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Chemical Analysis of Prosopis Africana (Guill. & Perr.) Seeds

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Abstract

The seeds of *Prosopis africana* (Guill. & Perr.) were collected and analysed for proximate, anti-nutritional factors, elemental, oxide composition and amino acid profile using standard procedures to evaluate the seeds' nutritional potentials. The results of the proximate composition indicated the following: ash content (3.94%), moisture (8.56%), protein (32.27%), lipids (2.36%), crude fibre (6.75%), and carbohydrate (46.12 %). The results of anti-nutritional factors showed that *Prosopis africana* seed contained oxalate (0.27 mg/100g), saponin (10.5 mg/100g), alkaloid (7.5 mg/100g), and tannin (16.24 mg/100g). Amino acid profile of the seeds was found to contain; lysine (2.77 mg/100g), methionine (1.86 mg/100g), isoleucine (3.46 mg/100g), leucine (13.26 mg/100g), phenylalanine (4.82 mg/100g), valine (4.13 mg/100g) and non-essential amino acids; arginine (3.62 mg/100g), serine (2.81 mg/100g), aspartic acid (4.58 mg/100g) and glycine (7.12 mg/100g). Elemental composition of the seeds showed potassium (1.397 mg/Kg), calcium (0.405 mg/Kg), sulphur (1.679 mg/Kg), zinc (0.008 mg/Kg), cadmium (0.002 mg/Kg), phosphorus (0.545 mg/Kg), chlorine (0.021 mg/Kg), manganese (0.01 mg/Kg), silicon (0.202 mg/Kg), and antimony (0.007 mg/Kg); While the oxides composition were: MnO (0.013%), CaO (0.567%), Al_2O_3 (0.061%), ZnO (0.01%) and SiO_2 (0.433%). The results of the study revealed that *Prosopis africana* seed contained high protein content which can be use to supplement the high cost conventional sources. However, the value of anti-nutritional factors suggests that proper processing methods should be adopted before it could be consumed.

Key words: *Prosopis africana,* Proximate, Composition, Amino acid, *Kpaaye*, and Anti- nutrients

Introduction

It is of great importance to evaluate the nutritional, anti-nutritional, organoleptic properties and other toxic substances of some wild but readily available plant food products in our communities. The knowledge and use of these plant foods can complement the conventional sources and hence it will assist in eliminating malnutrition in our communities (Julia *et al.,* 2000). Most of these wild edible plants are known to contain high amount of nutrients that could improve the dietary need of our body (Inayat *et al.,* 2017).

The intake of adequate nutrients had been known as a major determinant factor in fighting chronic diseases. Studies have shown that alteration in diets could have strong effects (both positive and negative) on human health (Sarah, 2017). According to Birt *et al*., (2013), dietary adjustment may lead to disease conditions such as diabetes, obesity, hypertension, certain cancers and cardiovascular diseases. The over-dependence on imported foods and socio-cultural changes has placed African traditional diets at distinct disadvantages (Sabate and Wien, 2015). Indigenous diets are being replaced with more refined carbohydrates fast foods. To tackle the multiple problems of food insecurity, malnutrition and reduced the burden of diseases, it is essential to mobilise and explore indigenous wild edible plants which are known to be rich in protein and other essential nutrients (Isengard, 2001).

Accordingly, many research works have reported immensely on the nutritional and health benefits of most indigenous wild edible plants and had established that they contained about 2-3 times the protein content of cereal grains. Therefore, if these plants are adequately utilised it will go a long way in solving the problem of malnutrition and food insecurity (Keay *et al*., 1964). This can also resolved some of dietary diseases like diabetes (Ajiboye, 2009).

