DEGRADABILITY AND FERMENTESCIBILITY ACCORDING TO FIBER CONTENT IN LOW QUALITY FORAGES

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ABSTRACT

The nylon bag technique and the gas-test method were compared with 6 different roughages representing a wide range of fiber contents in samples collected in the Senegalese Groundnut Basin. The results showed high correlation coefficients and low residual standard errors between the chemical composition of the roughages (mainly the acid detergent fiber fraction) and their degradability or fermentescibility. Reliable relationships between the two methods were also identified.

KEY WORDS

fermentescibility, degradability, low quality forages, Sahelo-Sudanese regions

INTRODUCTION

In the sub-Saharan regions of Africa, low quality forages represent the main part of the ruminant diets during the 7-8 months of the dry season. The type and level of fiber contents in these roughages are subjected to considerable variations. Their rate and extent of fermentation should thus be variable. However, such information is scarce albeit it is necessary to complement low quality forages correctly.

We aimed to evaluate the nutritive value of these forages by the nylon bag method (Ørskov & McDonald, 1979), used as reference method, and the gas-production technique developed by Menke and Steingass (1988). The objective was also to identify reliable relationships between both methods and between the chemical composition of the forages and their *in vitro* fermentescibility or *in sacco* degradability.

METHODS

The study was performed with 6 roughages: millet leaves, maize straw, straw of natural fallow, sugar canes, guinea grass straw (*Andropogon gayanus* Kunth cv. *bisquamilatus*), groundnut husks. The roughages were identified to ideally represent the high variability observed in a large sample of low quality forages collected in the Senegalese Groundnut Basin. Three sheep, fitted with permanent cannula in the rumen (Peul-Peul males of 40 kg live weight), received 800 g millet straw mixed with 10% sugar cane molasse, 300 g millet bran, 300 g balanced concentrate and 100 g groundnut cake. According to laboratory analyses, the diet supplied 0.84 UF (Unité Fourragère : energy unit corresponding to 1 kg barley) and 140 g DP (Digestible Protein) per kg DM.

The degradability was measured with nylon bags of 150 cm2 (42 µm) using 2.8 g milled roughage (2 mm) following the method described by ILCA (Osuji *et al.*, 1993). Each measure was repeated 4 times on each sheep. *In sacco* degradabilities of the DM, OM (Organic Matter), CF (Crude Fibers), NDF (Neutral Detergent Fibers) and ADF (Acid Detergent Fibers) were measured after 24 and 48 h of incubation. The gas-production technique used 1 and 2 g milled samples (1 mm). The fermentescibility was measured in 5 replicates with plastic syringes using 40 ml of filtered rumen fluid and 10 ml of the Burrough's buffer (Rouissi, 1994). The gas-production was noted at regular intervals up to a total duration of 72 h. The OM, CP and CF contents were analyzed according to the AOAC methods (1984), and NDF and ADF according to Van Soest and Wine (1967).

RESULTS

The chemical composition and the gas production determined after 72 h are presented in Table 1. The results show a very high variability of the CP and fiber contents in the roughages. No significant difference ($P>0.05$) was found between the gas volumes (ml g^{-1} DM) produced by 1 or 2 g sample (V1, V2). The statistical analysis revealed a higher fermentescibility ($P<0.05$) in the straw of natural fallow, millet leaves and maize straw compared with Guinea grass straw and sugar canes. The lowest fermentescibility ($P<0.05$) was found in groundnut husks.

The results of *in sacco* degradability are given in Table 2. The analysis of variance concerning the DM, OM and CF degradations showed a highly significant difference ($P<0.001$) between the incubation times. The linear relationships predicting the OM and NDF degradations (OMD and NDFD respectively) according to the chemical composition of the roughages gave high correlation coefficients, mainly with NDF (slower residual standard error). However, the CF degradations (CFD) were highly correlated to CP contents. No reliable relationship exists between the chemical composition of the roughage and the ADF degradation. The residual standard error was used here to appreciate the accuracy of the linear regression calculated to estimate the degradation coefficients using the chemical contents of the forages. The results were identical with 24 or 48 h of incubation. The following relationships are given here for example:

