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Nutritive value of by-product from dates for use in animal feed

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Abstract. In date packing and processing operations a number of by-products become available, therefore they should be used to improve the economics of the operation as a whole and to decrease disposal problems and costs. The main byproducts of date industry are cull dates and date pits from packing operations, and pits and press cakes from date processing. This study aims to evaluate the chemical composition and in vitro dry matter (DM) digestibility of pits, cull date and infested date for incorporation in animal feed and to evaluate the effect of tannins on *in vitro* fermentation through the use of tannin biding polyethylene glycol (PEG). The statistical results revealed a highly significant difference between by-products. Pits presented relatively high content of crude fiber (37.72% DM), crude protein (8.87% DM), and fat (6.29% DM) but low in vitro DM digestibility (22.78%). However cull date and infested dates had a high digestibility (87-89%). They were relatively high in carbohydrates but poor in crude protein (4.48-4.73% DM) and fat (0.42-0.45% DM). Because of their high carbohydrate content and relatively low fiber, cull and infested dates have a high energy value, as high as that of barley grain.

Keywords. Date –Tannins – In vitro fermentation – PEG.

Valeur nutritive des sous-produits de dattes pour l'alimentation du bétail

Résumé. *Lors du conditionnement et de l'emballage des dattes destinées à l'exportation, des quantités importantes de déchets et de sous produits sont obtenues et constituent une charge couteuse pour leur élimination. Ces déchets pourraient être valorisés par le bétail et constituer une source d'alimentation non négligeable. Cette étude vise à évaluer la composition chimique et la digestibilité* in vitro *des pédicelles, des noyaux, des dates infestées, des dates fermentées et des dates sèches et l'effet des tanins sur la fermentation* in vitro*. Les résultats statistiques ont révélé une différence hautement significative entre les différents types de déchets de dattes. Les noyaux ont présenté une teneur relativement élevée en cellulose brute (37,72% MS), protéines brutes (8,87% MS) et en matières grasses (6,29% MS), mais une faible digestibilité de la MS* in vitro *(22,78%). Les dattes infestées, fermentées et sèches étaient relativement riches en sucres totaux, très digestibles (87-89%), mais pauvres en protéines brutes (4,48 à 4,73% MS) et en matière grasse (de 0,42 à 0,45 % de MS). En raison de leur richesse en sucres et leur faible teneur en cellulose, ces différents types de dattes déclassées présentent une valeur énergétique comparable à celle de l'orge grain.*

Mots-clés. *Dattes – Tanins – Fermentation* in vitro *– PEG.*

I – Introduction

Date palm (*Phoenix dactylifera* L.) is one of the most important fruit tree growing in desert areas (Ramawat, 2010). The date palm industry produces fresh and dried dates, whole dates and pitted (stoned) dates, date paste, date syrup, and date wine with important quantity of by-products. Date by-products include cull dates, immature dates, date pedicels, date seeds, date press cake and date molasses. In the south of Tunisia, trade of wasted dates and stones is widespread on local markets and most of livestock owners use date by-products for feeding livestock (Genin *et al.*, 2004). This study aims to evaluate the chemical composition and in vitro dry matter (DM) di-

gestibility of pedicels, pits, fermented, infested and dry dates for incorporation in animal feed and to evaluate the effect of tannins on *in vitro* fermentation through the use of tannin biding polyethylene glycol (PEG).

II – Material and methods

Date by-products were obtained from a Tunisian factory (Boudjbel SA VACPA) for processing and exporting Tunisian dates mainly the Deglet Nour variety. Samples were dried in a forced-air oven (60°C) and ground to pass a 1-mm screen in a Wiley Mill. Nitrogen content was measured by the Kjeldahl method and crude protein (CP) was calculated as N×6.25. Total sugar (TS) was determined following the procedure of Dubois et al. (1956). Phenolic compounds were extracted in an ultra-sound bath with 10 ml of aqueous acetone solution (Makkar, 2003). Total phenols (TP) and total tannins (TT) were determined by adding 0.25 ml Folin-Ciocalteau reagent (2 N) and 1.25 ml sodium carbonate solution (200 g Na_2CO_3 l^{-1}) to an aliquot of the supernatant and absorbance readings at 725 nm. The concentrations of TP and TT were calculated as tannic acid equivalents.

Ruminal contents were collected from three ruminally fistulated rams weighing 47 ± 3 kg and fed twice daily with a total mixed ration containing 60% oat hay and 40% concentrate (consisting of 75% barley, 23% soybean meal, 1% vitamin and mineral mixture, 0.6% calcium carbonate and 0.4% salt).

The in vitro dry matter digestibility (DMD) was determined following the procedure of Tilley and Terry (1963). Cellulase was from *T. V**iride*** and pepsin was obtained from porcine stomach mucosa. The incubation inoculum was prepared by diluting the digesta inoculum with the artificial saliva (Tilley and Terry, 1963) in a 1:4 (vol/vol). Samples (0.5 g DM) of pedicels, pits, fermented, infested and dry dates were incubated into plastic tubes (six replicates for each) with 20 ml of the incubation inoculum for 48 h at 39°C. After 48 h incubation, tube contents were acidified by adding 6 M HCl to reach a final pH of 1.3-1.5 and pepsin was added to a final concentration of 0.2% (wt/vol). After 48 h of incubation, the tubes were centrifuged at 2500×g for 15 min, and the supernatant was discarded. A quantity of 50 ml of water was added to the pellet and the tubes were centrifuged to wash out the residual acid and dried in a forced-air oven at 60°C for 48 h to determine the residual DM weight. In vitro DMD was calculated as the DM which disappeared from the initial weight incubated into the tubes.

