Chemistry Research Journal, 2019, 4(3):105-110

Available online www.chemrj.org

Research Article

ISSN: 2455-8990
CODEN(USA): CRJHA5

Musa sapientum Peels as Infallible Components in Ruminants Feed Formulation

Hassan, U.F.*[1], Hassan, H.F.[2], Ibrahim, A.B.[1], Hassan, A.F.[3], Lawal, N.M.[1], Tabe, N.N.[4] Ushie, O.A.[5]

[1]Department of Chemistry, Abubakar Tafawa Balewa University, Bauchi, Nigeria
[2]Department of Internal Medicine, Women and Children Hospital, Bauchi, Nigeria
3Department of Pharmacy, Federal Medical Centre, Azare, Bauchi, Nigeria
[4]Department of Chemical Sciences, Cross River University of Technology, Calabar, Nigeria
[5]Deparment of Chemical Sciences, Federal University, Wukari, Nigeria
*Corresponding Author: ufhassan2007@gmail.com

Abstract The peels of *Musa sapientum* known as Ayaba in Hausa language was analyzed for its nutritive and mineral status using various standard analytical methods. The results of the investigation indicated that the nutrients (moisture content, crude fibre, crude protein, crude lipid, ash content and available carbohydrate) as well as mineral elements (K, Na, Mg, Ca, P, Cu, Zn, Mn and Fe) were found at different concentrations (mg/100 g). The wastes (peels) were found to contain 62.33 ± 0.06 % moisture content, 1.95 ±0.06 % crude protein, 5.93 ± 0.06 % crude lipid, 9.60 ± 0.01 % ash content, 8.37 ± 0.08 % crude fibre, 11.32 ± 0.97 % available carbohydrate and 445.00 kJ/100 g metabolizable energy content(nutrients composition). The peels were equally and respectively found to contain 211.30 ± 0.55, 44.50 ± 0.04, 115.10 ± 0.12, 47.00 ± 0.56, 59.10 ± 0.38, 0.51 ± 0.01, 4.39 ± 0.07, 0.70 ± 0.04 and 0.51 ± 0.02 mg/100 g of phosphorus, magnesium, sodium, iron, calcium, copper, potassium, manganese and zinc (mineral elements). The banana peels can therefore be used in compounding goats and sheep feeds, but this has to be fortified with some of the deficient mineral elements in order to meet up with the desired recommended dietary allowance (RDA) values.

Keywords *Musa sapientum*, recommended dietary allowance, fortified, metabolizable energy content, nutrients and minerals

1. Introduction

Banana is a long curved fruit with a thick yellow skin and soft flesh that grows as trees in hot countries [1]. The fruit fibre has a better quality than fibre from other sources, This might be due to its high total and soluble fibre content, water and oil holding capacities and its colonic fermentability as well as lower phytic acid and caloric value content [2]. Banana peels are generally utilized as feedstock since they have some nutritional values in them. The peels are therefore largely used for that purpose on small farms especially in areas or localities where bananas are grown. The fruit is known as Ayaba in Hausa language and the scientific name is *Musa sapientum* [3].

In Nigeria, the fundamental reason that deters the rapid development in livestock production is the increasing unavailability and high cost of conventional feeds [4]. This has therefore threatened the potential of increasing

animal feed production which is scarce. Nigeria as a country has an alarming rate of population growth for both human and livestock such as sheep, goats, poultry and cattle [5]. Food security for these millions of Nigerians and their domesticated ruminants is of paramount concern to the government since most staple food for human could also be used as livestock feeds, hence exalting intensive competition between human and livestock for the food items that are in short supply.