Prosopis africana (Guill. & Perr.) is a common flowering plant from the family *Leguminosae-Mimosoideae* and genus *Prosopis.* Its common names include; African mesquite, also known as an iron tree. The plant is called '*Kiriya*' in Hausa '*Ubwa*' in Igbo, '*Ayan'* in Yoruba '*Okpehe;* in Idoma and *Kpaaye* in Tiv. In Nigeria, the seeds of *P. Africana* are used to prepare a spice; a fermented soup condiment that is rich in protein and fatty acids (Agboola, 2004).

It had been reported that the seeds of the plant have the potential to meet year-round protein requirements of the most vulnerable population if domesticated. The seeds are known to contain high amount of protein, minerals, and fibre content. Its protein content is reported to be similar to that of some major proteineous crops (Abbiw, 1990). Its amino acid profile is comparable to those of cowpea, soybean, and pigeon pea. However, *Prosopis africana* is also known to contain anti-nutritional substances. According to Saman *et al*., (2016), anti-nutritional factors are secondary metabolites found in plants and are known to be biologically active substances.

These substances are found in fruits, seeds, and other parts of the plants (NST, 2011). They occur in varying amounts depending on the kind of crop, and their mode of propagation (Anthea *et al*., 1993). Habtamu and Negussie (2014) reported that anti-nutrients are chemicals produced by plants for their defense and other biological functions. Most of these plant substances have deleterious effect on human health. However, they could be beneficial to humans and animals if consumed in appropriate amounts (Ugwu and Oranye 2006). For example, Habtamu and Negussie (2014) observed that the intake of phytate, lectins, tannins and saponins at low levels, reduces blood glucose and increases insulin responses to starchy foods, while phytates, tannins, saponins, protease inhibitors, goetrogens, and oxalates reduce cancer risks in both human and animals.

Berdanier *et al*., (2016), reported that oxalate and phytate form chelates with *di* and trivalent metallic ions such as Cd, Mg, and Fe to form poorly soluble compounds that are not readily absorbed by the gastrointestinal tract, thus reducing their bioavailability in the body. The reduction of these anti-nutritional factors can be achieved by some processing methods such as soaking, boiling, fermentation, roasting, among others (Cammack, 2006).

In this study, the indigenous seeds of *P. africana* were analysed for proximate, anti-nutritional factors, elemental, oxides compositions, and amino acid profile to determine their nutritional potentials.

Materials and Methods

Study Area

The research was conducted in Makurdi, town the Benue State capital. The town is located at latitude 7°38′N - 7° 50′N and longitude 8°24′E - 8°38′E. It is situated in the Benue valley in North Central Nigeria.

Sample Collection

Seeds of *P. africana* were purchased from Wadata Market, Makurdi in April, 2018. The oral interview with the marketers indicate that the seeds were obtained from farmers in a local market in Guma Local Government area of Benue State in the same year. The seeds were identified at the Department of Biology, Benue State University, Makurdi.

Sample preparation

The seeds were sorted to remove stones and bad seeds. The seeds of *P. africana* were crushed to powdered form with a mortar and pestle, stored in an airtight container for further analysis.

Determination of moisture content

A clean porcelain crucible was placed in an air circulated oven at 105 °C for 35 minutes and was cooled in a desiccator for 30 minutes This was done to attain a constant weight (W_1). Two (2) g of the sample was weighed using PW 184 weighing balance into the pre-weighed porcelain crucible and weighed (W_2). The crucible with the sample was dried in the oven at 105 °C for 4 h. The crucible with the dried sample was transferred using a crucible tong into the desiccator to cool for 30 min., after which it was weighed (W_3). The percentage of moisture content was calculated from the expression below (Greenfield, 1992).

$$\text{Moisture content (\%)} \frac{W2-W3}{W2-W1} \times 100 \quad (1)$$

Determination of ash content

A clean porcelain crucible was placed in an air circulated oven at 105 °C for 35 minutes and was cooled in a desiccator for about 30 minutes This was done to attain a constant weight (W_1). Exactly 2 g of the sample was weighed accurately into the pre-weighed porcelain crucible and weighed (W_2). The crucible with the sample was placed in the muffle furnace and heated at 600 °C for 4 h. The crucible with the ash was transferred using the crucible tong into the desiccator to cool for 30 min., after which it was weighed (W_3). The percentage of ash content was calculated from the expression below (Binta, 1997).

