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Nutritional and Anti-nutritional Composition of *Ximenia americana* Fruit

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Abstract: In this work the nutritional and anti-nutritional composition of *Ximenia americana* fruit is investigate using standard analytical methods. The results of proximate analysis of the fruit on dry weight basis shows that it contains, Crude protein (7.26%), Crude lipid (13.0%), ash (10.5%), and moisture (64%Wet Weight), The pulp contains appreciable concentration of ascorbic acid (21.12 mg/100g). The mineral analysis, revealed that the pulp is rich in potassium (690mg/100g), magnesium (10.67mg/100g) phosphorus (4.48mg/100g), Calcium (0.65mg/100g) and sodium (45mg/100g). The analysis further revealed high content of Tannins (74.8mg/100g) and phytate (29.43mg/100g). This shows that the sample can serve as good source of mineral to both human and livestock.

Keywords: Proximate, Minerals, Anti-nutritional, Ximenia Americana Fruit

1. Introduction

The genus Ximenia belongs to the Olacaceae and comprises about 8 species [1]; Ximenia roiigi, Ximenia aegyptiaca, Ximenia parviflora, Ximenia coriaceae, Ximenia aculeata, Ximenia caffra, Ximenia americana and Ximenia aegyptica.

X. americana is a plant used in traditional medicine for the treatment of malaria, leproutic ulcers and infectious diseases of mixed origin by natives in Ethiopia, Guinea, Sudan and in the Northern part of Nigeria [2-7].

Ximenia americana L, commonly known as wild plum, blue sour plum and tallow nut. It belongs to family *Olacaceae*, it spreading or, less often, scrambling spiny shrub or small tree up to 6 m, commonly less than 4 m. Branches normally arching down often armed with straight spines. Leaves are simple, alternate or clustered on spur shoots with rounded and slightly notched; broadly tapering base or rounded and occasionally softly haired. Small greenish white, fragrant flowers, born on short shoots and greenish-cream, scented and 5-10 mm long; in small, branched inflorescences [3]. Fruits, up to 3 cm long, oval, shiny. Light green, turning yellow, orange or red on ripening. The fruit is yellow-red edible drupe which is oval, approximately 2.5cm in diameter and contains one large endospermic seed within its green pulp containing a small embryo near a thin testa. They have up to 60% oil content. Seedling morphology is variable, when young the leaves are densely hairy, but become smooth and shiny with growth [4-5].

The leaves of the plant are used for treatment of headaches and also as a poison antidote. The roots are used for the treatment of skin problems, headaches, leprosy, haemorrhoids, sexually transmitted diseases, guinea worm, sleeping sickness, oedema, and act as an antidote to poison [5]. The fruit is useful in treating habitual constipation. The bark of the plant is used in decoction, dried or powdered as a cicatrisant and applied to skin ulcers; it is put on the head for febrile headache, placed in bath water for sick children, and used for kidney and heart complaints. When it's eaten in large quantities acts as a vermifuge. A decoction of the roots or fruits is used to treat dysentery in calves. In east Shewa X. *Americana* were assumed to have multipurpose uses for humans, livestock, wild life and for environmental services.:

It is also used for treatment of cobra's attack (type of snake poisoning in humans) and a fresh or dried stem, boiled in water was served as a drink to treat cobra's bite and the residue is applied to the wound to hasten poison healing in the study area. Bark was chewed to treat swelling of the pancreas [2, 1].

In this present study, an attempt was made to exermine its proximate, minerals, anti-nutritional and ascorbic acid compositions of *Ximenia americana* fruit, using standard analytical methods.

The objectives of the study are summarised below:

i. To determine the nutritional content of *Ximenia americana* fruit pulp.
ii. To determine the ant nutritional content of *Ximenia americana* fruit pulp.
iii. To determine the minerals content of *Ximenia americana* fruit pulp.
iv. To determine the vitamin C content of *Ximenia americana* fruit pulp.

2. Material and Method

2.1. Sample Collection

Fruit of *Ximenia americana fruit* were collected from a BirninYauri wild, Ngaski local government, Kebbi State Nigeria. In the month of July 2018. The plant material was taxonomically identified at the Usmanu Danfodiyo University, Sokoto, Nigeria.

