EVALUATION OF CHEMICAL NUTRITIONAL COMPOSITION OF AFRICAN ELEMI PULP AND SEEDS

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Abstract- The aim of this study is to evaluate chemical nutritional constituents of the pulp and seed of African elemi. The evaluation of chemical compositions of pulp and seed of African elemi was obtained from Mararaba Jamma Market Jos, Plateau State in North Central Nigeria were determined using standard analytical methods. The parameters determined of proximate were protein, moisture, fat, ash as well as fibre of the seed were 6.90±0.60, 6.00±0.11, 61.00±0.33, 3.40±0.00 as well as 7.90±0.21 % respectively, in other hand the respective values of protein, moisture, fat, ash as well as fibre of the pulp were 6.80±0.10, 22.20±0.24, 44.50±0.31, 8.20±0.01 as well as 12.00±0.10 %. The carbohydrate content was lowest in the pulp (6.30±0.41%) and highest in the seed (14.80±0.22%). Energy values analyzed in this study were 2625.90±0.25 and 1869.20±0.01 KJ/100g for the samples seed and pulp respectively. These samples contained reasonable amounts of potassium, sodium, phosphorus, iron, zinc, calcium as well as magnesium. The anti-nutritional analysis revealed the presence of oxalate, phytate, saponins, alkaloids, and cyanide which were within the permissible limits. The pulp and seed of African elemi could, therefore, serve as an additional promising source of protein and mineral contents for human and animal feeds formulations.

Keywords- African, Chemicals, Composition, Pulp, Seeds

1. INTRODUCTION

Current trends have linked the conventional plant protein supplements with high amounts of anti-nutritional factors like the high trypsin inhibitor contents of legumes (soya beans) and gossypol (cotton). Studies on the use of other non-conventional plant protein supplements are highly required. Therefore, knowledge of both nutritional and anti-nutritional factors of these plants will stimulate the use of these plants as supplements for legumes in feeds formulations (Emire *et al.*, 2013).

This is a tropical tree whose fruits contain oils in its pulp and seed kernel. The tree is mostly grown in tropical countries like Nigeria and other Sub-Sahara Africa (Keay, 2003). The pulps are mostly eaten raw but also can be cooked (Hafchinson and Dalziel, 2005). The seed of this plant however, which contains the kernel oil is either thrown away or used as local beads for feet (Burkill, 2000). On the other hand, not like particular additional oil-bearing constituents such as cotton seed, groundnut, palm pulp, palm kernel as well as soya beans, the extraction of oils from elemi kernel in addition to pulp is not on commercial scale despite its ready availability in Nigeria especially in Niger State. This circumstances could increase if data desired for the operation as well as design of the oils’ extraction plants are accessible. The objectives of this research was to determine the proximate composition, mineral constituents and anti-nutritional factors of the pulp and seed of the African elemi of pulp and seed in order to exploit its usefulness to mankind.

2. Materials and Methods

2.1 Sample Collection and Preparation

The fruits were obtained from different parts of this country African elemi was obtained from Mararaba Jamma Market Jos, Plateau State in North Central Nigeria. The samples were washed and rinsed with distilled water respectively and allowed to dry at room temperature for three weeks. The dried seeds were milled in attrition mill, sieved through 200 µm wire mesh, packed in a plastic container which was sealed with aluminum foil and stored at ambient temperature prior to analysis (Ndamitso *et al*. 2017).

2.2 Proximate Analysis

The moisture, ash, fat and protein contents of the African elemi pulp and seeds were determined using the methods of AOAC, (2006). Total carbohydrate content was determined by subtracting percentage protein, ash, moisture, crude fiber, along with the fat from 100% (Mathew *et al.* 2018a). The energy value (kcal/100g) was estimated by multiplying the percentage of crude protein, crude lipid as well as carbohydrate by 4, 9 and 4 respectively as conversion factors (Mathew *et al.* 2014a).