$$\text{Ash content (\%)} = \frac{W3-W1}{W2-W1} \times 100 \quad (2)$$

Determination of crude protein

Protein digestion

Concentrated sulphuric acid (20 ml) and about 7.5 g of selenium catalyst were pour into a Kjeldahl digestion flask containing 1 g of sample. The flask was then placed in a fume cupboard, and digested for 45 minutes until a clear and pale green colour was obtained. The digest was cooled and diluted with 250 ml distilled water.

Distillation of the digest

The diluted digest was transferred into a 500 ml Kjeldahl flask containing anti-bumping chips and 70 ml of 50% NaOH was slowly added by the side of the flask. A 250 ml conical flask containing a mixture of 50 ml of 4% boric acid and 10 ml of the mixed indicator was used to trap the ammonia liberated. The conical flask and the Kjeldahl flask were then placed on the Kjeldahl distillation apparatus, with the tubes inserted into the conical flask and the Kjeldahl flask on the heating mantle. The flask was heated to distill out ammonia evolved. The distillate was then collected into the boric acid solution. From the point when the boric acid turned green, 10 min. was allowed for the complete distillation of the ammonia present in the digest. The distillate was then titrated with 0.1M HCl until a violet colour was obtained, indicating the endpoint of the titration. A blank was run under the same condition as with the sample. Total protein content was then calculated and expressed in percentage:

$$\text{Protein} = \frac{[titre\ value\ of\ sample - blank] \times 0.01 \times 14.007 \times 6}{1000 \times weight\ of\ sample} \times 250 cm^3 \quad (2)$$

(AOAC, 2010

where, 250 cm^3 = total volume of distillate

Determination of crude lipid

Ten (10) g of the sample was weighed into a pre-weighed fat-free thimble. About 350 cm^3 petroleum ether (40-60°C) was poured into

a previously weighed 500 cm^3 round bottom flask containing few anti-bumping granules. The soxhlet extractor was fitted into the 500 cm^3 flask and the extraction carried out for six hour The petroleum ether was then distilled off using a rotary evaporator leaving the lipid in the flask. This was dried in a water bath to constant weight. The percentage of lipid was calculated using the expression

$$\% \text{ Lipid} = \frac{\text{Weigh of lipid x 100}}{\text{Weight of Sample}} \quad \text{(AOAC, 2010)} \quad (4)$$

Determination of crude fibre

Two (2) g of ground sample was placed in a round bottom flask 100 cm^3 of 0.25 $moldm^3$ H_2SO_4 was added and the mixture was boiled under reflux for 30 min.. The hot solution was filtered under suction. The insoluble matter was washed several times with hot water until it was acid-free. Thereafter, it was transferred into a flask containing 100 cm^3 of hot (0.312 $moldm^{-3}$) NaOH solution. The insoluble residue was washed with hot water until it was base free by testing with litmus paper. It was dried to constant weight at 100°C, cooled in a desiccator and weighed (X_1). The weighed sample was incinerated in a muffle furnace at 525°C for two h, cooled in a desiccator, and re-weighed (X_2). The crude fibre was calculated using the expression.

$$\text{Crude fibre (\%)} = \frac{X_1 - X_2 \text{ x } 100}{\text{Weight of sample}} \quad (5)$$

Determination of carbohydrate

Carbohydrate content was determined using the formula adopted by Alozie *et al,* (2009), without modification. The total carbohydrate was determined by difference. The sum of the percentage of moisture, ash content, crude fat, crude fibre, and crude protein was subtracted from 100%. Total carbohydrate (%) = 100 - % (moisture + ash + fibre + fat + protein).

