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The Use of Ground Date Pits and *Atriplex halimus* as Alternative Feeds for Sheep

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Abstract: The present study was conducted to investigate the possibility of utilization ground date pits and atriplex (*Atriplex halimus*) as alternative for feeding sheep. Eighty Najdi lambs were used, 20 for digestibility, nitrogen balance and rumen fermentation trials, and other 60 rams were used for growing lambs trial. For the digestibility trials, the animals were fed 5 mixed rations as follows: diet containing alfalfa hay (control diet) or diet containing atriplex without date pits and three other diets containing atriplex with 15, 30 and 45% date pits instead of barley. Dry matter intake (g/head/day) was significantly ($P<0.05$) higher with diet containing *Atriplex halimus* without date pits than diet containing hay. There were no significant differences for dry matter intake between diets containing atriplex with date pits and the highest value was with diet containing 15% date pits. Dry matter and organic matter digestibility were significantly higher ($P<0.05$) with control diet than that of the diet containing atriplex with date pits. Digestibilities of crude fiber, acid detergent fiber and neutral detergent fiber were significantly lower ($P<0.05$) with diet containing atriplex without date pits than control diet or diets containing atriplex with date pits. The nitrogen balance values ranged between 5.86 and 7.26 g/day without significant differences among all diets. Rumen pH ranged between 6.11 and 6.55. There were no significant differences among all diets for NH_3-N concentrations, and the values were ranged between 16.15 and 26.75 mg NH_3-N/100 ml rumen liquor. Concentrations of VFA ranged between 8.71 and 12.96 mol/100ml rumen liquor, and the highest value with control diet and followed by diet containing atriplex with 45% date pits. Average daily gain was 245 g/day for diet containing atriplex with 30% date pits and 173 g/day for diet containing atriplex without date pits. The best value of feed conversion ratio was with lambs fed diet containing atriplex with 30% date pits. The results presented here demonstrate that atriplex and date pits could be use as alternative feeds for ruminants.

Key words: Date pits, *Atriplex halimus*, growth, fermentation, digestibility, nutritive value, lambs.

INTRODUCTION

Recently, the price of energy supplements in Saudi Arabia has increased dramatically with the increase of demand for feeds to animals. The increase in feed price encouraged nutritionists to search for cheaper high-energy feed ingredients. In the Kingdom of Saudi Arabia, about million tons of date palm can be produced annually (ASYB, 2007). There are significant by-products from the date industry that has limited or no value as human food. Some of the low quality dates, the discarded dates or the processing plant, the old dates of the previous year and date pits available in considerable amount to be used as feedstuff for animals. The amount of dates available for animal use was estimated to be about 20% of the total dates production in Saudi Arabia (Williams, 1978; Belal *et al.,* 1999) which could be used to feed animals with high-energy supplements (Al-Yousef *et al.,* 1993; Ahmed and Al-Dabeeb, 2000; Al-Dabeeb, 2005). Date-supplemented diets may improve animal performance. In Saudi Arabia, the livestock producers usually use standard diets containing barley grain, wheat bran and grass hay or alfalfa hay in feeding their sheep (Al-Dabeeb, 2005).

Atripdex halimus yield high biomass, contain high crude protein (Aganga *et al.,* 2003) and has high resistance to salinity (Areli *et al.,* 1989), and it can be used to manage the problem of water shortage and provide low cost fodder for animals. In general, Atriplex is characterized by moderate digestible crude protein (DCP) and high oxalate and mineral concentrations, particularly, Na, K, Cl and Ca, also digestible ether extract

