as Nubian goat's milk production and its component's yields.

Key words: Powdered date seeds, corn grains, fibrolytic enzymes, rumen fermentation, nutrients digestibility, milk production

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Utilization of date seeds (processed date by product) as a replacement for high cost corn grains in the diets of farm animals are being in spotlight[1]. Since date seeds contain starch percentage (55-73%) similar to that of grains, abundant in Egypt and are not utilized for human consumption[2]. Egypt has the first place of date producing countries with annual production reached to 1.350,000 t (16% of global production) which generate around 405000 t of seeds per year[3].

Date seeds, also called kernels, pits, pips or stones contain 6-8% crude protein, 2-9% oil, 9-22% crude fiber, 59-75% nitrogen free extract, 1-4% ash, 51-73% neutral detergent fiber, 40-57% acid detergent fiber, 24-46% cellulose, 7-28% hemicellulose and 7-26% lignin[2,4]. In addition, aspartic acid, arginine and glutamic acid account half of total date seeds amino acids, while oleic acid representing 50% of date seeds fatty acids[5]. Although date seeds are nutritious from point of view of the chemical composition, the feeding value of it still lowers than all of feed grains. The seed hard, enclosed structure makes digestion of its components difficult process[6]. Thus, to increase availability of date seeds components for farm animals, it is necessary to crush and grind it firstly and then treat it with chemical agents (e.g., urea) or biological agents (e.g., microbial enzymes)[7].

Microbial enzymes utilization for up-grading of the nutritive value of agricultural by-products had been evaluated by several researchers[8-12]. The main reasons for feed enzymes utilization are: Destroying the antinutritional factors of feeds and increase the availability of nutrients enclosed within fiber-rich feed ingredients through break down of specific chemical bounds on it[13]. Addition of fibrolytic enzymes to ruminant's diets can reduce the feed viscosity, which increases nutrients absorption[14], as well as milk production[8-10,15].

This study was carried out to investigate the effects of partial replacement of corn grains by powdered date seeds with or without fibrolytic enzymes supplementation on (1) Rumen fermentation characteristics, nutrients digestibility of Rahmani rams and (2) Some blood parameters, milk production and milk composition by lactating Nubian goats.

MATERIALS AND METHODS

This study was carried out at Agricultural Experimental Station, Sheep and Goat Research Unit, Faculty of Agriculture, Cairo University, Giza, Egypt and dairy science department, National Research Center (NRC), Dokki, Giza, Egypt. The entire experimental period was extended from May 19, 2015 to July 20, 2015. Analytical chemical grade was used for the chemical and microbiological analyses for all samples of this study.

Date seeds processing: The sun dried date palm seeds were purchased from local date market in Siwa Oasis, Marsa-Matrouh Governorate, Egypt. The seeds were ground in a heavy-duty high rotation hammer mill to pass through 1 mm mesh sieve to obtain the seed's fine powder. The resulting fine powder contain (on dry matter basis) 96.95% organic matter, 5.01% crude protein, 6.70% ether extract, 13.25% crude fiber, 3.05% ash, 71.99% nitrogen free extract, 53.02% neutral detergent fiber, 47.10% acid detergent fiber, 12.02% acid detergent lignin, 5.92% hemicellulose and 35.08% cellulose.