Determination of Oxalate

This determination involved three major steps: digestion, oxalate precipitation, and permanganate titration.

i. *Digestion:* Two (2) g of the sample was suspended in 190 ml of distilled water in a 250 ml conical flask.
ii. About 10 ml of 6 M hydrochloric acid (HCl) was added and the suspension digested at 100 °C for 1hour.
iii. The solution was cooled and then made up to mark in a 250 ml volumetric flask.

Oxalate precipitation

Five (5) g of the filtrate was measured into a beaker and four drops of methyl red indicator added. Then ammonium hydroxide (NH_4OH) solution was added (dropwise) until the test solution changed from pink to faint yellow colour (pH 4.0 - 4.5). The filtrate was then heated to 90 °C, cooled, and filtered to remove precipitate containing ferrous ion. The filtrate was again heated to 90 °C and 10 ml of 5% calcium chloride ($CaCl_2$) solution was then added, while being stirred constantly. The solution was then heated at 25 °C and left overnight to cool. It was then centrifuged at 2500 rpm for 5 minutes. The supernatant was decanted and the precipitate completely dissolved in 10 ml 20% (v/v) H_2SO_4 solution.

Permanganate Titration

The total filtrate resulting from the digestion of 2.0 g of the sample was made up to 300 ml. Aliquots of 125 ml of the filtrate were heated until near boiling and then titrated against 0.05 M standardised potassium permanganate ($KMnO_4$) solution to a faint pink colour which persisted for 30 s. The oxalate content was calculated and expressed in mg/100g (1ml of 0.05M $KMnO_4$ = 0.00225g) (Umeobika, 2015).

Determination of Tannins

The Follins Dennis titration method as described by Pearson, (1976) was adopted. Thirty (30) ml of petroleum ether was added to 5.0 g of the already crushed sample in a conical flask and corked for 24 hours. The sample was then filtered and allowed to stand for 15 minutes to evaporate the petroleum ether. It was re-extracted by soaking in 50 ml of 10% acetic acid in ethanol for 4 hours. The sample was then filtered and the filtrate collected. Twenty five (25) ml of ammonium hydroxide (NH_4OH) was added to the filtrate to precipitate the alkaloid. It was then heated to remove some ammonium hydroxide (NH_4OH) still in solution. The remaining volume of the solution after heating was noted and 5 ml of this solution was taken and 20 ml of ethanol was added to it and then titrated with 0.1M sodium hydroxide (NaOH) using phenolphthalein as an indicator until the

pink endpoint was reached. Tannins content was then calculated and expressed in mg/100g (Aremu, 2006).

Determination of Alkaloid

One (1) g of sample was weighed into a 250 ml beaker and 30 ml of 20% acetic acid in ethanol was added corked and allowed to stand for 4 hours at 25 °C. It was then filtered and the filtrate was concentrated using water-bath to one quarter of the original volume. Concentrated ammonium hydroxide was added drop-wise to the extract until the precipitation was completed. The whole solution was allowed to settle and the precipitate was collected and washed with dilute ammonium hydroxide (NH_4OH) solution. It was then filtered using a pre-weighed filter paper. The residue on the filter paper which is the alkaloid was dried in the oven at 80 °C. The alkaloid content was collected and expressed in mg/100g (Qayyum, 2012).

Determination of Saponin

One (1) g of the sample was put into 30 ml of 20% acetic acid in ethanol and allowed to stand in water-bath at 50 °C for 24 hours. This was filtered and the extract was concentrated using a water-bath to one-quarter of the original volume. Concentrated ammonium hydroxide (NH_4OH) was added dropwise to the extract until the precipitation was complete. The whole solution was allowed to settle and the precipitate was collected by filtration and weighed. The saponin content was weighed and calculated and expressed in mg/100g (Olaofe, 1994).

Determination of elemental composition

The elemental and oxides composition were determined by X-Ray fluorescence (XRF) spectrophotometer as described by (Igile, 2013).