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and soluble carbohydrates are low (Hassan and Abd El-Aziz, 1979; El-Shaer *et al.*, 1984; El-Shaer and Gihad, 1992; Ben Salem *et al.,* 2005). Deficiency of available carbohydrates and the rapid fermentation of the saltbushes crude protein (CP) in the rumen may be responsible for the poor utilization of their protein as judged from the large losses of nitrogen in urine (Hassan and Abd El-Aziz, 1979). They reported that feeding on atriplex solely adversely affects the general condition of sheep and goats with more pronounced effect on sheep. Coordination between the level of dietary readily available carbohydrates and ruminal-nitrogen is suggested to maximize the utilization of dietary nitrogen by micro-organisms (El-Shaer and Gihad, 1992). Barley grains as energy supplement was suggested to stimulate saltbush intake and to correct the loss of ruminal ammonia (El-Shaer, 1981; Hassan *et al.*, 1979; Shawket et al., 1998; Shawket, 1999). Saudi Arabia has limited of rain and ground water and this limit the production of roughage. Therefore, we expect that date pits and saltbush plants such as *Atriplex halimus* as alternative feed stuff is a feasible solution to minimize the problem of feed for ruminant animals. The objective of the current work was conducted to study the effect of use date pits as alternative energy source and *Atriplex halimus* as alternative roughage in mixed diets on growth performance and apparent digestion coefficients, nitrogen balance and rumen fermentation of Najdi lambs.

MATERIALS AND METHODS

Animals and Diets:

A total of 80 Najdi lambs were used in this study, 20 for digestibility and nitrogen balance trials (four rams for each diet, average body weight 37±0.22 kg) and 60 for growth performance (twelve rams for each diet, average body weight 23 ±0.40 kg) trials.

The animals were fed alfalfa hay two weeks prior to allocating to the experimental diets. Control and experimental diets are detailed in Table (1).

Table. 1: Ingredient components of the experimental diets

	Diets (%)				
Ingredients	Control	Atriplex without date pits	Atriplex+15% date pits	Atriplex+30% date pits	Atriplex+45% date pits
Alfalfa hay	20	-	-	-	-
Atriplex	-	20	20	20	20
Barley	55	55	40	25	10
Date pits	-	-	15	30	45
Soybean meal	7.5	10	11.5	9.4	8.9
Wheat bran	10.4	8	5.5	3	2
Corn	4.5	4.4	3.6	6	5.5
Urea	-	-	0.3	1	1.5
Oil	-	-	1.5	3	4.5
Sodium bicarbonate	1	1	1	1	1
Dicalcium phosphate	0.4	0.4	0.4	0.4	0.4
Lime stone	1	1	1	1	1
Vits & Min. mixture*	0.2	0.2	0.2	0.2	0.2

* Each kg of Vits. & Min. 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 Vit. A, 500,000 IU Vit. D, 10,000 IU Vit. E.

Digestibility Trial:

A metabolism study was conducted with 20 rams to determine digestibility and nitrogen balance. The animals were divided into 5 groups, each group contains 4 lambs. The animals were housed in metabolic cages during the preliminary and collection periods. The experiment started with a 15-day preliminary period and followed by collection period which was 7 days. Feed was offered once a day at 7:30 h a.m. Feces, urine and residual feed were quantitatively collected from each animal. Water was offered once a day during the trial and water intake was recorded. The feed offered and residual for each animal were weighed and recorded daily. Samples of feed and residual were taken daily and composted until the end of collection period, dried at 70ºC for 24 h, ground through a 1 mm screen and used for chemical analysis. Daily fecal excretions were collected at 07:00 h, weighed and recorded. Aliquots (10 %) of the sample from each animal were sampled daily; dried for 24 h at 70ºC for DM determination. The remaining fecal sample was composted for each sheep and stored at 4ºC until further analysis. Urine was collected using buckets containing sulfuric acid (10 %); urine volume was measured and then frozen until further analysis. Aliquots (10 %) of the well-mixed urine sample was taken daily in labeled bottles, preserved with 2–3 ml of concentrated sulfuric acid and stored at 4ºC.

At the end of the collection period individual rumen fluid was collected using a stomach tube at 2hr after the morning feeding for pH using pH meter, volatile fatty acids (VFA) and ammonia nitrogen (NH_3-N) concentrations determinations (AOAC, 1995).

