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## **Effect of Substitution of Date Pits in Concentrate Feed on Growth Performance and Nutrients Digestibility of Ardi Goats**

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### **ABSTRACT**

In Saudi Arabia, goats are one of the major sources of milk and meat. Goats are very tough animal that can survive under harsh environmental conditions. The main aim of this study was to evaluate the effect of substituting four levels (0, 10, 15 and 20%) of date pits with concentrate feed on nutrients digestibility and growth performance of Ardi goats. Twenty goats were randomly selected and distributed into four treatment groups with each group of 5 goats. Goats fed 60% alfalfa hay and 40% concentrate feed containing either 0, 10, 15 or 20% date pits. There were no significant difference among all the dietary treatments on Dry Matter Intake (DMI) and nutrient intakes. The Feed Conversion Ratio (FCR) and daily gain weight were significantly higher in goats fed on a concentrate feed containing 0 and 20% date pits than those fed on a diet containing 10% date pits while no significant difference was observed in goats fed on a diet containing 15% date pits. The digestibility coefficients of Dry Matter (DM), Organic Matter (OM), Crude Protein (CP) and Neutral Detergent Fiber (NDF) were significantly ( $p < 0.05$ ) higher in goats fed on a concentrate feed containing 0 and 20% than those fed with feed containing 10 and 15% date pits. In conclusion, replacing date pits up to 20% of concentrate feed in Ardi goat diets did not show adverse effects on nutrients digestibility and animal growth performance.

**Key words:** Ardi, average daily gain, crude fiber, growth performance

### **INTRODUCTION**

Goats are an important source of meat and milk in many developing countries due to their ability to survive and grow under harsh climatic environment than other ruminants. This phenomenon makes it easy to raise goats without sophisticated facilities and their nutritional requirements can be met from different types of available feeds or pastures. In Saudi Arabia, goat meat is consumed by many people and is especially used in special type of cooking called Mandi. Currently, due to high prices of traditional concentrate feeds, many goats producers in different regions of Saudi Arabia are searching for alternate feeds to provide nutrient needs of animal on a cost-effective basis for sustainable improvement in animal performance.

Saudi Arabia is one of the main date producing countries in the world (El-Habba and Al-Mulhim, 2013) with a total number of more than 2 millions date palm trees in Saudi Arabia (Ministry of Agriculture, 2013). It has been observed that huge quantity of date pits is produced locally every year at the date processing plants after manufacturing many date products such as date syrup and date confectionery. In recent years, animal producers utilized date pits as a part of concentrate feeds due to its availability and low cost in many cities in Saudi Arabia. However, the feeding value of date pits is lower than the traditional concentrate feed because the date pits have

hard seed coat that makes the seed components difficult to digest. Thus, to increase their nutritive value, it is necessary to process the seeds before feeding them to livestock. Among the different known methods to increase the nutrient availability of date pits, grinding is one of these methods which increases the nutrient availability by breaking and removing the seed coat. However, Barreveld (1993) indicated that the grinding processes of date pits may cause wear and tear to milling machine as well as is a energy-consuming technique. Therefore, to increase nutrient availability of the seeds for animals, it is strongly recommended to first crush the seed with a disk crusher and then grind them with a hammer-mill (Gohl, 1982; Barreveld, 1993). The use of regional by-products for animal feeding is a viable alternative to improve productivity, especially those with similar nutritional value to conventional feeds which are known to have high cost compared to by-products feed (Costa *et al.*, 2009). This study hypothesized the possibility of using date pits in goat diets by substituting a part of the commercial concentrate feed without any adverse effect on animal performance due to its high energy content and palatability. Therefore, the objective of this study was to investigate the effect of substituting partially date pits into traditional animal feed on growth and digestibility of Ardi goats.

## **MATERIALS AND METHODS**

**Experimental site:** The trials were conducted at Agricultural Research and Training Station at King Faisal University in Al-Ahsa, Saudi Arabia from September to January, 2013/2014. The average temperature and humidity were 48°C and 90%, respectively during the trial period.