The relevance of food in the growth and development of any country cannot be over-stressed. The population of Nigeria as a nation is presently at great risk now more than ever before considering the high level of food insecurity and deprivation [6]. Apparently, banana are usually eaten by man leaving large quantity of the peels as wastes in restaurants, offices, hotels, homes and even markets that constitute environmental menace. These when pooled together can serve as source of nutrients, minerals and energy for the ever-increasing livestock in our nation. This research work is aimed at determining the proximate composition (ash content, crude fibre, crude lipid, crude protein, moisture content, metabolizable energy content and available carbohydrate) and mineral contents (Fe, Cu, Mg, Na, Ca, K, Mn, Zn and P) of the peels of banana *(Musa sapientum)* as this may serve as a means of using the wastes in feed formulation of ruminant animals.

2. Materials and Methods

2.1. Materials

Analytical reagent (AnalaR) grade chemicals and distilled water were utilized in this research work. All the plastic and glass wares that were used were thoroughly washed with detergent solution, 20.00 % (v/v) trioxonitrate (v) acid, rinsed with tap water and finally with distilled water. The apparatus were then allowed to dry [5].

2.2. Methods

2.2.1. Sampling of *Musa sapientum* Fruits

Musa sapientum fruits were purchased within Bauchi metropolis, Nigeria. The samples were cleaned, washed, peeled, dried and kept prior to the analyses of the parameters investigated.

2.3. Determination of Parameters

The proximate/nutritive compositions of the peels of *Musa sapientum* were determined using different standard analytical techniques adopted by different researchers. The peels of the same *Musa sapientum* were digested and the mineral contents were determined at their different wavelengths using various standard methods.

2.3.1. Proximate Determinations

The proximate/nutritive content of the peels of banana (*Musa sapientum)* were determined. The moisture content, ash content, the crude fibre, lipid and protein were all assayed based on the methods of AOAC, 2000 [7]. The level of available carbohydrate was computed by difference, while the metabolizable energy content of the banana peels was evaluated using the method adopted by Onwuka, 2005 [8].

2.3.2. Mineral Determinations

The mineral composition of the peels of *Musa sapientum* was determined based on the method adopted by Hassan *et al*, 2013 [9]. The levels of the minerals (Cu, Zn, Fe, Mn, Na, Ca, Mg and K) were determined at their respective wavelengths using Atomic Absorption Spectrophotometer Model 210-VGP, whilst phosphorus was colorimetrically assayed using the method adopted by Hassan *et al*., 2017 [5] by means of a Cecil UV/Visible Spectrophotometer Model 91743.

3. Results and Discussion

3.1 Results

The results of proximate concentration/composition of the peels of banana (*Musa sapientum*) are as indicated in Table 1, while the mineral content/composition (mg/100 g) are shown in Table 2.

Table 1: Proximate Composition of *Musa sapientum* (Banana) Peels

Nutrients	% Composition (Dry Mass)
Moisture Content	62.33 ± 0.06
Crude Protein	1.95 ± 0.06
Crude Lipid	5.93 ± 0.06
Ash Content	9.60 ± 0.01
Crude Fibre	8.37 ± 0.08
Available Carbohydrate	11.32 ± 0.97
Metabolizable Energy Content (kJ/100 g)	445

Values are mean ± standard error of the mean (n = 5)

Table 2: Mineral Composition of *Musa sapientum* (Banana) Peels (mg/100 g) Dry Matter

Mineral Elements	Concentration	RDA (mg/100 g) [10]
Magnesium	44.50 ± 0.04	170
Calcium	59.10 ± 0.38	260
Potassium	4.39 ± 0.07	220
Sodium	115.10 ± 0.12	70
Iron	47.00 ± 0.56	35
Copper	0.51 ± 0.01	0.9
Zinc	0.51 ± 0.02	3
Manganese	0.70 ± 0.04	3
Phosphorus	211.30 ± 0.55	270

Values are mean ± standard error of the mean (n = 5)

3.2. Discussion

3.2.1. Proximate Concentration/Compositions

Table 1 shows the observed proximate nutrient composition of banana (*Musa sapientum*) peels. The percentage moisture level of the sample was found to be 62.33 %. The observed value (62.33 %) is the highest of all the proximate contents determined in the sample, which is an indication that it has high moisture content. The determined value compares relatively well with the spread moisture values of 61.95 to 72.07 % found in browse leaves and tuber peels used as ruminant feeds [11]. Animal feed with low moisture content is more desirable. This is because low moisture composition is a vital means of stability, susceptibility of microbial pollution and is also relevant for storage [9]. An animal feed with moisture level higher than 15.00 % is likely to favour or enhance microbial growth [12].