Growing Trial:

A total of 60 ram Lambs were weighed and divided to five groups, each group contained four lambs allotted by weight to one of the three replicate groups in each of the five rations. Lambs in group (1) were fed on diet containing hay with concentrate ingredients, lambs in group (2) were fed diet containing *Atriplex halimus* instead of hay while lambs in groups (3, 4 and 5) were fed on diet containing *Atriplex halimus* with different level of date pits (15, 30 and 45%) instead of barley, respectively. Lambs were offered their assigned diets once daily for *ad libtum* feed intake. Amounts of feed offered and residual feed were weighed and recorded daily. Feed intake were calculated weekly for dry matter intake and feed efficiency determinations. For average daily gain (ADG) determination, lambs were weighed in the morning before being feeding at 14 day intervals for 90 days.

Chemical Analysis:

Feed and feces were dried at 70°C for 24 h, then ground through a 1 mm screen. Samples of feed and residual feed were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash according to AOAC (1995). Urine samples were analyzed for nitrogen (N). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined according to Van Soest *et al.* (1991).

Statistical Analysis:

The data were analyzed according to SAS (1998). Duncan's tests (1955) were used to compare the treatment means.

RESULTS AND DISCUSSION

The proximate analyses of five experimental rations are shown in Table (2). Diets containing atriplex with or without date pits were nearly similar in DM, OM, CP, and ash contents relative to the control ration. EE in control diet and the diet contained atriplex without date pits was quit similar, but it was higher and linearly increased in the diets containing atriplex with date pits than that in control diet and the diet contained atriplex without date pits due to the addition of oils. The values of crude fiber, NDF and ADF were higher in the diets containing atriplex with or without date pits than that of control diet due to the content of CF, NDF and ADF in atriplex and date pits. These results are in general agreement with those reported by El-Hag *et al.* (1993) and Al-Dabeeb (2005) in CF and NFE, although they used in their experiments date palm.

The water and feed intake data are reported in Table (3). The highest water intake was by the animals fed atriplex without date pits (4.33 l/d) and followed by atriplex with 30% date pits (4.14 l/d), atriplex with 15% date pits (4.07 l/d) and atriplex with 45% date pits (3.74 l/d). The lowest water intake was by the animals fed on diet contained hay (3.21 l/d). There were significant differences ($P<0.05$) in water intake between diet containing atriplex with or without date pits, and control diet and this is due to high mineral contain in atriplex There were no significant differences ($P>0.05$) in water intake between diets containing atriplex with or without date pits. These results are in agreement with results of a number of previous studies (Shawket, 1999; Ahmed *et al.,* 2001; Shawket *et al.,* 2001; Abouheif *et al.,* 2000). Dry matter intake (DMI, g/head/day) was significantly higher with diet containing *Atriplex halimus* with or without date pits than that of diet containing hay. There were no significant differences for DMI between diets containing atriplex with date pits and the highest DMI value was observed with diet containing 15% date pits. The increased of DMI with the diets containing atriplex with or without date is due to the high proportion of soluble carbohydrates in atriplex and date pits compared to hay which led to a rise in the passage of food from rumen and thereby increase the amount DMI. These results are in agreement with that of Al-Owaimer *et al.* (2008), who reported that DMI was higher with the lambs fed on diet containing atriplex compared to hay. El-Gasim *et al.* (1986) also reported that lambs fed clover hay with 10 and 20 and 30% date pits were higher on DMI than that of the lambs fed conventional diets. Al-Ani *et al.* (1991) found that the average of DMI did not have significant differences among the groups fed increasing proportions of powder dates (15 and 30 and 45%). Craig (1975) reported the similar results in lambs consumed concentrated diet containing 25 and 50% of date pits consumed the same quantity of the intake of lambs fed concentrated diet without date pits.

Table (4) shows the digestibility coefficients, total digestible nutrients (TDN) and digestible crude protein (DCP) of the experimental diets. The digestibility coefficient of DM, OM and NFE was significantly higher ($P<0.05$) for the lambs fed on control diet than lambs fed diets containing atriplex with or without date pits.