**Procurement and processing of date pits:** A total of 1000 kg of date pits were purchased from local date market in Al-Ahsa, Saudi Arabia. Date pits were transported to Al Qadeer Feed Mill to be milled through a date pit grinder. Ingredients of the concentrate feeds (soybean, barley, wheat bran and vitamin and mineral premixes) were purchased from Al Qadeer Feed Mill and then mixed with date pits by feed mixture of 1000 kg capacity. The concentrate feeds were fed to goats in the form of pellets. The size of feed pellets was 1.0-1.5 cm as length and 0.5-0.7 cm in diameter.

**Animals and experimental diets:** Twenty Ardi goats with an average body weight of 24.3 kg and age between 4-5 months were selected for growth and digestibility trials. All the goats were examined regularly for health inspection before the beginning of trial to ensure that they are in good condition. The chemical composition of the experimental diets was determined before the trial. Four isocaloric and isonitrogenous treatments were formulated for goats according to the recommendation of NRC (1981). The ingredients used in formulating the experimental diets and their chemical composition are presented in Table 1.

**Growth trial:** A total of 20 growing Ardi kids were weighted and assigned randomly to one of four diets with each group having five animals. Animals in each group were fed individually in metabolic crate located under semi-shed. The total period of trial was 75 days. Animals in group 1 were fed on a control diet containing 60% alfalfa hay and 40% concentrate feed. The animals of group 2, 3 and 4 were fed the experimental diets, where 10, 15 and 20% of date pits were substituted as the concentrate portion. Forages (alfalfa hay) and the concentrate feeds were mixed carefully by hand to ensure uniformity before feeding. The feed rations were offered only once daily at 8 am. 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 and were composited every two weeks

Table 1: Ingredients and chemical composition of the experimental diets

Items	Inclusion of date pits (%)			
	0	10	15	20
<b>Ingredient (DM %)</b>				
Alfalfa hay	60.00	60.00	60.00	60.00
Date pit	0.00	10.00	15.00	20.00
Barley	4.00	5.00	3.60	6.39
Soybean	1.00	5.00	3.70	6.54
Wheat bran	31.27	16.32	14.15	3.43
Dicalcium phosphate	1.00	1.00	1.00	1.00
Limestone	1.99	1.97	1.90	1.98
Salt	0.64	0.61	0.55	0.56
Vit. and min. Premix <sup>a</sup>	0.10	0.10	0.10	0.10
<b>Chemical composition (Dry matter %)</b>				
Dry matter	89.10	88.90	88.80	88.70
Crude protein	14.20	14.10	13.90	14.30
Total digestible nutrient	64.17	64.41	64.40	64.39
Crude fiber	21.20	21.90	22.20	22.60
Neutral detergent fiber	40.20	41.10	40.90	41.60
Acid detergent fiber	25.60	26.50	27.40	28.20
Ether extract	2.10	2.20	2.20	2.30
Ash	6.70	6.30	8.20	7.00
Calcium	1.30	1.30	1.30	1.20
Total phosphors	0.60	0.50	0.50	0.60

<sup>a</sup>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: 6000 mg, Cobalt: 800 mg, Iodine: 2500 mg, Selenium: 100 mg (per kg premix)

for further analysis. The quantity of ration offered was adapted such that the leftovers were maintained between 1 and 2%. The live weight of goats was recorded every two weeks before the feeding time from the beginning of the trial until the termination. Parameters such as Dry Matter Intake (DMI), Feed Conversion Ratio (FCR) and the body weight gain were calculated to evaluate goat performance.

**Digestibility trial:** After finishing the growth trial, twelve goats were transferred to metabolic crates for digestibility trial. Goats were adapted to the metabolic crates for one week followed by the collection period lasting 7 days. The animals were divided into four groups with three goats per group. Feed was offered at 8:00 AM. During the trial, the quantity of feed offered and theorts were weighed and recorded daily. The feed and theorts were sampled daily and approximately 150-200 g was composted until the end of the collection period for further analysis. Daily fecal excretions were collected at 7:00 AM and weighed. A 10-15% sample of feces were collected daily from each animal, dried in a forced air oven at 60°C for 48 h, ground and passed through a 1 mm screen to determine the Dry Matter (DM) percentage. The remaining fecal samples were thoroughly and carefully mixed, placed in identified plastic containers and then stored at -4°C for subsequent analyses. The digestion coefficients were calculated for Dry Matter (DM), Organic Matter (OM), Crude Protein (CP), Ether Extract (EE), Crude Fiber (CF), Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) as a difference between nutrient intake and nutrient excreted in the feces divided by nutrient intake and then multiplied by 100.

