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PROXIMATE AND FIBER FRACTIONS OF SELECTED CEREAL HUSKS PROCESSED MANUALLY AND MECHANICALLY FOR RUMINANT PRODUCTION

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ABSTRACT

This study was conducted to assess the proximate compositions and fiber fractions of some cereal husks processed manually or mechanically for feeding ruminants. Three Agricultural Development Programmes (ADPs) in Jigawa State were used for this study. In each of the three ADPs, three sampling sites were selected and five samples were collected making a total of ninety samples. The samples were taken to laboratory to determine their nutritional compositions. The cereal husks included sorghum husk, millet husk, and pearl millet husk. The result of the proximate analysis showed significant ($p<0.05$) differences among the treatments. Manually processed sorghum husk had higher crude protein content (15.31%) while manually processed pearl millet husks had the lower (9.30%). Manually processed millet husk had the higher crude fiber content (14.41%) and manually processed pearl millet husks had the lower value (12.52). Mechanically processed sorghum husks recorded higher Ether Extract (0.65%) while mechanically processed millet husk was lower (0.35%). Mechanically processed sorghum husk was higher in ash (5.20%) while manually processed pearl millet husks (3.18%) was lower and manually processed pearl millet husks recorded the higher nitrogen free extract (NFE) value (74.41%) and manually processed sorghum husks recorded the lower value (65.52%). On the value of acid detergent fiber (ADF) and neutral detergent fiber (NDF), manually pearl millet husk recorded the higher value (37.05% and 51.15%), while mechanically processed pearl millet husk recorded the lower value (25.60% and 46.40%). It can therefore be concluded that, based on the results of the proximate analysis of the collected samples, the result shows that the husks can be used to feed ruminant animals and provide better results.

Keywords: Cereal husks, Proximate, Fibre, Ruminants

INTRODUCTION

Small ruminants occupy a substantial fraction of the livestock production in Nigeria due to their ability to utilize readily available and cheap fibrous feeds that are otherwise not consumed by humans and their monogastric counterpart. Key to their ability to utilize feeds of high fiber content is the existence of rumen fibro-lytic bacteria (Salami *et al.*, 2019). They form an important part of livestock for resource-limited farmers as they can be raised with lower capital compared to other livestock (Moyo *et al.*, 2019). These animals significantly contribute to animal protein supply in Nigeria (Aruwayo *et al.*, 2019). However, the feed and feeding stuff supply for small ruminant production remain the major constrain to their production. It has been reported that feeding which constitutes about 60% to 65% of the total cost of animal production in Nigeria remains the major setback in ruminant production as they majorly depend on pastures whose supply varies with season (Dayo, 2009). There are a numerous number of plant residues that have the potential of being used as feed for ruminants. Amongst them are a wide range of plants that are unknown to the public domain and some that are underutilized mainly due to the lack of information regarding their feeding value (Salami *et al.*, 2019). A preliminary study revealed that these plant residues are available during the periods of pasture scarcity. Thus, exploration of these plant residues will help not only in increasing the year-round availability of forage base for livestock but also help in assuaging the difficulties animals and their owners go through during the period of feed scarcity (Price *et al.*, 2020). To determine whether a forage crop can be a potential feed for a ruminant or not, requires the evaluation of its nutritional value. Feeding value and quality of forages as feed for ruminants can be assessed by determining chemical composition, intake, palatability, acceptability and digestibility (Gashaw and Defar, 2017).

This study was therefore designed to evaluate the nutritional composition of cereal (i.e., pearl millet husk, Sorghum husk and millet husk) processed manually and mechanically for feeding ruminant animals.

METHODOLOGY

Study Area

The study was conducted in Department of Animal Science Laboratory, Federal University Dutse, Jigawa State, Nigeria, 11.76°N 9.34°E 444m above sea level, the state has an estimated land size of 23,154 km^2 (Google Earth, 2012). Situated within the Sudan Savannah vegetation zone, but there are traces of Guinea savannah in the southern part of the state. The state is characterized by a long dry season of 7-8 months, mean annual rainfall ranges from 600 to 1000mm with a peak in August, minimum and maximum temperatures of 12^0C and 40^0C, and relative humidity 40% to 78%. Lowest temperatures occur during the harmattan (November - February) and highest from March to June (Olofin, 2008).