Table. 2: Chemical composition of the experimental diets (on % DM basis)

	Diets (%)				
Item	Control	Atriplex without date pits	Atriplex+15% date pits	Atriplex+30% date pits	Atriplex+45% date pits
DM	92.21	92.38	93.31	93.95	94.04
OM	92.01	93.44	92.54	92.75	93.00
CP	16.60	16.31	16.60	16.32	16.76
EE	2.99	2.37	5.71	6.82	8.25
CF	9.49	12.19	12.59	12.73	14.72
NFE	62.63	62.57	57.64	56.88	53.27
Ash	7.99	6.56	7.46	7.25	7.00
NDF	39.62	41.33	45.76	52.11	61.92
ADF	12.62	14.71	18.13	25.46	30.66

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: Feed intake (g/day) and drinking water (L/day) during the digestibility trial of the experimental diets (on % DM basis)

	Diets (%)				
Item	Control	Atriplex without date pits	Atriplex+15% date pits	Atriplex+30% date pits	Atriplex+45% date pits
Feed intake	1072^{b}	1374^{a}	1480^{a}	1442^{a}	1347^{a}
Drinking water	3.21^{b}	4.33^{a}	4.07^{a}	4.14^{a}	3.74^{ab}

^{ab} Means in the same row with different letters in their superscripts differ (P<0.05).

Table. 4: Digestion coefficients (%) of all nutrients, TDN and DCP of the experimental diets (on DM basis)

	Diets (%)				
Item	Control	Atriplex without date pits	Atriplex+15% date pits	Atriplex+30% date pits	Atriplex+45% date pits
Digestion coefficients (%)					
DM	73.92^{a}	69.19 ^{b}	69.98 ^{b}	67.83 ^{b}	68.73 ^{b}
OM	75.79^{a}	70.69 ^{b}	71.65 ^{b}	69.27 ^{b}	70.37 ^{b}
CP	70.91	72.29	73.98	72.44	74.39
EE	84.99^{ab}	82.83 ^{b}	88.10 ^{a}	86.72 ^{a}	86.13 ^{a}
CF	34.51^{a}	22.60 ^{b}	35.23 ^{a}	32.89 ^{a}	39.93 ^{a}
NFE	82.88^{a}	79.18 ^{b}	77.30 ^{bc}	74.40^{cd}	73.53 ^{d}
NDF	56.37^{b}	44.59 ^{c}	58.56 ^{b}	58.68 ^{b}	66.71 ^{a}
ADF	30.26^{cd}	23.37 ^{d}	37.06 ^{bc}	43.62 ^{b}	54.67 ^{a}
Nutritive value (%)					
TDN	72.91	68.49	72.59	71.63	73.48
DCP	11.77 ^{b}	11.79 ^{b}	12.28$^{a\ b}$	11.82$^{a\ b}$	12.45^{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.
^{abcd} Means in the same row with different letters in their superscripts differ (P<0.05).

There was no significant difference in digestibility coefficient of CP among all groups. The digestibility coefficient of EE was higher (P<0.05) in lambs fed atriplex with date pits than that of those fed control and atriplex without date pits. There were no significant differences in digestibility coefficient of CF among all groups except the group fed atriplex without date pits. The highest value of neutral detergent fiber (NDF, 66.71%) and acid detergent fiber (ADF, 54.67%) was observed in lambs fed atriplex with 45 % date. The lowest value of NDF and ADF was 44.59 and 23.37%, respectively in lambs fed atriplex without date pits. Al-Dabeeb (2005) reported that digestibility of DM, OM, CP, NFE and CF decreased with the increase of the level of dates in the diet. The present results of DM and OM are in agreement with the results of Al-Dabeeb (2005) when the diets contained date pits. El-Hag et al. (1993) and Al-Yousef *et al.* (1993) reported a similar decreased in digestion coefficients of CP and CF due to the inclusion of dates in the ration of sheep, and these results are contrary with the present results of CP and CF. Hmeidan *et al.* (1993) reported that using dates as an energy source up at the level of 44% resulted in a significant drop in nutrient digestibility, N retention and energy utilization. The contrary results were found by Al-Kinani and Al-Wash (1975), they were used date pits in various proportions to feed lambs and noted that the coefficients of OM and DM increased by increasing the proportion of date pits in the diets.