**Sample collection and analysis:** Compositated sample of feed, orts and feces were analyzed for DM (105°C for 24 h). The CP was determined by macro-Kjeldahl procedure (method 955.04; AOAC., 2002). The CF analysis was determined by filter bag technique (ANKOM Technology) (method 978.10; AOAC., 2002). Ether extract was determined with petroleum ether as the solvent (method 920.39; AOAC., 2002). The ash was determined according to AOAC procedures (AOAC., 2002). The ADF and NDF were determined using the method described by Van Soest and Robertson (1985). The total digestible nutrients values (TDN) of the experimental diets were calculated based on the TDN values of ingredients.

**Statistical analysis:** Each animal was considered as an experimental unit. The data obtained were subjected to one-way analysis of variance (ANOVA) and were expressed as means with a standard error of mean (Mean±SEM) using the General Linear Model (GLM) program (SPSS., 2007). Treatment means were separated ( $p < 0.05$ ) using Duncan's multiple range test to evaluate the effect of feeding date pits on growth performance, nutrients intake and apparent nutrient digestibility of Ardi goats.

## **RESULTS AND DISCUSSION**

The DM, CP and EE values were relatively close among dietary treatments. Diets containing date pits showed slightly higher percentages of CF, ADF and NDF due to high concentration of fiber in date pits. The Nitrogen Free Extract (NFE) of the control and dietary treatments were within normal range (Table 1). Similar results were reported by many researchers using date pits as an alternative to traditional concentrate feeds (Al-Owaimer *et al.*, 2011; Al-Shanti *et al.*, 2013). The TDN percent (average as 64%) was similar among the different dietary treatments and was more than the TDN requirement of goats at this weight according to NRC (1981) which indicated that the energy requirement of goats was met.

**Effect of experimental diets on animal performance:** Effect of the experimental diets on DM and nutrient intakes, initial and final body weight, average daily gain and FCR are presented in Table 2. Goats fed with the dietary treatments and the control diet did not show any significant differences in term of DMI (Table 2). This might be attributed to increased soluble carbohydrates and palatability of dietary treatments which increased the rate of passage from the rumen into the small intestine and thereby making the animal able to eat more. The study results agree with the findings of Al-Shanti *et al.* (2013) who found that inclusion of date pits replaced up to 100% of concentrate feed in lamb diets did not affect the DMI. In contrast, El-Gasim *et al.* (1986) showed that the DMI of lamb fed on clover hay with three levels of date pits (10, 20 and 30% of the concentrate feed) was significantly higher than the control group. The differences observed in this study with previous study regarding DMI might be attributed to type of date pits used, animal species and the physiological state of animals. However, the difference in DMI (expressed as percentage of body weight) was not significant ( $p > 0.05$ ) among treatments which showed that goats fed with the diets containing date pits maintained positive DM status by consuming an adequate amounts of DM which was more than 3% of their body weight that is the recommended daily DMI of goats raised in the tropic areas (Devendra and McLeroy, 1982). Nutrient intakes were not significantly different among dietary treatments which indicated that diets containing date pits supplied the trial animals with the essential nutrients required for maintenance and production. In this study, date pits were added up to 20% of the concentrate feed which was in agreement with

Table 2: Growth performance, dry matter intake and nutrient intakes of Ardi goats fed pelleted diets supplemented with date pits

