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Research Article

Effect of Substituting Different Dietary Levels of Date Pits and Urea Treated Palm Leaves on Growth Performance and Nutrients Digestibility of Ardi Goats

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Abstract

The aim of this study was to evaluate the effect of substituting date palm leaves and date pits with conventional concentrate feed and alfalfa hay on the performance and nutrients digestibility of Ardi goats. The Dry Matter Intake (DMI) was significantly higher in goats fed with 10/10 and 20/20 diets than the control group. But the difference in MDI intake was not significant between the control and the 30/30 group. However, goats fed with 10/10 diet showed significantly ($p < 0.05$) higher DMI compared to those fed with 30/30 diet. There was no significant difference in DMI intake between the 20/20 and 30/30 groups. Also, no significant differences in Feed Conversion Ratio (FCR) were found between the control and 30/30 diet treatment, while these two groups were significantly better ($p < 0.05$) compared to 10/10 and 20/20 groups. Goats fed with 20/20 diet showed significantly lower FCR than 10/10 group. The digestibility coefficients of dry matter (DM), Organic Matter (OM), Crude Protein (CP), fat and ash were not significantly different among the dietary treatments. The difference in CF and NDF digestibility was not significant in goats fed with 20/20 and 30/30 diets but was significantly ($p < 0.05$) higher than 0/0 and 10/10 groups. The difference in digestibility coefficient of ADF was not significant between the 20/20 and 30/30 groups but was higher than those fed with 0/0 and 10/10 diets. Goats fed with 0/0 diet showed significantly higher ADF digestibility coefficient than the 10/10 group. Feeding animals UTPL and date pits up to 30% replacing the conventional concentrate feeds and alfalfa hay provided animals with their nutrients requirement above maintenance needs.

Key words: Ardi goat, urea treated palm leaves, digestibility, average daily gain

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

INTRODUCTION

Saudi Arabia is recognized as one of the largest country in the world producing dates (El-Habba and Al-Mulhim, 2013). Presently, there are more than 25 million date palm trees in Saudi Arabia which is expected to increase dramatically in future annual report of Ministry of Agriculture (2013). Palm trees produce many crop residues such as date palm leaves, leaf petioles, racemes (without the dates) and pedicels. A date palm tree can produce up to 13.5-20 kg of dry fronds annually (Chehma and Longo, 2001; Pascual *et al.*, 2000). This can produce about 337-500 thousand tons of dry fronds per year. Unfortunately, large quantities of the fronds are not used and being burned by farmers thus causing environmental pollution. Due to the low nutritional value of date palm leaves, the farmers are not much interested to feed the animals these by-products. The crude protein concentration of date leaves is usually low, about 5-7% DM (Arhab *et al.*, 2006; Genin *et al.*, 2004; Medjekal *et al.*, 2011; El-Hag and Elkhanjari, 1992). In contrast, Ziaei and Sharifi Hosseini (2009) reported that date palm leaf contained 16.5% crude protein on dry matter basis. Bacha *et al.* (1993) found a seasonal variation in protein contents of date palm leaves in Saudi Arabia. They reported that it fluctuates from 8.5-9.5 in November-December to 7.5-8.0 in June-July. However, the percentage of NDF, ADF and ADL in date palm leaves ranges from 60-90, 42-65 and 10-20% DM, respectively (Arhab *et al.*, 2006; Ziaei and Sharifi Hosseini, 2009; Medjekal *et al.*, 2011; El-Hag and Elkhanjari, 1992; Genin *et al.*, 2004). The differences in nutritional values of date palm leaves can be attributed to the stage of maturity (young leaves harvested green or senescent ones) or according to the nature of the leaf portions fed to the animals (with or without the midrib or petiole). Arbouche and Arbouche (2008) showed that the nutritive value of the date palm leaves is limited by deficiencies of both the Crude Protein (CP) and Metabolizable Energy (ME). In addition, animal feed intake and digestibility may be reduced due to high level of lignifications in palm leaves (Genin *et al.*, 2004). Thus, animals consume these by-products as sole feed are more likely to meet only maintenance nutrient requirement (Arbouche and Arbouche, 2008). A long time ago, there were attempts to raise the nutritional value of these by-products and thereby increase their utilization in livestock feeding. In this regard, several chemical treatments were used in treating some crop residues. Among these treatments, use of urea in particular was more at farm level in the tropics and sub-tropics, as it was best suiting the conditions of smallholder farmers (Chenost, 1995). Another by-product of date processing plants is date pits, which are produced in large amounts annually.

