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In Vitro Assessment of Shed Sheabutter Tree Leaf as a Potential Feedstuff for Goat Production

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Abstract The potentials of shed sheabutter tree leaf (*Vitellariaparadoxa*) as a feedstuff for ruminant production was evaluated using proximate chemical composition and in vitro digestibility indices. Samples of shed sheabutter leaf were analyzed for dry matter and chemical compositions to assess their feeding values for ruminant livestock production. The sheabutter leaf was further subjected to in-vitro digestion over 0, 12, 24, 36 or 48-hour period to estimate the time required for optimum degradation, using rumen fluids obtained from West African Dwarf goats. Samples were analyzed in three replicates. Results on proximate analysis indicated that shed sheabutter leaf (90.2 % dry matter) is low in crude protein (3.6 %) but high in crude fiber (27.03 %) with 56.15 % and 44.2 % Neutral Detergent Fiber, (NDF) and Acid Detergent Fiber, (ADF) levels respectively. Dry matter and organic matter losses (%) were similar ($P>0.05$) for the dry sheabutter leaf samples incubated at 36-hour (34.26; 35.76) or 48-hour (36.04; 37.19) period but both were higher ($p<0.05$) than the values obtained for samples incubated at 12-hour (15.96; 18.03) or 24-hour (23.35; 25.56) period. It was concluded that the shedshea butter leaf investigated in the present study could be fermented by the rumen microbes to serve as a source of dry matter and nutrients to ruminant livestock following appropriate supplementation. An optimum level fermentation of the dry shed butter leaf was obtained at 36-hour post-incubation period signifying that the dry leaf is to be included in ruminants' diets at controlled levels.

Keywords: *Goat production, Sheabutter leaf, in-vitro assessment*

Introduction

The ruminant livestock feed industry is faced with the challenges of meeting an all-year feed demands for the various livestock species. The lush green forages that serve as major nutrient sources to ruminants during the wet season are always scarce in the dry season thereby making the dry matter and nutrient consumption by the animals to drop drastically. The available grains

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and feed crops are always in high demand resulting in competition among man, livestock and industries. However, several unconventional feed resources remain in abundance and sometimes constitute environment pollutants in the modern society. Shed tree leaves especially in the humid and sub-humid tropics, represent a potentially important source of roughages in the formulation of diets for the ruminant 1ivestock (Yousuf, 2004). Abidemi *et al*. (2009) reported that the nutrient composition of fresh sheabutter leaves to be moisture (80%); protein (2.45%); fat (0.33 %); crude fibre (1.39 %); ash (2.00 %) and Nitrogen free extract (13.82 %). The shed tree leaf is more abundant in the dry season when feed supply is more limiting to livestock production. Sheabutter tree grows well in many parts of Nigeria as it is abundant in the guinea savanna vegetation of West Africa Abidemi *et al*. (2009).

The present study is aimed at evaluating the potentials of shed sheabutter leaves as a source of feedstuff for ruminant production through proximate analyses and in-vitro dry matter and organic matter degradation measurements. The in-vitro technique has become a widely used tool in the evaluation of feeds for ruminants (Wood *et al.*, 2000). In vitro digestibility method provides a quick, inexpensive, and precise prediction of conventionally determined digestibility in ruminants as it accounts for all factors affecting digestibility which is feature that is lacking in the current chemical methods (Khan *et al.*, 2003).

Materials and methods

Sample Collection and Preparation

Dry shed sheabutter leaves were collected within the university premises. The leaves were air-dried in a well-ventilated room for five days and ground in a hammer mill of about 1mm sieve to reduce bulkiness and particle size. The other ingredients used in the formulation of concentrate were similarly treated.

Source of Inoculums

Rumen fluid used for the experiment was collected from goats of about seven months old previously fed a shed sheabutter leaf based-diet (shed sheabutter leaf, 60%; groundnut cake, 25 %; maize offal, 14 %; sodium chloride, 1% and bone meal 1 %) over a 21-day period. The rumen fluid was collected 3 hours post feeding from slaughtered animals. Rumen contents were strained through four layers of cheese clothes into thermal flask, gassed with carbon dioxide and immediately taken to the laboratory for further analysis .

In-vitro DM and OM Degradation

Three replicate samples (3 g) of shed sheabutter leaf or sheabutter leaf-based concentrate were incubated in a 250-mL Erlenmeyer flask containing eighty milliliters of strained ruminal fluid plus 80 mL of a phosphate–bicarbonate buffer solution. Fermentations were terminated after the appropriate time limit by placing the flasks into iced water. The contents of the flasks were then immediately dried, weighed, ground and homogenized.
The blank was determined by incubating tubes containing only ruminal fluid and buffer without shed sheabutter leaf to account for indigestible materials introduced into the vessel from the ruminal fluid inoculums (Galyean, 2010).

Microbial Evaluation

Total Viable Counts (TVC) of the rumen fluid was determined at 0, 12, 24, 36 and 48 hours of incubation, in the in-vitro digestion of shed sheabutter leaf and the concentrate diet using the supernatant fluids at the various time intervals. Nutrient agar was the medium used in a serial dilution technique, as outlined by Fawole and Oso (1998).