Digestibility trial: Three mature Rahmani rams weighting on average 51 kg were randomly assigned to treatments using 3×3 Latin square design. The entire experimental period was 63 days divided into three equal periods (21 day each) in which rams were kept in separate shaded pens for 14 days (adaptation period) . Rams were then moved individually to the digestion crates for the rest of each period (7 days) for samples collection. At the end of each period the rams were switched to a different ration, therefore each ram had received all of the experimental rations. Rams were fed dry matter according to 4% of their body weight twice daily at 8.00 am and 16.00 pm, water was offered freely. Powdered Date Seeds (PDS) with or without fibrolytic enzymes supplementation (Asperozym, a laboratory produced fibrolytic enzymes from *Aspergillus niger*, each gram of it contains 500 IU of cellulase and 150 IU of pectinase) was partially replaced the corn grains in ram's ration. The experimental rations were: Control (0% PDS), R1 (50% of corn of the control replaced by PDS), R2 (50% of corn of the control replaced by PDS) + 2 g Asperozym kg^{-1} DMI. The feed ingredients and the chemical composition of the experimental rations are shown in Table 1. The fecal samples were taken once daily during samples collection period then dried at 60°C for 72 h. Feed and fecal samples were ground through 1mm screen on a Wiley mill grinder and then analyzed according to the AOAC[16] methods to determine Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Crude Fiber (CF) and ash contents. Organic Matter (OM) and Nitrogen Free Extract (NFE) contents were calculated by difference. The Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Acid Detergent Lignin (ADL) contents were determined using the methods described by Van Soest *et al.*[17]. Rumen fluid samples were taken at the end of the collection period by stomach tube. Samples were collected 4 h post morning feeding. Samples were strained through four layers of gauze cloth to remove feed particles and immediately used for determination of ruminal pH using digital pH-meter. Ammonia nitrogen concentration (NH_3-N), Total Nitrogen (TN) and non-protein

Table 1: Feed ingredients and chemical composition of the experimental rations (on DM basis)

Items	Experimental rations		
	Control	R1	R2
Feed ingredients (%)			
Berseem hay	50	50	50
Yellow corn	25	12.5	12.5
Date seeds powder	0	12.5	12.5
Cotton seed meal	15	15	15
Wheat bran	8.5	8.5	8.5
Minerals-vitamins premix	0.5	0.5	0.5
Sodium chloride	0.5	0.5	0.5
Limestone	0.5	0.5	0.5
Asperozym (Fibrolytic enzymes)	0	0	2 g kg^{-1} DMI
Chemical composition (%)			
Organic Matter (OM)	91.44	91.25	91.25
Crude Protein (CP)	18.51	17.99	17.99
Ether Extract (EE)	3.25	3.49	3.49
Crude Fiber (CF)	12.96	14.35	14.35
Nitrogen Free Extract (NFE)	56.72	55.42	55.42
Ash	8.56	8.75	8.75
Cell wall constituents (%)			
Neutral Detergent Fiber (NDF)	34.23	37.66	37.66
Acid Detergent Fiber (ADF)	24.87	28.90	28.90
Acid Detergent Lignin (ADL)	7.50	8.37	8.37
Hemicellulose	9.36	8.76	8.76
Cellulose	17.37	20.53	20.53

Hemicellulose: NDF-ADF, cellulose: ADF-ADL. Control: 0% Powdered date seeds (PDS), R1: 50% of corn of control replaced by PDS), R2: 50% of corn of control replaced by PDS) + 2 g of fibrolytic enzymes (Asperozym) kg^{-1} DMI

nitrogen (NPN) were determined by the modified semi-micro-Kjeldahl digestion method according to AOAC[16]. The Total Volatile Fatty Acids (TVFA's) were determined according to method of Warner[18]. The ruminal microbial protein was estimated as described by Makkar *et al.*[19]. The classification and determination of protozoal count were done as described by Ogimoto and Imai[20] and Dehority and Orpin[21].

Lactation trial: Twenty seven lactating Nubian goats (about 3 years old and weighting on average 31±0.5 kg) after 7 days of parturition randomly assigned into three groups of nine animals each using complete random design. The entire experimental period was 63 days. Goats were fed dry matter according to 4% of their body weight twice daily at 8.00 am and 16.00 pm, water was offered freely. As in the digestibility trial the first group was fed control ration (0% PDS), the second group was fed R1 (50% of corn of the control replaced by PDS), while the third group was fed R2 (50% of corn of the control replaced by PDS) + 2 g Asperozym kg^{-1} DMI. The feed ingredients and the chemical composition of the experimental rations are shown in Table 1.

Blood samples were taken from jugular vein of three animals each group at the last day of the experimental period (4 h after morning feeding) and directly collected in glass tubes containing EDTA as an anticoagulant. Blood plasma samples were separated by centrifuge at 5000 rpm for 15 min. and kept frozen for later analysis. Plasma total protein, albumin, urea, glucose, aspartate aminotransferase (AST) and alanine aminotransferase (ALT) were determined[22].