Items	Inclusion of date pits (%)			
	0	10	15	20
DMI (g day <sup>-1</sup> )	1204.5±22.87	1164.9±25.49	1202.7±56.78	1111.9±55.21
DMI (BW %)	3.6±0.05	4.0±0.60	3.9±0.27	3.6±0.15
ADG (g)	124.1±5.06 <sup>a</sup>	75.6±9.39 <sup>b</sup>	104.2±6.19 <sup>ab</sup>	129.5±8.19 <sup>a</sup>
FCR	9.8±0.44 <sup>b</sup>	15.4±2.38 <sup>a</sup>	11.6±0.71 <sup>ab</sup>	8.7±0.62 <sup>b</sup>
Initial body weight (kg)	23.4±0.63	24.9±4.32	24.3±3.57	23.8±4.24
Final body weight (kg)	33.8±0.43	31.2±3.94	33.0±3.61	34.6±4.04
Total body weight gain (kg)	10.4±0.43 <sup>a</sup>	6.4±0.79 <sup>b</sup>	8.8±0.52 <sup>ab</sup>	10.9±0.69 <sup>a</sup>
CP (g day <sup>-1</sup> )	171.0±3.25	164.3±3.59	167.2±7.89	159.0±7.89
CP (BW/day %)	0.5±0.01	0.6±0.08	0.5±0.04	0.5±0.04
EE (g day <sup>-1</sup> )	25.3±0.48	25.6±0.56	26.5±1.25	25.6±1.27
EE (BW/day %)	0.1±0.01	0.1±0.01	0.1±0.01	0.1±0.01
CF (g day <sup>-1</sup> )	255.3±4.85	255.1±5.58	266.9±12.61	251.3±12.48
CF (BW/day %)	0.8±0.01	0.9±0.13	0.8±0.07	0.8±0.06
NDF (g day <sup>-1</sup> )	490.2±9.31	478.8±10.48	491.9±23.22	462.6±22.97
NDF (BW/day %)	1.5±0.02	1.6±0.25	1.5±0.12	1.4±0.11
ADF (g day <sup>-1</sup> )	308.3±5.85	279.6±6.12	329.5±15.56	313.6±15.57
ADF (BW/day %)	0.9±0.01	1.0±0.14	1.0±0.08	0.9±0.07
TDN (g day <sup>-1</sup> )	772.9±14.67	750.2±16.41	774.5±36.57	716.1±35.56
TDN (BW/day %)	2.3±0.03	2.6±0.39	2.4±0.19	2.1±0.17

<sup>a,b</sup>Means within a row with different superscripts differ (p<0.05). DMI: Dry matter intake, ADG: Average daily gain, FCR: Feed conversion ratio, CP: Crude protein, EE: Ether extract, CF: Crude fiber, NDF: Neutral detergent fiber, ADF: Acid detergent fiber, TDN: Total digestible nutrients

Suliman and Mustafa (2014) who indicated that lambs should not be fed more than 20% of date pits replacing corn grain to maintain animal performance and productivity. The FCR of goats fed with control and diet containing 20% date pits was significantly (p<0.05) better compared to those fed with diet containing 10% date pits. While no significant difference was observed in goats fed with diet containing 15% date pits. In addition, goats fed with diet containing 15% date pits did not show any significant difference with the other dietary treatments. This indicated that inclusion of date pits up to 20% in goat diets did not show any adverse effect on nutrient intakes. Al-Shanti *et al.* (2013) replaced 50, 75 and 100% of concentrate feed with date pits and found that FCR of lambs fed with control and 50% date pits was better compared to the other groups. The ADG ranged from 75.58 to 129.47 g with no significant difference between the control and those fed with diet containing 15 and 20% date pits. In addition, goats fed on the control and diet containing 20% date pits showed significantly (p<0.05) higher ADG compared to goats fed on a diet containing 10% date pits which was not significantly different from the diet containing 15% date pits. The lowest ADG was observed in goats fed on a diet containing 10% date pits. Al-Ani *et al.* (1991) showed that feeding Awassi lambs diets contained 15, 30 and 45% of dried pulp date substituted for barley for 60 days resulted in the highest ADG of lambs fed on a diet containing 30% followed by 15% date pits. However, Al-Owaimer *et al.* (2011) showed that Najdi lambs fed on a diet containing alfalfa hay (control) or diet containing only Atriplex halimus without date pits or Atriplex halimus with three different levels of date pits (15, 30, 45%) were higher in ADG than the ADG observed in this study. In their study, Najdi lambs had higher DMI that would increase OM and nutrient intakes which resulted in increased growth weight of lambs. In addition, the differences in ADG observed