2.3 Mineral Analysis

The sample was digested by weighing in triplicate 1.00 g into beakers and 10 cm^3 of the acid mixture ($HClO_4$:H_2SO_4:HNO_3) in the ratio of 1:4:3 was added in each case. The mixture was swirled and left in a fume cupboard overnight. The samples were then digested on a Kjedhal digestion block until the solutions became quite clear. The digests were allowed to cool, diluted with 20 cm^3 of water, filtered using Whatman filter papers, made up to mark with deionized water in 100 cm^3 volumetric flasks and then transferred into sample bottles. The samples were analyzed for their mineral contents (Ca, Cu, Fe, Zn, Mn and Mg) using atomic absorption spectrophotometer (AAS) Buck model 210 VGP. A flame photometer (AA-500F, China) was used for the determination of potassium and sodium, while phosphorus was determined calorimetrically using the vanudo-molybodate colorimetric method (KF1700, Sweden) (AOAC, 2006).

2.4 Evaluation of Anti-nutritional Factors

The phytate and saponins was determined using methods of Abubakar *et al.* (2015) while, alkaloids, cyanide and oxalate contents were determined using the methods of (AOAC, 2006).

2.5 Statistical Analysis

All determinations were performed in triplicate. The statistical analyses were conducted using analysis of variance (ANOVA).

3. RESULTS & DISCUSSION

Table 1: The Results of Proximate Composition of African elemi Pulp and Seeds

Parameters	Pulp	Seeds
Moisture	22.20±0.24[b]	6.00±0.11[a]
Ash	8.20±0.01[b]	3.40±0.00[a]
Protein	6.80±0.10[a]	6.90±0.60[a]
Crude fat	44.50±0.31[a]	61.00±0.33[b]
crude fibre	12.00±0.10[b]	7.90±0.21[a]
Carbohydrate	6.30±0.41[a]	14.80±0.22[b]
Energy value (kJ/100g)	1869.20±0.01[a]	2625.90±0.25[b]

Values are means ± SD of three determinations

The proximate compositions of the samples were presented in Table 1. The respective values of 6.80 ± 0.10 and 6.90 ± 0.60 % are obtained as protein contents of African elemi pulp and seed respectively, these values are similar to the protein contents ranging from 7.20 to 8.80 % in *Blighia sapida* seeds (Onwuka, 2005). Although, the values were lower when compared with unfermented *H. barteri* seed (26.31±0.20) by Mathew *et al.* (2018b). These protein values of these samples indicates that they can contribute to the daily human protein requirements based on 23 -56 g as stipulated by NRC (1980). The moisture content of any food is an index of its stability and susceptibility to microbial contamination (Mathew *et al.*, 2018a). Moisture contents of 22.20 ± 0.24 and 6.00 ± 0.11 % obtained for African elemi pulp and seed respectively are lower than the 75-91.33 % reported for the pulp of *Curcubita maxima* by Karanja *et al.* (2013). However, the values obtained from this work are high compared to 6.67± 0.12 % reported for *Acacia nilotical* seed by Ndamitso *et al.* (2017). Thus, inferring that the samples have a comparable higher microbial stability. The respective values of 12.00 ± 0.10 and 7.90 ± 0.21 % are obtained as the crude fibre contents of African elemi pulp and seed. These values are higher than earlier reports of Mathew *et al.* (2018a) who indicated 5.04 ± 0.15% for unfermented *C. populnea* seed. Low fibre in diet has been related by means of heart diseases, rectum along with cancer of the colon, phlebitis, varicose veins, appendicitis, obesity, constipation as well as diabetes (Saldhanha 1998). Crude fat contents of 44.50 ± 0.31 and 61.00 ± 0.33 % obtained for African elemi pulp and seed respectively are higher than the 0.43% reported for the seeds of *Parkia filicoidea* (Oderinde *et al.*, 2004). Fats are important in the biological as well as structural functioning of the cells and help in the transport of nutritionally essential fat soluble vitamins (Omotoso, 2006). The ash contents of the African elemi pulp and seed are 8.20 ± 0.01 and 3.40 ± 0.00 % respectively. These values, apart from that of the African elemi pulp, were lower than 7.45 % reported for *Cucurbita species* by Aruah *et al.* (2011). These values are higher than the 2.62 ± 0.23 % reported for unfermented *Anonna senegalensis* seeds by Mathew *et al.* (2018c). The proportion of ash content is a reflection of the mineral contents of food materials (Omotoso, 2006). The values of 6.30 ± 0.41 and 14.80 ± 0.22 % obtained as the carbohydrate contents of

African elemi pulp and seed respectively. Apart from the African elemi pulp, its seed had higher values than 6.39 ± 2.66% reported for *Arachis hypogaea* by Loukou *et al.* (2007) but lower than the 66.64 ± 0.10 % reported for *Cucurbita maxima* by Adebayo *et al.* (2013). The carbohydrate content of this fruit shows that they are not useful as alternative source of carbohydrate.