The goats were milked twice a day at 9.00 am and 5.00 pm during the last week of experimental period. Milk samples were immediately collected from each animal after morning and evening milking and milk yield was recorded. Milk samples were analyzed for total solids, fat, total protein and lactose by Bentley 150 infrared milk analyzer (Bentley Instruments, Chaska, MN, USA) according to AOAC[16] procedures. Solids-not-fat (SNF) was calculated by subtracting fat from total solids percentage. Fat corrected milk (4% fat) was calculated by using the Eq. 1[23].

$$FCM = 0.4\ M+15\ F \quad (1)$$

where, M is milk yield (g)and F is the fat yield (g).

Statistical analysis: Data obtained from this study were statistically analyzed by SAS[24] (Version 8) at level ($p<0.05$) of probability according to general linear model procedures outlined by Snedecor and Cochran[25] as follow:

Latin square design was used for statistical analysis of data of nutrients digestibility and rumen fermentation characteristics using the Eq. 2:

$$Y_{ijk} = \mu+R_i+C_j+T_k+E_{ijk} \quad (2)$$

where, Y_{ijk} is the parameter under analysis of the i_{jk} trait, μ is the overall mean, R_i is the effect of the period on the parameter under analysis, C_j is the effect due to the animals on the parameter under analysis, Tk is the effect due to treatment on the parameter under analysis and E_{ijk} is the experimental error for i_{jk} on the observation, assumed to be randomly distributed $(0, \sigma^2)$.

Data of milk yield, milk composition and blood parameters were statistically analyzed using the Eq. 3:

$$Y_{ij} = \mu+T_i+e_{ij} \quad (3)$$

where, Y_{ij} is the parameter under analysis of the i_j goats of lactation trails, μ is the overall mean, T_i is the effect due to treatment on the parameter under analysis and e_{ij} is the experimental error for i_j on the observation. Duncan's multiple range tests was used to test the significance among means[26].

RESULTS

Effect of experimental rations on ram's ruminal characteristics: Rams fed control ration showed the lowest ($p<0.05$) ruminal pH values followed by rams fed on fibrolytic supplemented ration (R2), then rams fed on R1 ration (Table 2). The total volatile fatty acids (TVFA's) concentrations tended to be greater ($p<0.05$) in rams fed control ration than those fed R1 ration. No significant differences were detected between rams fed control ration and enzymes supplemented ration (R2) in ruminal TVFA's concentrations. Concerning with protein utilization, ruminal total nitrogen and microbial protein concentrations showed significant ($p<0.05$) increase for rams fed the control ration compared with those of rams fed R1 ration. However, no significant differences were found between enzymes supplemented rams (R2) and the other rams in ruminal total nitrogen and microbial protein concentrations. Also, no change was detected among all tested rams in ruminal ammonia-nitrogen and non protein nitrogen concentrations.

The effect of tested rations on ruminal protozoa species and subspecies count is shown in Table 3. Rams fed control ration had the highest ($p<0.05$) total count of ruminal protozoa followed by rams received R2 (enzymes supplemented ration) then rams fed R1 ration. In contrast, *P. multivesiculatum* count tended to be greater ($p<0.05$) in rumen fluid of rams fed R1 ration than those fed control and R2 rations. On the other hand, no significant difference detected among all rams in count of *E. minimum*, *E. furca, E. triacum*, *E. caudatum*, *D. dentatum*, *D. elongatum*, *O. caudatus*, *O. purkynjei* and *I. intestinalis* ruminal protozoa subspecies.

