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Effect of Feeding Different Amounts of Discarded Dates on Growth and Efficiency of Digestion in Sheep

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Abstract: To evaluate the suitability of discarded dates as an alternative feed for sheep, 0 (control), 15 and 30% of the concentrates in the diets of Najdi lambs were replaced with discarded dates, and the feed intake, average daily weight gain (ADG) and feed efficiency of the lambs were determined. The nutritive value and digestibility coefficients of each experimental diet were also determined, including the percent of dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF), acid detergent fiber (ADF) and neutral detergent fiber (NDF). The ADG of the lambs ranged between 162.25 and 210.98 g/day. The ADG and feed intake were highest in lambs fed 30% discarded dates and lowest in lambs fed the control diet. Lambs fed 15% discarded dates showed intermediate ADG and feed intake values ($P<0.05$). However, the three diets were not significantly different ($P>0.05$) with respect to feed efficiency. The digestibility of EE, DM and CP was significantly ($P<0.05$) higher in the diet containing 30% discarded dates than in the control diet and the diet containing 15% discarded dates. Compared to diets containing 30% or 15% discarded dates, the digestibility of CF, NDF and ADF was significantly ($P<0.05$) lower in the control diet. These results indicate that inclusion of 30% discarded dates as an alternative feed in lamb diets can reduce production costs. Moreover, supplementation of lamb diets with discarded dates is an efficient utilization of existing resources.

Keywords: Discarded dates, growth, digestibility, nutritive value, lambs.

INTRODUCTION

The Kingdom of Saudi Arabia is one of the most important date-producing countries in the world. The Kingdom currently produces 850,000 tons of dates and is expected to produce one million tons by the end of 2010 (Ministry of Agriculture, 2008). Date factories use only 70,000 tons (about 8%) of the dates produced in Saudi Arabia, and only 3% of dates are exported. Moreover, date producers face serious difficulties in marketing their crops (Ministry of Agriculture, 2008). Of the total date waste in Saudi Arabia, at least 20% is produced by date factories (Ministry of Agriculture, 2008).

Date waste contains carbohydrates and minerals and is a significant source of energy; thus, it may be possible to use date waste as an energy source for ruminants. Date fruit can provide 2.67 Mcal/kg of digestible energy. In comparison, barley provides 3.06 Mcal/kg of digestible energy. Because dates contain approximately 78.5% dry matter, 2.2% crude protein, 0.5% crude fat, 2.3% fiber, 72.9% carbohydrate and 1.9% ash, dates can supply 87% of the digestible energy provided by the same unit mass of traditional feed grain (Al-Khateeb and Ali-Dinar, 2001). The amount of energy in the diet and the source of energy affect the animal's feed conversion efficiency (Nunes, 1994). Furthermore, the amount of energy available from animal diets is dependent on the type of animal, on the weather conditions and on the production efficiency of the animal (Higginbotham and Bath, 1993; Brydt *et al.*, 1995; Sumeghy, 1995; Strzetelski, 1996).

Because the price of animal feed has increased globally, alternative feeds with competitive prices must be developed. To this end, the objective of this study was to investigate the effect of including discarded dates in the diets of Najdi lambs on growth and digestion efficiency.

MATERIALS AND METHODS

The experiments were conducted at the Animal Production Farm of the College of Food and Agriculture Sciences, King Saud University, Saudi Arabia.

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Animals and Diets:

Thirty three- to four-month-old Najdi lambs weighing between 22 and 23 kg were used in this study. Table (1) shows the composition of the experimental diets. All diets were balanced and designed to meet the nutritional requirements of the lambs (NRC, 1985).

Growth Trial:

The animals were fed alfalfa hay two weeks prior to the allocation of the experimental diets, and the trial was conducted for 12 weeks. Thirty Najdi lambs were randomly assigned to three groups of ten lambs per group, and each animal was fed individually. Group 1 lambs were fed the control diet, which contained 73% concentrates and 27% alfalfa hay. The second and third groups of lambs were fed an experimental diet in which 15% and 30%, respectively, of the concentrates were replaced with discarded dates. Lambs were fed once per day, and the amount of feed offered to the lambs and the remaining were weighed and recorded daily. Feed intake, dry matter intake and feed efficiency were calculated weekly. To determine the average daily gain (ADG), lambs were weighed in the morning before feeding every 14 days for 84 days.

Digestibility Trial:

A metabolism study involving 12 lambs were conducted to determine the digestibility coefficients of the diets. The animals were divided into three groups with four lambs per group. The animals were housed in metabolic cages throughout the entire experiment, which included a 10-day adaptation period and a 7-day collection period. During the trial, feed and water were offered once a day at 7:30 A.M. The amount of feed offered and the remaining were weighed and recorded daily. The feed and the remaining were sampled daily and composted until the end of the collection period. The resultant material was dried at 70°C for 24 h, ground through a 1-mm screen and analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash. Daily fecal excretions were collected at 7:00 A.M. and were weighed. A 10% sample of the fecal from each animal was collected daily and dried for 24 h at 70°C to determine the DM content. The remaining fecal was composted and stored at 4°C for further analysis.

