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Research Article

Some Elements in The Fruit: An Assessment of Gingerbread Plum from Sokoto, Nigeria

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Abstract. A region like Sokoto that is been challenged by series of problems such as double burden of diseases, malnutrition, and food insecurity should utilized the available fruits for their inherent nutrient's compositions. Therefore, the objective of this study was to assess the proximate and elemental contents (sodium, phosphorus, potassium, calcium, and magnesium) in gingerbread plum (*Neocarya macrophylla*) fruit which are essential for normal growth and development of body tissues for the human health. *Neocarya macrophylla* fruit is screened for certain nutritionally needed elements and proximate compositions using standard methods. Results obtained show that, crude protein with (2.70 ± 0.0057%) has the lowest concentration, the moisture content was 5.83 ± 0.57 percent, ash content was 5.33 ± 1.54 percent, crude lipid was 5.23 ± 0.15 percent, and crude fiber was 13.33 ± 4.48 percent. The determined levels of mineral elements (calcium, magnesium, phosphorus, sodium, and potassium) reveal 30.25000 ppm, 4.9001 ppm, 90. 1000 ppm, 40.563 ppm, and 67.5601 ppm, respectively. Therefore, the plant is nutritious and vital for metabolic processes.

Keywords: Deficiency, ash, potassium, lipid, microelement, Gingerbread plum, fiber

1. Introduction

Many people living in western part of Africa, especially in the arid and semi-arid areas resort to the consumption of wild and related edible fruits to contribute to the fulfilment of nutritional needs. More especially, during the dry season period when there is shortage of food materials, many people relied on fruits from the wild to ameliorate the food security difficulties they faced (Amza et al., 2010; Diaby et al., 2016). This is an option of using wild plant products to compensate for the daily needs, because the wild materials contain a diverse array of nutrients that are accessible, cheap, and valuable (Amza et al., 2010; Diaby et al., 2016).

Parable, gingerbread plum is a typical native tree that has several applications in human life. The gingerbread is a scion that comes from the *Chrysobalanaceae* family (Diaby et al., 2016). Among other uses, the gingerbread plum is utilized in remedy of eye problems, stomach problem, and as toothpaste (through concoction) (Warra et al., 2013; Amza et al., 2016; Garba et al., 2022). People consume the fruits of gingerbread plum due its edibility in fresh form or in boiled form (along with cereals). Additionally, the fruits are utilized in orange crushes or lemonades, and when making a tangy gruel. Often, the nuts of the plant are subjected to roasting and consumed palatably. In sometimes, the nuts are used to prepare snacks, dishes, and release oil in cooking (Amza et al., 2010).

Gingerbread plum contains several useful compounds such as beneficial oils, proteins, minerals, carbohydrates, lipids etc (Warra et al., 2013; Diaby et al., 2016). In relations to that, some studies alluded to the fact that, the fruit of the plant has significant ability to be utilized in alternative medicine techniques because it has secondary metabolites that inhibits the microbial growth (Garba et al., 2022).

Noteworthy, the behavior of taking diet that is vast in fruits and vegetables is a renown act that promotes healthy life because of their vast nutrients therein (Slavin & Llyod, 2012; Yusuf et al., 2015). That is why most countries across

various parts of the world had documented dietary recommendations involving fruits (Slavin & Llyod, 2012). Fruits have possessed elevated contents of nutrients such as fiber, vitamins, minerals, that help animals to checkmate cardiovascular diseases, high blood pressure, several types of cancers, and other chronic ailments (Pem & Jeewan, 2015). Likewise, it is needful to redirect further attention to the consumption of fruits that are domesticated or wild, accessible, and cheap, in the region of Sokoto; where there are ravaging issues such as malnutrition, double burden of diseases, food insecurity, and other challenges (Zaragoza, 2015; Sarkingobir et al., 2019; Sarkingobir et al., 2020ab; Gada & Ismaila, 2021). However, it is worthy to note that, there is little or insufficient information divulging the nutrients present in gingerbread plum fruit in Sokoto, and West Africa region (Amza et al., 2010; Muhammad & Umar, 2015; Diaby et al., 2016; Garba et al., 2022). Therefore, the aim of this study was to assess the proximate and some mineral elements contained in the gingerbread plum fruit obtained from Sokoto state, Nigeria.

2. Method

2.1. Collection and preparation of plant material

The fruits of *Neocarya macrophylla* were purchased from Tungar Madugu village Gwadabawa Sokoto, Nigeria. The eatable flesh of the fruit of *Neocarya macrophylla* was peeled off and was air dried. The dried sample was pulverized to fine powder using mortar and pestle and ready for Nutritional analysis as shown in Figure 1.