Table 3: Apparent nutrient digestibility coefficients of Ardi goats fed pelleted diets supplemented with date pits

Items (%)	Inclusion of date pits (%)			
	0	10	15	20
Dry matter	74.81±0.31 <sup>a</sup>	64.21±0.56 <sup>b</sup>	66.23±0.89 <sup>b</sup>	74.11±0.38 <sup>a</sup>
Organic matter	76.27±0.17 <sup>a</sup>	66.57±0.08 <sup>b</sup>	67.82±0.09 <sup>b</sup>	74.99±0.59 <sup>a</sup>
Crude protein	68.92±1.04 <sup>a</sup>	61.80±0.77 <sup>b</sup>	62.43±0.39 <sup>b</sup>	70.15±1.81 <sup>a</sup>
Crude fiber	40.23±3.02	45.29±1.60	46.64±4.97	36.39±2.17
Neutral detergent fiber	72.32±2.09 <sup>a</sup>	59.21±1.08 <sup>b</sup>	57.90±2.24 <sup>b</sup>	70.24±0.65 <sup>a</sup>
Acid detergent fiber	48.13±3.42	42.96±3.98	45.44±2.77	47.88±5.12
Fat	52.79±3.72	63.17±0.87	59.96±3.65	47.24±6.59
Nitrogen free extract	85.11±2.89	76.35±1.62	81.97±3.01	86.98±5.49
Ash	54.42±4.75	29.17±7.69	53.29±12.02	32.82±13.92
<b>Nutritive value (%)</b>				
Digestible crude protein	10.05±0.15 <sup>a</sup>	8.72±0.11 <sup>b</sup>	8.68±0.06 <sup>b</sup>	10.03±0.26 <sup>a</sup>
Total digestible nutrients	72.55±0.11 <sup>a</sup>	63.89±0.13 <sup>b</sup>	63.85±0.09 <sup>b</sup>	76.23±1.87 <sup>a</sup>

<sup>a,b</sup>Means within a row with different superscripts differ (p<0.05)

between the two studies might be attributed to forage types, animal species and pellet quality components used in this study. In the current study, there was a negative correlation ( $r = -0.92$ ) between ADG and FCR which was in agreement with Arthur *et al.* (2001) who showed a negative correlation of -0.74 between ADG and FCR in beef cattle. This indicated that goats characterized by a rapid growth rate tend to have a lower feed conversion ratio. The initial weight of the goats at the beginning of the trial was not significantly different and the weight of goats was 23.38, 24.88, 24.25 and 23.75 kg for control, 10, 15 and 20% dietary treatments, respectively. However, no significant difference was found among the dietary treatments with respect to the final body weight. The result of final body weight was in agreement with Yagoub and Eleman (2012) who fed 0, 5 and 10% date pits to lambs and did not find any significant difference among dietary treatments. Total body weight gain for goats fed with 10% date pits was significantly ( $p<0.05$ ) lower than those fed the control and 20% diets while no significant difference was observed between goats fed on a diet containing 15% date pits and the other treatments. This indicated that supplemented date pits did not show any negative effect on dry matter intake and consequently in nutrient uptake of growing Ardi goats. This might be due to higher palatability of date pits resulted in increased feed intake which increased microbial activity in the rumen and therefore the nutrient metabolism. Ismail (2000) showed that dates contain growth-promoting compounds that helped in increased lamb body weight which might explain the similarity between goats fed the control and 20% date pits in term of total body weight gain.

