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Feeding Value and *in vitro* Digestibility of Date-Palm Leaves Supplemented with Different Supplementary Energy

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Abstract: The aim of this study was to evaluate the feeding value and also the effect of different supplementary energy on increasing *in vitro* DM digestibility of date-palms leaves obtained in pruning. A randomized complete design with different energy supplementary with 3 replicates was conducted. Harvested date-palm leaves were air-dried, ground through a 5 mm screen, then palm leaves (L) ensiled with different levels of urea (U) and other supplementary energy. Combination, mixture was packed tightly in 21 (10 L) plastic containers. The containers were opened after a fermentation of 60 days. Treatments consisting: L (Palm leaves)+5% U (urea) (T_1), L+5% U+5% BP (Beet pulp) (T_2), L+5% U+10% BP (T_3), L+5% U+5% M (Molasses) (T_4), L+5% U+10% M (T_5), L+5% U+5% CP (Citrus pulp) (T_6) and L+%5 U+10% CP (T_7). The results of this experiment showed that supplementation of date-palm leaves with energy supplements significantly ($p<0.05$) increased IVDMD and T_5 had higher digestibility than those of the other treatments. ADF content of silage was not affected by dietary treatments. However, NDF content was significantly ($p<0.05$) affected by treatments and T_2 and T_6 had higher NDF content compared with the other treatments. Supplementation of palm leaves with energy supplementary had no significant effect ($p>0.05$) on Crude Protein (CP) content of silages. However, these supplements had a significant effect ($p<0.05$) on calcium and phosphorus levels of silage materials and T_7 had higher Ca and P content compared with the other treatments. In conclusion, supplementation of date-palm leaves with energy supplements can improve IVDMD and feeding value of this feed source.

Key words: Date palm, feeding value, *In vitro* digestibility, palm leaves, sheep

INTRODUCTION

Recently, energy supplements cost has been increased considerably due to the raise of feeds demand to animals. The enhancement in feed price encouraged nutritionists to search for cheaper high-energy feed ingredients (Al-Dabeeb, 2005). Semi-arid and arid regions characterized by low rainfall have a low primary production and forage quality. Under these environment, it is convenient to use foliage from trees and shrubs as an adequate source of food for small ruminants (Pascual *et al*., 2000). Date-palm (*Phoenix dactilifera*) dominates the vegetation on several million hectares of rangeland in semi-arid and arid regions of the world. In Iran there are more than 26 million date palm trees which most of them are in Banı, a city located in Southeast of Kerman Province, in Iran. The date production in Iran in average is about 20 kg tree^{-1}, although, many varieties may produce more than 125 kg tree^{-1}. Like in other industries, production of dates in Iran leaves behind a sizable amount of by-products in the form of discarded dates and date pits, which these are not suitable for packing (Al-Dabeeb 2005). These could be used to feed animals with high-energy supplements (Al-Dabeeb 2005). Dates could be used as an energy source to replace a part of the concentrates in the ration. Energy level and source in the diet affect the animal performance and feed utilization (Al-Dabeeb, 2005). The level of energy supplementation in the diet depends on animal species, climatic condition and productive performance, etc., (Higginbothanı and Bath, 1993; Al-Dabeeb, 2005). Rumen microorganisms are also affected by the dietary energy source and level (Al-Dabeeb, 2005). In addition of the discarded dates, the results of some experiments showed the date palm leaves can be used in ruminant nutrition. A date-palm annually produces approximately 20 kg of leaves. However, with respect to their possible utilization, existing information concerning voluntary intake and nutritive value of date-palm leaves in ruminants are scarce (El-Din and Tag-El-Din, 1996; cited in Pascual *et al*., 2000); Bahman *et al*. (1997) suggested that date-palm leaves might be an acceptable alternative to barley straw in highly concentrated diets for dairy cows, despite their low nutritive value. Therefore, the aim of this study was to evaluate the feeding value and also investigation the

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effect of different supplementary energy on increasing *in vitro* DM digestibility of date-palms leaves obtained in pruning.

