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Evaluation of proximate content and vitamin profile of *Moringa oleifera* seed hull

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Moringa plant is a plant with increase awareness of its health and nutritional benefits in Nigeria. This study was conducted to examine the nutrient composition of underutilized hull of *Moringa oleifera* seed. Proximate composition, antinutrients, minerals and vitamins profile of the hull were determined using standard analytical methods. The hull contained crude protein 5.25±0.011%, crude fibre 19.5±0.038%, ash 5.0±0.026%, crude lipid 4.25±0.011%, carbohydrate 55.2±0.062 and moisture content of 10.8±0.033%. Sodium (45.49 mg/100 g) and potassium (24.52 mg/100 g) were the most abundant minerals with appreciable amount of vitamin E and beta-carotene. Alkaloid (0.25%), saponin (10%), oxalate (0.015 mg/100 g) and phytate (0.487 mg/100 g) were found in the hull. It was therefore concluded that the findings of *M. oleifera* seed hull contain nutritive values that may necessitate its usage in alternative feed formulation instead of just remaining an agro waste.

Key words: Antinutrients, hull, minerals, *Moringa oleifera,* vitamins.

INTRODUCTION

Moringa oleifera is a widely cultivated medium sized tree species that originated from Northwest India. It is a fast growing aesthetically appealing tree characterised by long, drumstick shaped pods that contain about five to seven seeds within its first year of growth (Aja et al., 2013). Moringa tree grows in humid or hot dry lands and well adapted in less fertile soils and drought affected areas. In Nigeria, there is increasing awareness of the health and nutritional benefits of different parts of Moringa plant and government at various levels are now supporting the growth of this important tree (Bello et al., 2015).

The seed is composed of edible inner part covered with a round shaped semi permeable hull with whitish wings that run from top to bottom at an interval of 120°C. The seeds can be grounded into powder when dried and used as food or other purposes (Anjorin et al., 2010; Quattrochi, 1999).

M. oleifera seed hull does not seem to have any known uses and are generally peeled and dumped. Thus, this necessitates the study to provide relevant scientific data on the nutrient composition of *M. oleifera* seed hull.

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This work therefore aims at assessing the proximate composition, mineral and vitamin content and antinutrients of *M. oleifera* seed hull.

MATERIALS AND METHODS

Collection and sample preparation

Pods were collected from *M. oleifera* plantation in National Research Institute for Chemical Technology, Zaria. The hulls were removed from the seeds, dried at room temperature and then ground to a powder using mechanical grinder.

Proximate analysis

Crude protein was determined using Pearson (1976), while moisture content, crude fibre, lipids, and ash were determined using standard analytical procedures of AOAC (2000). Carbohydrate content was obtained by difference [100-% (protein+ash+lipid+moisture+fibre)].

Determination of minerals and vitamin contents

After digestion, sodium and potassium were determined using a GallenKamp Flame analyzer; Calcium, Magnesium, Iron, Zinc, and Copper were determined using Buch Model 205 Atomic Absorption Spectrophotometer (AAS); while the remaining mineral elements were determined by methods of Ruperez (2002). Vitamin C, vitamin E and beta-carotene contents were determined using UV-VIS spectrophotometer of Shimadzu.

Determination of antinutrients

Determination of oxalate

Titrimetric method of Munro and Bassir (1969) was used with slight modification. Exactly 75 cm^3 of 1.5 M H_2SO_4 was added to 1 g of the ground samples and the solution was carefully stirred intermittently with a magnetic stirrer for about 60 min and filtered. Then, 25 cm^3 of the filtrate was collected and titrated against hot (90°C) 0.1 M $KMnO_4$ solution until a faint pink colour that persisted for 30 s appeared. This was repeated two more times and the concentration of oxalate in each sample was obtained from the calculation: 1 cm^3 of 0.1 M $KMnO_4$ is equivalent to 0.006303 g Oxalate.