Figure 1. *Ximenia americana Fruit.*

2.2. Preparation of Fruit of Ximenia americana Fruit

The *Ximenia americana* fruit were properly washed with distilled water, the peels were removed separately then the pulps were cut into smaller size. The samples were then dried at room temperature. Then the seed were separated from the pulp. The sample was grinded to powder form using mortar and pestle and used for analyzing as sample. All the analysis were conducted in chemistry laboratory Kebbi State University of Science and Technology, Aliero, Nigeria.

2.3. Determination of Moisture Content

The method described by AOAC (2000 was adopted. Two crucibles were properly washed and allowed to dry in an air oven at 110°C for 10 min to a constant weight. The crucibles were allowed to cooled in a desiccators for 30 min, then labelled A and B and weighed (W1). 2.0 g of each of fresh sample was accurately weighed into the previously labelled crucibles and reweighed (W2). The crucibles containing the samples were placed in an oven maintained at 105°C and left for overnight and weighed, heated and cooling was repeated several times at 30 min interval untilled a constant weight was obtained.

The percentage moisture was calculated using equation 1.

$$\%moisture = \frac{Loss\ weight}{weight\ of\ fresh\ sample} \times 100 \quad (1)$$

2.4. Determination of Ash Content

The word ash means the residue left after combustion of oven dried sample and it is a measure of the mineral content of a given sample [8].

The AOAC (2000) method was used. Two porcelain crucibles were washed and dried in an oven to a constant weight at 100°C for 10minute. They were allowed to cool in a desiccator, then labeled A and B and weighed (W1). 2.0 g of each fresh sample was weighed into each of the previously weighed porcelain crucibles and reweighed (W2). The crucibles containing the samples were transferred into a furnace, which was set at 550°C for 6h to ensure proper ashing. They were then removed and allowed to cool in desiccator then finally weighed. The percentage ash content was calculated with equation 2.

$$\%ash = \frac{weight\ of\ residue\ after\ combustion}{weight\ of sample\ before\ ignition} \times 100 \quad (2)$$

2.5. Determination of Crude Protein

The method proposed by AOAC (2000) was used for determination of crude protein content in the samples, the amount of crude protein is obtained by multiplying the nitrogen content by constant value of 6.25. This factor is based on the assumption that 16% nitrogen and all the nitrogen is present as protein [9].

Procedure

Digestion, distillation and titration are the three categories of the procedure;

Digestion

20cm^3 of conc. H_2SO_4, 2g of the dried sample and selenium catalyst was added in to kjeldhal digestion flask The flask were swirled to soak the sample and then titrated on an electric heater in a fume chamber untilled the solution become clear. This converts carbon to CO_2 and organic nitrogen to NH_4SO_4 by oxidation. After the solution were cooled it was diluted to 50cm^3 in volumetric flask.

Distillation

Firstly the distillation apparatus were washed by passing the steam through for about 10minute, 20cm^3 of 20% boric acid were pipette and transferred into a 100cm^3 conical flask. The conical flask were placed at a receiving end of the condenser in such a way that it touches liquid boric acid indicator solution. 10cm^3 of diluted digested solutions were

poured into a distillation apparatus. 20cm^3 of 40% NaOH solutions were added and the inlet was closed. Steam was allowed to pass through for 5min to heat the sample untilled the quantity of the distillate and the boric acid indicator were about 50cm^3. The ammonia produced was trapped in the acid; the distillate changed the boric acid indicator from purple to green. The change is as result of ammonium ion present in boric acid solution.

$$NH_4SO_4 + 2NaOH \rightarrow 2NH_3 + 2H_2O + Na_2SO_4 \quad (3)$$

$$NH_3 + H_2BO_3 \rightarrow NH_4H_2BO_3 \quad (4)$$

$$NH_4H_2BO_3 \rightarrow NH_4^+ + H_2BO_3^- \quad (5)$$

Titration

The distillate were titrate against 0.01M H_2SO_4 solution to give an equivalent point detected by change of color from green to pink.

$$H^+ + H_2BO_3^- \rightarrow H_3BO_3$$

From the titer value obtained the crude protein content was calculated

$$\%\text{crude protein} = \frac{TV \times M \times 0.014 DF \times 6.25}{Weight\ of\ sample} \quad (6)$$

Where TV=Titer value for the digested samples
DF=Dilution factor
M=Molarity of the acid (0.01M) (AOAC 2000).