A low crude protein level of 1.95 % was found in the banana peel sample (Table 1). Feed with a crude protein content of 8.00 % (approximately 1.30 % nitrogen) is considered as being deficient since this cannot provide the minimum levels of ammonia that is required by ruminants [11]. The observed crude protein (1.95 %) is also lower than the threshold value of 10.00 % needed to meet the requirement for the body maintenance of sheep and goats [5]. Protein is a substance that constitutes the muscle, wool, skin and high proportions of the body of animals and is required in the feed of animals for producing milk, eggs and meat. The peel of *Musa sapientum* is therefore regarded as a poor source of protein.

The crude lipid content determined (5.93 % ± 0.06) was low. The low crude fat content can increase the storage life of the ruminant feed by reducing the chances of developing rancidity. The observed value can therefore not be a good source of fat soluble vitamins, but it can contribute significantly to energy content of the feed. The experimental value is higher than literature value of 1.86 % found in *Dioscorea alata* peels [4]. This shows that it is a better source of animal lipid than the *Dioscorea alata* peels. The peels are however not economical for exploitation at commercial level. Lipids are important since they are source of fat soluble vitamins that facilitate their absorption. Lipids are also high energy nutrients which do not add to the bulk of animal diet [13].

The level of ash determined was 9.60 % which is far greater than 2.40 % found in *Cinnamon* [14], but relatively higher than 9.08 % found in whole *Typha domingensis* plant [13]. The concentration of ash in a plant is an index of its mineral composition that is vital to animals in the prevention of some blood related ailments and also necessary

for blood coagulation. An animal feed with a fairly high level of ash is needed. This is because it is required for the provision of magnesium and calcium that are needed for the formation of bone [15].

The concentration of crude fibre determined in the test sample was 8.37 %. The experimental value (8.37 %) is lower than 10.17 % found in the peels of *Solanium tuberosum* [5]. It is also far less than reported literature value of 17.46 % determined in whole *Typha domingensis* plant [13]. Fibre in animal feed is basically employed as a measure of value in feeding stock feeds as well as in poultry. It also aids in reducing some diseases in animals [13]. Considering the level of crude fibre determined in the peel sample, it is therefore evident that the sample can be used in feed formulation. This is because ruminant animals such as goat, sheep, deer and cattle can ferment fibre for energy.

An available carbohydrate content of 11.32 % was assayed in the peel sample (Table 1). The determined value (11.32 %) is higher than reported carbohydrate literature value of 4.89 % in whole *Typha domingensis* plant [13]. The same determined value was however lower than 52.00 % in *Cinnamon* [14].This indicates that the sample is a relatively poor source of energy. It is essential in the maintenance of animals as well as plants lives and also provides the raw materials that are needed by various industries. The peel is therefore relevant in high temperature feed processes because of its low carbohydrate concentration [13].

3.2.2. Mineral Compositions

The results of mineral composition of the peels of banana (*Musa sapientum*) are presented in Table 2. The level of phosphorus determined in the analytes was 211.30 mg/100 g, which is comparatively and relatively lower than the recommended dietary allowance (RDA) of 270.00 mg/100 g for goats [10]. Phosphorus is important in the carbohydrate metabolism of animals, alkaline/acid balance in their blood as well as for their healthy growth [16].

The concentration of magnesium determined was 44.50 mg/100 g. A magnesium concentration of 12.00 to 18.00 mg/100 g was reported to be sufficient for ruminant animals [17]. The peel is certainly an important source of magnesium for ruminants. Magnesium is an important mineral element since it is needed for muscle tone and heart functions. It is also relevant in the nervous system of animals and also in the production of energy [16].