Sample and Sampling Procedures

Multistage sampling techniques was employed in collecting the samples from the study areas. The three Agricultural Development Programs (ADPs) Zones of Jigawa state were selected purposely. Three sampling sites were selected from each of the three ADPs Zones for sample collection of the husks each based on cereals farming population. Finally, five samples were collected for each husk; Millet husk (T1), Sorghum husk (T2) and Pearl millet husk (T3). Making a total of forty-five (45) each for manually and mechanically processed cereals husks. The collected husks were cleaned by removing all debris materials. The samples collected were labelled as follows;

Table 1 Mechanically and Manually Processed Cereal Husks and their sources of collection

Cereals Husks	**Treatment**	**ADPs**	**Sample Sites**	**Number of samples**
	MCP			
Millet	T1	Birnin Kudu	3	15
Sorghum	T2	Hadejia	3	15
Pearl Millet	T3	Kazaure	3	15
	MNP			
Millet	T4	Birnin Kudu	3	15
Sorghum	T5	Hadejia	3	15
Pearl Millet	T6	Kazaure	3	15

Note: MCP: Mechanically Processed Husks, MNP: Manually Processed Husks

Laboratory Analysis

The cleaned samples were subjected to proximate analysis as described by Association of Official Analytical Chemist (AOAC), (2013) procedures for dry matter (%DM), crude protein (%CP), crude fiber (%CF), ether extract (%EE), nitrogen free extract (%NFE) and ash (%ASH). Fiber fractions were determined according to Van Soest, (2013) procedures for acid detergent fiber (ADF), neutral detergent fiber (NDF), carbohydrate (%CHY) and hemicellulose (HEMI). Energy was calculated using Pauzenga (1985) formula. Metabolizable energy (ME) Kcal/Kg = 37 * %CP + 81 * %EE + 35.5 * %NFE.

Data Analysis

Data generated from these studies were analyzed using One-way Analysis of Variance (ANOVA) procedure of Statistical Analytical System (SAS, 2013). Significant treatment means were separated using least significant difference (LSD) at 5% level of significance.

RESULTS

Proximate Composition of Some Selected Cereal Husks

The proximate composition of millet husk, sorghum husk and pearl millet were shown in Table 2. The values obtained indicated significant difference ($p<0.05$) among the treatments. Ash content ranges from 3.18-5.20%. Mechanically processed sorghum husk (T2) had the highest ash content (5.20 %) while manually processed pearl millet husk (T6) recorded the lowest value of ash content (3.18%). The moisture content values range from 4.53-6.08%. The manually processed pearl millet husk (T5) had the highest moisture content (6.08%) while mechanically processed sorghum husk (T2) had the least moisture content (4.53%). The values of crude protein (CP) content range from 9.30-15.31%. Manually processed sorghum husk (T5) recorded the highest CP content (15.31%) as compared with that of manually processed pearl millet husk (T6). The sorghum husks processed mechanically had the highest dry matter content value of 95.50% (T2) while manually processed sorghum husk (T5) had the lowest dry matter content (93.90%). The highest crude fibre

(CF) content (14.41%) was recorded in manually processed millet husk (T4) while manually processed pearl millet husk (T6) had the lowest CF content (12.52%).
The values of ether extract content ranged from 0.35-0.60%. The mechanically processed sorghum husk (T2) recorded the highest value (0.60%) while mechanically processed millet husk (T1) had the lowest ether extract values (0.35%). Nitrogen free extract (NFE) content ranged from 65.52-74.41%. Manually processed pearl millet husk (T6) had the highest NFE (74.41%) while manually sorghum processed millet husk (T5) had the lowest NFE (65.52%).

Table 2 Proximate Analysis of Some Cereal Husks Processed Mechanically and Manually

Treatments	%Ash	%DM	%CP	%CF	%EE	%NFE
Mechanically processed millet, sorghum and pearl millet husks						
T1	4.68^{b}	94.55^{b}	10.38^{d}	12.60^{c}	0.35^{d}	71.99^{ab}
T2	5.20^{a}	95.50^{a}	11.98^{c}	12.84^{c}	0.65^{a}	69.34^{bc}
T3	3.73^{c}	94.75^{b}	12.58^{bc}	13.27^{b}	0.55^{bc}	67.48^{c}
Manually processed millet, sorghum and pearl millet husks						
T4	4.33^{b}	94.70^{b}	13.67^{b}	14.41^{a}	0.50^{bc}	67.11^{c}
T5	4.43^{b}	93.90^{c}	15.31^{a}	14.29^{a}	0.45^{cd}	65.52^{c}
T6	3.18^{a}	94.50^{b}	9.29^{d}	12.52^{c}	0.60^{b}	74.41^{a}
SE±	**0.201**	**0.144**	**0.614**	**0.233**	**0.032**	**0.989**