2.6. Determination of Crude Lipid Content

The AOAC (2000) method was used. 5.0 g of sample was placed in two different extraction thimbles respectively then covered with cotton wool. The extraction thimbles containing the samples were placed in the extraction jacket. Two clean dried 500 mL round bottom flasks containing few anti-bumping granules was weighed (W1) and 300 mL of petroleum ether was poured into each flask fitted with sohxlet extraction units. The round bottom flasks and the condenser were connected to the sohxlet extractor and cold-water circulation was put on. The heating mantle was switched on the heating rate was adjusted until the solvents were refluxing at a steady rate. Extraction was carried out for 6 h. The solvents were recovered and the oil was dried in the oven at 70°C for 1h. The round bottom flask and oil was cooled and then weighed (W2). The lipid content was calculated by the equation 3.

$$\%\text{Crude lipid} = \frac{weight\ of\ oil\ extracted}{weight of\ sample} \times 100 \quad (7)$$

2.7. Determination of Crude Fiber

Dietary fiber is the indigestible portion of plant foods having two main components; soluble and insoluble. Soluble fiber that is readily fermented in the colon into gasses and physiologically active by products and insoluble fiber that is metabolically inert, absorbing water throughout the digestive system and easy defecated. Chemically, dietary fiber consist of non-starch polysaccharides such as cellulose, lignin, pectin's and oligosaccharides.

The method described by AOAC (2000) was adopted and briefly explain as follow. 2.0 g of sample were weighed into two separate round bottom flasks, 100 mL of 0.25 M sulfuric acid solutions was added to the sample in the flask, and the mixtures were boiled under reflux for 30 min. The hot solutions were quickly filtered under suction. The residues were thoroughly washed with hot water until acid free. Residue was transferred into the flask and 100 mL of hot 0.3 M sodium hydroxide solution was added and the mixture were boiled again under reflux for 30min and filtered quickly under suction. The insoluble residue was washed with hot water until it was base free. It were dried to a constant weight in an oven at 100°C for 2hours, cooled in desiccator and weighed (C1). The weighed sample were then incinerated, and reweighed (C2). Percentage crude fiber content was calculated with equation blow;

$$\%\text{crude fiber} = \frac{C1-C2}{C1-CO} \times 100 \quad (8)$$

2.8. Determination of the Minerals Content

The method described by AOAC (2000) was adopted. Calcium, phosphorus, potassium magnesium and sodium were analyzed from the triple acid digestion (wet digestion method). 1 g of sample was weighed into a 150 mL beaker, and 10mL of conc. $HNSO_3$ was added to the sample in the beaker and allowed to soak thoroughly. 3 mL of 60% $HClO_4$ was added and the mixture was heated slowly at first until frothing ceases. Heating was continued until HNO_4 evaporated; the heating was stopped as charring occurred. 10 mL conc. HNO3 was added and heating continued until white fumes were observed. The digests were allowed to cool and 10 mL conc. HCl was added and transferred to 50 mL volumetric flask. The volume of the solutions ware made up to the mark with distilled water, and then transferred to a bigger flask. The solutions were further diluted to 100 mL with distilled water. Calcium, potassium, and sodium were measured using flame photometer while phosphorus is measured using spectrophotometer.

2.8.1. Determination of Cyan Genic Glycoside

The alkaline picrate method of Oke (2011) was adopted. 5.0 g of sample were weighed and dissolved in 50mL distilled water in corked conical flasks. The mixtures were allowed to stay overnight and then filtered. The extract was collected. Different concentration of hydrogen cyanic acid (HCN) was prepared containing 0.02 to 0.10 mg/mL cyanide. The absorbance of each was taken in a spectrophotometer at 490 nm and the cyanide standard curve was plotted. 1 Ml of the sample filtrate and standard cyanide solution was measured into three test tubes respectively and 4 mL of alkaline picrate solution was added and incubated in a water bath for 15min. After colour development (reddish brown), the absorbance of each content in the test tubes was taken in a spectrophotometer at 490 nm against a blank containing only 1 mL distilled water and 4 mL alkaline picrate solution (1 g of picrate and 5 g of sodium carbonate (Na_2CO_3) were dissolved in a warm water in 200 mL flasks and made up to

200 mL with distilled water). The cyanide content for each sample was extrapolated from the cyanide curve.