In recent years, date pits are widely fed to animals in Saudi Arabia substituting a part of conventional concentrate feeds due to its low cost and easy availability. However, date pits are characterized by hard seed coat that impedes digestibility of seeds by animals (Ecocrop, 2011). Thus, it is recommended to process the seeds before feeding them to animals to increase their nutritive value. Grinding is one of several methods known to increase nutrient availability of date pits by breaking and removing the seed coat. Therefore, to increase nutrient availability of the seeds for animals, these must be crushed first with a disk crusher and then grind them with a hammer-mill (Gohl, 1982; Barreveld, 1993). Regional by-products are used widely by many animal breeders substituting conventional concentrate feeds, especially those with similar nutritive values (Costa *et al.*, 2009). These by-products can be fed to cattle, sheep and goats and are usually given to those animals during the periods of feed shortage or higher feed costs (Genin *et al.*, 2004). The hypothesis of this research was the benefits of feeding date pits and palm tree leaves treated with urea, which may increase the protein content and the rate and extent of fiber digestibility and consequently leads to higher energy availability and dry matter intake of animals without negative effects on animal performance. Therefore, the objective of this study was to investigate the effect of urea treated palm leaves and date pits by substituting a part of the commercial concentrate feed and alfalfa hay on growth and digestibility of Ardi goats.

MATERIALS AND METHODS

Experimental site: The trials were carried at Agricultural Research and Training Station at King Faisal University in Al-Ahsa, Saudi Arabia from August to October, 2015.

Animals and experimental diets: Twenty Ardi goats averaging 18.9 kg and 4-5 months of age were assigned randomly to one of four diets in growing and digestibility trials. Goats were subjected to regular health inspection before the beginning of the trials to ensure that they are in good condition. Each animal was housed in a separate pen. Chemical composition of Urea Treated Palm Leaves (UTPL) and experimental diets were determined before the beginning of the trial. Four isocaloric and isonitrogenous treatments were formulated according to the recommendation for goats by NRC (1981). The chemical composition of the feed ingredients and experimental diets are presented in Table 1.

Table 1: Ingredients and chemical composition of the experimental diets

Item	Inclusion of date pits and UTPL (%)			
	0/0	10/10	20/20	30/30
Ingredient (DM %)				
Alfalfa hay	40.00	30.00	20.00	10.00
Urea treated palm leaves	0	10.00	20.00	30.00
Date pit	0	10.00	20.00	30.00
Barley	47.00	42.20	28.80	14.37
Soybean	0.01	4.30	7.57	9.70
Wheat bran	9.40	0.47	0.08	2.87
Dicalcium phosphate	1.00	0.91	0.98	0.95
Limestone	1.89	1.76	1.99	1.95
Salt	0.60	0.52	0.60	0.59
Vit. and Min. Premix ^a	0.10	0.09	0.10	0.10
Chemical composition (% of dry matter)				
Dry matter	88.88	88.98	89.12	89.20
Crude protein	13.63	13.55	13.44	13.11
Total digestible nutrient	67.14	66.48	63.91	61.49
Crude fiber	16.59	15.25	14.39	13.57
NDF	46.27	40.12	36.36	33.25
ADF	28.59	25.76	23.78	21.73
Ether extract	2.32	2.44	2.74	3.13
Ash	5.66	5.98	6.59	7.26
Calcium	1.59	1.20	1.30	1.27
Total phosphor	0.55	0.46	0.46	0.48
DE (Kcal kg ⁻¹)	2871	2829.00	3088.00	2534.00

UTPL: Urea treated palm leaves, ^aVit. and Min. premix contain 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)

Growth trial: Twenty Ardi goats were weighted and assigned randomly to one of four diets with five replicates in each treatment. Animal in each group was fed individually in metabolic crate located under semi-shed. Total period of the trial was 75 days. Alfalfa hay and portion of concentrate feed were partially substituted by UTPL and date pits, respectively. Dietary treatments were: (1) 0/0 (40% alfalfa hay+60% concentrate), (2) 10/10 (10% of alfalfa hay (diet 1) was substituted by UTPL in forage portion+10% of concentrate feed was substituted by 10% of date pits), (3) 20/20 (20% of alfalfa hay was substituted by UTPL+20% of concentrate feed was substituted by 20% of date pits) and (4) 30/30 (30% of alfalfa hay was substituted by UTPL+30% of concentrate feed was substituted by 30% of date pits). Diets were offered as a Total Mixed Ration (TMR) and the forages and concentrates were mixed thoroughly by hand before feeding to ensure uniformity. Rations were offered once daily at 8 am in the morning. All goats had access to mineral blocks and water at all time. The amounts of feed and orts were weighed daily to determine the feed intake and were composited every week for further analysis. The amount of ration offered was adapted to ensure no more than 2% of feed refusals. Goats were weighed every two weeks before the feeding time from the