Table (4) shows also the nutritional value of the experimental diets as TDN and DCP. There were no significant differences among all groups for TDN and the values were ranged between 68.49 and 73.48 %. The present results of TDN are in agreement with the results Al-Owaimer *et al.* (2008). As for DCP, there were significant differences between the diets containing atriplex with 45% date pits and both of control and atriplex without date pits, while there were no significant differences among the diets containing atriplex with dets pits

(15 and 30 and 45%). The highest value was recorded with the diet containing atriplex with 45% date pits (12.45%), while the lowest value was recorded with values control diet (11.77%) and followed by the atriplex without date pits (11.79%).

The nitrogen balance data are reported in Table (5). There were no significant differences between all diets. These results are in agreement with the results of Al-Owaimer *et al.* (2008), who reported that there were no significant differences between the balance of nitrogen-containing control diet (hay) and other diets, which contained atriplex and balance of nitrogen values were ranged between 7.1-8.54 g/day. Hmeidan *et al.* (1993) reported a drop in nitrogen balance due to the inclusion of dates in sheep diets. Al-Dabeeb (2005) reported that there were no significant differences in fecal nitrogen between the experimental groups which contained control diet or the diets contained date with 10 or 20%. Nitrogen balances for lambs fed date supplemented diets were similar to that of the control group and these results are in agreement with the current study.

The rumen pH, ammonia nitrogen (NH_3-N) and total volatile fatty acids (VFA) are reported in Table (6). The pH values ranged between 6.11-6.55. The lowest pH value which was 6.11 in the group fed on atriplex with 45% date pits. These values are in agreement with the results of Abouheif *et al.* (2000), who found that the values of pH in rumen liquor of sheep fed on diets contained hay or halophytes were ranged between 6.2 and 6.9. No significant differences were observed for NH_3-N concentrations, and the values ranged from 16.15 to 26.75 mg /100 ml R.L. The highest value was observed in the control and followed by the group fed on atriplex without date pits, while the lowest value was recorded with the group fed atriplex with 45% date pits. Annison *et al.* (1954) explained that the concentration of ammonia in the rumen under natural conditions, was ranged from 5-120 mg / 100 ml R.L. and these values depend on the degradability of protein. Satter and Slyter (1974) and Russell and Strobed (1987) pointed that the concentration of ammonia in the rumen should not be less than 5 mg / 100 ml R.L. and these values were requested to synthesis the highest rate of microbial protein in the rumen.

The value of VFA concentration was between 8.73-12.96 mol / 100 ml R.L. and the highest value was with control diet and followed by the group fed on atriplex with 45% date pits (12.96 and 12.86 mol / 100 ml R.L.) without significant difference. The lowest value was with the group fed on atriplex with 30% date pits (7.81 mol / 100 ml R.L.) with significant differences compared to the groups fed on control diet and atriplex with 45% date pits. Borhami *et al.* (1995) found that the concentration of VFA in lambs fed on conventional feed between 9.3-13.39 mol / 100 ml R.L.