Saponin determination

Saponin was determined using the method reported by Ejikeme et al. (2014) and Obadoni and Ochuko (2002). Exactly 100 cm^3 of 20% C_2H_5OH(aq) was added to 5 g of each powder sample in a 250 cm^3 conical flask. The mixture was heated over a hot water-bath (55°C) for 4 h with continuous stirring. The residue of the mixture was re-extracted with another 100 cm^3 of 20% C_2H_5OH(aq) after filtration and heated at 55°C for 4 h stirring. The combined extract was evaporated to 40 cm^3 over water-bath at 90°C, where 20 cm^3 of diethyl ether was added to the concentrate in a 250 cm^3 separator funnel and vigorously agitated from which the aqueous layer was recovered while the ether layer was discarded. This purification process was repeated twice, as 60 cm^3 of n-butanol was added and extracted twice with 10 cm^3 of 5% NaCl. After discarding the NaCl layer, the remaining solution was heated in a water bath for 30 min, after which the solution was transferred into a crucible and was dried in an oven to a constant weight.

The saponin content was calculated as a percentage:

% Saponin = Weight of saponin / Weight of sample × 100

Phytic acid determination

Phytic acid was determined using the procedure described by Haug and Lantzsch (1983). A portion (2 g) of each sample was weighed into 250 cm^3 conical flask; 100 cm^3 of 2% concentrated HCl was used to soak each sample for 3 h. The mixture was then filtered and 50 cm^3 of each filtrate was placed in 250 cm^3 beaker, where 107 cm^3 of distilled water was added to each solution and titrated with standard $FeCl_2$ (aq) which contained 0.00195 iron per cm^3.

% Phytic acid = Y × 1.19 × 100

where Y = Titre value × 0.00195

Determination of alkaloid

The method reported by Ijarotimi et al. (2013) was adopted to determine the alkaloid content of the *M. oleifera* seed hull. Exactly 5 g of the sample was dispersed in acetic and ethanol (1:10) solution. The mixture was left for about 4 h at 28°C and filtered. The filtrate was evaporated and treated with concentrated $NH_4OH_{(aq)}$ drop wise to precipitate alkaloid. It was then washed in a pre-weighed filter paper and dried at 80°C in an oven and estimated.

Statistical analysis

All the analysis was carried out in triplicates and results expressed as mean ± standard error mean.

RESULTS

The proximate composition of *M. oleifera* seed hull is shown in Table 1. The hull contained crude protein 5.25±0.011%, fibre 19.5±0.038%, ash 5.0±0.026%, crude lipid 4.25±0.011%, carbohydrate 55.2±0.062 and moisture content of 10.8±0.033%.

The mineral composition of *M. oleifera* seed hull is shown in Table 2, where the most abundant minerals in the hull are sodium (45.49 mg/100 g) and potassium (24.52 mg/100 g).

The result of the vitamin content is shown in Table 3, with vitamin E (46.189 mg/100 g) having the highest value.

Alkaloid (0.25%), phytate (0.487mg/100 g), oxalate (0.015mg/100 g) and saponin (10%) were found in the hull of the seed (Table 4).

DISCUSSION

The crude fibre content of *M. oleifera* seed hull from this study is higher than 5.03±0.07% for *M. oleifera* seed reported by Ijarotimi et al. (2013), 11.40% and 15.34% in

Table 1. Proximate composition of *Moringa oleifera* seed hull.

Parameter	Proximate composition (%)
Moisture	10.8±0.033
Crude Fibre	19.5±0.038
Crude lipid	4.25±0.023
Crude protein	5.25±0.011
Ash	5.0±0.026
Carbohydrate	55.2±0.62

Expressed values were mean of three determinations ± their standard deviation

Table 2. Elemental analysis of *Moringa oleifera* seed hull.

