TREE FORAGES AS NITROGEN SOURCE FOR RUMINANTS IN SAHELIAN AGRO-SILVIPASTORAL SYSTEMS

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ABSTRACT
Tree forages contribute up to 80% DM and 100% nitrogen content in the ruminants diet in the Sahel during the dry season. However, crude protein (CP) concentration in browse within a wide range and variation factors remain to be elucidated for better integration of browses in ruminants feeding systems. Variation factors of CP content and in vivo digestibility of four Sahelian browse species were investigated to appreciate the potential as nitrogen sources in Sahelian ruminant feeding systems. Seasonal variations in nitrogen content were evaluated in different plants part of *A. raddiana*, *B. rufescens*, *B. aegyptiaca* and *G. senegalensis* harvested in the Sahelian zone during the dry and the wet season. In vivo CP digestibility of browse based ration was measured in sheep. Average CP content was of 16%DM. CP content varied significantly ($P<0.05$) according to plant species while plant part effect was not constant. *B. rufescens* leaves were higher in CP than fruit while *A raddiana* fruits and leaves did not differ. Significant seasonal variations were observed for G. senegalensis while the other species were constant a year round. *In vivo* CP digestibility was influenced by browse level in the diet ($P<0.01$). Non digestible crude protein (NDCP) were positively linked to browse proportion in the diet (L). Those relationships would suggest browse limitation in the diet.

KEYWORDS
Browse plants, seasonal variations, nitrogen, *In vivo* digestibility.

INTRODUCTION

Tree forages play a major role in ruminant diet improvement for livestock maintenance and productivity in the Sahel. Many studies have been conducted to evaluate nitrogen content and quality in browses (Le Houerou, 1980; Devendra, 1989) and large variations are often reported. Variation factors remain to be elucidated. Plant part and phenological stage linked to seasonal influence may be involved in CP fluctuations.

In vivo dry matter digestibility of browse based rations may be affected by digestive interactions (Fall, 1993). The digestibility of crude protein may also be influenced by browse level in the diet though the occurrence of secondary compounds (Mc Leod, 1974; D'Mello, 1992).

The aim of that study was to evaluate variation factors affecting CP content and in vivo digestibility in four common browse species in Sahelian region in Senegal.

MATERIAL AND METHODS

Experiment 1: Variation factor of CP content in four browse species: Tree forage species including *Acacia raddiana*, *Bauhinia rufescens* leaves and pods, *Balanites aegyptiaca* and *Guiera senegalensis* leaves were harvested in the Sahelian region of Senegal during each of the 4 seasons (early and late dry and wet season). Samples were sun dried and ground to pass 1 mm screen for chemical analysis. Total crude protein was evaluated according to kjeldahl method (AOAC, 1975).

Experiment 2: *In vivo* digestibility trial: Classical in vivo balance trial was performed using 6 Peul-peul sheep to evaluate CP digestibility of two browse species *Pithecellobium dulce* and *Guiera senegalensis* dry leaves. *In vivo* trial were conducted during 15 days adjustment and 6 days measurement periods at the ISRA LNERV (Dakar, Senegal). Each sheep was housed in an individual pen for measurement of daily feed intake and faecal output. Tree forages were included in sheep diet in a proportion varying from 0 to 85 % on the DM basis and from 0 to 59% on CP basis. Basal diet was made of rice straw and peanut cake. Average crude protein content in the diet was of 12% DM.

In vivo ration CP digestibility (RCPD) was evaluated by the following relation:

RCPD = (Total nitrogen ingested - total faecal nitrogen) / total nitrogen intake

To check the influence of browse level and calculation method, browse CPD (BCPD) was comparatively calculated by regression and difference (Fall, 1993).

The influence of season, plant species and part on the browse total nitrogen content were appreciated using factorial analysis (SAS, 1985). Significance of difference was checked by analysis of variance.

Relations between browse level in the diet and CPD was examined by regression.

RESULTS AND DISCUSSIONS

Variation factors of nitrogen content in tree forages: Average CP content was of 16% DM varying from 11% for *Guiera senegalensis* to 19%DM for Balanites aegyptiaca leaves (table 1). Species played a major role in CP fluctuations. *B. aegyptiaca* and *A. raddiana* had close and highest CP value.

