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Chemical composition and fatty acid profiles of some local forage resources in southern Tunisia

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Abstract. In arid areas, livestock feed is based on the use of rangelands and other local feeds harvested and dry range species and weeds as natural hay locally called "khortane". Other resources are commonly used such as dried *Stipa tenacissima* L. and dried olive leaves. The aim of this study was to evaluate chemical and fatty acid composition of local feeds (khortane*, S. tenacissima* and dried olive leaves and oat hay). A large variability in chemical composition was observed among the different feeds. Crude protein content was higher in khortane (12.17% DM). *S. tenacissima* had the highest NDF content (P<0.05). The results obtained for the fatty acids composition showed that the highest polyunsaturated fatty acids and monounsaturated fatty acids content were observed in khortane (7.64 and 47.7% respectively). The saturated fatty acids content was higher *(P<0.05)* in *S. tenacisima* followed by dried olive leaves, oat hay and khortane (67.09, 57.19, 45.99 and 44.66% respectively). The omega-3 was significantly higher (P<0.05) in the khortane (24.33%) compared to oat hay, dried olive leaves and *S. tenacissima* (12.51, 12.49 and 10.25% respectively) because it is rich in pastoral species.

Keywords. Arid area – Local resources – Chemical composition – Fatty acids.

Composition chimique et profils en acide gras de quelques ressources fourragères dans les zones arides de Sud-Tunisien

Résumé. *Dans les zones arides, l'alimentation du bétail, est basée sur l'utilisation de la végétation des parcours pâturée ou par la récolte des espèces spontanées séchées sous forme de foin localement appelé le « khortane ». D'autres aliments de récolte sont couramment utilisés, tels que les feuilles d'olivier séchées et le* Stipa tenacissima*. L'objectif de ce travail était d'évaluer la composition chimique et le profil en acides gras de quelques ressources locales (khortane,* S. tenacissima*, feuilles d'olivier séchées et le foin d'avoine).* Les *fourrages analysés* présentaient une *grande variabilité de composition chimique. La teneur en matières azotées totales était supérieure dans le khortane (12,17% MS). Les teneurs en NDF étaient les plus élevées dans* S. tenacissima*. Les résultats obtenus sur la composition en acides gras ont montré que le khortane avait les plus fortes concentrations en acides gras polyinsaturés et mono-insaturés (7,64 et 47,7% respectivement). La teneur en acides gras saturés était plus élevée chez* S. tenacissima *(67,09%) comparé aux feuilles d'olivier (57,19%), au foin d'avoine (45,99%) et au khortane (44,66%). Les oméga-3 étaient significativement plus élevés dans le khortane (24,33%) que pour le foin d'avoine (12,51%), les feuilles d'olivier séchées (12,49%) et* S. tenacissima *(10,25%) parce qu'il est riche en espèces pastorales (2,33, 12,51, 12,49 et 10,25% respectivement pour le khortane).*

Mots-clés. *Zone aride – Les ressources locales – La composition chimique – Les acides gras.*

I – Introduction

In arid areas, ruminants depend mainly on pasture and grain cereals. Because the high feed prices in the market, it is difficult to provide enough grain to feed the animals. Other feed resources are used to maintain the production of ruminants such as hay of natural grass (khortane), oat or alfalfa, agricultural by-products (cereal bran and straw, dried olive and fig leaves, olive cakes, wasted palm dates and stones) and harvested *S. tenacissima* (Visser *et al.*, 2002). These feeds

may contain variable amounts of fat and polyunsaturated (PUFA). Diets based on pasture can improve the nutritional quality of milk and meat by shifting their fatty acids (FA) composition toward less saturated FA and more PUFA, especially omega-3 (Dewhurst *et al.*, 2006). Recently, much effort has been made to study the fatty acid (FA) profile of forage in relation to meat and milk quality with regard to potential health aspects. Most studies on the FA composition of individual species were carried out on legume species (Dewhurst *et al*., 2001; Elgersma *et al*., 2003). Data on alternative forage species are scarce. The pastoral resources are an important part of the diet of ruminants producing milk and meat. The aim of this study was to determine the chemical and fatty acid composition of some feeds used in Tunisia.

II – Material and methods

Feedstuffs used in the study were: oat hay, khortane, dried *S. tenacissma* and dried olive leaves. Oat hay was purchased in the market. *S. tenacissima* L, was hand-harvested on native rangelands from the Benikdeche Mountains (South-East Tunisia) during the late growing period (April), air-dried, stored in a dry area and then used in periods of drought. Khortane was harvested during the spring season from Djefera region. It was composed of several annual and perennial species of which the most representative were *Launaea resedifolia* (44%) and *Lolium multiflorum* (30%) on specific contribution basis. Dried olive leaves were supplied from the neighbouring private farmers.

Forages dried at 60°C were ground to 1-mm screen size to determine the chemical composition. The ash content was determined by incinerating samples in a furnace at 600°C for 6 h and crude protein (CP) was determined by Kjeldahl method (AOAC, 1190). Analysis of neutral and acid detergent fiber (NDF, ADF) was done according to the method described by Goering and Van Soest (1970).

The fatty acid composition was determined after extraction by the method of Folch *et al.*, (1957). Methylation was carried out according to the method of Chin *et al.*, (1992).

1. Statistical analysis

Data were statistically analysed by ANOVA (SPSS, 11.5) to determine the effect of feed types (oat hay, khortane, dried *S. tenacissma* and dried olive leaves) on the chemical composition and fatty acid profile. Statistical significance of the difference between feeds was tested using Duncan's new multiple range test (α = 5%).