Determination of Amino Acids

Thirty (30) mg of the sample was hydrolyzed with 6 M HCl at 110 °C for 24 hours. The amino acid analysis was performed on reverse phase-high pressure liquid chromatography (HPLC) (Buck scientific BLC 10/11 USA). The post-column samples were derivatized with O –phthaldialdehyde. The analysis was performed by injecting 20 ul of the prepared sample into the HPLC equipped with UV 338 nm detector. A C18, 2.5x 200 mm 5 um column and a mobile phase of 1:2:2 (100 mM sodium phosphate, pH 7.2, acetonitrile: methanol) at a flow rate of 0.45 mL/minute and an operating temperature of 40 °C. A 0.1 mg of each mixed amino acid standards were analysed similarly for identification. Peak identification was conducted by comparing the retention times of authentic standards and those obtained from the samples. Concentrations were calculated using a four-point calibration curve and data were integrated using peak simple chromatography data system (Buck SCI. chromatopac data processor) (Aremu, 2006).

Results and Discussions

The percentage moisture content of *P. africana* seed (Table 1) was found to be 8.56% which is slightly above the (8.01%) value reported by Coe *et al.,* (2005) for chickpea. The value revealed that the moisture content was lower since it is below the 15% maximum limit described by regulatory bodies for the resistance and growth of microorganisms. This implies that the seeds could be stored for a long time without deterioration hence extending shelf life.

The ash content of *P. africana* seed was found to be 3.94% (Table 1). The ash content of a plant material is a measure of its inorganic matter content. However, due to volatilisation of some volatile inorganic elements at high temperature (525°C) the ash content is a direct measure of the total mineral content. The value, however, is lower compared with the result reported by Mole and Waterman (1982) for similar plants.

The percentage crude protein (32.27%) of *P. africana* seed was high compared with crude protein for proteinous rich foods such as pigeon peas (19.0 – 21.7)%, Bambara nuts (15.0 – 22.2)% and some oilseeds (34.10 – 49.10)% (Coe, 2005). Therefore, it can be used as an alternative source of proteins in diets.

The percentage crude fat content (2.36%) of *P. africana* seed was lower compared to other proteinous foods like soya bean which have higher (28.20%) fat content and tend to cause some effects such as overweight (obesity), high-level cholesterol, high blood pressure (Dcuncan, 2000). Fats are known to facilitate the intestinal absorption and transport of fat soluble vitamins A, D, E and K. (Ogbemudia *et al*., 2017). The lower value is an indication that *P. africana* seeds could be a better fat product for people that could be

vulnerable to disease conditions like obesity.

The crude fibre content (6.75%) was observed to be high compared to groundnut (2.10%) and pigeon pea (2.60%). This indicates that it may aid digestion, absorption of water from the body. High fibre content prevents constipation by softening and formatting bulky stool. The consumption of higher fibre food helps minimise some common health problems. The values obtained compared favourably with those of African yam bean (Ghaniyah and Abiodun, 2016).

The carbohydrate content of *P. africana* was found to be 46.12%. The high carbohydrate content of *P. africana* indicates that its seed will provide more heat and energy to the body when supplemented to the diets of humans and livestock (Olorunmaiye *et al* 2019).

The result of anti-nutrients analysis (Table 2) indicates oxalate to be 0.27 mg/100g. The concentration of oxalate was observed to be lowest compared with the other anti-nutritional factors. Oxalates form large kidney stones that may obstruct the kidney tubules. Studies have shown that 80% of kidney stones are from calcium oxalate (Duncan, 2000). Price *et al.,* (1987), stated that the intake of 5 g or more of oxalic acid could be fatal to humans while Onnins *et al*., (1987), reported the estimated threshold of oxalic toxicity in humans to be 2 - 5 g/100g. The value observed in this study was much lower indicating that there could be no effect of oxalate on consumption of the seeds. It is important to note that high levels of oxalate in some plants deter even herbivores from feeding on such plants (Monago, 2002).