The influence of plant part was not permanent. *B. rufescens* leaves were higher in CP than fruits while *A. raddiana* plant parts did not differ significantly ($P<0.05$).

CP variation profiles show maximum levels in june-july, during the early wet season for *B. aegyptiaca* (CP=24.6%DM) and *G. senegalensis* (CP=15.3%DM) leaves while that peak where observed at the end of the rainy season for *A. raddiana* leaves (CP = 20%DM) and *B. rufescens* leaves and pods (CP = 17.4 and 14.1 %DM respectively). However, seasonal variations were significant ($P<0.05$) only for *G. senegalensis* leaves.

CP content in studied browses was higher than in standing forages from rangelands which is often less than 5% CP. Their nitrogen content is comparable to that reported by Le Houerou (1980) and Devendra (1989). However, fluctuations in CP content were observed. Plant species seems to be the main variation factor. Morphological characteristics determining plant access to water and soil nutrients as well as growing conditions and nitrogen fixing capacity may explain strong inter species variations in browse CP content.

Although inconstant in the present study, seasonal influence in browse CP content is well recognised (Craig *et al*., 1991). However, Grouzis and Sicot (1980) have emphasised variations in browse phenological

profiles in the Sahel. Pellew (1980) reported a quick modification in CP content in Acacia very new shoots and leaves of few days old. So only actively flushing materials are subject to modifications; after a short period CP content remains constant. Therefore, seasonal sampling may not be appropriate to demonstrate CP variations.

***In vivo* digestibility of crude protein:** *In vivo* CP digestibility is presented in tables 2 and 3 for the two studied species. Total ration CPD was significantly influenced ($P<0.01$) by browse proportion in the ration. Linear relationships were calculated between the two parameters. Poor CPD was observed in Guiera leaves based rations while CPD was intermediate for *P. dulce* leaves. That may be explained by high faecal output linked to poor nitrogen digestibility associated to high condensed tannins levels in the diet as reported by Reed *et al.*, (1990).

Linear CPD response to increasing browse level in the diet does not support occurrence of digestive interactions regarding protein digestion in browse based rations. Therefore difference method seems to be appropriate for evaluation of CPD for studied species. Close results were obtained between regression and difference calculation method when average browse contribution was of 55% total CP.

The potential of browses as nitrogen sources is confirmed. Quality monitoring of Sahelian tree forages would suggest plant harvesting during the wet season.

Negative effect of secondary compounds on CPD resulted in high faecal nitrogen output for both studied species suggesting their limitation in ruminant diets.

Table1
CP content in four browse species: influence of the plant part

Browse species	Plant part	N	Average CP % DM (standard deviation)	Mean CP content per species
A. raddiana	leaves	17	18.05 (2.40)	17.91a
	fruits	7	17.60 (1.85)	
B. aegyptiaca	leaves	22	19.50 (3.86)	19.52a
B. rufescens	leaves	18	16.30 (2.68)	
	fruits	14	12.48 (2.00)	14.50b
G. senegalensis	leaves	30	11.10 (2.23)	11.24c

Means with the same letter are not significantly ($P<0.05$) different

Table 2
Influence of the browse proportion on the non digestible nitrogen of the ration

		P. dulce				*G. senegalensis*			
Browse level									
	% CP	0	27.4	51	58.7	0	14.2	37.4	52.0
CP	%DM	10.9	13.3	15.0	15.7	13.4	13.1	13.0	14.9
NDCP	%DM	4.15	4.48	4.93	5.22	5.05	5.21	7.36	10.90

CP: crude protein
NDCP: non digestible crude protein

Table 3
Influence of the calculation method on non digestible crude protein (NDCP) content in browses

1. Regression method:

Browse species	Regression equation	Sxy	R	NDCP g/kg MS	CPD %MS
P. dulce	NDCP = 40.8 + 0.175L	1.2	0.98	58.3	68.3
G. senegalensis	NDCP = 45.1 + 1.050L	3.3	0.92	150.1	-47.1

2. Difference method:

Browse species	Browse level %DM	CP g/kg DM	CPD %CP	NDCP g/kg MS
P. dulce	60	184	75.7	44.7
G. senegalensis	50	102	-47.7	151

CPD: crude protein digestibility

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