



Effect of Feeding Date Pits on Milk Production, Composition and Blood Parameters of Lactating Ardi Goats

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ABSTRACT: Twenty Ardi lactating goats were used to investigate the effect of substituting 10%, 15%, and 20% of concentrate feed with date pits on milk production, composition, and blood parameters. Four isocaloric and isonitrogenous dietary treatments were used. Four levels (0% [control], 10%, 15%, and 20%) of date pits were used to replace concentrate feed. The forages to concentrate ratio used was 60 to 40. Dry matter intake (DMI) of goats fed diets containing 10% and 15% date pits was significantly ($p < 0.05$) higher than those fed diets containing 0% and 20%. However, goats fed a diet containing 20% date pits were significantly ($p < 0.05$) lower in DMI compared to those fed control diet. The protein percent was significantly higher for goats fed control diet compared to the other dietary treatments. Total solids percent was significantly the lowest for goats fed diet supplemented with 10% date pits. Goats fed a diet containing 20% date pits was significantly ($p < 0.05$) higher in the total protein compared to those fed a diet containing 10%. In addition, goats fed a diet containing 15% date pits exhibited no significant differences in the total protein percent compared to those fed a diet containing 20% date pits. Triglyceride was significantly higher for goats fed diets containing 10% and 20% date pits compared to those fed 15% date pits. Results obtained in the present study suggest that date pits can be added up to 20% of the concentrate feeds into lactating Ardi goat diets without negative effects on their productive performance. (**Key Words:** Goats, Date Pits, Dietary Treatments, Milk Production, Albumin, Triglyceride)

INTRODUCTION

Saudi Arabia is considered as one of the largest producer of dates in the world (Haider et al., 2014). The number of date palm trees in Saudi Arabia is more than 25 million and this number is expected to increase gradually (Ministry of Agriculture, 2013). Date palm trees produce large quantity of agricultural waste. Although the quantity of date palm trees by-products produced in Saudi Arabia is relatively large, most of these are disposed by dumping, burning or burying. Date seeds are one of these wastes that are the product of many date processing plants producing pitted dates, date syrup, and date confectionery. Date pits can be utilized efficiently by animals as non-traditional feed. However, the feeding value of the date pits are lower than the traditional concentrate feed because date pits have a

hard seed coat that makes the seed components difficult to be digested. Thus, to increase their nutritive value, it is necessary to process the seeds before feeding them to ruminant animals. Grinding of date pits makes nutrients more available for animals by breaking and removing the seed coat. However, one of grinding drawbacks is its energy-consuming and may cause wear and tear to the machine used in grinding (Barrevel, 1993). Many feeders search for alternatives to high priced traditional feeds that provide will the nutrient requirements of the animal in a cost-effective manner. Thus, regional agricultural by-products, especially those with a similar nutritional value, can be a viable alternative to high cost conventional feed. (Costa et al., 2009).

Goats belong to the small ruminant group of animals and they are important livestock for meat and milk production in many developing countries. The number of goats in Saudi Arabia in 2012 was estimated to be 1,075,394 (Ministry of Agriculture, 2013). Furthermore, milk from goats is more digestible and has longer shelf life

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compared to cow milk. Nagura (2004) found that goat milk is very beneficial for diabetic patients. Also, people that have some diseases such as stomach ulcers, some types of allergy, and various gastro intestinal disorders that develop from intolerance to cow milk may benefit from consumption of goat milk (Haenlein, 2004). These facts also favors goats for adoption as dairy animals, especially in the developing world where a majority of the goat population is found with people having low economic status. To this end, the objective of this study was to investigate the effect of partial substitution of date pits with conventional concentrate feeds on lactation performance and blood parameters profiles of Ardi goats.

MATERIALS AND METHODS

Experimental site

The trial was conducted at Agricultural Research and Training Station at King Faisal University in Al-Ahsa, Saudi Arabia from July to September, 2013. The local environment in Al-Ahsa is characterized by its high temperature and humidity in summer, particularly in July and August. The average temperature and humidity in these two months are 48°C and 90%, respectively.

Procurement and processing of date pits

A total of 500 kg of date pits was purchased from local date market in Al-Ahsa, Saudi Arabia. Date pits were transported to AL-Ghadeer Feed Mill in Al-Ahsa to be milled through a date pit grinder and then used in the experimental diets.

