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Nutritive value of green chopped alfalfa and sorghum in Tunisia

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Abstract. In Tunisia, oats harvested as hay or silage is the forage the mostly used to feed cattle. Because of climatic conditions, it is generally cut at a period where its feeding value is low. The use of other green chopped forages in irrigated small farms could be an interesting alternative to provide good quality forage. The objective of the work was to study the nutritive value of alfalfa and sorghum at different vegetative stages. Six digestion trials were conducted using 10 Noire de Thibar breed sheep. Digestibility parameters were determined for 3 stages for alfalfa (bud, early bloom, late bloom) for 3 stages for sorghum (late vegetative, early bloom, dough). For each trial, the forage was fed *ad libitum* for 14 day adaptation and preliminary period and at 90% of maximum intake during a 7 day collection period. CP content of alfalfa were very high varying from 25.18% for bud stage to 16.8% for late bloom; where as the CP contents of sorghum were low varying from 9.25% for late vegetative stage to 5.2% for dough stage. Condensed tannin content was lower for the late vegetative (0.84 g/kg DM) compared to early bloom stage (1.1 g/kg DM) for sorghum. DM, OM, CF, NDF, ADF and CP digestibilities were different between the 3 stages for both forages.

Keyword. Summer forage – Nitrogen – Tannins – Digestibility.

Valeur nutritive de la luzerne et du sorgho cultivés en vert en Tunisie

Résumé. *En Tunisie, l'avoine exploitée sous forme de foin ou d'ensilage est la culture la plus prédominante dans l'alimentation du bétail. Néanmoins à cause des conditions climatiques elle est coupée à un stade caractérisé par une faible valeur nutritionnelle. L'utilisation d'autres fourrages exploités en vert et cultivés dans les périmètres irrigués des petites exploitations pourrait présenter une alternative intéressante pour l'obtention de fourrages de bonne qualité. L'objectif de notre travail était d'étudier la valeur nutritive de la luzerne et du sorgho à différents stades végétatifs. Six essais de digestibilité ont été conduits en utilisant 10 moutons de la race Noire de Thibar. L'ingestion et les paramètres de digestibilité ont été déterminés sur 3 stades pour la luzerne (bourgeonnement, début floraison, formation de gousses) et 3 stades pour le sorgho (montaison, début épiaison, grain pâteux). Pour chaque essai le fourrage a été distribué* ad libitum *pour les 14 jours d'adaptation et la période préliminaire et 90% de l'ingestion maximale pendant les 7 jours de la période de collecte. Le contenu en PB de la luzerne était très élevé variant de 25,18% pour le stade bourgeonnement à 16,8% pour le stade formation de gousses ; par contre le contenu en PB du sorgho était très faible variant de 9,25% pour le stade montaison à 5,2% au stade grain pâteux. Le contenu en tannins condensés pour le sorgho était moindre au stade montaison (0,84 g/kg MS) comparé au stade début épiaison (1,1 g/kg MS). Les digestibilités de la MS, MO, CB, NDF, ADF et PB des deux fourrages étaient différentes pour les 3 stades de coupe.*

Mots-clés. *Fourrages d'été – Azote – Tannins – Digestibilité.*

I – Introduction

In Tunisia, cultivated crops are limited in quantity and quality, oats harvested as hay or silage is the forage the most used to feed cattle. Because of climatic conditions characterized by cool, wet winters and summer drought, it is generally cut at a period where its feeding value is low. The use of other green chopped forages in irrigated small farms could be an interesting alternative to provide good quality forage. Nutritive value of forage depends enormously on pedo-climatic

conditions and stage of maturity. In summer, many forages are cultivated in irrigated small farms mainly alfalfa for nitrogen supply and sorghum for energy supply. The association of the two forages permits to have better balanced rations. The objective of this work was to study their nutritive value at different vegetative stages.