Chemical Analysis:

According to AOAC (1995) standards, Feed and feces were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined according to Van Soest *et al.* (1991).

Statistical Analysis:

Duncan's tests were conducted to Compare the means of each treatment, and the data were analyzed in SAS (1998).

Table 1: Composition of the experimental diets.

Ingredient	Diet (%)		
	Control	15% Discarded dates	30% Discarded dates
Alfalfa hay	27.03	27.03	27.03
Discarded dates	0	15	30
Barley	65.02	46.61	28.21
Soybean meal	5.18	8.59	11.99
Sodium bicarbonate	1	1	1
Sodium Chloride	0.8	0.8	0.8
Limestone	0.77	0.77	0.77
Vitamin and mineral mixture*	0.2	0.2	0.2

* Each kg of vitamin and mineral mixture contained 0.30 g $CoSO_4$, 20.1 g $CuSO_4$, 10 g $FeSO_4$, 50 g ZnO_2, 40.2 g $MnSO_4$, 0.75 g KI, 878 g NaCl, 500,000 IU vitamin A, 500,000 IU vitamin D and 10,000 IU vitamin E

RESULTS AND DISCUSSION

The proximate analysis of the experimental diets is shown in Table (2). Diets containing discarded dates displayed DM, OM, CP, EE and ash contents nearly identical to those of the control diet, the CP content of diets containing dates ranged from 13.8% to 15.4%. The EE content of the control diet and of diets containing 15% and 30% discarded dates was 1.24%, 1.52% and 1.54%, respectively. These results are in good agreement with those of El-Hage *et al.* (1993) and of Al-Dabeeb (2005), who found that the DM and fat content of a control diet and of diets containing 10 and 20% discarded dates were 91.8%, 90.3% and 89.5% and 1.6%, 1.9% and 1.9%, respectively.

The differences between the experimental diets in the present study and the diets used in previous investigations are likely due to the different proportions of barley and soybean in the diets. In this study, soybean meal was added to the experimental diets to compensate for the shortage of crude protein in discarded dates. The addition of supplemental protein is an accepted practice that has been used in a number of previous studies (Ali *et al*., 1956; Robinson and Lucas, 1974; Ørskov *et al*., 1976).

Growth Trial:

The feed intake (g/day), average daily gain (ADG) and feed efficiency of the animals in the study are shown in Table (3). The average initial body weight of the lambs ranged from 22.14 to 23.13 kg, and their final body weights ranged ($P<0.05$) from 35.93 to 40.92 kg. Lambs fed a diet containing 30% discarded dates had the highest mean final weight, while lambs fed the control diet had the lowest mean final weight ($P<0.05$)). The ADG of the diets ranged between 162.25 and 210.98 g/day ($P<0.05$). The highest ADG was observed in animals fed the diet containing 30% discarded dates, followed by those fed the diet containing 15% discarded dates ($P<0.05$). The inclusion of 11% and 35% discarded dates in the fattening ration of lambs (Richter and Becker, 1956, Shubre, 1979, El-Gasim *et al*., 1986, Hemeidan *et al.*, 1993, Al-Debeeb, 2005, Al-Ani *et al.*, 1991, Al-Yousef *et al*., 1993) and of 20% and 60% dates in the feed of young camels (Al-Mutairi and Ismail, 1422 H) did not negatively affect animal health or productivity. Al-Dabeeb (2005) replaced 10% and 20% of the concentrate of Najdi lamb diets with discarded dates, and significant differences in the body weights of the lambs were not observed. In other studies, replacing a portion of the concentrate in the diet of Awasi lambs with 10% or 30% (El-Gasim *et al.*, 1986) or 15% or 30% (El-Hag et al., 1993) discarded dates resulted in increased body weight. The positive effects of diets containing dates on the weight gain and fattening of animals were attributed to the presence of growth-promoting compounds in dates (Ismail, 2000).
The feed intake results obtained in our study are reported in Table (3). Lambs fed a diet containing 30% dates had the highest feed intake, followed by lambs fed a diet containing 15% dates. However, statistically significant differences in feed intake were only observed between lambs fed a diet containing 30% dates and those fed the control diet ($P<0.05$). Significant differences were not observed among the diets with respect to the efficiency of feed conversion (Table 3). These results show that the replacement of concentrate with discarded dates leads to an increase in the final weight of the animals without improvement in feed efficiency. These results are consistent with the findings of El-Gasim *et al.* (1986) and Al-Dabeeb (2005). Discrepancies between the results obtained in the present study and those reported in previous studies may be attributed to differences in the proportion of dates, varieties of dates and/or the individual components of food concentrates in the diets used, as well as to differences in the type of animals used and in the study duration.