**Effect of experimental diets on nutrients digestibility:** The effect of dietary treatments on nutrient digestibility of Ardi goats are presented in Table 3. All the dietary treatments used in this trial were similar in chemical composition for the purpose of accurate digestibility comparison. The digestibility of DM and OM was not significantly different between the control and the diet containing 20% date pits but were significantly ( $p<0.05$ ) higher than those diets containing 10 and 15% date pits. Goats fed on a diet containing 10% date pits was not significantly ( $p>0.05$ ) different from those fed on a diet containing 15% date pits. The study results agree with those of Al-Kinani and Al-Wash (1975) who showed that the DM and OM digestibility increased as the percentage of date pits increased in lamb diets. The average values of DM and OM digestibility

obtained in this study were 69.94 and 71.41%, respectively. These values were comparable with those obtained by Al-Owaimer *et al.* (2011) who fed Najdi lambs on a diet containing different levels of date pits. The finding of this study indicated that the diets formulated was highly digested and date pits up to 20% could replace part of concentrate feeds as an alternative feed in goat diets. The CP and NDF digestibility followed similar trend as DM and OM digestibility. Higher NDF digestibility of goats fed on a diet containing 20% date pits may be attributed to increased palatability and energy content of diets because of increased date pits proportion. The value of NDF digestibility observed in the current study was slightly lower than the result reported by Alhomidy *et al.* (2011) who fed discarded dates to Najdi lambs. However, Mahmoud and El-Bana (2013) showed that camels fed with date pits with barley grains had lower NDF digestibility (57.77%) than what has been observed in this study. The CP digestibility coefficient obtained in the current study was lower than the result of Alhomidy *et al.* (2011) who reported that CP digestibility was 74.8% when lambs were fed on a diet containing 30% discarded dates. However, the result of this study for CP digestibility was not consistent with the finding of Al-Dabeeb (2005) and Al-Yousef *et al.* (1993) who observed a reduction in CP digestibility when date pits were added to lamb diets. This result showed that inclusion of date pits in goat diets up to 20% supplied animals with their protein requirement necessary for growth of rumen microbes and metabolism of nutrients in the rumen. The digestibility coefficients of CF, ADF, EE, NFE and ash were not significantly different among dietary treatments. The result of this study with regard to CF digestibility was in agreement with those of Al-Owaimer *et al.* (2011) who did not find any significant differences among all treatments in CF digestibility of Najdi lambs fed on diets containing different levels of date pits except the one fed on atriplex without date pits but it was not comparable with their finding in term of EE digestibility where the inclusion of date pits in the diet resulted in increased EE digestibility compared to the control and atriplex without date pits. In contrary to this study, Al-Dabeeb (2005) reported that the CF digestibility in lamb diets decreased significantly as the percentage of date pits increased. With regard to the digestibility of ADF and NFE, those results did not agreement with Al-Owaimer *et al.* (2011) who stated that ADF digestibility of lambs increased with an increasing date pits percentage while NFE digestibility decreased significantly with increasing the percentage of date pits in the diet. In this study, no correlation was found between NFE content in the diets and the NFE digestibility which was in contrary to the finding of Okah *et al.* (2012) who found that NFE digestibility decreased as the percentage of NFE was increased in diets. Goats fed on the control and diet containing 20% date pits were significantly ( $p < 0.05$ ) higher in TDN and Digestible Crude Protein (DCP) than those fed on diets containing 10 and 15% date pits while there was no significant difference between the diets containing 10 and 15% date pits. Higher DMD of the control and 20% date pits resulted in increased TDN and DCP in these two dietary treatments. However, a positive correlation of 0.90 was found between DMD and TDN and 0.92 between DMD and DCP. This result was in disagreement with Al-Owaimer *et al.* (2011) who did not find any significant difference in TDN but it was similar with their results with respect to DCP which increased significantly with increasing the percentage of date pits in lamb diets.

## **CONCLUSION**

This study showed that substituting date pits in concentrate animal feed gave similar results on the animal performance and nutrients digestibility to those fed on traditional concentrate feeds. This suggested that date pits can be utilized efficiently by Ardi goats by replacing the conventional

concentrate feed up to 20% without any adverse effect on goat health and productivity. Low price of date pits and its availability seems to be encouraging for animal producers to feed date pits by partially substituting concentrate feed to their animals.

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