The value of observed sodium found in the banana peels was 115.10 mg/100 g (Table 2). This compares favourably with the sodium RDA value (70.00 mg/100 g) of goats [10]. This shows that the peel sample has adequte amount of sodium that can be used by goats and sheep. Sodium is important to animals in regulating their body fluids, gastric acids as well as in transporting nutrients in their blood [16].

An iron concentration of 47.00 mg/100 g was found in the peels of *Musa sapientum*. The experimental iron value is higher than the RDA value (35.00 mg/100 g) for goats [10]. This therefore shows that the banana peel is a good source of mineral element (iron) for goats and sheep. Iron deficiency hardly manifest except when there are signs of parasitic infections. The mineral element is a relevant component of haemoglobin and is useful to animals in transporting oxygen to their cells [16], [18].

The concentration of calcium determined (59.10 mg/100 g) in the present study was much lower than the RDA value (260.00 mg/100 g) for goats. A calcium concentration of between 120.00 and 260.00 mg/100 g is needed for the maintenance of lactating and growing sheep and cattle [19]. This implies that the concentration of calcium determined in the analyte is insufficient in feed formulation. Calcium is important to animals for nervous system, muscular and heart functions as well as in the development of bones and teeth [16].

It can be seen from Table 2 that the peels of *Musa sapientum* are poor source of copper, potassium, manganese and zinc respectively. The levels of the mineral elements found in mg/100 g are: copper (0.51), potassium (4.39), manganese (0.70) and zinc (0.51) are separately and respectively less than their corresponding RDA concentrations (mg/100 g) of 0.90, 220.00, 3.00 and 3.00 for goats [10]. In order to meet up with he RDA values of sheep, goats and possibly cattle, other sources of these mineral elements would have to be fortified in the feed formulation. Copper is vital to animals in the production and maintenance of collagen, enzyme function and the maturation of red blood corpuscles or cells. Potassium is important to animal in the formation of hormones, functioning of muscles and also aids in maintaining alkaline/acid balance in their blood.Manganese is essential to animals in cartilage and

bone production, enzyme system, reproduction and immune response. Finally, zinc is also relevant to animals in immune system, protein formation and epithelial tissue integrity [16].

3.3. Statistical Analysis

All the observed/experimental values were subjected to standard error of the mean (a measure of precision). Precision is the closeness between several replicate determinations of the same variable.

4. Conclusion

This research work has indicated that the peels of *Musa sapientum* (banana) contain significant concentration of some nutrients as well as mineral elements and can therefore be used in the formulation of animal feed. And since the peel/waste is deficient in some of the nutrients and mineral elements, there is need to fortify it in compounding the feed so as to meet up with the desired recommended dietary allowance.

References

[1]. Hornby, A.S. (2005). "Oxford Advanced Learner's Dictionary". (7th Ed.). *Oxford University Press, New York*. pp. 101.

[2]. Figuerola, F., Hurtado, M.L., Estevex, A. M., Chifelle, I. & Aserijo, F. (2005). Fibre Concentrates from Apple Pomace and Citrus peel as Potential Fibre Sources for Food Enrichment. *Food Chemistry*. 9: 395-401.

[3]. Agishi, E.C. & Shehu, Y (2004). "Hausa, Fulfulde & Scintific Names of Plants". *Agitab Publishers Ltd, Nigeria.* pp. 3-129.

[4]. Yahaya, I.A., Nok, A.J., Saidu, S.A., Achi, S.S. & Bomire, J.J. (2007). Nutritional and Anti-nutritional Assessment of the Peel of *Dioscorea alata* (Water Yam). *Chemclass Journal*. 4: 65-69.

[5]. Hassan, U.F., Hassan, H.F., Shibdawa, M.A., Baba, H. & Sabo, I. (2017). The Potential of the Peel of Solanium tuberosum (Irish potatoes) Feed Formulation. *International Journal of Advanced Research and Technology*. 6(1): 181-185.