Chemical Analyses

Evaluation of the proximate composition of shed sheabutter leaves was carried out following using the AOAC (1984) procedures while NDF and ADF were determined by the methods of Goering and Van Soest (1970), as modified by Van Soest *et al*. (1991).

Statistical Analysis

Data from proximate study were compared among treatment groups while in-vitro digestibility and microbial data were subjected to analysis of variance of a Completely Randomized Design, CRD experiment (SAS/ SPSS 1999 version 10.0 for windows). All multiple comparisons among treatment means were performed using the Duncan's Multiple Range Test (1955).

Results and Discussion

Table 1 shows data on dry matter and proximate analyses of the sheabutter leaf. The gross energy content of the sheabutter leaf was estimated from an equation developed by Garret and Johnson (1983).

Table 1. Proximate Composition of Shed Sheabutter Leaf

Item	%
Dry Matter	90.2
Ash	6.80
Crude Protein	3.60
Ether Extract	2.20
Crude fibre	27.06
NDF	56.15
ADF	44.20
NFE	50.54
GE (Kcal/kg) – calculated (Garret and Johnson, 1983)	374.79

The shed sheabutter leaves with a DM level of 90.20 % notwithstanding its relatively low crude protein content could serve as a source of bulk in ruminant diets to which appropriate supplements must be added. Njidda (2010) in an analysis of dry matter and chemical compositions of 8 indigenous browse species one of which was Sheabutter tree (*B. paradoxum*) reported a DM range of 95 % to 97 %. The dry shed sheabutter leaf is relatively high in crude fibre (27.06 %) with NDF and ADF levels of 56.15 and 44.20 % respectively. The ADF fraction of the sheabutter correlated with the values of 53.2, 54.3, 54.2 and 51.3 % obtained (Reed and VanSoest (1985) for sorghum leaf shealth, wheat straw, rice straw and maize respectively. Njidda (2010) had reported NDF and ADF levels of 47.60 and 32.10 % respectively for fresh leaves harvested from the sheabutter tree. The levels of crude protein and other proximate components estimated in the present study were higher than the respective values reported (Abidemi *et al.,* 2009) for the fresh sheabutter leaf. Variations in leaves chemical compositions can be attributed to a range of plant, soil and climatic conditions. Mosimanyana and Kiflewahid (1991) had observed that dropped and dried leaves are likely to be of poor quality because of leaching and other factors.

Analysis of the rumen fluid for the in vitro experiment (Table 2) shows that the olive yellowish coloured fluid has a temperature of 38.6^{o}C, pH of 6.87. The VFA concentrations (mMol/liter) 66.91, 21.13 and 12.24 for acetate, propionate and butyrate measurements respectively. A Total Viable Counts of 1.9 X 10^{6} was obtained.

Ramin *et al.* (2008) reported acetate as the major VFA produced from straw rice incubated with *Enterobacteraurogenes* species. The rumen is an

anaerobic environment that is buffered over a pH range of 5.7-7.3 at a tightly controlled temperature of 36 – 41^0 C (Ghorbani *et al.,* 2002).

Table 2. Characteristics of the Rumen Fluid

Temperature	**38.6°C**
pH	6.87
Colour	Olive yellowish
VFA Concentration (mmol/l)	
Acetate	66.91
Propionate	21.13
Butyrate	12.24
Microbial counts	
TVC	1.9 X 10^6

Table 3. Effects of Incubation Time on In-vitro Fermentation of Shed Sheabutter Leaf

Parameters/Time(Hr)	**0**	**12**	**24**	**36**	**48**	**SEM**
pH	6.87[a]	6.92 [a]	6.96 [a]	7.01 [a]	7.42 [b]	0.55
IVDML (%)	-	15.96 [a]	23.35 [b]	34.26 [c]	36.04[c]	3.53
IVOML (%)	-	18.03 [a]	25.56 [b]	35.76 [c]	37.19[c]	3.68
TVC (X10[6])	1.9 [a]	2.1[a]	2.3[a]	2.7 [b]	2.8[b]	0.928

IVDML = In vitro Dry Matter Loss; IVOML = In vitro Organic Matter Loss; TVC= Total Viable Counts

There were no significant differences (P>0.05) in pH values of the fermentation medium recorded at the different time intervals. Dry matter and organic matter losses at the end of 36 and 48 hours incubation periods were similar ($p > 0.05$) suggesting that optimum digestibility of shed sheabutter leaves could be obtained in the rumen at 36-hour. Khan *et al.*, (2003) had observed positive correlation between the in-vitro and in-vivo methods of feed analysis. The increase in dry sheabutter breakdown after 36- and 48- hour incubation could be attributed to increased ($p < 0.05$) concentration of total viable microbial counts recovered from the incubation medium (Table 3). Isah *et al.* (2013) had attributed an increase in rumen microbial biomass to an increase in feed digestibility.

Conclusion and Recommendation

Results from the present study indicated that dry shed sheabutter could be fermented by the rumen microbes to serve as a source of dry matter and nutrients to ruminant livestock. An optimum level fermentation of the dry shed butter leaf was obtained within a period of 36-hour signifying that the dry leaf is to be included in ruminants' diets at controlled levels since it would be digested within 24-hour period. The use of dry shed sheabutter leaf would further expand the feed-base for ruminant livestock and alleviate the perennial dry season feed shortage in the livestock-feed industry.

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