Element	mg/100 g
Potassium	24.520
Sodium	45.490
Calcium	0.237
Iron	3.623
Magnesium	0.450
Copper	0.122
Cobalt	2.427
Lead	4.336
Cadmium	0.065
Manganese	0.210
Zinc	0.948
Nickel	0.836
Chromium	5.060

Table 3. Vitamin content of *Moringa oleifera* seed hull.

Parameter	Content (mg/100 g)
Beta-carotene	2.749
Vitamin C	0.698
Vitamin E	46.189

Table 4. Antinutrients content of *Moringa oleifera* seed hull.

Parameter (Unit)	Values
Alkaloid (%)	0.250
Saponin (%)	10.000
Phytate (mg/100 g)	0.487
Oxalate (mg/100 g)	0.015

Garcinia kola seeds and its hull, respectively (Eleyinmi et al., 2006) but lower than 83.22% in *Annona diversifolia* seed hull (Cuevas-Sanchez et al., 2011). The obtained value of crude fibre from this study is significant considering its possible health implication in the gastrointestinal tract of the animals (Bolanle et al., 2014). The carbohydrate and the crude fibre contents for instance may allow the hull to be used as alternative ingredient in feed formulation where necessary, except for the poor crude protein content.

The mineral composition findings agree with the report by Ijarotimi et al. (2013) who asserted that the most abundant mineral in raw *M. oleifera* seed was sodium (295.10±0.10 mg/100 g). Eleyinmi et al. (2006) also reported potassium as the most abundant mineral in *G. kola* seed hull. These two elements play a significant role in the nervous system and the regulation of pH and osmotic balance of fluids in the body. Iron (3.623 mg/100 g) was also detected in this hull, which is essential in the production of haemoglobin and as a critical cofactor in some metabolic reactions in animals (Ejidike and Ajileye, 2007).

The most abundant vitamin in *M. oleifera* seed hull was vitamin E (46 mg/100 g). Meanwhile, vitamin C (8.17 mg/100 g) was reported the most abundant in *Musa paradisiaca* Bract (Adeolu and Enesi, 2013). Vitamin E, a fat soluble antioxidant interferes with the propagation of reactive oxygen species (free radicals) that are implicated in disease conditions related to oxidative stress such as deficiencies in vitamin E which may result in nerve problems due to poor conduction of electrical impulses as well as weakness, weight loss and scurvy in vitamin C. *M. oleifera* seed hull has higher vitamins content when compared with cassava, *Magnifera indica* and *M. paradisiaca* (Adeolu and Enesi, 2013; Fowomola, 2010; Okigbo, 1980). Vitamins are needed in micro quantities but essential for healthy living. Also, vitamins have been shown to be effective in the damage of nucleic acid in pathogen that is found in plasma and platelets (Bruijn et al., 2010; Ruane et al., 2004).

The antinutrients result is similar to the findings from the work of Bolanle et al. (2014) who reported the presence of phytate in the seed of *M. oleifera* at a significantly low concentration. Presence of antinutrients in the *M. oleifera* seed hull is very minimal as compared to 2.0 to 2.4% phytate in *Cajanus cajan, Vigna ungiculata* and *Sphenostylis stenocarpa* (Onwuka, 2006). Phytate and oxalate react with divalent minerals such as calcium and magnesium to form complexes thereby hindering absorption, thus slowing down digestion.

Conclusion

There have been many researches on *M. oleifera* plants over the last few years, but its seed hull has been somehow neglected as an agro waste. This study has shown that *M. oleifera* seed hull may be a cheaply available alternative source of livestock feed formulation

to other costly feedstuff sources as a result of its satisfactory good nutritional qualities revealed from the data of this study. The satisfactory contents of crude fibre, carbohydrate, lipids, minerals and vitamins, as well as low antinutrients strengthen the implication that the seed hull may have positive health implication on animal if use for livestock feed formulation. Hence, further research is recommended on its nutritional evaluation to involve feeding tests and digestibility in animals for its inclusion in livestock feed formulation.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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