MATERIALS AND METHODS

Treatments and experimental design: The experiment carried out at Horticultural Research Centre of Shahid Bahonar University of Kerman, Iran. Date-palm leaves were given by the Agricultural Research Centre in Southeast of Kerman Province in Iran and were obtained from the Bam Horticultural Research Centre Date-Palm Garden. The date-palm leaves were separated from the palm and cut with a forage grinder to 5 cm length. Harvested date-palm leaves were air-dried, ground through a 5 mm screen, then palm leaves (L) ensiled with different levels of urea (U) and other supplementary energy as a randomized complete design consisting experimental treatments: L (palm-leaves) +5% U (urea) (T_1) (control group), L+5% U+5% BP(Beet pulp) (T_2), L+5% U+10% BP (T_3), L+5% U+5% M(Molasses) (T_4), L+5% U+10% M (T_5), L+5% U+5% CP (Citrus pulp) (T_6) and L+%5 U+10% CP (T_7) to improve feeding value and digestibility of this source. Combination, mixture was packed tightly in 21 (10 L) plastic containers with 3 replicates per combination. The containers were opened after a fermentation of 60 days. Silage samples and date-palm leaves were dried at 65°C and ground (1 mm) and analyzed for DM and CP by procedure of AOAC (2006). Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) contents were measured according to the procedure of Van Soest *et al*., (1991). *In vitro* dry matter digestibility (IVDMD) of silages were determined according to the procedure (Denek and Can, 2006). Ruminal fluid inoculum was obtained from a rumen fistulated cow given alfalfa hay *ad libitum*.

Data analysis: Treatments in this experiment were arranged as a randomized complete design with different energy supplementary with 3 replicates. Data were subjected to an Analysis of Variance using the General Linear Model command in the statistical package MINITAB (McKenzie and Goldman, 2005). The means were compared using Tukey-test. The statistical model used for the analysis of dependent variables was:

$$Y_{ijklm} = \mu + T_i + B_r + e_{ijklm}$$

where, Y_{ijklm} was the individual observation, μ was the experimental mean, T_i was the treatment effect, B_r was the replicate effect and e_{ijklm} was the random error.

RESULTS

The chemical composition of date-palm leaves and energy supplements and results of this experiment are shown in Table 1-3 respectively. As can be seen from Table 2, supplementation of date-palm leaves containing 92.0% DM with energy supplements significantly ($p<0.05$) increased IVDMD and T_5 had higher digestibility than those of the other treatments. ADF content of silages were not affected by dietary treatments. However, NDF content was significantly ($p<0.05$) affected by treatments and T_2 and T_6 had higher NDF content compared with the other treatments. Supplementation of palm leaves (6.0% CP) with energy supplementary had no significant effect ($p>0.05$) on Crude Protein (CP) content of silages. However, these supplements had a significant effect ($p<0.05$) on calcium and phosphorus levels of silage materials and T_7 had higher Ca and P content compared with the other treatments (Table 3) which can be attribute to the citrus pulp which has high Ca content. Unfortunately, in this regard there was no more information to discuss the case.

Table 1: Chemical composition and energy content of date-palm leaves, citrus and beet pulp

Variables	DM (g kg^{-1})	CP (g kg^{-1})	Ca (g kg^{-1})	P (g kg^{-1})
Palm leaves	930	16.5	-	-
Citrus pulp	203	64.0	11.9	5.7
Beet pulp	900	90.0	6.8	1.0

Table 2: *In vitro* dry matter digestibility (IVDMD), NDF and ADF (%) of palm leaves supplemented with different supplementary energy

	Treatruents								
Feeding values	L+5%U	L+5% U+5%BP	L+5% U+10%BP	L+5% U+5%M	L+5% U+10%M	L+5% U+5%CP	L+5% U+10%CP	SE	p-value
IVDMD	9.8^a	9.3^a	11.7^a	14.3^b	16.0^b	10.10^a	10.0^a	0.08	0.015
NDF	79.6^a	85.3^b	73.2^a	80.6^a	76.6^a	81.60^b	77.4^a	0.20	0.020
ADF	37.3^a	36.1^a	42.2^a	39.0^a	42.0^a	37.70^a	30.5^a	0.04	0.445

L: Palm leaves, U: Urea, BP: Beet pulp, M: Molasses, CP: Citrus pulp. ^{a,b}Means having different letters within row are significant at $p<0.05$