Animals and experimental diets

Twenty Ardi goats of almost the same age and body weight were assigned randomly to one of four diets with five animals each. All goats were subjected to regular health inspection before the beginning of the trial to ensure that they were in good condition. Chemical composition of the experimental diets was determined before the beginning of

Table 1. Ingredients of the experimental diets

Ingredient (% of DM)	Inclusion of date pits (%)			
	0	10	15	20
Alfalfa hay	60.0	60.0	60.0	60.0
Date pit	0.0	10.0	15.0	20.0
Barley	6.2	11.07	9.55	5.74
Soybean	1.9	4.0	5.0	7.6
Wheat bran	28.12	11.18	6.7	2.9
Dicalcium phosphate	1.0	1.0	1.0	1.0
Limestone	1.99	1.97	1.97	1.96
Salt	0.69	0.68	0.68	0.70
Vit. and Min. premix ¹	0.1	0.1	0.1	0.1

DM, dry matter.

¹ Vit. and Min. premix contains vitamin A 10,000,000 IU, vitamin D₃ 1,000,000 IU, vitamin E 10,000 mg, magnesium 100,000 mg, manganese 50,000 mg, zinc 45,000 mg, iron 80,000 mg, copper 6,000 mg, cobalt 800 mg, iodine 2,500 mg, selenium 100 mg (per kg premix).

the trial. Four isocaloric and isonitrogenous treatments were formulated according to the recommendation for goats (National Research Council, 1981). The total digestible nutrients (TDN) and crude protein of the four treatments were around 60% and 14%, respectively. Ingredients used in formulating the experimental and control diets and chemical composition of date pits and dietary treatments are presented in Table 1 and 2. Group 1 was fed a control diet which contained 60% alfalfa hay and 40% concentrate feed (soybean meal, wheat bran, barley, and vitamins and minerals premix). Group 2, 3, and 4 were fed experimental diets, in which 10%, 15%, and 20% of date pits were substituted for the concentrate portion of the concentrate feed. All ingredients in concentrate feed were mixed thoroughly through a 100-kg feed mixer. Forages and concentrates were mixed carefully by hand before feeding in order to ensure uniformity and diets were offered as a total mixed ration. Animals in each group were fed individually in metabolic crates located under a semi-shed and the trial lasted for 90 days. Goats were milked daily at 8 a.m. and milk samples of each goat were collected weekly and analyzed by infrared spectroscopy (Milko-Scan FT 110,

Table 2. Chemical composition of date pits and experimental diets

Chemical composition (% of dry matter)	Date pits	Inclusion of date pits (%)			
		0	10	15	20
Dry matter	89.0	89.3	88.8	88.6	88.4
Crude protein	6.4	14.9	14.2	14.1	14.6
Total digestible nutrients	63.0	61.2	61.5	61.1	60.6
Fat	7.0	2.29	2.38	2.52	2.66
Ash	2.0	7.1	5.7	6.2	6.1
Crude fiber	28.9	21.6	23.0	23.9	24.9
Neutral detergent fiber	66.1	42.3	42.2	43.1	43.9
Acid detergent fiber	45.5	26.1	28.9	30.5	32.3
Calcium	0.35	1.87	1.87	1.89	1.91
Total phosphorus	0.23	0.7	0.6	0.5	0.5

Foss Electric, Hillerod, Denmark) to determine the milk components (fat, protein, lactose, total solids, and solid-not-fat). Rations were offered once daily, after milking. Mineral blocks and water were available to goats all the time. Feeds and orts of each treatment were weighed daily to determine the feed intake. The amount of ration offered was adapted so refusals were maintained between 1% and 2%. Goats were weighed every two weeks before the feeding time from the beginning of the trial until the end. Feed intake, feed conversion ratio, and body weight gain were calculated to evaluate goat performance.

Sample collection and analysis

Alfalfa hay and experimental diets were composited every two weeks for analysis. These composited samples were oven-dried (60°C), ground through a Wiley mill (1-mm screen), and analyzed for dry matter [DM] (105°C for 24 h). Crude protein (CP) was determined by macro-Kjeldahl procedure (method 955.04; AOAC International, 2002). Crude fibre (CF) analysis was determined by filter bag technique (ANKOM Technology, 2052 O'Neil Rd, Macedon, NY, USA) (method 978.10; AOAC International, 2002). Ether extract was determined with petroleum ether as the solvent (method 920.39; AOAC International, 2002). Ash was analyzed according to AOAC procedures (AOAC International, 2002). Acid detergent fiber (ADF) and neutral detergent fiber (NDF) (Van Soest and Robertson, 1985). TDN of the experimental diets were calculated based on the TDN values of ingredients.