(1) OMD (24 h) = 95.0 - 0.80 x NDF r = 0.957 s= 3.209
(2) CFD (24 h) = 22.8 + 1.86 x CP r = 0.906 s = 2.413
(3) NDFD (24 h) = 35.4 - 0.14 x NDF r = 0.933 s = 0.720
(4) V1 (72 h)= 47.2 - 0.54 x ADF r = 0.936 s = 3.299
(5) NDFD (24 h) = 21.0 + 0.19 x V1 (72 h) r = 0.889 s = 0.904

According to the NDF degradation, the classification of the feedstuffs was the same in the *in vitro* and *in sacco* methods. Therefore, the residual standard error of equation (5) is the most remarkable. Compared to other studies on temperate forages (Khazaal *et al.*, 1993; Blummel & Ørskov, 1993), the relationships are very simple and more accurate. They offer large possibilities for further investigations on the nutritive value of poor and fibrous forages. Nevertheless, a large screening in the data base available on low quality forages is necessary to confirm the preliminary results registered in this experiment. The gas-production technique also merits further studies in order to assess its potential to predict a roughage quality.

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Table 1
Chemical composition (% of DM) and gas production (ml g^{-1} DM) after a period of 72 h fermentation of the roughages (means ± standard errors of 12 replicates).

Roughages	OM	CP	CF	NDF	ADF	Gas volumes (ml g^{-1} MS) SW = 1 g	SW = 2 g
Millet leaves	88.	18.6	26.2	60.0	30.1	29.0 ± 5.6 a	30.3 ± 1.6 a
Maize straw	88.	35.7	29.9	59.9	40.2	29.1 ±4.1 a	26.9 ± 5.8 a
Straw of natural fallow	93.9	2.5	33.3	74.9	46.8	24.5 ± 4.6 a	28.8 ± 3.0 a
Sugar canes	95.	43.0	49.9	88.0	63.1	12.3 ± 2.6 b	15.6 ± 1.2 b
A. Gayanus straw	97.	11.5	43.6	88.2	54.6	13.6 ± 3.6 b	17.0 ± 5.7 b
Groundnut husks	93.	42.5	45.7	84.7	76.9	7.2 ± 1.1 c	5.5 ± 3.0 c

OM: organic matter; CP: crude protein; CF:crude fibers; NDF: neutral detergent fibers; ADF: acid detergent fibers; SW: sample weights.
a, b, c: samples with the same letter in the column are not significantly different (P > 0.05).

Table 2
Degradation (D in %) of the DM, OM, and CF contents of the roughages in nylon bags (means standard errors of 5 replicates and 2 sheep) after 24 or 48 h incubation.

Roughages	OMD	CFD	NDFD (*)	ADFD (*)
24 h incubation				
Millet leaves	23.4 ± 2.0 a	-	27.7 ± 5.1	27.8 ± 4.6
Maize straw	49.3 ± 1.9 b	37.2 ± 1.5 a	26.3 ± 2.1	23.9 ± 0.6
Straw of natural fallow	27.4 ± 2.0 a	25.3 ± 2.5 b	22.8 ± 1.8	19.6 ± 2.0
Sugar canes	32.1 ± 3.6 a	26. 3 ± 2.0 b	24.7 ± 6.4	24.6 ± 8.3
A. Gayanus straw	46.8 ± 2.8 b	36.9 ± 2.0 c	22.8 ± 1.8	19.6 ± 2.0
Groundnut husks	26.7 ± 1.9 a	28.2 ± 3.9 ab	23.8 ± 1.4	28.2 ± 1.5
48 h incubation				
Millet leaves	29.4 ± 2.1 a	-	47.5 ± 1.7	46.3 ± 1.6
Maize straw	55.0 ± 4.1 b	44.5 ± 3.1 a	34.1 ± 0.3	31.2 ± 0.1
Straw of natural fallow	29.8 ± 6.3 a	32.4 ± 8.4 a	37.4 ± 0.9	34.5 ± 1.4
Sugar canes	46.6 ± 2.6 c	40.3 ± 4.0 a	30.4 ± 3.1	31.4 ± 3.2
A. Gayanus straw	58.5 ± 4.6 b	56.0 ± 1.9 b	31.9 ± 3.0	28.9 ± 3.1
Groundnut husks	36.4 ± 5.1 a	40.6 ± 4.7 a	22.7 ± 1.6	29.4 ± 1.8

a, b, c: samples with the same letter in the column are not significantly different (P > 0.05).
DM: dry matter; OM: organic matter; CF:crude fibers.
(*): samples were pooled for analyses and no statistical treatment was applied.