II – Materials and methods

Six digestion trials were conducted to determine the digestibility of 3 stages of alfalfa (bud, early bloom and late bloom) and 3 stages of sorghum (late vegetative, early bloom and dough). These trials were conducted at Institut Supérieur Agronomique in Tunisia between June and October 2008 using 10 Noire de Thibar breed sheep (average weight: 32.3 kg). For each trial the forage was fed *ad libitum* to 5 animals for 14-d adaptation and preliminary periods and at 90% of maximum intake during 7-d total collection period. Daily feed intake and faecal output were recorded during the 7-day collection period. Samples of feeds offered and refused and one-tenth by weight faecal output were taken daily in plastic bags. Samples were stored at −20 C. Urine was collected from each sheep in 10-l capacity plastic container over 100 ml of 0.1 sulphuric acid solution to maintain pH below 3.0. The volume of urine excreted was recorded every 3 days and one-tenth by volume was stored in plastic bottles. Animals were weighed at the beginning and at the end of every trial. Samples of feed, refusals, faeces and urine were pooled for each animal and representative sub-samples were used for analysis.

Samples of feeds offered, feed refusals and faeces were dried at 60°C for 72 h and ground through 1 mm screen then, they were analysed for ash, nitrogen (N) and crude fibre (CF) contents (AOAC, 1985). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were analysed by the method of Van Soest *et al.* (1991). Neutral detergent insoluble N (NDIN) and acid detergent insoluble N (ADIN) were determined by Dumas method. Condensed tannins (CT) were analysed by vanillin method (Broadhurst and Jones, 1978).

Statistical analysis: data were analyzed using the GLM procedure of SAS for each forage separately. We applied one factor model (stage of maturity). Comparison of least square means was made by the Student test (t-diff).

III – Results and discussion

For alfalfa, the bud stage showed very high crude protein (CP) content (25.18%) and low fibre contents (25.86, 48.5 and 31.8% for CF, NDF and ADF respectively). For the early bloom stage there was a large drop in CP and at the late bloom there was a further drop. NDIN and ADIN contents did not differ between stages (Table 1). The CP for the bud stage is higher than values reported by Jarrige (1988) and Nefzaoui and Chermiti (1989).

For sorghum, we observed a decrease in CP content and an increase in CF, NDF and ADF contents as we passed from late vegetative to early bloom to dough stage. NDIN was high and did not differ between stages. The values for CP content were comparable to those reported by Nefzaoui and Chermiti (1989) but were lower than those reported by Jarrige (1988). CT content was low varying from 0.84 g/kg DM for late vegetative to 1.1 g/kg DM for early bloom (Table 1). These values are low compared to those reported in the literature which may explain the absence of an astringent effect and negative effect on intake. The CT content increased from the vegetative stage to bloom stage but then decreased with the dough stage. Lees and Suttill (1995) reported that CT content increases with the development of leaves then decreases with senescence and reach the minimum when leaves turn yellow.

Table 1. Chemical composition of alfalfa and sorghum in different vegetative stages

	Alfalfa			Sorghum		
	Bud	**Early bloom**	**Late bloom**	**Late vegetative**	**Early bloom**	**Dough**
DM, %	16.02	19.48	24.87	18.63	20.07	24.61
OM, % DM	87.1	89.1	89.2	90.12	91.44	92.3
CP, % DM	25.18	18.41	16.8	9.25	6.18	5.2
CF, % DM	25.86	33.45	35.41	34.12	35.43	38.51
NDF, % DM	48.5	53.8	49.5	68.5	67.65	66.6
ADF, % DM	31.8	37.6	31.6	36.5	39.11	42.6
ADL, % DM	7.28	7.14	6.31	1.38	2.59	2.19
CT, g/kg DM	-	-	-	0.84	1.1	0.92
NDIN, g/kg N	212	212	229	464	431	364
ADIN, g/kg N	97.5	56.8	53.5	34.2	91.4	71.0

CT: condensed tannins, NDIN: neutral detergent insoluble nitrogen, ADIN: acid detergent insoluble nitrogen.

DM, OM, CF, NDF and ADF digestibilities did not differ between the bud and early bloom stages and were lower for the late bloom stage. CP digestibility was different for the 3 stages (high for bud stage, intermediate for early bloom stage and low for late bloom stage). N balance was very high for the bud stage and decreased for the other 2 stages reflecting differences in N intake (Table 2).