Saponin was observed to be 10.5 mg/100g. High percentages of saponins in food to induces a bitter taste hence reduced the palatability of the food or even imbue animals with life-threatening toxicity (Lalitha *et al.,* 1990). The consumption of a high concentration of saponin may be deleterious. This implies that *P. africana* seeds need to be properly processed to eliminate the high content of saponin before it could be consumed.

Table 1: Proximate composition of *P. africana* seeds

Parameters	**Percentage (%)**
Ash	3.94
Moisture	8.56
Crude protein	32.27
Crude Lipid	2.36
Crude Fibre	6.75
Carbohydrate	46.12

Table 2: Anti-nutritional analysis of *P. africana* seed

Anti-nutritional factors	**mg/100g**
Oxalate	0.27
Saponin	10.50
Alkaloid	7.50
Tannin	16.24

Table 3: Amino acids composition

Parameters	Concentration (mg/100g)
Essential Amino acids	
Lysine	2.77
Methionine	1.86
Threonine	2.25
Isoleucine	3.46
Leucine	13.26
Phenylalanine	4.82
Valine	4.13
Tryptophan	3.16
Histidine	32.16
Non-Essential Amino acids	
Arginine	3.62
Serine	2.81
Cysteine	0.52
Tyrosine	3.24
Alanine	1.78
Aspartic acid	4.58
Glutamic acid	4.68
Glycine	7.12
Proline	4.22

Table 4: Elemental Composition of *P. africana* seed Using X-Ray Fluorescence (XRF) Cu-Zn Method

Parameters	Concentration mg/kg
Si	0.202
P	0.545
Sl	1.679
Cl	0.021
K	1.397
Ca	0.405
Mn	0.01
Zn	0.008
Cd	0.002
Sb	0.007
Mg	ND
Al	ND
Ti	ND
V	ND
Cr	ND
Fe	ND
Co	ND
Ni	ND
Cu	ND
As	ND
Se	ND
Rb	ND

Sr	ND
Zr	ND
Nb	ND
Mo	ND
Pd	ND
Ag	ND
Sn	ND
Ba	ND
W	ND
Au	ND
Pd	ND
Bi	ND

Table 6: Oxide Composition of *P. africana* seed Using X-Ray Fluorescence (XRF) Cu-Zn Method

Parameters	**Concentration (%)**
CuO	ND
NiO	ND
Fe_2O_3	ND
Mn_O	0.013
Cr_2O_3	ND
TiO_2	ND
CaO	0.567
Al_2O_3	0.016
MgO	ND
ZnO	0.01
SiO_2	0.433

ND = Not detected

Studies had shown that saponin could be beneficial to the body if consumed in the right quantity. For example, a concentration of 1 mg/100g in the diet of rats decreases plasma cholesterol and increase bile acid production.

The concentrations of alkaloid and tannins were found to be 7.5mg/100g and 16.24mg/100g, respectively. Alkaloids have been reported to cause gastrointestinal upset and neurological disorders especially when taken in excess (Abhishek *et al*., 2019). The values of alkaloids and tannins observed in this study were relatively higher when compared with literature values for similar plants. This implies that these anti-nutritional factors need to be eliminated during processing before consumption. Despite their toxicity level, tannins are known to have some medicinal values especially in the prevention of diarrhoea, dysentery and controlled hemorrhage (Philip *et al.,* 2018).