beginning of the trial until the end. Dry Matter Intake (DMI), nutrient intakes, Feed Conversion Ratio (FCR) and body weight gain were calculated to evaluate goat performance.

Digestibility trial: After the end of the growing trial, twelve goats were adapted to the metabolic crates for one week followed by collection period lasting 7 days. The animals were divided into 4 groups with three goats per group. Animals were fed at 8:00 am. The parameters such as feed intake, feed refusal and fecal output were recorded daily during the collection period. During the trial, the amount of feed offered and the orts were weighed and recorded daily. The samples from feed and orts were collected daily and approximately 100-150 g was composted until, the end of the collection period for further analysis. Daily fecal excretions were collected at 7:00 am and were weighed. A 10-15% sample of feces were sub-sampled daily from each animal, dried in a forced air oven at 60°C for 48 h and ground 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 kept in freezer at -4°C for subsequent analyses. Digestion coefficients were calculated for 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 total nutrient intake and then multiplied by 100.

Procurement and processing of date pits: Date pits (approximately 700 kg) were purchased from local date market in Al-Ahsa, Saudi Arabia. After that, date pits were transferred to Al-Qadeer Feed Mill for crushing by a date pit grinder and then mixed with the concentrate feed. Concentrate feeds included soybean, barley, wheat bran and vitamin and mineral premixes and were purchased from Al-Qadeer Feed Mill. Later on all these ingredients were mixed thoroughly with date pits through a 1000 kg feed mixer.

Urea treatment of palm leaves: Palm Leaves (PL) were obtained from a commercial farm located in Al-Ahsa. The leaves were manually separated from the coarse midrib by grass shear. The leaves were cut by forage grinder to 3-5 cm length. The UTPL were prepared by dissolving 4 kg of urea (fertilizer grade) in 100 L of water (40 g urea per liter water) to 100 kg of PL. The UTPL were stacked in a trash container having a capacity of 25 kg, compressed by feet to minimize the presence of air. After filling the container, polyethylene sheet were used to cover the container and then the container

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

Item	Inclusion of date pits and UTPL (%)			
	0	10/10	20/20	30/30
DMI (kg d ⁻¹)	0.820±0.03 ^b	1.030±0.03 ^a	0.948±0.04 ^{ac}	0.883±0.04 ^{bc}
DM (BW%)	3.8±0.07 ^b	4.7±0.09 ^a	4.5±0.12 ^a	3.9±0.07 ^a
ADG (g)	110.4±4.84 ^a	83.1±3.59 ^c	96.1±4.98 ^b	111.7±4.83 ^a
FCR	8.3±0.44 ^d	13.0±0.46 ^a	11.1±0.68 ^b	8.8±0.57 ^{cd}
Initial body weight (kg)	18.8±3.6	18.7±1.0	19.0±5.1	19.1±3.3
Final body weight (kg)	26.5±3.72	24.7±1.3	25.7±5.3	26.9±3.4
Total body weight gain (kg)	7.7±0.44 ^a	6.0±0.27 ^b	6.7±0.30 ^b	7.8±0.49

^{aa,b}Means within a row with different superscripts differ significantly at p<0.05, DMI: Dry matter intake, ADG: Average daily gain, FCR: Feed conversion ratio

were closed by the lid and sealed by tape to make it airtight and left to incubate for twenty-one days as recommended by Sundstol (1988).

Sample collection and analysis: Alfalfa hay, date pits, UTPL samples and total mixed rations were composited every two weeks for analysis. These samples in addition to the composited feed, orts and feces of the digestibility trial were oven-dried at 105°C for 24 h to determine the DM. Sample were ground through a Wiley mill (1 mm screen). The CP was determined by macro-Kjeldahl procedure given in method 955.04 (AOAC., 2002). The CF analysis was determined by filter bag technique (ANKOM Technology) as described in 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). Acid Detergent Fiber (ADF) and NDF were determined using the method of Van Soest and Robertson (1985). The Total Digestible Nutrients (TDN) values of all the ingredients were used to calculate the TDN values of the dietary treatments.