The fibre fractions of millet, pearl millet and sorghum husks are shown in Table 3. The values of acid detergent fibre content ranged from 25.60 to 37.05%. The highest value (37.05%) was recorded in manually processed pearl millet husk (T6) while mechanically processed pearl millet husk (T3) had the lowest acid detergent fibre content (25.60%). The values of neutral detergent fibre content ranges from 46.40-51.15%. Mechanically processed pearl millet husk (T3) had the highest neutral detergent fibre (51.15%) while mechanically processed millet husk (T1) had the lowest neutral detergent fibre content (46.40%). On the values of carbohydrate content, the manually processed sorghum husk (T5) had the highest carbohydrate content (28.41%) while manually processed pearl millet husk (T6) recorded the lowest carbohydrate content (25.60%). The metabolized energy (ME) ranges from (2905.55-3034.26 Kcal/Kg) and hemicelluloses ranges from (10.85-25.55%).

3 Table fiber fractions of some selected cereal husk processed manually and mechanically

Treatments	%ADF	%NDF	%CHY	%HM	ME (Kcal/Kg)
Fiber fractions of some selected cereal husks processed mechanically					
T1	32.10^{c}	46.40^{c}	22.56^{c}	14.30^{c}	2936.83
T2	30.80^{d}	49.60^{ab}	26.09^{b}	18.80^{b}	2957.48
T3	25.60^{e}	51.15^{a}	24.89^{b}	25.55^{a}	2905.55
Fiber fraction Manually processed millet, sorghum and pearl millet husks					
T4	34.50^{b}	49.20^{bc}	28.40^{a}	14.70^{c}	2928.88
T5	37.05^{a}	47.90^{bc}	20.14^{d}	10.85^{d}	3034.26
T6	34.50^{b}	49.20^{bc}	28.40^{a}	14.70^{c}	2928.88
SE±	1.064	0.526	0.873	1.434	12.427

%ADF (acid detergent fibre), %NDF (neutral detergent fibre), %CHY (carbohydrate), %HM (hemicelluloses), ME (metabolized energy Kcal/Kg)

DISCUSSION

Development of a feed for ruminant production entails evaluation of proximate composition, fiber fractions, digestibility and performance efficiency as well as cost implications and conditions of application (Kassahun *et al.*, 2012). The current study was conducted to evaluate the effect of different processing methods on proximate compositions and fiber fractions of some cereal husks which can potentially be used for ruminant feeding. The finding of this study revealed that processing methods can significantly influence the proximate composition of cereal husk. For instance, the crude protein content of pearl millet husk processed mechanically was about 12.58% which was significantly higher than that of same millet husk which was manually processed (9.29%). This trend was observed not only in crude protein content but in the rest of the proximate compositions analyzed in this study. Moreover, the finding of this study showed that processing method could improve the crude protein content of cereal husk. As most of the analyzed components were within or even above the normal range reported by different researchers (Ganesan and Rajauria, 2020; Chong *et al.,* 2019; Yesritha *et al.,* 2019). The result of this study is in contrary to that of Hindrichsen *et al.* (2001) who reported that most crop residues were low in crude protein and high in fiber content. Studies have shown that, crude protein content of crop residues are influenced by many factors such as stage of growth, maturity and species or variety and soil types (Promkot and Wanapat, 2005). These factors may partially explain the reason for the differences in the crude protein content analyzed between this study and others. According to Ramon and Jorge (2005) the factors that contributed to low concentration of protein were the high levels of fiber. Abubakar *et al*. (2010) recorded lower values for DM 91.75 % and ADF 27.84 %, in this current study the value of DM ranges from (94.55 to 95.50%) and ADF values ranges from 25.60 to 32.10%) in mechanically processed, while the value of DM in manually processed husks ranges from 93.90 to 94.70% and ADF value 31.20 to 37.05% in this research. DM intake is an important factor in the utilization of feed by ruminants and is a critical determinant of energy and performance in small ruminants. Minson (2000) recommended critical CP level of 7 %, below which feed intake of ruminants will be depressed, thus a combination of these feedstuffs in a compounded ration will appear ADF and NDF in these by-products showed that they are of better feeding quality than feeds with higher ADF and NDF contents. In this research, mechanically processed husks had the NFE value of (67.48 to 71.10%) while that of manually processed husks ranges from (65.52 to 74.41%) and the value of ether extract ranges from 0.35 to 0.65%, that is, the high value of ether extract is 0.65%. In view of the information obtained from this research, feeding livestock with mechanically processed sorghum husks in fattening business could give better result.

CONCLUSION

The study conducted that the selected cereal husk processed both mechanically and manually can sustain ruminant animal production and therefore farmers shall be advising to use it for better ruminant production.