2.8.2. Determination of Phytate

The phytic acid was determined using the procedure described by Markkar *et al*., (2011). 2.0 g of sample were weighed into 250 mL conical flask. 100 mL of 2% concentrated HCL acid was used to soak the sample in the conical flask for 3 h and then filtered through a double layer of hardened filter papers. 50 mL of the filtrate was placed in 250 mL beaker and 100 mL of distilled water was added to give proper acidity. 10 mL of 0.3% ammonium thiocyanate solution was added into the solution as indicator. Solution was titrated with standard iron chloride solution, which contained 0.00195g /mL. The end point colour was slightly brownish - yellow which persisted for 5minute. The percentage phytic acid was calculated.

2.8.3. Determination of Tannins

The method described by Markkar *et al*., (2011) was adopted. Briefly, 400 mg of sample was placed into two conical flasks each and 40 mL diethyl ether containing 1% acetic acid (v/v) was added, then the mixtures were properly mixed to remove the pigment materials. Each supernatant was carefully discarded after 5 min and 20 mL of 70% aqueous acetone was added and the flasks were sealed with cotton plug covered with aluminium foil, then kept in electrical shaker for 2 h for extraction. Each content in the flasks was filtered through Whatman filter paper and samples (filtrates) were used for analyzing. 50 mL of tannins extract from each sample was taken into test tubes and the volume of each was made up to 1.0 mL with distilled water. 0.5 mL Folic ciocalteu reagent was added to each and mixed properly. Then 2.5 mL of 20% sodium carbonate solution was added and mixed. The mixtures were kept for 40 min at room temperature, after which absorbance was taken using spectrophotometer and concentration was estimated from the tannic acid standard curve.

2.8.4. Determination of Oxalate

Oxalate was determined by using the method of Oke (2011). 1.0g of sample was placed in a 250 mL volumetric flask, 190 mL of distilled water and 10 mL of 6M HCL were added. The mixture was warmed on a water bath at 90°C for 4h and the digested sample were centrifuged at a speed of 2,000 rpm for 5 min. The supernatant were then diluted to 250 mL. Three 50 mL aliquot of supernatant were evaporated to 25 m L, and then the brown precipitate was filtered off and washed. The combined solution and washed were titrated with concentrated ammonia solution in drops until Salmon pink colour of methyl orange changed to faint yellow. The solution was heated on a water bath to 90°C and the oxalate was precipitated with 10 mL of 5% calcium chloride ($CaCl_2$) solution. The solution was allowed to stand overnight then centrifuged. The precipitate was washed into a beaker with hot 25% H_2SO_2 diluted to 125 mL with distilled water and after warming to 90°C it was titrated against 0.05m $KMnO_4$.

2.8.5. Determination of Vitamin C Content

Hundred gram fresh samples was cut into small pieces and was grinded in a mortar and pestle. 10 ml of distilled water was added several times while grinding the samples and decanting off the liquid extract into a 100 ml volumetric flask. Finally, the ground samples pulp was strain through cheese cloth. The pulp was rinsed with a few 10 ml portions of distilled water and all filtrate and washing were collected in the volumetric flask. The extracted solution was made to 100 ml with distilled water. Five ml of the aliquot sample solution was pipetted into 250 ml conical flask and 20ml of distilled water, 2 ml of starch indicator solution added to each of the samples. The samples were titrated rapidly with an accurately standardized 0.01M iodine solution containing 16 g potassium iodide per acid. The end point of the titration was identified as the colour changes. Each millilitre of iodine is equivalent to 0.88 mg of ascorbic acid, lactone form. The milligram of vitamin C per millilitre can be calculated from the relationship, titre value x 0.88mg [13].

3. Results

The nutritional and anti-nutritional factors of *Ximenia americana* were investigated.

The result of the proximate analysis of Ximenia americana are shown in table 1. The results of some minerals analyses of Ximenia americana fruit are shown in table 2: The results of the level of some anti-nutritional factors found in Ximenia americana fruit are shown in table 3;

Table 1. *Proximate composition and ascorbic acid.*

Parameters (%)	(%)
Moisture	64±0.2
Ash	10.5±0.1
Crude fiber	3.0±0.01
Crude protein	7.26.±0.2
Crude lipid	13.0±0.02
Vitamin C	21.12±0.01

Values are mean ± standard deviation of triplicate determination.

Table 2. *The result of some minerals.*

Parameter (%)	Conc. (mg\100g)
Na	45±0.1
K	6900±47.14
Ca	0.65±0.2
Mg	1.9±0.2
P	4.48±0.02

Values are mean ± standard deviation of triplicate determination.