Table 2: Effect of treatments on ram's ruminal characteristics

Items	Control	R1	R2	±SEM
PH	6.42^{c}	6.82^{a}	6.60^{b}	0.21
Total volatile fatty acids (mg %)	12.82^{a}	10.92^{b}	12.75^{a}	0.29
Ammonia-nitrogen (mg %)	24.33	20.06	23.90	1.18
Non protein nitrogen (mg %)	44.05	35.20	42.95	0.94
Total nitrogen (mg %)	122.70^{a}	103.35^{b}	117.85^{ab}	5.17
Microbial protein (mg %)	78.85^{a}	65.75^{b}	75.10.^{ab}	3.54

Means with different letters with each row are significantly different ($p<0.05$). Control: 0% Powdered date seeds (PDS), R1: 50% of corn of control replaced by PDS, R2: 50% of corn of control replaced by PDS + 2 g of fibrolytic enzymes (Asperozym) kg^{-1} DMI

Table 3: Effect of treatments on ram's ruminal ciliate protozoa count ($\times 10^4$ cell mL^{-1} rumen liquor)

Items	Control	R1	R2	±SEM
Entodinum spp.				
E. caudatum	333.61^{a}	275.27^{b}	324.66^{a}	12.57
E. simplex	145.72^{a}	131.94^{b}	138.33^{ab}	6.17
E. minimum	236.38	227.22	238.66	5.71
E. bursa	104.77^{a}	83.00^{b}	97.61^{ab}	3.88
E. furca	2.16	2.50	1.66	0.75
E. triacum	6.83	7.50	6.66	2.30
Epidinium spp.				
E. ecaudatum	28.61	31.66	29.83	0.48
Polyolastron spp.				
P. multivesiculatum	37.50^{b}	51.99^{a}	46.94^{ab}	2.20
Diplodinum spp.				
D. psitaceum	137.50^{a}	119.66^{b}	120.27^{b}	6.79
D. dentatum	28.89	30.94	28.49	0.70
D. elongatum	24.22	19.97	23.88	0.73
Ophryoscolox spp.				
O. caudatus	18.89	13.05	14.94	0.64
O. purkynjei	16.11	11.66	14.16	0.76
Isotrchia spp.				
I. prostoma	28.61^{a}	21.66^{b}	23.75^{b}	0.24
I. intestinalis	18.39	15.39	16.83	0.82
Dasytrachia spp.				
D. rummantium	55.00^{a}	43.88^{b}	44.44^{b}	2.31
Total count	1223.19^{a}	1087.29^{b}	1171.11^{a}	17.89

Means with different letters with each row are significantly different ($p<0.05$). Control: 0% Powdered date seeds (PDS), R1: 50% of corn of control replaced by PDS, R2: 50% of corn of control replaced by PDS + 2 g of fibrolytic enzymes (Asperozym) kg^{-1} DMI

Effect of experimental rations on ram's nutrient digestibility: The nutrients digestibility and nutritive values of all tested rations are shown in Table 4. There were significant ($p<0.05$) increase in all nutrients digestibility (except EE digestibility) by rams fed control rations compared with rams fed the R1 ration, while no significant difference were detected among rams received control and R2 rations in all nutrients digestibility except in case of CF digestibility. The rams that fed control ration recorded the highest CF digestibility followed by rams that fed enzyme supplemented ration (R2), then rams fed R1 ration, while no significant differences among all rams in EE digestibility. The nutritive values of the experimental rations as Total Digestible Nutrients (TDN) and Digestible Crude Protein (DCP) match nutrients digestibility trend.

Effect of experimental rations on blood plasma parameters: The goats received control and R2 rations had higher ($p<0.05$) plasma glucose and albumin concentrations than those fed R1 ration (Table 5). There were no significant differences ($p>0.05$) among all groups in plasma total protein, globulin, urea, ALT, AST and cholesterol concentrations.

Effect of experimental rations on milk production and milk composition: Milk yield, 4% Fat Corrected Milk (FCM) yield and all milk constituents yields (except solids not fat yield) were higher ($p<0.05$) for control and enzymes treated goat's groups than goats of the R1 group (Table 6). On the other hand, fat, lactose, total solids and solids not fat percentages showed significant increase ($p<0.05$) in milk of control and enzymes treated goat's groups compared to goats of the R1 group. No significant differences ($p>0.05$) among all groups in milk solids not fat yield or milk total protein, ash, total solids and solids not fat percentages.

