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THE INFLUENCE OF CRUDE SHEABUTTER LEAF-EXTRACTS ON DIGESTIBILITY AND NITROGEN ECONOMY IN GOATS FED A CONCENTRATE DIET

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ABSTRACT

A 28-day feed intake and digestibility trial was conducted with sixteen adult West African Dwarf goats to evaluate the influence of crude aqueous extracts of sheabutter leaf, added to maize-soy bean meal based concentrate diet (18.53 % CP). Goats were divided into four equal dietary groups balanced for body weight (range = 8.34 – 11.62; average = 9.17) and sex (4 males; 12 females). Each group was assigned to one of four treatments in a completely randomized design. Treatments consisted of different levels of crude extracts of shed sheabutter leaf added to 50 kg of the concentrate diet. The extracts were obtained by boiling 0, 12.5, 25.0 or 50.0 g) of powdered sheabutter leaf for 15 minutes in 1000 dm^3 water. The four dietary treatments were designated as A, B, C and D respectively. Goats fed shed sheabutter leaf extracts- treated diet C or D consumed less ($P < 0.05$) dry matter than the control group A. Coefficients of digestibility of dry matter, crude protein, crude fibre, or ether extracts were higher ($P < 0.05$) for goats receiving the control diet A than for the treatment group C or D. Urinary nitrogen excretion was reduced ($P < 0.05$) in goats on sheabutter leaf extracts treatments, when compared with the control group and resulted in higher ($P < 0 .05$) nitrogen retention for goats on treatments B. All the goats remained in positive weight balance and showed no sign of malaise throughout the 28-day feeding trial. Results from the study supported the hypothesis that crude sheabutter leaf extracts at moderate dietary levels could positively influence the feeding values of concentrate diets as goats receiving dietary treatment B had improved ($P < 0.05$) body weight change, feed conversion ratio and nitrogen retention.

Keywords: *sheabutter leaf extracts, digestibility nitrogen economy and goat*

INTRODUCTION

A concentrate-based feeding system for livestock production has several advantages over a forage based system; it promotes efficiency of conversion of feeds to meat, milk and other animal products; allows for adjustment of feed nutrients intakes with changes in physiological states and production levels in the animal and offers the convenience of feeding the different classes of livestock at different ages and physiological states. In ruminants however, an inherent inefficiency of the rumen fermentation of diets reduces the benefits of concentrate feeding. Too rapid rumen

fermentation alters the nutrients profile of diets and reduces the quantity and quality of nutrients available for post-ruminal digestion of the often expensive, protein-rich concentrate diets (Preston and Leng, 1987)

Plant polyphenols are known to have the capability of reducing the rates of fermentation and subsequent degradation of dietary proteins by rumen microbes (Longo *et. al.* 2008). At appropriate levels in the diet, plant polyphenols particularly the tannins group would bind dietary proteins to increase escape rates from rumen degradation (Dawason and Buttery, 1995). High levels of tannins and other polyphenol compounds have been reported (Kumar, 1992) in the leaves, stems and roots of tropical trees and shrubs including the sheabutter tree; they are also shown to be extractable (Aiyegoro and Okoh, 2009) in aqueous medium.

Sheabutter tree, *Vitellaria paradoxa* is a tropical plant of numerous domestic and industrial applications (Abbiw, 1990). The leaves of sheabutter tree have been successfully included in the diets of goats at levels of up to 60 % (Yousuf, 2003) without any detrimental effect. Manipulation of diets to enhance nutrients utilization by ruminants offers an efficient, low-cost strategy that is adoptable by rural farmers for increased productivity.

The present work was intended to observe the influence of crude extracts of shed sheabutter leaves in maize-soybean meal-based concentrate diet (18.53 % CP) fed to the West African Dwarf goat.

MATERIALS AND METHODS

The site of the Experiment

Feeding trial was conducted at the Department of Animal Production, Faculty of Agriculture, University of Ilorin, Ilorin Nigeria (Longitude, 08: 29^0 N, Latitude, 04: 35^0 E). The mean daily temperature readings (^{0}C) at the time of the experiment were 27, 31 and 34 for the early morning, midday and late afternoon periods respectively.