Table 3. *Anti-nutritional composition.*

Parameter	mg/100g
Tannins	74.8±0.02
Phytate	29.43±0.1
Oxalate	0.001±0.1
Cyanide	5±0.002

Values are mean ± standard deviation of triplicate determination.

4. Discussion

The moisture content of *Ximenia americana* pulp is 64mg\100g while some of the fruit parts have relatively high moisture content which is typical of fresh fruits at maturity [14]. The relatively low moisture content is an indication that these fruits parts will have high shelf life especially when properly packaged against external conditions [15].

Lipids content in *Xemenia* pulp is 13mg/100g which can be compare with those of soybean oil, locust bean and cottonseed; 19.10 g/100 g, 20.30g/100 g and 14.05 g/100 g crude fat, respectively. Which are commercially exploited and classified as oil seed [16]. This showed that *Ximenia americana* pulp is rich in oil and could be sources of edible vegetable oil if well annexed, hence could complement conventional vegetable oils, which are very expensive.

According to Dreon *et al.,* (1990). Lipid is essential because they provide the body with maximum energy; approximately twice that for an equal amount of protein or carbohydrate and facilitate intestinal absorption and transportation of fat-soluble vitamins A, D, E and K. The crude protein content of *Xemenia* pulp is 7.26 mg/100g which is low when compared with that of melon seed; 33. 8 g/100 g [18], and do not fall within the range of 21-34 g/100 g reported for cowpea [19]. The high protein content may enhance growth and maintenance of tissue, and will no doubt complement protein from cereals and other plant foods that are known to be low in protein and can complement melon seed as a source of protein in the diet of Nigerians.

The crude fibre of *Xemenia* pulp is 3.0mg/100g. Fibre helps in the maintenance of human health and has been known to reduce cholesterol level in the body. The level of fiber is low when compared with that of14.57 g/100 g for *G. Erubescens*fruit reported by [18]. Fibre helps in the maintenance of human health and has been known to reduce cholesterol level in the body. The low level of fibre is may be desirable in their incorporation in weaning diets. Emphasis has been placed on the importance of keeping fibre intakes low in the nutrition of infants and pre-school children [21]. High fibre levels in weaning diet can lead to irritation of the gut mucosa, reduced digestibility, vitamin and mineral availability. Those with high fibre content are desirable in adult diet. Fibre diets promote the wave-like contraction that move food through the intestine, high fibre food expands the inside walls of the colon, easing the passage of waste, thus making it an effective anti-constipation. It also lowers cholesterol level in the blood, reduce the risk of various cancers, bowel diseases and improve general health and well-being Presence of high crude fibre improves glucose tolerance and is beneficial in treating maturity on set diabetics [21].

The ash content of *Xemenia* pulp is 10.5% the percentage ash of the sample gives an idea about the inorganic content of the sample from where the mineral content could be obtained. The ash content obtained is high to a range of 1.63 g/100 g to 8.53 g/100 g in commonly consumed fruits [9]. The high percentage of ash content of the *Xemenia* pulp is expected to have high concentrations of various mineral elements, which are expected to speed up metabolic processes and improve growth and development [22].

The vitamin C content (21.12±0.1 mg/100g) is higher than 10.83±0.25 mg/100g reported by 10mg/100g for *Diospyrosmespiliformis* [23]; but lower (30.48 mg/100g) than that reported for mango-olomi pulp [24]. The Recommended Dietary Allowance (RDA) of vitamin C is 60 mg/day for a male adult [25]. Thus, *Xemenia* fruit pulp can satisfy the daily vitamin C requirement.

Table 2 presents the mineral composition of *Xemenia*fruit pulp. The fruit pulp is rich in potassium, calcium, magnesium, sodium and phosphorus. It was reported that, plant based foods are usually high in potassium [22]. High amount of potassium in the body increases iron utilization [26]. Potassium is essential in the maintenance of cellular water balance, pH regulation in the body and it is also associated with protein and carbohydrate metabolism [27]. Calcium is very essential in blood clotting, muscle contraction and for the activity of certain enzymes metabolic processes [28]. Calcium help in regulation of muscle contractions transmit nerve impulses and help in bone formation [29]. Magnesium plays a major role in relaxing muscles along the airway to the lung thus allowing asthma patients to breathe easier. It plays fundamental roles in most reactions involving phosphate transfer, believed to be essential in the structural stability of nucleic acid and intestinal absorption while deficiency of magnesium in man is responsible for severe diarrhoea, migraines, hyper-tension, cardiomyopathy atherosclerosis and stroke [30]. About 0.15 g dry weight of *Xemenia*fruit pulp would be required to meet the 320 mg/day RDA of magnesium. The concentration of sodium is very low compared to 1430 and 1580 mg/kg sodium reported for grape fruit juice and orange juice [31]. For RDA of 1.5 g/day of sodium to be attained 6.67 g of *Xemenia*fruit pulp will have to be consumed.

