COMPARATIVE STUDY ON THE NUTRIENT VALUES OF DIFFERENT PRODUCTS FROM PROCESSED *MORINGA OLEIFERA* LEAVES

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ABSTRACT

The study was carried out to determine the nutrient values of different products of Moringa oleifera leaves after processing. The experiment entailed comparison of M. oleifera fresh leaf, M. oleifera leaf residue, M. oleifera leaf protein concentrate and M. oleifera sediment, each treatment had three replicates. The experiment was arranged in a completely randomized design and the data obtained for the study was subjected to one-way analysis of variance. Result shows that the highest ($p<0.05$) values of dry matter, ether extract, ash and crude protein contents were recorded for M. oleifera leaf residue, sediment, fresh leaves and leaf concentrate, respectively, while the leaf residue had significantly higher ($p<0.05$) neutral detergent fibre, acid detergent fibre and hemicellulose contents above other treatments. The highest significant ($p<0.05$) values of organic matter were recorded for M. oleifera leaf residue (95.00 %) and sediments (96.50 %), while leaf protein concentrate had the highest ($p<0.05$) significant values for dry matter digestibility, dry matter intake, relative feed value and cell content above other treatments. The results of the present study indicated that all the products of processed M. oleifera had an appreciable nutritive value with high digestibility. However, better nutrient availability was observed in M. oleifera leaf protein concentrate when compared with other products after processing.

Keywords: Digestibility, *Moringa oleifera* leaves, nutritive value, processing, protein concentrate.

INTRODUCTION

In many developing countries, ruminant production is largely limited by the unavailability and high cost of feeds. Low-quality feeds are considered to be the major constraints hampering the productivity of farm animals. The availability of feed is particularly low in the dry season when natural pastures are mature, highly fibrous and inadequate (Oni *et al.,* 2010), with low nutritive value due to low crude protein content (Moyo *et al.,* 2012). Generally, farmers feed their animals with crop residues and low-quality hay that are low in nitrogen, high in lignocellulose and poor in vitamin and mineral contents, which leads to low digestibility and reduced voluntary intake (Gerbregiorgis *et al*., 2012). Intake and digestibility of poor-quality roughages could be enhanced by supplementing concentrate diets (Nurfeta, 2010). However, smallholder livestock production systems are limited to the use of such supplements due to the unavailability and high cost of cereal grain or their byproduct ingredients. To alleviate the problems associated with the lack of protein supplements, there is a necessity to look for alternative protein sources that farmers can generate at their farms without incurring additional costs.
Utilization of fodder trees and shrubs that provide a good and cheaper source of protein and micronutrients (Moyo *et al*., 2012) such as *Moringa oleifera* leaves could be a potential strategy for increasing the quality and availability of feeds for resource-limited livestock farmers during the dry season.
This study was aimed to determine the effects of processing on the nutritive values of products of *Moringa oleifera* leaves.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Pasture and Range Management (PRM) experimental unit of the College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta, (FUNAAB) Ogun State, Nigeria. The site lies within the latitude 7° 10' N and longitude 3° 2' E. It is located in the derived savannah zone of South-Western Nigeria. It has a humid climate with a mean annual rainfall of about 1037 mm and a temperature of about 34.7° C (Google Map, 2022).

Collection and processing of plant materials

Leaves of *Moringa oleifera* were collected from the multipurpose tree arboretum of the Department of PRM, FUNAAB. The leaves were separated from the stems and rinsed in clean water.

The leaves of *Moringa oleifera* were milled in an electric grinding machine to extract the juice. Water was poured at intervals to allow the free flow of the milled leaves from the grinder. The ground sample was poured into four layers of cheesecloth and squeezed by hand to extract the juice. Water was added to the content in the cheesecloth, and squeezed until the juice coming from the cheese cloth appeared colourless. The remains of the leaves after juice extraction were referred to as the residue and was air dried. The extracted juice was heated at 90 ºC for 10 minutes to coagulate the leaf protein concentrate. As the protein coagulates on top of the extracted juice with the application of heat, it was scooped from it until all the coagulates were removed. The coagulates obtained in the form of paste were air dried at room temperature and it was referred to as the leaf protein concentrate. After the concentrate had been removed from, the remnant that settled at the bottom of the container was referred to as Sediments. This was then spread out on a tray to dry. The subsamples of the fresh leaves, leaf residue, leaf protein concentrates and sediments of *M. oleifera* were put into a drying cabinet to determine the dry matter contents.

EXPERIMENTAL DESIGN

The experiment was arranged in a completely randomized design with four components taken as treatments, each had three replicates.

DATA COLLECTION

Sub samples of fresh leaves and processed *Moringa oleifera* leaves were dried at 65 ºC until a constant weight was attained. Each of the samples was milled, allowed to pass through a 1 mm sieve screen and were subjected to chemical analyses.