Blood collection and biochemical analyses

Blood samples, about 10 mL, were withdrawn every two weeks via jugular venipuncture into vacuum glass tubes containing no anticoagulant. Samples were kept for one hour after collection and then plasma samples were obtained by centrifugation at 3,500 rpm for 20 min. The plasma samples were stored at -25°C until chemical analysis. Plasma total proteins (g/dL), creatinine (mg/dL), blood urea nitrogen (mg/dL), plasma glucose (mg/dL), triglycerides (mg/dL), albumin (g/dL), alanine amino transferase (ALT; IU/L), and aspartate amino transferase (AST; IU/L) activities were analyzed using available kits supplied by Bio Mérieux SA, F-69280 Marcy l'Etoile, France.

Statistical analysis

A completely randomized design was proposed with the experiment composed of four treatments with five animals each. The traits studied were milk production, milk composition, and blood parameters. Data were analyzed using SPSS version 14.0 (SPSS Inc., 2007) according to the following model:

$$Y_{ij} = \mu + t_i + e_{ij}$$

Where Y_{ij} is the trait studied, μ is the overall mean; t_i is the i^{th} treatment; and e_{ij} is the error term which is assumed to be randomly and normally distributed with 0 mean and variance δ^2e . Duncan's multiple range test was used to compare differences among treatment means using 0.05 level of significance (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Chemical composition of the experimental and control groups shows that the dry matter, crude protein, fat, and TDN were relatively close in values (Table 2). Crude fiber, NDF, and ADF were higher in the diets contained date pits because of high concentration of fiber in the date pits.

Effect of experimental diets on milk yield and composition

Effects of the experimental diets on the initial and final body weight, milk yield, and milk composition are presented in Table 3. Goats fed the experimental and control diets showed no significant difference in terms of initial body weight, final body weight, and body weight gain which indicated that the experimental diets supplied goats with their nutrient requirements for maintenance and production. These results were in disagreement with Suliman and Mustafa (2014) who found that weight gain of lambs increased as the percentage of ground date seeds increased up to 30%. In another study, the addition of ground date seeds to lamb diets improved animal performance (Soliman et al., 2006). In addition, results obtained in this study were not comparable with Abdel-Fattah et al. (2012) who found that total gain of lambs reduced when concentrate feed contained 30% ground date seeds. The differences observed in this study compared to others in term of total body gain may be attributed to the differences of date varieties used, the percent of date pits included in the diets, the breed of animals, and physiological response of the animal to date pits. Milk yield was not significantly affected by the dietary treatments. This indicated that inclusion of date pits up to 20% in lactating dairy goat diets had no detrimental effect on milk production and the energy availability requirements of the animals was met. Dry matter intake (DMI) of goats fed 10% and 15% of date pits was significantly ($p < 0.05$) higher than the goat fed 20% and the control group. In addition, goats fed 20% date pits showed significantly ($p < 0.05$) lower DMI compared to the control group. The reduction in DMI for the goats fed 20% date pits may be attributed to higher content of fiber in date pits that may affect digestibility of the diet and therefore decrease the rumen passage rate. The result of this study was consistent with the finding of

Table 3. Dry matter intake, live body weight and daily milk production and composition of Ardi lactating goats fed diets supplemented with date pits

Item	Inclusion of date pits			
	0	10	15	20
Initial body weight (kg)	59.6±3.61	57.60±1.87	57.9±0.81	57.6±1.08
Final body weight (kg)	62.8±3.15	60.90±2.15	63.8±1.46	60.2±1.08
Body gain (kg)	3.20±0.97	3.30±0.70	5.90±1.44	2.60±0.19
Milk production (kg/d)	1.40±0.02	1.41±0.02	1.43±0.01	1.39±0.01
DMI (gm/d)	1,468.6±2.29 ^b	1,479.8±2.35 ^a	1,483.2±1.20 ^a	1,449.8±0.86 ^c
MY/DMI (feed conversion ratio)	1.22±0.01	1.16±0.01	1.17±0.01	1.21±0.01
Fat (%)	3.69±0.33	3.28±0.28	3.29±0.37	2.90±0.28
Fat yield (gm/d)	51.71±4.62	45.73±3.89	46.45±5.32	40.22±3.84
Protein (%)	2.57±0.03 ^a	2.46±0.05 ^b	2.43±0.02 ^b	2.47±0.03 ^b
Protein yield (gm/d)	36.00±0.83	34.79±0.95	34.83±0.11	34.60±0.44
Lactose (%)	4.25±0.09	4.05±0.04	4.07±0.13	4.08±0.12
Lactose yield (gm/d)	59.52±0.89	56.98±1.14	58.04±1.71	56.67±1.56
Total solids (%)	12.55±0.09 ^a	12.27±0.08 ^b	12.61±0.03 ^a	12.62±0.01 ^a
Solid not fat (%)	7.32±0.10	7.21±0.11	7.20±0.20	7.26±0.18