Statistical analysis: Each animal was considered as an experimental unit. Data was subjected to the one-way analysis of variance, as a completely randomized design. Data was analyzed by the general linear model, using SPSS (2007). Treatment means were compared (p<0.05) using Duncan's multiple range test to evaluate the effect of feeding date pits and UTPL on growth performance and apparent nutrient digestibility of Ardi goats.

RESULTS AND DISCUSSION

The DM, CP and EE values were similar among dietary treatments. The percent of CF, NDF and ADF in diets containing UTPL was lower than the control group. This indicated that the reduction in NDF and ADF as percent of

body weight for goats fed with UTPL could be attributed to the effect of urea in reducing NDF and ADF contents of treated diets. Aregawi *et al.* (2013) showed that sesame straw treated with 2 and 4% urea decreased NDF, ADF and cellulose compared to control. The reduction in NDF and ADF observed in this study due to ammoniation may be attributed to the release of hemicellulose and lignin fraction in treated palm leave (Theander and Aman, 1984). The TDN percentage of the dietary treatments was higher than the TDN requirement of goats at this weight according to NRC (1981), which indicated that the energy requirement of goats was fulfilled.

Effect of dietary treatments on animal performance: Effect of the dietary treatments on DM intake, initial and final body weight, average daily gain and FCR are presented in Table 2. Dry matter intake was not significantly different between the control and 30/30 group but goats fed with 10/10 and 20/20 diet were significantly higher in DMI than the control group. Goats fed with 10/10 diet was significantly higher (p<0.05) than goats fed the 30/30 diet, while no significant difference was observed with goats fed with 20/20 diet. Goats fed with 20/20 diet was not significantly different in DMI than the 30/30 group. The result was in agreement with the finding of El-Hag and Elkhanjari (1992), who showed that young kids fed on a diet containing 20% palm leaves and 20% date pits resulted in similar or slightly higher voluntary DM intake compared to a diet based on cereal and soybean meal. This showed that inclusion of date pits and UTPL up to 20% in goat diets did not show any adverse effect on feed intake. In addition, inclusion of date pits and treating palm leave with urea may increase soluble carbohydrates and dietary palatability which increased the passage rate of dietary nutrients from the rumen into the small intestine and thereby making animal able to consume more feed. In addition, the reduction of NDF and ADF in these diets may increase the ability of microorganisms in the rumen to digest feed more easily.

Al-Shanti *et al.* (2013) found that inclusion of date pits in lamb diets replacing up to 100% of concentrate feed did not cause any effect on DMI. However, Al-Suwaiegh (2015), showed no significant difference in DMI of goats fed up to 20% date pits and the control group. The differences observed in this study compared to previous studies can be attributed to type of date pits used in the trial, feeding UTPL to animals and physiological state of animals. Dry Matter Intake (DMI) expressed as percentage of body weight was significantly lower ($p < 0.05$) for the control group compared to the dietary treatments while no significant difference was found among the different dietary treatments. Devendra and Mcleroy (1982) reported that the recommended daily DMI of goats raised in tropic areas should be more than 3% of their body weight. In this study, goats fed with date pits and UTPL maintain a positive DM status by consuming more than 3% of their body weight. The possibility of higher DMI may be attributed to the effect of urea treatment on palm leaves which induced partial cleavages between lignin and structural carbohydrates thereby, causing hemicellulose and cellulose to be more subjected to rumen microbes and increase fiber digestibility, which enhanced feed intake. Goats fed with control and 30/30 diets were not significantly different in ADG but were significantly higher than 10/10 and 20/20 groups. However, ADG of goats fed with 20/20 diet was significantly higher compared to goats fed with 10/10 diet. The lowest ADG was observed for goats fed with 10/10 diet. The higher ADG of goats fed with 30/30 diet implied that UTPL supplemented with date pits in goat diets maintained nutrient requirements above the maintenance needs.