Table 2: The Result of Mineral Compositions (mg/100g) of African elemi Pulp and Seeds

Parameters	Sample Pulp	Parameters Seed
Na	10.26±0.05^{a}	11.07±0.14^{b}
K	13.54±0.70^{a}	14.46±0.09^{b}
P	16.04±0.06^{b}	14.15±0.21^{a}
Fe	18.30±0.14^{b}	10.04±0.25^{a}
Ca	5.66±0.12^{a}	7.51±0.60^{b}
Mg	8.81±0.14^{a}	15.17±0.01^{b}
Cu	3.95±0.23^{b}	3.20±0.61^{a}
Zn	6.45±0.35^{a}	9.89±0.27^{b}
Mn	2.45±0.25^{b}	1.15±0.07^{a}
Pb	BDL	BDL

Key: BDL = Below Detection Limit
Values are means ± SD of three determinations

The mineral contents of the test samples as presented in Table 2 shows that African elemi pulp and seed had 18.30 ± 0.14 and 10.04±0.25 mg/100g respectively for iron contents. The values obtained from African elemi pulp in this study are high when compared to the 10.25 ± 0.31 mg/100g for African pear reported by Etsuyankpa *et al.* (2019). Iron deficiency is a major problem facing women especially during pregnancy in the developing world, and especially in Africa (Mathew *et al.*, 2018c). The concentrations of this mineral implies that, these samples will serve as blood building foods and should be desired for human and animal feed formulations. The intake of phosphorus helps in bone growth, cell growth as well as proper kidney function. It also plays a role in maintaining the body's acid-alkaline balance (Dauda *et al.*, 2014). The phosphorus contents of the samples are 16.04 ± 0.06 and 14.15 ± 0.20 mg/100g for African elemi pulp and seed respectively. The values are very low when compared to the 4000 mg/100g reported for beniseeds (Richard *et al.*, 2007). The dietary allowance for phosphorus is 800 mg/100g (NRC, 1989). Therefore, these samples may not be good sources to be solely relied on for this element. Potassium plays a significant role in the human body as well as adequate amounts of it in the diet protect against heart disease, diabetes, hypoglycaemia, kidney dysfunction as well as obesity. Regular intakes of potassium lower blood pressure (Mathew *et al.*, 2014). The potassium contents of African elemi pulp and seed are 13.54 ± 0.70 and 14.46±0.09 mg/100g respectively. These values are high when compared to those of *Boerhavia diffusa* (0.71 mg/100g) and *Commelina nudifora* (0.68 mg/100g) reported by Onwuka (2005). Zinc contents obtained from the samples (African elemi pulp and seed) are 6.45 ± 0.35 and 9.89 ± 0.27 mg/100g respectively. The zinc content is lower than that observed in *C. nilotica* seed 148.00± 10.00 mg/100g reported by Ndamitso *et al.* (2017). Zinc plays a role in gene expression, regulation of cellular growth and participants as a co-factor in enzymes responsible for carbohydrate protein and nucleic acid, metabolism (Adeboye *et al.* 2007). The sodium contents of African elemi pulp and seed are 10.26 ± 0.05 and 11.07 ± 0.14 mg/100g respectively. The dietary allowance for sodium is 110 mg/100g – 3300 mg/100g for adults (NRC, 1989). The values obtained from these samples are low and may not serve as dietary supplement for sodium. Calcium is an essential mineral for bone development. The calcium contents of African elemi pulp and seed obtained are 5.66 ± 0.12 and 7.51 ± 0.60 mg/100g respectively. The recommended daily allowance for calcium is 210 - 1200 mg/day (Richard *et al.*, 2007) based on this, these samples could be classified as poor sources of calcium. The magnesium contents of African elemi pulp and seed are 8.81 ± 0.14 and 15.17 ± 0.01 mg/100g respectively. These values are higher than 7.76 mg/100g reported for *Parkia biglobosa* seeds and 6.65 mg/100g for *Boerhavia diffusa* (Adeboye *et al.*, 2007). Magnesium is needed for more than 300 biochemical reactions in the body, helping to maintain normal muscle and nerve functions, keeping heart rhythm steady, supporting a healthy immune system and regulating blood sugar levels (Mathew *et al.*, 2018c). The copper contents of the samples are 3.95 ± 0.23 and 3.20 ± 0.61 mg/100g for African elemi pulp and seed respectively. These values were low compared to the 12.80± 0.13 mg/100g reported for unfermented *H. barteri* seed by Mathew *et al.* (2018b). Copper stimulates the immune system to fight infections, repair injured tissues as well as promote healing. Severe deficiency of copper in pregnant mothers increases the risk of health complications in their foetuses and infants (Etsuyankpa *et al.*, 2019).