DMI, dry matter intake; MY, milk yield.

^{a,b} Means within a row with different superscripts differ ($p < 0.05$).

Suliman and Mustafa (2014) who showed that as the percentage of ground date seeds increased in lamb diets up to 15.57%, the DMI was significantly increased compared to other groups fed lower percentage of date pits but it was in contrast with the finding of Al-Shanti et al. (2013) who found that DMI of lambs was not affected when crushed date seeds replaced 50%, 75%, and 100% of corn and barley of concentrate feeds.

Feed conversion ratio was not significantly different among all the dietary treatments. Al-Shanti et al. (2013) showed that feed conversion ratio of Assaf lambs fed crushed date seeds was reduced when the ratio of date seeds was 45% and 60% of the concentrate feed mixture. Suliman and Mustafa (2014) indicated that the inclusion of date pits in lamb diets should not exceed 20% of the corn grain to avoid an adverse effect on nutritive value of feed intake and consequently on animal performance. The fat percent and yield was not significantly different among all the dietary treatments which indicated that goats fed diets containing date pits produced an adequate amount of acetate required for milk fat synthesis. In this study, the percentage of fiber and NDF of date pits was 29% and 66%, respectively (Table 2). However, Al-Farsi and Lee (2008) indicated that the total dietary fiber of date pits was much higher than this study. They found that date pits contained 58% crude fiber and 53% of it was insoluble dietary fiber mainly as hemicellulose, cellulose, and lignin. The fat percentage obtained in this study is lower than the values obtained by Al-Dobaib et al. (2009), but it was consistent with those of Strzalkowska et al. (2009) who found that the fat percentage in the first stage of lactation of goats was similar to the result of this study. In terms of percentage protein, goats in

the control group showed significantly ($p < 0.05$) higher protein percent compared to the treatment groups. In fact, the inclusion of date pits at 20% of concentrate feed reduced protein yield by 1.4 g/d compared with the control group. The reduction of percentage protein from goats fed date pits may be attributed to lower protein availability for ruminal microbes, which would limit microbial protein synthesis. The protein percentages observed in this study for all the dietary treatments were comparable and fall into the range of those reported by Strzalkowska et al. (2009). Al-Dobaib et al. (2009) indicated that feeding discarded dates up to 30% to lactating Ardi goats increased protein percent compared to the control group. They attributed the higher protein percent in the milk to the higher non-fiber carbohydrates of dates. Goats fed the control and experimental diets showed no significant difference in terms of lactose percent, lactose yield and solid not fat percent. Total solids percent was significantly ($p < 0.05$) lower for goats fed 10% diet compared to the other treatments. The results obtained in this study for Ardi goats were higher than that reported by Suranindyah and Astuti (2012), but it was comparable with the values found by Strzalkowska et al. (2009). The differences in composition of goat milk observed in this study compared to the others depended on many factors, but the most important among them was diet (Min et al., 2005).

Effect of experimental diets on blood parameters

Hematological data was used as an indication of the health status of the goats fed the experimental diets. The effects of experimental diets on serum biochemical values of Ardi lactating goats are presented in Table 4. Goats fed

Table 4. Serum biochemical values of Ardi lactating goats

Item	Inclusion of date pits			
	0	10	15	20
Total protein (g/dL)	8.21±0.30 ^{ab}	7.33±0.18 ^b	7.97±0.37 ^{ab}	8.57±0.28 ^a
Albumin (g/dL)	3.02±0.05	2.72±0.08	2.87±0.18	3.01±0.10
Urea (mg/dL)	18.80±1.55	12.89±1.51	14.93±2.23	16.70±1.77
Triglycerides (mg/dL)	8.24±0.56 ^{ab}	9.45±1.22 ^a	7.40±1.10 ^b	9.46±1.79 ^a
Creatinine (mg/dL)	0.87±0.03	0.69±0.05	0.81±0.04	0.84±0.04
Glucose (mg/dL)	45.09±7.63	43.05±8.81	53.80±8.97	54.06±5.89
ALT (IU/L)	16.86±0.88	16.30±0.68	16.92±0.99	14.87±1.02
AST (IU/L)	61.60±5.28	67.60±3.55	62.56±4.81	57.81±1.19

ALT, alanine amino transferase; AST, aspartate amino transferase.