Al-Ani *et al.* (1991) fed Awassi lambs with diets containing 15, 30 and 45% of date pits and showed that the highest ADG was observed for lambs fed with 30% diet followed by those fed with 15%. Yadete (2014) showed that feeding lambs urea treated wheat straw supplemented with 300 g leucaena leucocephala resulted in higher ADG compared to untreated wheat straw. However, Al-Suwaiegh (2015) showed that feeding Ardi goats with diets containing 10, 15 and 20% date pits resulted in the highest ADG of animals than the control and 20% followed by those fed with 15%. The highest ADG reported by Al-Suwaiegh (2015) compared to this study might be the result of lower DMI in the current study and consequently lower nutrient intake which decreased growth weight of goats. In addition, other factors such as forage quality, and date pits used in this study might have played an influential role in ADG of goats. The FCR ranged from 8.3-13.0 g/g with no significant differences between the control and those fed with 30/30 diet, Whereas, these two groups were significantly better ($p < 0.05$) compared to 10/10

and 20/20 groups. Goats fed with 20/20 diet showed significantly lower FCR than 10/10. The results indicated that inclusion of UTPL and date pits up to 30% replacing conventional concentrate feed and alfalfa hay in Ardi diet did not show any adverse effect on nutrient intakes.

However, palm leaves treated with urea increased feed palatability and crude protein contents in 30/30 diet which increased the availability of ammonia for rumen microbes and consequently increased nutrients digestibility. The initial body weight of the animal at the beginning of the trial was not significantly different. In addition, no significant differences in the final body weight were observed among the dietary treatments. The result of final body weight in the current study was in agreement with the finding of Yagoub and Elemam (2012), who fed 0, 5 and 10% date pits to lambs and did not find any significant differences among dietary treatments. In contrast, Pachauri *et al.* (2014) showed that feeding heifers urea treated wheat straw increased final body weight compared to untreated wheat straw. The differences between the two studies can be attributed to the difference of species. Total body gain of goats fed with control and 30/30 diets were not significantly different but these two groups showed significantly higher total body weight gain compared to the 10/10 and 20/20 groups. However, no significant differences were observed between 10/10 and 20/20 groups. In contrast to this study, Mahgoub *et al.* (2007) investigated the potential use of date palm by-products for feeding Omani local sheep. Urea-treated ensiled date palm fronds supplemented by a concentrate made of local by-products and a pelleted commercial cubes showed to support only the maintenance requirements of growing sheep with a very low weight gain and feed intake over 120 days. The current study indicated that feeding UTPL and date pits to Ardi goats did not show any adverse effect on dry matter intake and consequently in nutrient uptake. Thus increasing palatability and protein percent caused an increase in feed intake which increased microbial activity in the rumen and therefore, nutrient metabolism.

Effect of experimental diets on nutrients digestibility: The effect of dietary treatments on nutrient digestibility of Ardi goats are shown in Table 3. The digestibility coefficients of DM, OM, CP, fat and ash were not significantly different among the different dietary treatments. The DM digestibility of the dietary treatments ranged from 65-67.5%. Ziaei and Sharifi Hosseini (2009) showed that supplementation of date palm leaves with energy supplements had lower *in vitro* dry matter digestibility compared to this study. These authors attributed the reduction in DM digestibility to high level of cellulose,

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

Items (%)	Inclusion of date pits and UTPL (%)			
	0/0	10/10	20/20	30/30
Dry matter	66.79±0.61	64.99±0.89	66.65±3.64	67.53±0.87
Organic matter	70.78±0.64	69.13±1.01	70.55±3.09	71.20±0.69
Crude protein	64.79±2.59	65.09±1.45	67.54±4.03	65.22±3.21
Crude fiber	41.89±2.44 ^b	42.69±3.83 ^b	61.04±4.55 ^a	64.94±2.69 ^a
Neutral detergent fiber	52.36±2.09 ^b	48.00±3.49 ^b	60.84±4.81 ^a	65.86±0.83 ^a
Acid detergent fiber	54.47±1.86 ^b	44.63±2.72 ^c	59.46±5.31 ^a	60.46±1.39 ^a
Fat	56.39±1.41	62.06±3.65	54.14±11.91	65.38±4.91
Nitrogen free extract	85.16±0.76 ^a	83.08±0.06 ^{ab}	81.29±1.34 ^{ab}	76.82±3.23 ^b
Ash	13.77±5.22	15.72±2.76	24.07±9.59	26.27±3.18
DCP	11.05±0.44 ^a	10.41±0.23 ^a	9.56±0.57 ^{ab}	8.15±0.40 ^b
TDN	66.73±0.63	64.82±1.06	65.24±2.89	66.07±1.34 ^{ab}