DISCUSSION

The pattern of pH, TVFA's and NH_3-N concentrations reflects the pattern of fermentation efficiency in the rumen. The ruminal pH reduction and higher TVFA's production of rams fed the control and R2 rations can be attributed to liberation of a large amount of fermentable carbohydrate as a result of high solubility of corn carbohydrates in the control ration and the highly hydrolytic effect of fibrolytic enzymes on structural and nonstructural carbohydrates of date seeds in R2 ration. This finding supported the previous results of Mahmoud and El-Bana[4] who found that feeding camels on barley grains decreased ruminal pH and increased ruminal TVFA's concentrations significantly after 3 and 5 h of feeding compared with their values in rumen fluids of camels

Table 4: Apparent nutrient digestibility and nutritive values of the experimental rations

Items	Control	R1	R2	±SEM
Apparent nutrients digestibility (%)				
Dry matter (DM)	69.85^{a}	64.99^{b}	69.52^{a}	0.83
Organic matter (OM)	69.96^{a}	63.99^{b}	69.08^{a}	1.00
Crude protein (CP)	69.93^{a}	65.92^{b}	69.44^{ab}	0.78
Ether extract (EE)	68.14	66.60	68.30	1.12
Nitrogen free extract (NFE)	71.34^{a}	64.33^{b}	68.82^{a}	0.65
Crude fiber (CF)	69.64^{a}	59.30^{c}	65.10^{b}	0.99
Neutral detergent fiber (NDF)	67.75^{a}	59.49^{b}	66.45^{a}	0.99
Acid detergent fiber (ADF)	66.73^{a}	59.58^{b}	66.26^{a}	0.98
Nutritive value (%)				
Total digestible nutrients (TDN)	67.41^{a}	61.25^{b}	65.34^{a}	0.76
Digestible crude protein (DCP)	12.94^{a}	11.86^{b}	12.49^{ab}	0.16

Means with different letters with each row are significantly different ($p<0.05$). Control: 0% Powdered date seeds (PDS), R1: 50% of corn of control replaced by PDS, R2: 50% of corn of control replaced by PDS + 2 g of fibrolytic enzymes (Asperozym) kg^{-1} DMI

Table 5: Blood plasma parameters of lactating goats fed different experimental rations

Items	Control	R1	R2	±SEM
Glucose (mg dL^{-1})	73.84^{a}	65.74^{b}	73.87^{a}	1.81
Total protein (mg dL^{-1})	7.11	6.77	7.13	0.08
Albumin (mg dL^{-1})	3.31^{a}	2.80^{b}	3.21^{a}	0.09
Globulin (mg dL^{-1})	3.80	3.96	3.92	0.07
Urea (mg dL^{-1})	20.89	19.18	22.74	0.90
Cholesterol (mg dL^{-1})	125.67	121.33	123.00	1.86
AST (U mL^{-1})	45.33	48.00	48.33	1.33
ALT (U m L^{-1})	23.67	25.00	24.67	0.60

Means with different letters with each row are significantly different ($p<0.05$). Control: 0% Powdered date seeds (PDS), R1: 50% of corn of control replaced by PDS, R2: 50% of corn of control replaced by PDS + 2 g of fibrolytic enzymes (Asperozym) kg^{-1} DMI

Table 6: Milk yield and milk composition of lactating goats fed different experimental rations

Items	Control	R1	R2	±SEM
Yields (g day^{-1})				
Milk yield	969.31[a]	844.33[b]	951.56[a]	14.68
4% FCM yield	917.02[a]	758.01[b]	886.15[a]	16.78
Total protein yield	34.19[a]	26.32[b]	32.99[a]	0.97
Fat yield	35.29[a]	28.02[b]	33.70[a]	0.78
Lactose yield	43.56[a]	34.83[b]	42.20[a]	0.90
Ash yield	7.07[a]	6.27[b]	6.91[a]	0.13
Total solids yield	120.10[a]	95.44[b]	115.81[a]	2.39
Solids not fat yield	84.82	67.42	81.48	1.77
Milk composition (%)				
Total protein	3.53	3.13	3.47	0.08
Fat	3.64[a]	3.33[b]	3.54[a]	0.05
Lactose	4.50[a]	4.14[b]	4.44[a]	0.06
Ash	0.73	0.74	0.73	0.01
Total solids	12.40[a]	11.34[b]	12.17[a]	0.14
Solids not fat	8.75[a]	8.02[b]	8.56[a]	0.12