Table 3: The Result of Anti-nutritional Factors of African elemi Pulp and Seeds (mg/100g)

Parameters	Sample	
	Pulp	Seed
Alkaloid	1.06 ± 0.36^{c}	3.96 ± 0.33^{b}
Cyanide	0.51 ± 0.07^{a}	0.24 ± 0.61^{b}
Saponins	3.30 ± 0.17^{a}	2.12 ± 0.43^{b}
Oxalate	0.13 ± 0.03^{c}	0.50 ± 0.63^{a}
Phytate	2.53 ± 0.81^{c}	3.79 ± 0.21^{b}

Key: Values are means ± SD of three determinations

The manganese contents of African elemi pulp and seed are 2.45 ± 0.25 and 1.15 ± 0.07 mg/100g respectively. These values are similar when compared to 2.61± 0.38 mg/100g observed in *C. populnea* reported by Mathew *et al.* (2018a). Lead contents are below detection limit in both the samples. This shows that incidence of lead toxicity is unlikely with African elemi pulp and seed.

The result of anti-nutritional compositions of African elemi pulp and seed are presented in Table 3. These values are generally low such that none of them is above the lethal dosage approved by standard bodies like National Agency for Food and Drugs Administration and Control (NAFDAC) in Nigeria (2002). The cyanide contents of the samples are 0.51 ± 0.07 and 0.24 ± 0.61 mg/100g for African elemi pulp and seed respectively. These values are higher than 0.17 ± 0.01 mg/100g reported for *Devar parvicarpa* by Ibanga and Okon (2009). This indicates that the samples will not contribute to cyanide toxicity if consumed in a large quantity. Only plants with more than 200 mg of hydrocyanic acid equivalent per 100g fresh weight are considered dangerous (Bahl, 2010). Oxalate contents of the samples are 0.13 ± 0.03 and 0.50 ± 0.63 mg/100g for African elemi pulp and seed respectively. These values are low compared to the 17.60 ± 0.08 mg/100g reported for *Devar parvicarpa* (Ibanga and Okon, 2009). Oxalates form insoluble complexes with calcium, magnesium, zinc and iron which interfere with utilization of these minerals (Mathew *et al.*, 2018b). Phytate contents of the samples are 2.53 ± 0.81 and 3.79 ± 0.21 mg/100g for African elemi pulp and seed respectively. These values are lower than 18.02±0.40 mg/100g reported for *A. senegalensis* (Mathew *et al.*, 2018c). Phytatic acid intake of 4-9 mg/100g decreases Fe^{2+} absorption by 4 - 5 fold in humans (Hurrel *et al.*, 1992). The alkaloid contents are 1.06 ± 0.36 and 3.96 ± 0.33 mg/100g for African elemi pulp and seed respectively. Alkaloids cause gastrointestinal and neurological disorders especially when taken in doses in excess of 20 mg/100g sample (Soetan and Oyewole, 2009). This indicates that the samples are within safe limit for alkaloids.

4. CONCLUSION

The outcome of this research revealed that the mineral as well as proximate compositions make African elemi seed and pulp justify possible valuable for human and his animal nourishment. Mostly the seeds are rich in phosphorus, potassium, magnesium as well as zinc which make it an exceptional source of these main minerals needed in greater quantities through the body. The anti-nutritional constituents are within the safe limit.

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