REFERENCES

Abubakar, M., Adegbola, T. A., Abubakar, M. M., Shehu, Y., Ngele, M. B., and Kalla, D. J. U. 2010. Nutritional evaluation of different sources of nitrogen on digestible nutrient intake, nitrogen balance and production of rumen metabolites in growing Yankasa sheep. *Emirates Journal of Food and Agriculture,* 298-307.

AOAC 2013. Official methods of analysis (19th Edition). Association of Official Analytical Chemist,Washington D.C., USA.

Aruwayo, A., Ahmed, K. S., and Muhammad, I. R. 2019. Socio-Economic Characteristics and Animal Feed Resources of Ruminant Farmers in Katsina State, Nigeria. *Journal of Applied Sciences and Environmental Management,* 23 (7): 1357-1363.

Chong, R. W. W., Ball, M., McRae, C., and Packer, N. H. 2019. Comparing the chemical composition of dietary fibres prepared from sugarcane, psyllium husk and wheat dextrin. *Journal of Food Chemistry,* (298): 125-132.

Dayo, P., Ephraim, N., John, P., Omobowale, A. O. 2009. Constraints to increasing agricultural productivity in Nigeria. Nigeria Strategy Support Programme (NSSP) background paper No. NSSP 06, International Food Policy Research Institute, Washington D. C., USA.

Ganesan, A. R., and Rajauria, G. 2020. Cereal Based Animal Feed Products. Innovative Processing Technologies for Healthy Grains, 199-226.

Gashaw, M., and Defar, G. 2017. Livestock feed resources, nutritional value and their implication on animal productivity in mixed farming system in Gasera and Ginnir Districts, Bale Zone, Ethiopia. *International Journal of Livestock Production,* 8 (2): 12-23.

Google Earth 2012. Google Location Map; Google Earth Imagery

Hindrichsen, I. K., Osuji, P. O., Odenyo, A. A., Madsen, J. and Hvelplund, T. 2001. Effect of supplementation of maize stover with foliage of various tropical multipurpose trees and *Lablab purpureus* on intake, rumen fermentation, digesta kinetics and microbial protein supply of sheep. *Journal of Animal Feed Science and Technology,* 113 (1-4): 83-96.

Kassahun, A., Waidbacher, H., and Zollitsch, W. 2012. Proximate composition of selected potential feedstuffs for small-scale aquaculture in Ethiopia. Livestock Research for Rural Development, 24 (6): 1-118.

Minson, D. 2000. An evaluation of the Daisy II-220 technique for determining in vitro digestibility of animal feeds in comparison with the Minson and McLeod technique. *South African Journal of Animal Science,* 30 (1): 45-46.

Moyo, M., Bhiya, S. T., Katamzi, M., and Nsahlai, I. V. 2019. Evaluation and prediction of the nutritive value of underutilised forages as potential feeds for ruminants. Forage Groups.

Olofin, E. A. 2008. The Physical Settings in Wudil within Kano region: A geographical perspective synthesis. Kano city, Adamu Joji publisher pp.1-34

Pauzenga, U. 1985. Feeding Parent Stock. *Zootech. International,* pp. 22-25.

Price, M., Rowan, Y. M., Kersel, M. M., and Makarewicz, C. A. 2020. Fodder, pasture, and the development of complex society in the Chalcolithic: isotopic perspectives on animal husbandry at Marj Rabba. Archaeological and Anthropological Sciences, 12 (4): 1-14.

Promkot, C. and Wanapat, M. 2005. Effect of level of crude protein and use of cotton seed meal in diets containing chips and rice straw for lactating dairy cows. *Asian-Australian Journal of Animal Science,* (18): 502-511.

Ramon, M. and Jorge, G. 2005. Factors contributing to proteolysis and distruption of myofibrillar proteins and the impact on tenderization in beef and sheep meet. Thirteenth European Signal Processing, (5): 1-5.

Salami, S. A., Luciano, G., O'Grady, M. N., Biondi, L., Newbold, C. J., Kerry, J. P., and Priolo, A. 2019. Sustainability of feeding plant by-products: A review of the implications for ruminant meat production. *Journal of Animal Feed Science and Technology*, (251): 37-55.

SAS, 2013. SAS user's guide. Statistics. SAS Institute, Cary, North Carolina, USA.

Van, S. 2013. Lipid detection in artherosclerotic human coronaries by spectroscopic intravascular photoacoustic imaging. Optic Express, 21 (18): 21472-21484.

Yesritha, Y., Jaganmohan, R., and Babu, A. S. 2019. Effect of Water Treatment and Size Reduction on Dietary Fiber Content of Blackgram Husk. *Asian Journal of Dairy & Food Research*, 38 (4).