Table 3: Crude protein, calcium and phosphorus levels (%) of palm leaves supplemented with different supplementary energy

	Treatruents								
Contents	L+5%U	L+5% U+5%BP	L+5% U+10%BP	L+5% U+5%M	L+5% U+10%M	L+5% U+5%CP	L+5% U+10%CP	SE	p-value
CP	7.80^a	9.00^a	8.30^a	8.20^a	7.60^a	7.40^a	9.30^a	0.010	0.429
Ca	0.40^a	0.30^b	0.40^a	0.40^a	0.40^a	0.40^a	0.50^a	0.004	0.040
P	0.05^a	0.04^a	0.05^a	0.04^a	0.04^a	0.05^a	0.06^b	0.004	0.002

L: Palm leaves, U: Urea, BP: Beet pulp, M: Molasses, CP: Citrus pulp. ^{a,b}Means having different letters within row are significant at $p<0.05$

DISCUSSION

In the current experiment the highest IVDMD of date-palm leaves was 16% which is still low which can be explained by this fact that this feed source containing high cellulose, hemi-cellulose and lignin content. Although, there is scarce information in this regards in the literature, Obese *et al.* (2001) reported higher IVDMD for Palm Press Fibre (PPF) treated with NaOH. The significant improvement in both the IVDMD and the IVOMD of PPF following treatment with 5% NaOH may be attributed to the breaking of intermolecular ester linkages in the PPF by the NaOH. The action of NaOH, hydrolyzing intermolecular ester linkages, solubilizing hemicellulose and causing cellulose microfibrils to swell, enhances the penetration of ruminal microbes and increases the extent and rate of cellulose and hemicellulose digestion (Obese *et al.*, 2001; Lesoing *et al.*, 1981 Chaudhry and Miller, 1996; Chaudhry, 1997). The formation of an indigestible soap that might have affected the ability of the ruminal microbes to digest date-palm leaves probably accounts for the relatively small improvement in the digestibility of this source and also the different methods of treatments may account for the differences in IVDMD of date-palm leaves. With regard to the digestibility of date-palm leaves in goats, Pascual *et al.* (2000) reported 48.65% for the apparent digestibility coefficients of date-palm fractions which were similar to those shown for sheep by Pascual *et al.* (2000), but their results were slightly low for DM (41 vs. 43.6-53.9%). These differences could be ascribed to chemical composition differences in date-palm leaves. In current experiment NDF content of supplemented date-palm leaves differed from 73.2 to 85.1% which is higher than those of Pascual *et al.* (2000) who reported 544.3NDF g kg^{-1} DM for palm-leaflets which can attributed to processing method and material used. However, present ADF results concur with those of his report (400.7ADF g kg^{-1} DM for palm-leaflets). Supplementation of palm leaves with energy supplementary had no significant effect on Crude Protein (CP) content of silages. Pascual *et al.* (2000) reported 6.4 CP (g kg^{-1} DM) for untreated date-pal leaves. In current experiment the highest CP content was observed in T_7 (9.3% CP) which means supplementation of date-palm leaves with energy supplementary can improve CP content of this source. Energy supplements increased calcium and phosphorus content of silage containing 5% urea and 10% citrus pulp and this silage had higher Ca and P content compared with the other treatments. It is clear that urea has no Ca and P content and increasing in Ca and P content of silage containing 10% citrus pulp can be attributed to the citrus pulp which has higher Ca content. Unfortunately, in this regard there was no more information in the literature to discuss the case.

Based on the data from this experiment, supplementation of date-palm leaves with energy supplements significantly increased the IVDMD from 9.3 to 16% in treatment containing 5% urea and 10% molasses, these supplements had no significant effect on ADF and CP content of silages. However, supplementation of date-palm leaves with energy supplements increased NDF and Ca and P in treatment containing 5% urea and 10% citrus pulp compared with the other treatments. Therefore, it was concluded that supplementation of date-palm leaves with energy supplements can improve IVDMD of this feed source, (although it was not considerable, maybe due to high fibre content) and feeding value. This feedstuff can be used as roughage for animals during the insufficiency periods of roughages, although further research into appropriate feed processing methods are required to increase its digestibility for efficient use as ruminant feed.

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