Means with different letters with each row are significantly different ($p<0.05$). Control: 0% Powdered date seeds (PDS), R1: 50% of corn of control replaced by PDS, R2: 50% of corn of control replaced by PDS +2 g of fibrolytic enzymes (Asperozym) kg^{-1} DMI

fed date stones. Also, Kholif *et al.*[7] reported that goats fed diets containing enzymes treated date kernels showed greater decrease in ruminal pH values and increase TVFA's concentrations than those fed diets containing date kernels without enzymes treatment. Furthermore, partial substitution of corn by date seeds does not affect ruminal NH_3-N and non protein nitrogen concentrations of all tested rams, this because of ruminal low degradability of corn protein[27] and ruminal low degradation rate of date seeds[28]. The differences in crude protein content between corn grains and date seeds (8.3 vs 5.01) and high solubility of corn carbohydrates than date seed's carbohydrates may be the main reasons for higher ruminal total nitrogen concentrations and microbial protein synthesis of the control rams than R1 rams. Our findings agree with those of Abdou[29] and Sayeda *et al.*[30], who stated that replacing yellow corn up to 100% by date seed in the concentrate mixture had no marked effect on ruminal NH_3-N concentration. In addition, Kholif *et al.*[7] concluded that goats fed diets containing enzymes treated date kernels showed greater increase in ruminal NH_3-N concentration than those fed diets containing untreated date kernels.

As for ruminal ciliate protozoa, it is obvious that *Entodinum* spp. represents the most count of all different species of ruminal protozoa for all rams received different experimental rations. This finding is supported by data of Franzolin and Dehority[31], who reported that *Entodinum* spp. constituted around 90% of the total protozoal count in the rumen. Higher solubility of corn carbohydrates and hydrolytic action of fibrolytic enzymes may illustrate increase count of ruminal protozoa for rams fed the control and R2 rations. Kholif and Aziz[32] found that goats fed diets treated with cellulytic enzymes showed greater increase in the count of ruminal protozoa than those fed untreated diets. Higher count of *Polyolastron multivesiculatum* in the rumen of rams fed R1 ration than the other rams may be due to its resistance to changes in the ruminal pH[22].

The occurring drop in apparent nutrient digestibility and nutritive values by rams fed R1 ration compared with those of rams fed on control and R2 rations is probably because of high crude fiber and fiber fractions content and low nutritional value of date seeds. The improvement of R2 digestibility and nutritive value is mainly attributed to action of fibrolytic enzymes on ration's fiber content especially date seed's fiber. It has been reported that fibrolytic enzymes may increase total tract digestibility by increasing ruminal NDF fraction digestion rate through enhancing ability of ruminal bacteria and protozoa to attach to cell walls of feed particles[33], or by reducing viscosity of the digesta[34] and/or by synergism with ruminal endogenous enzymes[35]. Low nutrients digestion coefficients by rams fed R1 ration compared with rams of control is reasonable because corn of the control ration is highly fermented feedstuff especially when compared with low fermented date seeds of R1 ration. These findings are in good agreement with those obtained by Mahmoud and El-Bana[4], who found that barley grains significantly increased ($p<0.05$) all nutrients digestibility (except EE and ADF digestibility) by treated camels when compared with date stones as alternative feedstuff. Also, Taghinejad-Roudbaneh *et al.*[28] found that lamp's digestion for OM, CP, CF and NFE being higher when lamps fed barley containing diets than diets with date seeds. Moreover, Kholif *et al.*[7] reported that goats fed diets with enzymes treated date kernels showed significant improvement ($p<0.05$) in all nutrients digestibility compared with those fed diets containing date kernels without enzymes treatment.