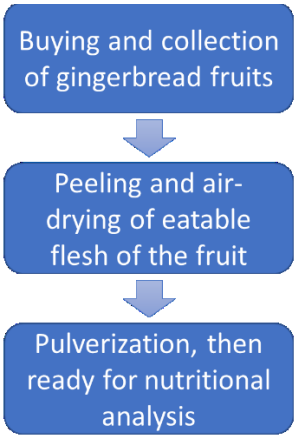


Figure 1. Collection and preparation sample for further analysis

2.2. Moisture content determination

When a known weight of a biological is exposed to heat under controlled conditions, the material evaporates leaving behind the dry matter. The difference in weight after heating gives the moisture content of the material. A clean crucible was dried to a constant weight in an oven at 110°C, cooled in a desiccator and weighed (W_1). Two (2g) of finely ground sample was accurately transferred into the previously weighed crucible and reweighed (W_2). The crucible containing the sample was dried in an oven to a constant weight (W_3). The percentage of moisture content was calculated using the equation (1).

$$\% \text{ Moisture} = \frac{W_2 - W_3}{W_2 - W_1} \times 100 \qquad (1)$$

With, W_1 is weight of dish (g), W_2 is weight of sample + weight of dish (g), and W_3 is weight of the dried sample + weight of dish (g) (Kari et al., 2022).

2.3. Ash content determination

Biological materials when heated in a muffle furnace at high temperature have their organic matter burnt off living the inorganic residues and the weight is expressed as percentage. A porcelain crucible was dried in an oven at 100°C for 10 minutes, cooled in a desiccator and weighed (W_1). Quantitatively, (2g) of the finely ground sample was placed into the previously weighed porcelain crucible and reweighed (W2), it was first ignited and then transferred into a furnace which was set at 550°C. The sample was left in the furnace for 2-3 hours to ensure proper ashing. The crucible containing the ash was then removed cooled in a desiccator and weighed (W_3). The percentage ash content was calculated following equation (2).

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$$\% \text{ Ash} = \frac{W_3 - W_1}{W_2 - W_1} \times 100 \quad (2)$$

With, W_1 is weight of crucible (g), W_2 is weight of sample + weight of crucible (g), and W_3 is weight of ashed sample + weight of crucible (g) (Kari et al., 2022).

2.4. Crude Lipid Estimation

The extraction method is based on the principle that non-polar compounds of the same sample are easily extracted into organic ether apparatus. This gives the proportion of free fat present due to the particular fatty acids involved. A clean, dried 500 ml round bottom flask containing few anti-bumping granules was weighed (W1) and 300 ml of petroleum ether added. The extractor thimble weighing 20 g was fixed into the soxhlet unit. The round bottom flask and a condenser were connected to the soxhlet extractor and cold-water circulation was also connected. The heating mantle was switched on and the heating rate was adjusted until the solvent was refluxing at a steady rate. Extraction was carried out for 6 hours. The solvent was recovered and the oil dried in an oven at 70°C for 1 hour. The round bottom flask and oil was then weighed (W_2). The lipid content was calculated following equation (3) (Kari et al., 2022).

$$\% \text{ Crude lipid} = \frac{W2 - W1}{Weight\ of\ sample\ (g)} \times 100 \quad (3)$$

2.5. Crude Fiber Estimation

Procedure:

Quantitatively, 2 g of the finely ground sample was taken in a round bottom flask, 100 ml 0.25 M sulphuric acid solution were added and the mixture was boiled under reflux for 30 minutes. The hot solution was quickly filtered under suction. The insoluble matter was washed several times with hot water until it was acid free and then transferred into the flask and 100 ml of hot 0.31 M sodium hydroxide solution were added and the mixture allowed to boil under reflux for 30 minutes and filtered under suction. The residue was washed with boiling water until it was base free and then dried to a constant weight in an oven at 100°C. It was then cooled in a desiccator and weighed (W_1). The weighed sample (W_1) was then incinerated in a muffle furnace at 550°C for 2 hours, cooled in a desiccator and reweighed (W_2). The % crude fiber was calculated following equation (4).

$$\% \text{ Crude fiber} = \frac{W_1 - W_2}{Weight\ of\ sample\ (g)} \times 100 \quad (4)$$

With, W_0 is weight of empty crucible (g), W_2 is weight of weight of ash sample (g), and W_3 is weight of weight of sample (g) (Kari et al., 2022).

2.6. Crude Protein Estimation by Using Kjeldahl Method

The various reactions taking place are shown in equation (5) to (8).

$$N_2 + 4H_2SO_4 \rightarrow (NH_4)2SO_4 \quad (5)$$

$$(NH_4)2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O + 2NH_3 \quad (6)$$