Proximate composition: The dry matter content (DM), crude protein (CP), ether extract (EE) and ash were determined according to AOAC (2000).

Fibre fractions: Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined according to Van Soest *et al*. (1991) procedure. Hemicellulose was estimated as the difference between NDF and ADF.

The forage quality indices were calculated from the chemical composition results:

Organic Matter = 100 – Ash (Lanyasunya, *et al.*, 2007), Total Carbohydrate content – CHO (g kg^{-1} DM) = OM content – (CP + EE); Arieli *et al.* (1999). Dry matter digestibility – DMD (% DM) = 88.9-0.779x ADF (% DM), dry matter intake – DMI (% Bodyweight) = 120/NDF (% DM). Relative feed value = [(88.9 – (0.78 x ADF%)) x (120/NDF%)]/ 1.29 (Agric-facts, 2006), Cell contents are determined by subtracting NDF from 100 (Linn and Martin. 1999).

Statistical analysis

Data obtained from this experiment were analyzed using one-way analysis of variance option of the SPSS (IBM SPSS Statistics 23) software. Treatment means were statistically compared using Duncan's Multiple Range Test to identify differences between means and significant differences were declared if $P<0.05$.

RESULTS AND DISCUSSION

Proximate composition and fibre fractions of fresh and processed leaves of *Moringa oleifera* as shown in Table 1 were significantly ($p<0.05$) different from one another. The highest ($p<0.05$) values of DM, EE, ash and CP were recorded for *M. oleifera* leaf residue, sediment, fresh leaves and leaf concentrate, respectively while leaf residue had the highest ($p<0.05$) significant values for NDF, ADF and hemicellulose contents above other treatments.

Table 1: Proximate composition and fibre fractions of fresh and different components of processed leaves of *Moringa oleifera*

Parameter (%)	*Moringa oleifera* Leaf				SEM	P-value
	Fresh leaf	Residue	Leaf protein concentrate	Sediment		
Dry matter	92.00^{ab}	95.50^{a}	80.00c	90.00^{b}	1.87	0.001
Ether extract	14.50^{b}	5.50^{c}	15.00^{b}	21.00^{a}	1.72	0.000
Ash	11.00^{a}	5.00^{bc}	6.50^{b}	3.50^{c}	0.90	0.001
Crude protein	24.79^{c}	15.24^{d}	40.52^{a}	33.25^{b}	2.89	0.000
Neutral detergent fibre	34.50^{b}	79.50^{a}	13.50^{d}	21.00^{c}	7.74	0.000
Acid detergent fibre	25.50^{b}	52.00^{a}	7.50^{c}	10.00^{c}	5.37	0.000
Hemicellulose	9.00^{c}	27.50^{a}	6.00^{c}	11.00^{b}	2.56	0.000

^{abcd} Means along the same column with different superscripts are significant (P<0.05)

Moringa oleifera fresh and the different components of the leaves contained high levels of CP, which was above 7% required by ruminants for optimum production, which makes both the processed and unprocessed *M. oleifera* to be better alternative feed supplements for animals while avoiding human-livestock conflict and reducing the production/purchase cost. Tisch (2006) emphasized that protein sources for livestock ration are more expensive than carbohydrate sources and the costliest component of a finished feed.

Moringa oleifera leaf residue had the highest contents of fibre fractions which makes it a better energy source. When a feedstuff' is high in ADF, it will be of low digestibility to animals (Ogbe and Affifu, 2011). The values of hemicellulose concentration showed that the samples have the potential to support rumen contraction and relaxation, proper rumen function and promote dietary efficiency. Humphreys (1991) opined that the higher the hemicellulose fraction, the higher the feed value.

Table 2 shows the dry matter digestibility, dry matter intake and relative feed value of fresh and components of *M. oleifera* leaves. The highest significant (p<0.05) value of organic matter was recorded for *M. oleifera* leaf residue (95.00 %) and sediments (96.50 %), while there were highest (p<0.05) significant differences in DMD, DMI, RFV and CC of leaf protein concentrate above other treatments. The highest value of carbohydrates was recorded for the residue.