III – Results and discussion

1. Chemical composition

The chemical composition showed differences ($P<0.05$) in nutrient content between feeds (Table 1).The DM content of khortane was high, which can be explained by the late stage of maturity of the foliages at the time of collection. The ash content ranged from 2.93% DM in *S. tenacissima* to 11.40% DM in oat hay. The CP content (% DM) ranged from 5.39 in *S. tenacissima* to 12.17 in khortane. The CP content in oat hay was comparable (6% DM) to the value in tables (Jarrige, 1988). In the case of khortane, floristic composition influences the chemical composition. The increase of Leguminosae and Compositae families proportion increase the CP content (Ayeb, 2009). The CP content of *S. tenacissima* was in the range of values observed by Genin *et al.*, (2007). CP content obtained in olive leaves was between the values (77-105 g/kg DM) recorded by Moujahed *et al.* (2000). The CP content in forage was related both to the presence of leaves and to the stage of cutting. Among the forages measured, we can assume that khortane has the

advantage of supplying to the animal a diet rich in CP. Therefore, these feed types could be associated with a feed of low nitrogen content, such as straw, *S. tenacissima* and oat hay, to improve the level of CP in the diet.

The NDF and ADF content were different (P<0.05) among the forages. They tend to be higher in *S. tenacissima* followed by oat hay, khortane and dried olive leaves (Table 2). In oat hay, NDF and ADF content in the present study was lower than the value (75.7 and 48.1% DM) observed by Moujahed *et al.* (2011). The NDF and ADF values for *S. tenacissima* were higher than those reported by Laudadio *et al.* (2009) (74.6 and 47.2% DM). In dried olive leaves, ADF content was higher than the values 29.9% DM reported by Moujahed *et al.* (2000).

Table 1. Chemical composition of the used feeds (% DM)

Feeds	Khortane (n = 6)	*S. tenacissima* (n = 5)	Dried olive leaves (n = 6)	Oat hay (n = 4)	*P*
DM (% FM)	88.86 ^{bc}	92.51 ^{a}	87.25 ^{c}	90.04 ^{b}	<0.0001
Ash	11.34 ^{a}	2.93 ^{b}	11.32 ^{a}	11.40 ^{a}	<0.0001
CP	12.17 ^{a}	5.39 ^{c}	8.80 ^{b}	6.60 ^{bc}	<0.0001
NDF_{mo}	53.06 ^{c}	73.99 ^{a}	31.03 ^{d}	57.71 ^{b}	<0.0001
ADF_{mo}	29.32 ^{c}	55.51 ^{a}	30.35 ^{c}	42.72 ^{b}	<0.0001
CUD_{mo}	59.87 ^{a}	33.98 ^{b}	59.84 ^{a}	55.10 ^{a}	<0.0001

DM, dry matter (en % of fresh matter; CP, crude protein; NDF, neutral detergent fibre; ADF, acid detergent fibre.

Table 2. Fatty acids composition (% fatty acids methyl ester) of studied forages

Fatty acids	Khortane (n = 7)	*S. tenacissima* (n = 8)	Dried olive leaves (n = 8)	Oat hay (n = 8)	SEM	P
C16 :0	26.68 ^{b}	20.48 ^{c}	32.98 ^{a}	30.35 ^{ab}	0.08	<0.0001
C18 :0	4.09 ^{b}	6.08 ^{a}	6.43 ^{a}	5.47 ^{a}	0.26	0.0083
C18 : 1	6.94 ^{b}	6.43 ^{b}	17.36 ^{a}	16.17 ^{a}	1.12	<0.0001
C18:2	20.50 ^{a}	11.20 ^{b}	9.84 ^{c}	21.00 ^{a}	1.37	0.0006
C18:3	24.33 ^{a}	10.25 ^{b}	12.49 ^{b}	12.51 ^{b}	1.07	<0.0001
C22 :0	4.89 ^{a}	4.49 ^{a}	2.16 ^{b}	2.99 ^{b}	0.25	<0.0001
C20:5	2.87 ^{b}	4.50 ^{a}	2.38 ^{b}	3.01 ^{b}	0.23	0.0027
C24 :0	3.24 ^{c}	24.17 ^{a}	5.58 ^{b}	1.27 ^{c}	1.72	<0.0001
SFA	44.66 ^{c}	67.09 ^{a}	57.19 ^{b}	45.99 ^{c}	2.06	<0.0001
MUFA	7.64 ^{b}	6.96 ^{b}	18.01 ^{a}	17.05 ^{a}	1.18	<0.0001
PUFA	47.07 ^{a}	25.95 ^{c}	24.71 ^{c}	36.52 ^{b}	1.91	<0.0001

SEM: Standard error of mean.

a,b: Means in the same line with different superscripts are significantly different (P < 0.05).

SFA: saturated fatty acids; PUFA: polyunsaturated fatty acids; MUFA: monounsaturated fatty acids.

2. Fatty acid composition

All feeds have a significantly different (P<0.05) FA composition (Table 2). Saturated fatty acids (C16:0; C18:0; C 22:0 and C 24:0) were higher in *S. tenacissima* than other feeds. The values of C18:1 were higher in dried olive leaves. However, Conte *et al.* (2010) reported that the oleic acid (C18:1) was largely predominant in olive by- products. The highest (P<0.0001) concentrations of PUFA, particularly C18:3, were observed in khortane, which can be explainedby it's composition of grass. French *et al.* (2000) showed that the grass accumulate higher levels of n-3 fatty acid

and PUFA and lower AGS. Also, The forage with high amounts of PUFA, particularly C18:3, are searched in diet of animals. Moreover, the linolenic acid content in forage increases the content of omega-3 fatty acids in animal products (Wyss *et al.*, 2006).

VI – Conclusion

It could be concluded that the chemical composition of used feeds is diversified; some of them is rich in CP and others are rich in FA. Diets with forage-rich pastoral species, showed a clear advantage in terms of PUFA, which have very positive impact on human health.

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