The levels of the anti-nutritional factors were reported in Table 3. Tannin about 74mg/l in the studied sample. Tannin in fruits imports an astringent taste that affects palatability, reduce food intake and consequently body growth. Tannins are known to inhibit the activities of digestive enzymes and nutritional effects of tannin are mainly related to their interaction with protein. Tannin protein complexes are insoluble and the protein digestibility is decreased. The value was however low when compared to 13.3, 19.1 and 99.2 g/kg tannin reported for cashew nut, fluted pumpkin and raw breadnut, respectively [32]. Studies on rats, chicks and livestock revealed that high tannin in diet adversely affects digestibility of proteins and carbohydrates, thereby reducing growth, feeding efficiency, metabolizable energy and bioavailability of amino acids [33]. From medicinal point of view, polyphenol to which tannin belongs has been reported to act as antioxidant by preventing oxidative stress that causes diseases such as coronary heart disease, some types of cancer and inflammation [10]. This shows that fruit like *G. erubescens*is likely to have antioxidant activity.

Phytate value is 29.43 mg/g. The values reported is higher

than the level of phytate in Thailand fruits commonly consumed by diabetic patients; longan, 0.37 mg/g, dragon 0.39 mg/g, durian 0.51 mg/g, guava 0.8 mg/g, mango 0.86 mg/g and pineapple 0.90 mg/g [34]. The problem with phytic acid in foods is that it can bind some essential minerals nutrients in the digestive tract and can result in mineral deficiencies. The level is however fall within the range when compared to a phytate diet of 10 – 60 mg/g if consumed over a long period of time that has been reported to decrease bioavailability of minerals in monogastric animals. Phytic acid also binds to phosphorus and converts it to phytate, while other mineral elements like calcium, zinc manganese, iron and magnesium are converted to the phytic complexes, which are indigestible substance, thereby decreasing the bioavailability of these elements for absorption. Phytic acids also have a negative effect on amino acid digestibility, thereby posing problem to non-ruminant animals due to insufficient amount of intrinsic phytasenecessary to hydrolyze the phytic acid complex, but the presence is also beneficiary because it may have a positive nutritional role as an anti-oxidant and anti-cancer agent [35].

Oxalate has the conc. (0.001mg/100g) and it is a concern because of its negative effect on mineral availability. High oxalate diet can increase the risk of renal calcium absorption and has been implicated as a source of kidney stones [6]. The level of oxalate in studied fruit pulp is very low compare to 0.33 g/100 g oxalate in orange pulp, 0.28 g/100 g in okro, 0.99 g/100 g in red pepper and 1.31 g/100 g in tangarine pulp [36]. The levels of oxalate in the studied fruits might not play important role in their nutritive values. The highest oxalate level of 1.17 g/100 g in *S. innocua*juice would require ingestion of 3.85 kg dry matter to provide the 45 g reported to be toxic to mature sheep [37]. Thus the level of oxalate in the sample is not as high as that it can affect minerals availability.

5. Conclusion and Recommendation

5.1. Conclusion

The result of this work shows that *Ximenia americana* fruit pulp can be considered a good source of lipid, mineral elements such as potassium, sodium, magnesium, phosphorus and calcium and is also rich in vitamin C (ascorbate). But the fruit also contains substances that may be harmful to health when ingested in high quantity. The non-essential substances are low indicating that little processing is needed before they are consumed.

5.2. Recommendation

Based on the result obtained it is recommended the pulp of this fruit is safe for consumption and further studies should be conduct to analyze the toxicity or otherwise of the said sample.

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References

[1] Brasileiro, M. T.; Egito, M. A. & Lima, J. R.; Randau, K. P.; Pereira G. C.; Neto, P. J. R. (2008). Ximenia americana L: botânica, química e farmacologia no interesse da tecnologia farmacêutica. Revista Brasileira Farmacognosia, 89, 2, pp. 164-167, ISSN 0370-372X.