Digestibility Trial:

The digestibility coefficients of the experimental diets are reported in Table (4). The diet containing 30% dates had the highest dry matter (DM) digestibility value, followed by the diet containing 15% dates ($P<0.05$). Similar results were obtained for the digestibility coefficients of crude protein (CP) and ether extract (EE). The digestibility coefficient of soluble carbohydrates (NFE) was significantly higher ($P<0.05$) in the control diet than in the diets containing discarded dates (Table 4). Similar results were observed for the digestibility of crude fiber (CF). As demonstrated by Al-Kinani and Al-Wash (1975), the presence of discarded dates improved the efficiency of fiber digestion. The ADF and NDF of the diet containing 15% dates ($P>0.05$) were similar to those of the control diet; however, both the ADF and the NDF were significantly higher in the diet containing 30% dates ($P<0.05$). The CP and CF results obtained in this study differ from those reported by El-Hag *et al*. (1993) and Al-Dabeeb (2005). Al-Yousef *et al*. (1993) compared the digestibility coefficient of discarded dates to that of other agricultural wastes including palm tree waste, wheat straw and alfalfa straw; the results indicated that, among agricultural wastes, discarded dates are a superior feed for ruminants. Moreover, the addition of 33% discarded dates did not negatively affect the feed intake, digestibility or nitrogen retention of Najdi lambs (Hemeidan *et al*., 1993). However, Hemeidan *et al*. (1993) and Al-Dabeeb and Ahmed (2002) found that the addition of 20% and 44% discarded dates to the diets of Najdi lambs reduced the digestibility of protein and of soluble carbohydrates.

Table (5) shows the nutritional value of the experimental diets expressed as the percent total digestible nutrients (% TDN) and the percent digestible crude protein (% DCP). No significant ($P>0.05$) differences in the TDN were observed among the three diets. However, diets containing discarded dates possessed a higher DCP than the control diet ($P<0.05$). The TDN and DCP values obtained in this study are in agreement with TDN and DCP values previously reported for similar experimental diets (Al-Dabeeb, 2005).

The results of this study demonstrate that discarded dates can be used as a replacement for concentrate in lamb diets. Due to the relatively low cost of discarded dates, their inclusion in lamb diets can reduce both the cost of feed and overall production costs.

Table 2: Proximate analysis of the experimental diets (% DM basis).

Item	Diet		
	Control	15% Discarded dates	30% Discarded dates
DM	95.21	95.84	95.37
OM	91.25	91.28	92.35
CP	14.97	15.78	13.46
EE	1.36	1.58	1.55
CF	10.20	11.64	9.83
NFE	64.72	62.28	67.51
Ash	8.75	8.72	7.65
NDF	37.62	53.29	62.31
ADF	12.19	21.23	39.20

DM = dry matter; OM = organic matter; CP = crude protein; EE = ether extract; CF = crude fiber; NFE = nitrogen-free extract; NDF = neutral detergent fiber; ADF = acid detergent fiber

Table 3: Growth performance, feed intake and feed conversion in Najdi lambs fed the experimental diets (mean ± SE).

Item	Diet		
	Control	15% Discarded dates	30% Discarded dates
No. animals	9	9	9
Experimental period (days)	84	84	84
Initial weight (kg)	22.14±1.35	23.13±1.43	22.9±1.05
Final weight (kg)	35.93±2.32^{b}	38±1.96$^{a\ b}$	40.92±±3.45 ^{a}
Average daily gain (g)	162.25. ±36.00 ^{b}	174.90±15.27 ^{ab}	210.98±34.96 ^{a}
Feed intake (g/d)	1201.82. ±81.87 ^{b}	1299.59±89.97 ^{ab}	1465.89±258.66 ^{a}
Feed conversion*	7.41±1.37^{a}	7.43±0.80^{a}	6.95±0.68^{a}

^{ab} Means in the same row with different letters are significantly different (P<0.05)
*Feed intake (g)/average daily gain (g)

Table 4: Digestion coefficients (%) of the experimental diets (on DM basis).

Item	Diet		
	Control	15% Discarded dates	30% Discarded dates
DM	59.3^{c}	61.4 ^{b}	67.9 ^{a}
OM	68.6^{a}	63.4 ^{b}	62.6 ^{b}
CP	69.5^{c}	71.6^{b}	74.8^{a}
EE	68.9^{c}	72.8 ^{b}	75.8 ^{a}
CF	52.5^{b}	54.4^{a}	58.2 ^{a}
NFE	75.4^{a}	71.2 ^{b}	67.3 ^{c}
NDF	70.3^{b}	71.4^{b}	76.8 ^{a}
ADF	38.9^{b}	43.6 ^{b}	54.7 ^{a}

DM = dry matter; OM = organic matter; CP = crude protein; EE = ether extract; CF = crude fiber; NFE = nitrogen-free extract; NDF = neutral detergent fiber; ADF = acid detergent fiber
^{abc} Means in the same row with different letters are significantly different (P<0.05)

Table 5: Nutritive value of the experimental diets, including total digestible nutrients (TDN %) and digestible crude protein (DCP %).

Item	Diet		
	Control	15% Discarded dates	30% Discarded dates
TDN	54.48 ^{a}	52.16 ^{a}	49.31 ^{a}
DCP	6.12 ^{b}	7.14 ^{a}	7.37^{a}

^{ab} Means in the same row with different letters are significantly different (P<0.05)

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