The result of amino acid analysis (Table 3) revealed that *P. africana* contained varying concentrations of essential amino acids such as lysine, methionine, phenylalanine, leucine, threonine, tryptophan, histidine, isoleucine, valine and some non-essential amino acids such as arginine, serine, cysteine, tyrosine, alanine, aspartic acid, glutamic acid, glycine and proline which could play important roles in the body. Leusine (13.2 6mg/100g) was found to be highest, followed by phenylalanine (4.82 mg/100g) and then methionine (1.86 mg/100g) the least. The result of the analysis, shows that *P. africana* has some essential amino acids which are in higher amount than those of *S. stenocarpa* seeds (Onyechi and Nwachi, 2008 and Aluko and Monu., 2009). These high values of these essential amino acids suggest that this seed could serve as a good source of amino acids by rural and urban dwellers hence it is cheap and readily available.

The non-essential amino acids were also observed to be in varying amounts with glycine, glutamic acid, aspartic acid, proline arginine and tyrosine to be 7.12 mg/100g, 4.68 mg/100g, 4.58, 4.22 mg/100g, 3.62 mg/100g and 3.24 mg/100g respectively, while cysteine (0.57 mg/100g) was found to be the lowest. These amino acids help in regulating the blood sugar levels, promote the growth and recovery of muscles and bones, as well as the production of the growth hormones. Isoleucine takes part in the formation of haemoglobin, used for energy by muscular tissues. Methionine helps remove toxic waste from the liver and assist in regeneration. Glycine enhances sleep and supports whole-body health, maintains the strength and support of muscles and bones. Cysteine helps prevent damages from alcohol and tobacco use, stimulates white blood cell activity, while glutamic acids are a chemical that helps nerve cells in the brain, send and receive information from other cells. Adewuni and Odunfa (2009), reported that tryptophan improves depression symptoms by increasing the level of serotonin in the brain. The results of amino acids indicate that the seeds of *P. africana* are excellent sources of both essential and non-essential amino acids which can supplement the conventional sources.

The result of essential elements (Table 4) of the seeds were found to be calcium (0.405 mg/kg), phosphorus (0.545 mg/kg), sulphur (1.679 mg/kg), potassium (1.397 mg/kg), chlorine (0.021 mg/kg), silicon (0.202 mg/kg). The sample also contains trace elements in varying amounts, manganese (0.01 mg/kg), zinc (0.008 mg/kg), cadmium (0.002 mg/kg) and antimony (0.007 mg/kg).

Among the elements, sulphur (1.679 mg/kg) and potassium (1.397 mg/kg) were observed to be the highest while cadmium (0.002 mg/kg) and antimony (0.007 mg/kg) were the lowest. The values obtained from the analyzed sample were slightly above those reported by Agundale *et al*., (2009) on cowpea. This indicates that the seeds are good sources of both macro and microelements. These macro and microelements are essential to the body for the normal metabolic and proper well-being of humans.

The results of oxides composition (Table 5) indicate MnO to be 0.013%, CaO (0.567%), Al_2O_3 (0.061%), ZnO (0.01%) and SiO_2. These values were similar to those reported on the preliminary studies of *Parkia biglobosa* (Fasoyiro *et al.,* 2006). According to Zhongzhou *et al*, (2015), the toxicity of metal oxides is concentration dependent, since the values recorded in this study are very low; it implies that the toxicity of the metals oxides may not have any significant effect even when consumed.

Conclusion

Based on the results of this research work, it has been revealed that *P. africana* is a good source of protein, carbohydrate, and lipids, and also contained both essential and non-essential amino acids such as leusine, valine, tryptophan, arginine, serine, tyrosine, and many more. It contained good composition of macro and micro elements like potassium, sulphur, phosphorus, manganese, zinc, which are essential for proper growth and development of the body. However, the results of the anti-nutritional analysis revealed that *P. africana* contained anti-nutritional factors such as oxalate, saponin, tannin, and alkaloid present in varying amounts.

Acknowledgments

We acknowledge the contributions of all those that made this research successful. Worthy of mention are; Charity Emmanuel and Linus Terna Stephen, all technical staff of the analytical Laboratory of the Dangote cement factory Gboko, and the Department of Chemistry Benue State University Makurdi.

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