Table 2. Dry matter intake, nitrogen intake and apparent digestibility of alfalfa and sorghum in different vegetative stages

	Alfalfa				Sorghum			
	Bud	**Early bloom**	**Late bloom**	**Pr>F**	**Late vegetative**	**Early bloom**	**Dough**	**Pr>F**
Apparent digestibility (%)								
DM	78.95^{a} ±2.68	75.64^{a} ±4.91	66.71^{b} ±4.65	**	72.98^{a} ±2.58	64.41^{b} ±2.13	54.75^{c} ±3.26	***
OM	79.37^{a} ±2.72	75.78^{a} ±4.85	67.32^{b} ±4.30	**	76.57^{a} ±2.37	67.41^{b} ±2.06	58.36^{c} ±3.57	***
CP	87.66^{a} ±1.05	82.69^{b} ±2.79	74.98^{c} ±4.52	***	78.37^{a} ±1.86	72.05^{b} ±2.31	64.27^{c} ±4.89	***
CF	67.56^{a} ±5.47	65.54^{ab} ±6.37	59.27^{b} ±4.77	*	69.03^{a} ±3.43	57.61^{b} ±2.22	50.77^{c} ±4.89	***
NDF	73.25^{a} ±3.83	69.66^{a} ±6.33	56.81^{b} ±4.88	***	72.32^{a} ±2.49	63.1^{b} ±2.51	52.5^{c} ±4.85	***
ADF	70.47^{a} ±4.41	68.33^{a} ±6.47	51.75^{b} ±6.15	***	69.27^{a} ±2.98	62.06^{b} ±2.68	53.83^{c} ±4.31	***
DM intake, g/d	1075.1^{a} ±23.53	842.7^{b} ±22.35	974.0^{c} ±9.55	***	955.3^{a} ±21.13	754.2^{b} ±11.3	656.8^{c} 24.4	***
N intake, g/d	44.4^{a} ±0.7	26.75^{b} ±0.8	26.57^{b} ±0.78	***	15.48^{a} ±0.19	8.16^{b} ±0.03	6.87^{c} ±0.22	***
N balance, g/d	38.19^{a} ±1.17	20.97^{b} ±1.71	19.02^{c} ±1.28	***	12.01^{a} ±0.25	5.75^{b} ±0.12	4.37^{c} ±0.23	***

*, **, ***: significant at P<0.05, P<0.01, P<0.001, respectively.

For sorghum, DM, OM, CF, NDF and ADF digestibilities were different between stages with the late vegetative having the highest values and the dough stage the lowest values and the early bloom stage intermediate. N balance followed the same pattern reflecting differences in N intake (Table 2).

Energy and protein values were calculated according to the French system by equations reported by Andrieu *et al.* (1981). Fodder units for milk and fattening (UFL and UFV) were high for the bud stage for alfalfa; however they decreased drastically for early bloom and late bloom stages. For digestible protein in the intestine (PDIN and PDIE) they were higher for the late vegetative stage, the dough stage showed very low value (Table 3).

Table 3. Nutritive value of alfalfa and sorghum in different vegetative stages

	Alfalfa			Sorghum		
	Bud	**Early bloom**	**Late bloom**	**Late vegetative**	**Early bloom**	**Dough**
UFL / kg DM	0.80	0.59	0.53	0.63	0.59	0.55
UFV / kg DM	0.83	0.59	0.52	0.54	0.49	0.45
MAD, g/kg DM	203.4	139.2	124.0	57.6	29.9	21.0
PDIN, g/kg DM	174.3	127.4	116.3	62.6	41.8	35.2
PDIE, g/kg DM	143.6	112.7	105.2	78.1	66.6	63.2

For sorghum the energy values (UFL and UFV) were low for all stages. The late vegetative stage showed higher PDIN and PDIE values than the other stages.

IV – Conclusions

This work underlines the effect of maturity stage on forage nutritional value. The association of alfalfa and sorghum which contains a small amount of CT can improve nitrogen balance and permits to have better balanced ration.

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