Table 2: Forage quality indices of mixtures of of fresh and processed leaves of *Moringa oleifera*

Parameter (%)	*Moringa oleifera* Leaf				SEM	P-value
	Fresh leaf	Residue	Leaf protein concentrate	Sediment		
Organic matter	89.00^{c}	95.00^{ab}	93.50^{b}	96.50^{a}	0.90	0.001
Carbohydrates	49.71^{b}	74.26^{a}	37.98^{c}	42.25^{c}	4.27	0.000
Dry Matter Digestibility	69.04^{b}	48.39^{c}	83.06^{a}	81.11^{a}	4.18	0.000
Dry Matter Intake	3.48^{bc}	1.51^{c}	9.31^{a}	5.71^{b}	0.93	0.000
Relative Feed Value	186.59^{c}	56.78^{c}	600.31^{a}	359.32^{b}	64.63	0.000
Cell Content	65.50^{c}	20.50^{d}	86.50^{a}	79.00^{b}	7.74	0.000

^{abcd} Means along the same column with different superscripts are significant (P<0.05)

The mean estimated DMD and DMI compared favourably with mean values of 65.07% and 3.47%, respectively, reported by Zhou *et al.* (2011) for several tropical legumes in China. However, the overall RFV in the residue was lower than the mean value of 181.00, while other treatments have higher values than the RFV standard and may be regarded as having high relative feed value for ruminants. Isah *et al.* (2012) reported an increase in predicted dry matter intake value, as NDF in browse plants investigated declines. A similar result was observed in this study. The implication of this is that, as the percentage of NDF increases in forage, animals will consume less (Schroeder, 1994). The highest value of carbohydrate recorded for the residue could be attributed to cell content.

CONCLUSION

It is suggested that the different products of *M. oleifer*a and unprocessed *M. oleifera* leaves in this study have the potential to be used as protein supplements in animal feeding. However, *M. oleifera* leaf protein concentrates with the highest values for CP, DMD, DMI RFV, CHO and CC showed potential that can improve the performance characteristics of ruminants better than other treatments.

REFERENCES

Agric– Facts, 2006. Know your feed terms. Practical information for Alberta's agriculture industry, July, Alberta, Canada. pp 1-5.

AOAC (2000). Official methods of analysis 15th edition. Association of Official Analytical Chemists, Washington D.C

Arieli, A., Shahar, K., Mabjeesh, S. J., Zamwel, S., & Sklan, D. (1999). Estimation of the digestible energy of ruminant feedstuffs by the combined bag technique. *Journal of dairy science*, *82*(3), 566-573.

Google Map 2022. Federal University of Agriculture, Abeokuta. 16° 28' 19.76"S, 151° 45' 15.01"W, Eye alt 11049 feet. http://www.earth.google.com.

Humphreys, L.R. 1991.Tropical Pasture utilization, Cambridge University Press, Cambridge, U.K. 202 pp.

Isah, O. A., Fayemi, P. O., Gazaly, M. B., & Aderinboye, R. Y. (2012). Nutritional characteristics of four browse plants consumed by free-ranging ruminants in Western part of Nigeria. *African Journal of Agricultural Research*, *7*(12), 1944-1949.

Lanyasunya, T. P., Wang, H., Kariuki, S. T., & Mukisira, E. A. (2007). Effect of maturity on chemical composition, phenolics and amino acids content and rumen degradability of Sorghum almum. *Tropical and Subtropical Agroecosystems*, *7*(2), 63-72.

Linn, J. and Martin, N. (1999) 'Forage quality tests and interpretations. University of Minnesota Extension service, Food and Environmental science'.

Moyo, B., Masika, P. J., & Muchenje, V. (2012). Effect of supplementing crossbred Xhosa lop-eared goat castrates with Moringa oleifera leaves on growth performance, carcass and non-carcass characteristics. *Tropical animal health and production*, *44*, 801-809.

Nurfeta, A. (2010). Feed intake, digestibility, nitrogen utilization, and body weight change of sheep consuming wheat straw supplemented with local agricultural and agro-industrial by-products. *Tropical animal health and production*, *42*, 815-824.

Ogbe, A.and Affifu, J. (2011). Proximate study, mineral and anti-nutrient composition of *Moringa oleifera* leaves harvested from Lafia, Nigeria: Potential benefits in poultry nutrition and health. Journal of Microbiology, *Biotechnology and Food Sciences*, 1(3), 296-308.

Oni, A. O., Arigbede, O. M., Oni, O. O., Onwuka, C. F. I., Anele, U. Y., Oduguwa, B. O. and Yusuf, K. O. (2010). Effects of feeding different levels of dried cassava leaves (*Manihot esculenta*, Crantz) based concentrates with *Panicum maximum* basal on the performance of growing West African Dwarf goats. *Livestock Science*, *129*(1-3), 24-30.

Schroeder, J.W., 1994. Interpreting forage analysis.

Tisch, D. (2006). Animal feeds, feeding and nutrition, and ration evaluation. United States: Thomson Delmar Learning. Retrieved from http://www.delmarlearning.com

Van Soest, P.J., Robertson, J.B. and Lewis, B.A. 1991. Methods for dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science,* 74 (10): 3583-3597.

Zhou, H., Li, M., Zi, X., Xu, T., & Hou, G. (2011). Nutritive value of several tropical legume shrubs in Hainan province of China. *Journal of Animal and Veterinary Advances*, *10*(13), 1640-1648.