[6]. Hassan, L.G., Umar, K.J. & Tijjani, A.A. (2007). Preliminary Investigation in the Feed Quality of *Monechma ciliatum* seeds. *Chemclass Journal*. 4 (1): 83-86.

[7]. AOAC (2000). Official Methods of Analysis. (15th Ed.). Association of Official Analytical Chemists, Washington DC.

[8]. Onwuka, G.I. (2005). "Food Analysis and Instrumentation, Theory and Practice". *Naphthali Prints*, Nigeria. pp. 133-135.

[9]. Hassan, U.F., Baba, H., Shibdawa, M.A., Mahmood, A.A. & Ishaku, J. (2013). Assessment of Feed Quality Efficiency of *Moringa oleifera* seeds. *Journal of Chemical Society of Nigeria*. 38 (2): 70-73.

[10]. Ramirez, O. R., Ramirez, R.G., Gondalez, R. & Haelin, G.F.W. (2005). Cited in: Hassan, L.G.,Umar, K.J. & Tijjani, A.A. (2007). Preliminary Investigation in the Feed Quality of *Monechma ciliatum* seeds. *Chemclass Journal*. 4 (1): 83-86.

[11]. Afolabi, T. A., Onadeji, R.S., Ogunkunle, O.A. & Bamiro, F.O. (2013). Cited in: Hassan U.F., Hassan, H.F., Baba, H. & Suleiman, A.S. (2018). The Feed Quality Status of Whole *Typha domingensis* Plant. *International Journal of Scientific and Engineering Research*. 9 (5): 1609-1617.

[12]. Hassan, L.G., Umar, K.J., Adeyemi, J.O. & Mohammed, A.S. (2005). Proximate Composition and Physicochemical Properties of Seed and Oil of *Cassia sismea*. *Bulletin of Science Association of Nigeria*. 26: 373-380.

[13]. Hassan U.F., Hassan, H.F., Baba, H. & Suleiman, A.S. (2018). The Feed Quality Status of Whole *Typha domingensis* Plant. *International Journal of Scientific and Engineering Research*. 9 (5): 1609-1617.

[14]. Shumaila, G. & Mahpara, S. (2009). Proximate Composition and Mineral Analysis of *Cinnamon. Pakistan Journal of Nutrition*. 8 (9): 1456-1460.

[15]. Okeke, J. A. (2001). Cited in: Hassan, U.F., Hassan, H.F., Shibdawa, M.A., Baba, H. & Sabo, I. (2017). The Potential of the Peel of *Solanium tuberosum* (Irish potatoes) in Feed Formulation. *International Journal of Advanced Research and Technology*. 6 (1): 181-185.

[16]. Jurgens, M.H. (2001). Cited in: Hassan U.F., Hassan, H.F., Baba, H. & Suleiman, A.S. (2018). The Feed Quality Status of Whole *Typha domingensis* Plant. *International Journal of Scientific and Engineering Research*. 9 (5): 1609-1617.

[17]. Leterme, P. & Munoz, L.C. (2002). Cited in: Hassan U.F., Hassan, H.F., Baba, H. & Suleiman, A.S. (2018). The Feed Quality Status of Whole *Typha domingensis* Plant. *International Journal of Scientific and Engineering Research*. 9 (5): 1609-1617.

[18]. FAO (Food and Agricultural Organizaton of the United Nations). (2011). Cited in Hassan U.F., Hassan, H.F., Baba, H. & Suleiman, A.S. (2018). The Feed Quality Status of Whole *Typha domingensis* Plant. *International Journal of Scientific and Engineering Research*. 9 (5): 1609-1617.

[19]. Reuter, D.J. & Robinson, J.B. (1997). Cited in: Afolabi, T. A., Onadeji, R.S., Ogunkunle, O.A. & Bamiro, F.O. (2013). Comparative Analysis of the Nutritional Quality of Browse Leaves *(Spondias mombin and Albizia saman)* and Tuber Peels (Yam and Cassava) used as Ruminant Feeds. *Journal of Chemical Society of Nigeria*. 38 (2): 59-65.