^{a,b} Means within a row with different superscripts differ ($p < 0.05$).

the 20% date pits was significantly ($p < 0.05$) higher in total protein compared to goats fed 10%, but no significant differences were found between the control and the other experimental groups. However, goats fed the 15% date pits was not significantly different from the goats fed the 20%. In term of albumin, no significant differences were found among all dietary treatments. The results of total protein and albumin were in the normal ranges reported for goats (Kahn and Line, 2010) and it was in agreement with the finding of Opara et al. (2010). The values of total protein and albumin observed in this study might indicate that date pits contain low level of tannins, known to reduce nutrient permeability in the digestive system as well as decrease protein utilization in the body, which are then subsequently excreted in feces without alteration to their metabolism. Turner et al. (2005) studied the effect of feeding growing goat diets containing lespedeza or alfalfa hay. They showed that concentration of condensed tannins in lespedeza hay had a negative effect on the uptake of protein from the small intestine causing the muscles to release more amino acids to support gluconeogenesis since forage quality of lespedeza was lower than alfalfa hay. The blood urea level of both the experimental and control groups were not significant different and it was within the normal ranges. The result in this study was inconsistent with the finding of Njidda et al. (2013) who found high serum urea of goats. The values of urea observed in the present study showed that goats fed the date pits diets had adequate amounts of protein for maintenance and production since high serum urea is a good indicator of protein deficiency (Oduye and Adadevoh, 1976). However, it might indicate that the level of glucose in blood of goats fed the experimental diets was normal since catabolic activity was increased for gluconeogenesis which increased serum urea level (Radostits et al., 1994). Triglyceride was significantly ($p < 0.05$) higher for the goats fed 10% and 20% compared to those fed 15% date pits, but no significant differences were found between the control and the experimental diets. The triglyceride values observed in this study were

inconsistent with the values found by Elitok (2012) in Saannen goats. The normal range of triglycerides observed in this study might indicate that goats fed the experimental diets did not experience negative energy balance which was reflected in the level of blood urea. The diets in this study did not significantly affect the creatinine levels in the serum of goats. Creatinine levels were within the normal range and they were comparable with the finding of Elitok (2012). Goats fed the experimental and the control groups showed no significant difference in glucose level. The value of blood glucose concentration obtained in this study was within the normal range from 48 to 76 mg/dL reported for goats (Kahn and Line, 2010). Since blood glucose concentration is an important indicator of dietary energy intake, the values reported in this study confirmed that the experimental diets supplied the animals with their requirement for energy. Date pits are recognized as a rich source of carbohydrates (Hamada et al., 2002) and might increase glucose circulation in blood and consequently the body responds by releasing insulin and inhibiting glucagon to stimulate the uptake of glucose by body cells. This study showed no significant difference in the concentrations of both AST and the ALT and the values of both enzymes were within the normal ranges reported for goats (Kahn and Line, 2010). The AST and ALT concentrations in this study were in agreement with Njidda et al. (2013) while were in disagreement with the values reported by Abdel-Fattah et al. (2012) who fed ground date seeds to male lambs. Higher liver enzymes were associated with lower nutrient intake (Oni et al., 2006) which indicated that goats fed the experimental diets had adequate amounts of nutrients to sustain their maintenance and milk production.

CONCLUSION

A big concern to ruminant breeders is the increasing prices of concentrate feeds around the world which is driving the search for an alternative traditional concentrates. Date pits can be considered as a good alternative feed

ingredient that can be utilized efficiently by ruminants. Taking into account that the feed mills must have grinding machines that operate efficiently in milling date pits without the occurrence of any problems during the milling process, the finding of this study may indicate that date pits can be added to local lactating goat diets up to 20% of the concentrate feeds with no adverse effects on animal health or production.

CONFLICT OF INTEREST

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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