Animals and Treatments

Sixteen adult West African Dwarf goats (4 males and 12 females) were assigned in a randomized complete block design experiment, to four dietary treatments after a prophylactic course of treatments against ecto- and endo- parasites using Ivomectin. Dietary treatments consisted of crude extracts of shed sheabutter leaf obtained by boiling varying quantities (0, 12.5, 25.0 and 50.0 g) of the powdered leaf for 15 minutes in 1000 dm^3 water. The leaf extracts were used separately, to mix 50 kg of maize-soybean meal based concentrate diet (Table 1). The sheabutter leaf extracts-treated diets were air-dried on concrete slabs in a well ventilated room before being packaged for use in the 28-day feeding trial.

Data on compositions of the concentrate diet used in the study were as presented in Table 1. The concentrate diet which was offered at 3 % of the animal's body weights satisfied the energy and crude protein requirements (NRC, 1981) for maintenance and weight gain in the goat.

Table 1: Compositions of the Concentrate Diet

Ingredient	%
Maize	42
Soybean meal	25
Maize offal	18
Rice husk	14
Salt + Bone meal (1: 1)	1
Dry matter and Chemical Composition, %	
Dry matter	90.8
Crude protein	18.53
Crude fiber	13.48
Ether extract	3.26
GE, Mcal/kg (Calculated)	3.27

COLLECTION OF DATA AND ANALYSES

Total faeces and urine produced daily by each goat were collected and measured over a 7-day period that was preceded by a 21-day feeding and adaptation to diets. About 10 % of dried faecal samples were preserved, mixed and sub-sampled for dry matter determination and chemical analyses (AOAC, 1990). About 10 % of the urine was sampled daily, bulked and preserved in plastic bowls containing 100 ml sulphuric acid (urine pH < 4). Nitrogen in the faeces and urine was estimated following the micro-kjeldahl procedure. Data were collected on feed intake and body weight changes in the individual goats.

Empirical data were subjected to analysis of variance (Steel and Torrie, 1980) with significant differences between treatment-means separated using the Duncan's (1955) Multiple Range Test.

RESULTS AND DISCUSSION

All animals remained in good state of health throughout the 28-day feeding period. .A marked suppression of feed intake was observed among the treatment groups, which was gradually overcome from the 6th day of the feeding trial.

The effects of treatments on dry matter intake by the goats were significant at $p<0.05$ level. Goats on the control diet B had the highest dry matter intake (g/Kg W $^{0.75}$) value of 73.23 that was similar to the value of 71.07 obtained for the control group but higher ($P < 0.05$) than 51.52 in dietary group C or 50.49 in group D. The differences were attributed to reduction in feed palatability with increase in dietary concentration of crude sheabutter leaf extracts. Dry matter

intakes represented 4.17, 3.02 and 2.89 % of body weights in treatment groups B, C and D respectively, compared to the 4.03 % in the control. Coefficient of dry matter digestibility was similar (P>0.05) for goats receiving diet B and those on the control diet A (68.15vs. 67.66) but goats on treatments C and D had lower (P < 0.05) values of 54.29 and 51.28 respectively. A similar trend was obtained for the digestibility of crude protein among the dietary groups. Wagohrn and Shelton (1992) had attributed reduction in browse crude protein digestibility to the presence of secondary plant metabolites. The increasing levels of sheabutter leaf extracts in the treatment diets B, C and D could have resulted in a corresponding increase in secondary plant metabolites concentrations with adverse effects on dry matter and crude protein digestibility assuming significance at the levels used in treatment groups C and D. Supplementation of condensed tannins at 1-2 % level significantly reduced *in vitro* nitrogen digestibility of groundnut cake (Dey *et. al.,* 2006). Effects of treatments on the digestibility of crude fiber or ether extract in all the dietary groups were similar (P< 0.05).