The feed intake (g/day), average daily intake (ADG) and feed efficiency data are reported in Table (7). The average initial body weight of lambs ranged between 23.01 and 24.13 kg, and the final body weight ranged ($P<0.05$) from 38.28 to 43.95 kg. The lambs fed atriplex with 30% date pits had the highest final weight and lambs fed atriplex with 45% date pits had the lowest final weight. The ADG ranged between 182 and 245 g/day with the highest value for animal fed 30% date pits followed by control and then 15% date pits ($P<0.05$) and the lowest value was for animal fed atriplex with 45% date pits diets ($P>0.05$). Shawket (1999) showed that feeding on atriplex diet led to the reduction of growth lambs. Al-Owaimer *et al.* (2008) found that the ADG was higher with the lambs fed on hay diet than those fed on atriplex diet without significant difference. The current results are in agreement with the results of Al-Ani *et al.* (1991), who found when animals fed on barley with 0, 15, 30 and 45% date pits for 60 days, the highest value of ADG with the lambs fed on barely with 30% date pits and the lowest value was the group fed on barely with 45% date pits. Al-Dosari *et al.* (1995) found the ADG of Awassi sheep was linear increased when the diets containing increasing levels of date pits compared to barley diet. Al-Dabeeb (2005) indicated that incorporation of dates at 10 or 20% of the diet did not show an improvement in growth rate when compared with the control group. This finding is contrary to the findings of El-Hag *et al.* (1993), who reported that the addition of discarded dates at the levels of 15 or 25% of the whole DM of ration was associated with an increase in growth rate of Awassi lambs. Dry matter intake (g/head/day) decreased in lambs fed atriplex 45% date pits diet with significant difference with other groups ($P<0.05$), while there were no significant differences in dry matter intake of the lambs fed control diets and the diets contained atriplex with 15, 30% or without date pits. Feed conversion was better in the lambs fed atriplex with 30% date pits than other groups (Table 7). Shawket *et al.* (2001) and Ahmed *et al.* (2001) reported the contrary results compared to the current results of feed conversion, they found that the best efficiency of feed conversion was with the lambs fed on hay compared to the lambs fed on atriplex diet.

In general, the discrepancy in the results of previous studies on date pits is probably due to the disparity in the relative proportions of components, as well as components of feed concentrates and different species of animals used in different studies and different time period during which the fed animals.

Table. 5: Nitrogen balance (g/day) in Najdi sheep fed on the experimental diets

	Diets (%)				
Item	Control	Atriplex without date pits	Atriplex+15% date pits	Atriplex+30% date pits	Atriplex+45% date pits
Nitrogen intake	28.46[b]	35.85 [a]	39.31 [a]	37.66 [a]	36.11 [a]
Fecal nitrogen	8.28	9.89	10.23	10.48	9.27
Digested nitrogen	20.18 [b]	25.96 [a]	29.08[a]	27.18[a]	26.84[a]
Urinal nitrogen	12.91 [b]	19.21 [a]	23.21 [a]	21.45 [a]	20.39[a]
Nitrogen balance	7.26	6.75	5.86	5.72	6.45

[ab] Means in the same row with different letters in their superscripts differ (P<0.05).

Table. 6: Ammonia nitrogen (NH_3-N), volatile fatty acids (VFA) and pH in rumen liquor (R.L.) of Najdi sheep fed on the experimental diets

	Diets (%)				
Item	Control	Atriplex without date pits	Atriplex+15% date pits	Atriplex+30% date pits	Atriplex+45% date pits
pH	6.45[ab]	6.55 [a]	6.33 [ac]	6.13[bc]	6.11[c]
NH_3-N, mg/100 ml R.L.	26.75	23.18	16.68	16.32	16.15
VFA, mol/100 ml R.L.	12.96 [a]	12.25 [ab]	8.73 [ab]	7.81 [b]	12.86[a]

[abc] Means in the same row with different letters in their superscripts differ (P<0.05).

Table. 7: Growth performance, feed intakes and conversions in Najdi sheep fed on the experimental diets

	Diets (%)				
Item	Control	Atriplex without date pits	Atriplex+15% date pits	Atriplex+30% date pits	Atriplex+45% date pits
No. of Animals	12	12	12	12	12
Experimental period (days)	84	84	84	84	84
Initial weight (kg)	23.05	24.13	23.30	23.41	23.01
Final weight (kg)	41.27[a]	38.64 [b]	41.33 [a]	43.95 [a]	38.28 [b]
Average daily gain (g)	217 [a]	173 [b]	215 [a]	245 [a]	182 [b]
Feed intake (kg/d)	1.29 [a]	1.32 [a]	1.33 [a]	1.39 [a]	1.12 [b]
Feed conversion*	5.94 [b]	7.63 [a]	6.18 [b]	5.67 [b]	6.15 [b]

[abc] Means in the same row with different letters in their superscripts differ (P<0.05).
*Feed intake (g) /average daily gain (g).

Conclusion:

The current study recommended that using atriplex by 20% instead of alfalfa hay with 30% date pits give the best animal performance among trail diets.

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