The in vitro fermentation and tannin activity were determined using the method of Menke and Steingass (1988). Samples (200 mg) with and without PEG (200 mg) were weighed into 100 ml glass syringes and incubated at 39°C for 48 hours. *In vitro* incubation of the samples was conducted in triplicate and three syringes without substrate (blanks) were included as a laboratory controls. The syringes were hand shaken frequently and the volume of gas produced was recorded after 48 h of incubation. The ME values of the by-product were calculated as follows: ME (MJ / Kg DM) = 2.20 + 0.136 Gp + 0.057 CP (Menke and Steingass, 1988).

Data were analyzed by SAS (SAS, 2002) using the general linear models procedure as a completely randomized design. Statistical differences between the five date palm by-products were determined using Turkey's test. Mean differences were considered significant at $P<0.05$.

III – Results and discussion

The results of chemical analyses of the date by-products (pedicel, pit, fermented, infested and dry fruits) are shown in Table 1. They show that date by-product samples had different chemical compositions. Infested and fermented dates had lower CP contents compared with pits and dry dates. Pits had the highest CF and EE values ($P < 0.05$), however they contained as much PT and TT as pedicels ($P > 0.05$), but more ($P < 0.05$) TS and EE than pedicels, and the difference was particularly pronounced for EE with pedicels having about one-third of the EE content of pits. The

three wasted dates, infested, fermented and dry fruits, had different CP, TS and TP concentrations ($P < 0.05$), with fermented date being highest in TS and lowest in TP. All date by-product had low CP contents (<9%) as found in literature; Al-Showiman et al. (1990) found that the percentage of protein ranged from 4.79 to 7.50% in date pits from seven varieties from Saudi Arabia. Lower values (<7%) were reported for date palm by-product of Deglet Nour variety (Genin *et al.,* 2004).

Table 1. Chemical analysis (DM basis) of date palm by-products

Date by-products	DM	OM*	Ash*	CP*	CF*	EE*	TS**	TP**	TT**
Pedicels	816.9	946.8 d	50.4 a	50.6 bc	317.9 b	13.4 b	68.9d	17.5 a	15.9a
Pits	858.8	985.9 a	14.1 e	88.7 a	377.2 a	62.9 a	149.3c	17.9 a	14.6 a
Infested date	868.2	975.7 b	24.2 d	44.8 c	38.9 c	4.5 c	147.3c	14.3 b	9.9b
Fermented date	781.1	971.9 b	28.1 c	47.3 c	54.1 c	4.6 c	517.1a	9.6 c	9.5 b
Dry date	828.8	964.2 c	35.7 b	64.9 b	67.5 c	4.1 c	279.2b	14.1 b	10.7 b
SEM	*23.07*	*0.70*	*0.26*	*6.95*	*26.99*	*0.97*	*30.1*	*1.63*	*1.63*
Probability	*0.2507*	*0.0001*	*0.0001*	*0.0002*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0002*

*In g/kg DM: DM, dry matter; OM, organic matter; CP, crude protein; CF, crude fibre; EE, ether extract; **In mg/100 g DM: TS: total sugar; TP: Total phenol; TT: total tannin; SEM, mean standard error. Means within the same column with differing superscripts (a-c) are significantly different at P<0.05.

Table 2 shows DMD, ME and in vitro gas production of date by product samples. Data showed high DMD (68.37-89.85%) and in vitro gas production with PEG (22.92-30.75 ml/200 mg DM) and without (22.44-25.56 ml/200 mg DM) for wasted fruits. These results fit with those reported by Genin *et al*. (2004) who mentioned higher in vitro DMD of wasted dates in respect to other date palm by-products. Metabolisable energy was estimated to be lower for pedicels and pits. This finding could be attributed to the higher CF, TP and TT contents. The increase in gas production with PEG emphasizes the negative effect tannins may have on digestibility of pits. This improvement was possibly due to an increase in the available nutrients to rumen micro-organisms, especially the available nitrogen. Tannins might form a less digestible complex with dietary proteins and might bind and inhibit the endogenous protein, such as digestive enzymes (Kumar and Singh 1984).

Table 2. Dry matter digestibility (%), gas production (ml/200 mg DM), and metabolisable energy (ME, Kcal/kg DM) of date by-products

	DMD (%)	ME (Kcal/kgDM)	Gas 48 h ml/200 mg DM	
			- PEG	+ PEG
Pedicels	51.56 c	4680	15.13 c	16.17 c
Pits	22.79 d	3570	6.46 dB	13.33 cA
Infested fruits	89.85 a	5990	24.48 b	26.01 ab
Fermented fruits	87.94 a	5940	25.56 ab	30.75 a
Dry fruits	68.37 b	5460	22.44 b	22.92 b
SEM	*2.87*	*nd*	*0.99*	*1.08*
Probability	*0.0001*	*0.0001*	*0.0001*	*0.0001*

Means with differing superscripts are significantly different (P < 0.05) within the same column (a-c) and row (A,B) for gas production with and without PEG.

The date palm by-product examined in this study showed a great variation in chemical composition, in vitro degradation and in vitro fermentation. Similar trends have been reported in literature (Al-Farsi *et al.*, 2007).

IV – Conclusion

Because of their high sugar content and relatively low fiber, wasted dates (infested, fermented and dry dates) are highly digestible and have a high energy value, as high as that of barley grain. However, protein supplementation is required when wasted dates are included in the diet of ruminants.

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