Higher ($p<0.05$) plasma albumin and glucose concentrations in blood of goats fed control and R2 rations than those fed R1 ration is reasonable depending on higher OM, CP, CF and fiber fractions digestibility (Table 4). The values of glucose, total protein, albumin, globulin and urea observed in this study might indicate that goats fed different experimental rations had adequate amounts of energy and protein for maintenance and milk production since high plasma urea is indicator for protein deficiency[36]. Furthermore, the high solubility of control ration carbohydrates and fibrolytic enzymes addition to R2 ration let for more improvements in animal's energy metabolic pathways which in turn may increase blood glucose circulation and glucose uptake by body cells. It is worth mentioning that all measured blood plasma parameters among the experimental goat's groups are within the normal physiological range for healthy animals. Our findings are consistent with those of El-Sayed[37], who found no marked effect on blood total protein, albumin, globulin, urea-N, cholesterol and creatinine as well as Glutamic-Oxaloacetic Transaminase (GOT) and Glutamic-Pyruvate Transaminase (GPT) as a result of feeding sheep on date seeds at levels of 25, 50 and 75% replacing concentrate feed mixture. Also, Abdou[29] reported that replacing 50-100% of yellow corn in the concentrate mixture of lactating cows by date seeds had no significant effect on all blood constituents. Moreover, Farahat[2] reported that goats received diets containing enzymatically treated date kernels showed significant increase ($p<0.05$) in serum total protein and albumin concentrations compared with those fed diets containing untreated date kernels, but enzymatically treated or untreated diets had no effect on serum globulin, AST, ALT, cholesterol and glucose concentrations.

The observed increase in milk and its component's yields for goats of control and R2 groups compared to goats of R1 group is probably due to higher TVFA's content in the rumen of animals fed these rations (Table 2) and higher nutrient digestion coefficients and so TDN and DCP values of these rations (Table 4). The reduction of milk protein and fat production from goats fed date seeds (R1) may be attributed to less OM, CP, CF and fiber fractions digestibility (Table 4) and lower availability of NH_3-N, NPN and total nitrogen (protein) and TVFA's (energy) for ruminal microbes, which would limit microbial protein synthesis (Table 2). Increased plasma albumin concentrations in blood of control and R2 groups (Table 5) may be explaining their higher milk protein yields. This result related to that albumin is the main source of milk protein synthesis[2]. In addition, Jacobs and McAllan[38] reported that supplemented diets with fibrolytic enzymes have been associated with improved energy utilization and efficiency of microbial protein synthesis in the ruminants. This may explain the reason for higher milk fat and protein yields for goats fed R2 ration. The elevating milk lactose yield and percentage for goats feed on control and R2 rations could be attributed to higher OM digestibility which downward the acetate to propionate ratio and led to more glucogenic precursor's delivery to the mammary gland. Also, increase blood glucose concentration of these goats may illustrate increase their milk lactose production compared to goats of R1 group. It's well known that, higher milk production reflecting higher milk components production. Increased milk total solids and solids not fat production by goats of control and R2 were likely due to increased milk components (lactose, ash, protein and fat) that had been used in their calculations. In this concern, effect of date seeds feeding on animal's milk yield and milk composition have been investigated by limit number of researchers. Mohamed *et al.*[39] found that using date seeds up to 25% of the lactating cows diets did not affect the daily milk yield. Also, AL-Suwaiegh[6] found that diets containing 10, 15 and 20% date pits did not negatively affect goat's milk production and its components. In addition, Farahat[2] reported that goats received diets containing enzymatically treated date kernels showed significant increase ($p<0.05$) in milk and its constituent's yields compared with those fed diets containing untreated date kernels.

CONCLUSION

In view of the obtained results, it could be concluded that ration containing enzymatically treated date seeds had (1) Positive effect on rumen fermentation characteristics and nutrients digestibility by Rahmani sheep. (2) There was marked increase in milk production and its component's yields by lactating Nubian goats compared to goats fed untreated date seeds rations.

SIGNIFICANCE STATEMENTS

This study discover the possibility of using enzymatically treated powdered date seeds as alternative feedstuff for high cost grains in the rations of dairy animals without any negative effects on the productive performance of the treated animals. This study will help the dairy animal's breeders to: (1) Use date seeds as alternative for corn in their animal's diets at the optimum level, (2) Reduce their animals feeding cost to become at the minimum and (3) Maximizing their profits.

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