[2] Geyid, A.; Abebe, D.; Debella, A.; Makonnen, Z.; Aberra, F.; Teka, F.; Kebede, T.; Urga, K.; Yersaw, K.; Biza, T.; Mariam, B. H. & Guta, M. (2005). Screening of medicinal plants of Ethiopia for their anti-microbial properties and chemical profiles. Journal of Ethnopharmacology, Vol. 97, pp. 421-427, ISSN 0378-8741.

[3] James, D. B.; Abu, E. A.; Wurochekke, A. U. & Orgi, G. N. (2007). Phytochemical and Antimicrobial Investigation of the Aqueous and Methanolic Extracts of Ximenia americana. Journal of Medical Science, Vol. 7, No. 2, (15th february 2007), pp. 284-288, ISSN 20721625.

[4] Magassouba, F. B.; Diallo, A.; Kouyaté, M.; Mara, F.; Mara, O.; Bangoura, O.; Camara, A.; Traoré, S.; Diallo, A. K.; Zaoro, M.; Lamah, K.; Diallo, S.; Camara, G.; Kéita, A.; Camara, M. K.; Barry, R.; Kéita, S.; Oularé, K.; Barry, M. S.; Donzo, M.; Camara, K.; Toté, K.;. Vanden Berghe, D.; Totté, J.; Pieters, L.; Vlietinck, A. J. & Baldé, A. M. (2007). Ethnobotanical survey and antibacterial activity of some plants used in Guinean traditional medicine. Journal of Ethnopharmacology, Vol. 114, pp. 44-53, ISSN 0378-8741.

[5] Maikai, V. A.; Maikai, B. V. & Kobo, P. I. (2009). Antimicrobial Properties of Stem Bark Extracts of Ximenia americana. Journal of Agricultural Science. Vol. 1, No. 2, (December 2009), pp. 30-34. ISSN 00218596.

[6] Ogunleye, D. S.; Ibitoye & Trop, S. F. (2003). Studies of antimicrobial activity and chemical constituents of Ximenia americana. Journal of Pharmmaceutical Research, Vol. 2, No. 2, (December 2003), pp. 239-241, ISSN 00223549.

[7] Omer, M. E. F. A. & Elnima, E. I. (2003). Antimicrobial activiy of Ximenia americana. Fitoterapia, Vol. 74, pp. 122-126, ISSN 0367326X.

[8] AOAC (2000). Official methods of analysis of the association of official analytical chemists, 15th edition, Washington D. C., 20044.

[9] Oluyemi, E. A., Akinlua, A. A., Adenuga, A. A., and Adebayo, M. B. (2006). Mineral Contents of Some Commonly Consumed Nigerian Foods. Science Focus, 11 (1): 153–157.

[10] Onibon, V. O., Abulude, F. O. and Lawal, L. O. (2007). Nutritional and Anti-nutritional Composition of Some Nigerian Fruits. Journal of Food Technology, 5 (2): 120–122.

[11] Oke, O. L., 2011. Chemical studies on some Nigerian foodstuffs. Latum W. Afr. J. Biol. Appl. Chem., 8: 53-56.

[12] Markkar, H. P. S., M. Blummer, N. K. Browy and K. Becker, 2011. Gravimetric of Tannins and their correlation with chemical and protein precipitation methods. J. Sci. Food Agr. 61: 161-165.

[13] Sarkiyayi S, Mohammed, M, Yakubu A. ComparativeAnalysis of Nutritional and Anti nutritional Contents of Some Varieties of Mango (Mangiferaindica) in Kaduna Metropolis-Nigeria. Research Journal of Applied Sciences, Engineering and Technology. 2013; 5 (4): 387-391.

[14] Umoh IB (1998). Commonly used fruits in Nigeria. In: Nutritional Quality of Plant Foods. (EdsOsagie AU, Eka OU). Post-harvest Research Unit, University of Benin, Benin city. Nigeria. Happiness and mental health. Science Daily. Retrieved January 31, 2013 from http://www.science daily.com/releases/2012/10/ 2012009102003.htm.

[15] Eka OU (1987). Evaluation of nutritive value of feed for growing broilersin Northen Nigeria. Niger. J. Sci. 21: 52-54.

[16] Ayodele JT, Alao OA, Olagbemiro TO (2000). The Chemical Composition of Sterculiasetigera. Trop. J. Anim. Sci. 3 (2): 69-76.

[17] Dreon DM, Vranizan KM, Krauss RM, Austin MA, Wood PD (1990). The effects of polyunsaturated fat and monounsaturated fat on plasma, Lipoproteins. J. Am. Med. Assoc. 263: 2462.