Means within a row with different superscripts differ significantly at $p < 0.015$, DCP: Digestible crude protein, TDN: Total digestible nutrients

hemicellulose and lignin content in palm leaves. In this study, treating palm leaves with urea may have cleaved linkages between cellulose and lignin or hemicellulose and lignin thus making these components more available to be attacked by ruminal microbes resulting in increased the rate of cellulose and hemicellulose digestion (Obese *et al.*, 2001). However, addition of date pits to UTPL increased energy content of the dietary treatments and therefore increased DM, OM and CP digestibility. Inclusion of date pits and UTPL in goat diets up to 30% supplied animals with their protein requirement necessary for growth of rumen microbes. Djajanegara and Doyle (1989) reported that feed treated or supplemented with urea resulted in an increased in intake, rate of digestion and digestibility of nutrients which explained the high rate of DM, OM and CP digestibility in the dietary treatments. In contrast to this result, Al-Kinani and Al-Wash (1975) observed an increase in DM and OM digestibility as the level of date pits increased in lamb diets.

The finding of this study indicated that diets containing date pits and UTPL by substituting the conventional concentrate feed and alfalfa hay up to 30% is highly digested and can be used as an alternative feed in goat diets. Goats fed with 20/20 and 30/30 diets were not significantly different in CF and NDF digestibility, while they were significantly ($p < 0.05$) higher than 0/0 and 10/10 groups. However, no significant difference was found between 0/0 and 10/10 groups. The higher CF and NDF digestibility observed in this study for 20/20 and 30/30 diets is in accordance with the opinion of Leng (1991), who stated that fibrous feed treated with urea will make fibrous components more easily exposed to microorganisms enzymes besides supplying more nitrogen necessary for the growth of ruminal bacteria. The results is in disagreement with Al-Dabeeb (2005), who showed that increase the percentage of date pits in lamb diets resulted in decreased CF digestibility. The digestibility coefficient of ADF

was not significantly ($p > 0.05$) different between the 20/20 and 30/30 groups while these two groups showed significantly higher ADF digestibility coefficient than those fed with 0/0 and 10/10 diets. Goats fed with 0/0 diet showed significantly higher ADF digestibility coefficient than the 10/10 group. The result of this study was in agreement with the finding of Al-Owaimer *et al.* (2011), who showed that the ADF digestibility of lambs increased with an increase in date pits percentage. Moreover, Yadete (2014) observed higher ADF digestibility in lambs fed with urea treated wheat straws compared to those fed with untreated straw. The digestibility values for NFE in this trial were found to be 85.16, 83.08, 81.29 and 76.82 for 0/0, 10/10, 20/20 and 30/30 diets, respectively. No significant differences were observed among 0/0, 10/10 and 20/20 groups while 0/0 group showed significantly higher NFE digestibility compared to 30/30 group. However, goats fed with 30/30 diet were not significantly different from goats fed with 10/10 and 20/20 diets. The result was in agreement with Al-Owaimer *et al.* (2011), who showed that the NFE digestibility of lambs decreased as the date pits percentage increased. The values of NFE digestibility obtained in this study for the dietary treatments were higher than the finding of Mahmoud and El-Bana (2013), who fed barley and palm leaves to camels. With regards to DCP, goats fed with 0/0, 10/10/ and 20/20 diets were not significantly different but 0/0 and 10/10 were significantly ($p < 0.05$) higher than 30/30. However, no significant difference was observed between 20/20 and 30/30 groups. No significant differences were found among all the dietary treatments in TDN values. The finding of this study was in accordance with Al-Owaimer *et al.* (2011), who did not find any significant difference in TDN but it was in disagreement with their results with regard to DCP which increased significantly with increased percentage of date pits in lamb diets. However, The DCP and TDN obtained in the current study was higher than the result of Mahmoud and

El-Bana (2013), who reported that the DCP and TDN were 4.81 and 46.33, respectively, when camels were fed on diet with 34% palm leaves.

CONCLUSION

The finding of this study showed that date pits and palm leaves can be fed to Ardi goats with no detrimental effect on nutrient intakes and digestibility. Date palm leaves and date pits could be suitable from now on as an economic perspective due to their low prices and large availability, although the costs of the other supplements may compensate the benefit of these two feeds. The low nutrient value of palm leaves can be improved by chemical treatment such as urea, which is used widely in many countries. Such treatment generally increased both the rate and extent of fiber digestion in the rumen which benefits the animal by increasing both energy value and feed intake. Treatment of palm leaves will thus not only increase fiber digestibility but has also a beneficial effect on nitrogen metabolism.

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