Table 2: Dry matter and nutrient intake and digestibility in the goats

Item/Treatment	A	B	C	D	SEM
No of goats	4	4	4	4	
Averageinitial live weight, Kg	9.63	9.24	8.47	9.16	1.03
Dry matter intake, g/ $W^{0.75}$ Kg	71.07^{a}	73.23^{a}	51.52^{b}	50.49^{b}	4.71
Dry matter Digestibility, %	73.36^{a}	75.45^{a}	64.48^{b}	61.32^{b}	2.26
Crude protein intake, g/ $W^{0.75}$ Kg	13.17^{a}	13.54^{a}	9.54^{b}	9.35^{b}	1.68
Crude protein Digestibility, %	67.33^{a}	65.26^{a}	57.89^{b}	54.27^{b}	2.32
Crude fibre intake, g/ $W^{0.75}$ Kg	9.56^{a}	9.87^{a}	6.94^{b}	6.80^{b}	0.98
Crude fibre Digestibility, %	68.15	67.66	54.27	52.28	8.17
Ether extract intake, g/ $W^{0.75}$ Kg	2.31^{a}	2.38^{a}	1.43^{b}	1.64^{b}	0.16
Ether extract Digestibility, %	61.28	63.56	63.49	62.17	1.81

a, b, c- means along a row followed by the same superscript letter are similar (P < 0.05)
SEM - standard error of treatment means

Table 3 shows data on intake and loss of nitrogen by goats in response to dietary sheabutter leaf-extracts treatments. Goats on Treatment B consumed 11.49 g/day of dietary nitrogen which was similar (P > 0.05) to the value (11.59 g N/day) obtained for the control group A but higher (P < 0.05) than the N-intakes (g/day) of 7.79 and 8.08 in treatment groups C and D respectively. The effects of treatments on faecal nitrogen loss were significant (P < 01) and accounted for the low nitrogen retention values (g/day) of 1.75 and 1.72 obtained for goats on treatment diets C and D respectively as compared to the values of 3.22 or 3.96 in the control group A or treatment group B. An increase in fecal nitrogen loss with a concomitant decrease in urinary nitrogen excretion in goats fed wattle tannin supplements had earlier been reported (Bengaly *et. al.* 2007).

Table 3: Influence of dietary crude shea butter leaf extracts on nitrogen metabolism in the goats

Index/treatment	A	B	C	D	SEM
Nitrogen intake, g/day	11.59[a]	11.49[a]	7.79[b]	8.08[b]	1.29
Faecal Nitrogen, g/day	3.91[b]	4.32[a]	4.39[a]	4.75[a]	0.18
Urinary nitrogen, g/day	4.46[a]	3.21[b]	1.68[c]	1.58[c]	0.76
Nitrogen Digested, g/day	7.68[a]	7.17[a]	3.40[b]	3.33[b]	1.57
Nitrogen Retained, g/day	3.22[b]	3.96[a]	1.72[c]	1.75[c]	0.48
Retained-N as % of N-intake	27.78[b]	34.46[a]	22.08[c]	21.66[c]	2.48

a, b, c- means along a row followed by the same superscript letter are similar ($P < 0.05$)
SEM - standard error of treatment means

Effects of sheabutter leaf-extracts treatments on urinary nitrogen concentrations could be attributed to the protective influence of tannins on dietary protein encouraging the escape rate from rumen microbial fermentation. The effects could also be attributed to an increase in utilization of protein-tannins complex at the cellular and tissue levels. Longo *et. al.* (2008) observed that protein-tannins complexes from different plant sources are utilized differently and in an animal species. Faecal nitrogen loss was increased but neither urinary nitrogen excretion nor nitrogen retention was affected in goats fed (Bengaly *et. al.* 2007) wattle tannins at different dietary levels. In the present study, the crude aqueous extracts of sheabutter leaf used could contain high level of tannins alongside several other phenolic compounds, none of which was quantified.

CONCLUSION

The results indicated a positive role for phenolic substances present in circle shearbutter leaf extracts. This is evident from the dietary treatment Group B which tended to be superior to the control group in terms of dry matter and crude protein digestibility as well as in nitrogen retention.

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