[18] Achinewu SC (1983). Protein quality of breadfruit, climbing melon andcreeping melon. Nutr. Rep. Int. 27: 641-645.

[19] Adewusi SRA, Falade OS (1996). The Effect of Cooking on extractable tannin, phytate, sugars and mineral solubility in some improved Nigerian Legume Seeds. Food Sci. Technol. Int. 2: 231-240.

[20] Eromosele IC, Eromosele CO (1993). Studies on the chemical composition and physio-chemical properties of seeds of some wild plants: (Netherland) Plant Food Hum. Nutr. 43: 251-258.

[21] Hassan, L. G., Dangoggo, S. M., Umar, K. J., Sa'idu, I., and Folorunsho, F. A. (2008). Proximate, Minerals and Anti-nutritional Factors of *Danielliaoliveri*Seed Kernel. *Chemclass Journal*, 5: 31–36.

[22] Hassan, L. G., Abdulrahman, F. W. and Zuru, A. A. (2004). Nutritional and Phytochemical Investigation of *Diospyrosmespiliformis* (L). *Nigerian Journal of Basic and Applied Science*, 13: 1-8.

[23] Ngi, F. and Funmi Onajobi, F (2002). A Vitamin C Content of Aome Tropical Fruits. *International Journal of Food Science and Technology*, 17: 253–261.

[24] WHO (1985). Energy and protein requirement, Report of a joint FAO/WHO United Nation meeting, Geneva, WHO Technical Report Series, 72.

[25] Adeyeye, E. I. (2002). Determination of Chemical Composition of the Nutritionally Valuable parts of Male and Female Common West African Fresh Water Crab *Sudananautes Africanus*. *International Journal of Food Sciences and Nutrition*, 53: 189–196.

[26] Onibon, V. O., Abulude, F. O. and Lawal, L. O. (2007). Nutritional and Antinutritional Composition of Some Nigerian Fruits. *Journal of Food Technology*, 5 (2): 120–122.

[27] Atasie, V. N., Akinhanmi, T. F. and Ojiodu, C. C. (2009). Proximate Analysis and Physico-Chemical Properties of Groundnut (*Srachishypogaea*L.). *Pakistan Journal of Nutrition*, 8 (2): 194–197.

[28] Bello, M. O., Falade, O. S., Adewusi, S. R. and Olawore, N. O. (2008). Studies on the Chemical Compositions and Anti-nutrients of Some Lesser Known Nigeria Fruits. *African Journal of Biotechnology,* 7 (21): 3972-3979.

[29] Appel LJ (1999). Non pharmacologic therapies that reduce blood pressure: A fresh perspective. Clin. Cardiol. 22: 1111-1115.

[30] Olaofe O, Akogun OO (1990). Mineral and Vitamin C content and their distribution in some fruits. Nigeria. *Food J*. 8: 111.

[31] Fagbemi TN, Oshodi AA, Ipinmoroti KO (2005). Processing Effects on Some Antinutritional Factors and In vitro Multienzyme Protein Digestibility (IVPD) of Three Tropical Seeds: Breadnut (*Artocarpusaltilis*), Cashewnut (*Anarcardiumoccidentale*) and Fluted Pumpkin (*Telfairiaoccidentalis*). Pak. J. Nutr. 4 (4): 250-256.

[32] Aletor VA (1993). Allelochemicals in plant food and feeding stuffs (1) Nutritional, biochemical and physiopathological aspects in animal production. J. Vet. Hum. Toxicol. 35: 57-67.

[33] Suree N, Surat K, Akekachai N (2004). Phytate and Fiber Content inThaiFruits commonly Consumed by Diabetic Patients. J. Med. Assoc. Thai. 87 (12): 1444-6.

[34] Turner BL, Paphazy JM, Haygarth MP, Mckelvie DI (2002). Inositol phosphate in the Environment. Online J. Royal Soc. 357: 469-449.

[35] Munro A, Bassir O (1989). Oxalate in Nigerian vegetables. W. Afr. J. Biol. Appl. Chem. 12: 14-18.

[36] Muhammed IR, Muh SK, Olorunju SAS, Bale JO, Abdullahi US, Lawal R (2002). Response of Nutrients and Anti-Nutritional Constituents in the seeds of Cassia tora L. to Treatments. J. Agric. Environ. 3 (2): 225-234.