$$2NH_3 + 2H_3BO_3 \rightarrow 2NH_4H_2BO_3 \quad (7)$$

Ammonium borate

$$NH_4H_2BO_3 \rightarrow NH_4Cl + H_3BO_3 \quad (8)$$

One (1) g of each of the samples was accurately taken in a standard 250 ml Kjeldahl flask containing 1.5 g CuSO4 and 1.5 g Na2SO4 as catalysts and 5 ml concentrated H2SO4. The Kjeldahl flask (digestion) was heated gently on a heating mantle to prevent frothing until a clear bluish solution was obtained. The digestion solution was allowed to cool and then transferred quantitatively to a 100 ml standard flask and made up to the mark with distilled water. A 20 mL portion of the digest was taken in a semi micro Kjeldahl distillation apparatus and treated with equal volume of 40% NaOH solution. The ammonia evolved was steam distilled into a 100 mL conical flask containing 10 ml of saturated boric acid to which 2 drops of methyl red and methylene blue known as Tashirus indicator (double indicator) were added. The tip of the condenser was immersed into the boric acid double indicator solution and the distillation continued until about 2/3 of the original volume was obtained. The tip of the condenser was rinsed with a few ml of distilled water in the distillate which was then titrated with 0.1 M HCl to a purple pink end point. The blank determination was carried out in a similar manner but the omission of the sample. The crude protein was obtained by multiplying the % Nitrogen content by a factor (i.e., 6.25) as shown in equation (9).

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$$\% \text{ Crude Protein} = \% \, Nitrogen \times Factor \ (\text{i.e.}, 6.25) \quad (9)$$

The % Nitrogen was then calculated following equation (10) and (11).

$$\% \text{ Nitrogen} = \frac{\text{TV}\times\text{NA}\times 0.014\ (\text{NF})\times\text{DF}\times 100}{\text{Weight of Sample (g)}\times\text{aliquat (ml)}} \quad (10)$$

$$\% \text{ Crude Protein} = \% \text{ Nitrogen} \times \text{CF(g\%)}(6.25) \quad (11)$$

With, TV is titre value, NA is normality of acid (0.1), NF is nitrogen factor (0.014), DF is Dilution factor (50ml), and CF is conversion factor (6.25). The Nitrogen value was therefore multiplied by 6.25 to get the weight of protein (Kari et al., 2022).

2.7. Determination of total carbohydrate by using difference method

The total carbohydrate in each sample was determined by differences obtained after subtracting the sum of the percentage moisture, ash, crude lipid, crude protein and crude fiber from 100 as shown in equation (12).

$$\% \text{ Carbohydrate} = 100 - (\% \text{ Moisture} + \% \text{ Ash} + \% \text{ fat} + \% \text{ Protein} + \% \text{ Fiber}) \quad (12)$$

3. Result and Discussion

3.1. Proximate composition of Neocarya macrophylla fruit

The proximate outcomes obtained from *Neocarya macrophylla* were shown in Table 1 and Figure 2. The result has revealed moisture percentage as 5.83 ± 0.57 % DW, a value that is significantly($P<0.05$) lower than the finding from a study in China (Amza et al., 2010) and also lower than the values reported by a study from Lagos, Nigeria on the plant (Garba et al., 2022). In line with the finding in Table 1, it is good to have a lower moisture content in fruits, vegetable and relations because there is a significant link between microbial presence and spoilage (Kari et al., 2022). Consequently, low moisture leads to an environment that does not supports the growth of microbes that spur spoilage (Garba et al., 2022). Additionally, the low moisture in the fruit of *Neocarya macrophylla* is a portend that guaranteed its ability to be stored for a longer period of time (Garba et al., 2022).

5.33 ± 1.54 % DW was the determined values of ash content of *Neocarya macrophylla* and is in consonance with the content (6.70 ± 0.05) revealed by Garba from Lagos, Nigeria. Ash content in plant is a good value as it depicts the availability of mineral elements present in the examined sample of plant materials (Danjuma et al., 2017; Aletan & Kwazo, 2019).

The crude fiber content in *Neocarya macrophylla* fruit has divulged a fiber of 13.33 ± 4.48 % DW, a value that is lower than the result reported by a study from Kebbi, Nigeria (Garba et al., 2022). Certainly, it is a good thing to have an elevated fiber level, because it is useful in the maintenance of health through reducing cholesterol values, aiding food digestion, neutralization of constipation, and deferring of stomach emptiness (Garba et al., 2022). However, the value reported therein (in Table 1), is lower than the report divulged from Crasssifolia leaves in Nigeria by Aletan & Kwazo (2019). *Neocarya macrophylla* has the lipid content of 5.23 ± 0.15 % DW, therewith lipids are utilized by cells and tissues during consumption for provision of energy in two-fold fashion better than carbohydrates, and also play roles in making secretions by the cells and tissues (Okonwu & Ariaga, 2016). However, the lipid value shown in this study is comparatively lower than the value reported from the gingerbread seed obtained in China (Amza et al., 2010).

2.70 ± 0.0057 % DW is the level of determined of crude protein the fruit, therewith, the value is low compared to other plant materials reported elsewhere such as in Ahongshangbam & Devi (2017). This level of protein obtained in this study (indicated in table 1 and figure 2) of *Neocarya macrophylla* is significantly below the amount of protein obtained from another study elsewhere (Amza et al., 2010).

The found levels of carbohydrate present in the studied fruit is 67.56±5.54 % DW, which is considered an elevated value and advantageous because carbohydrates are among the major macromolecules required by animals, plants, and microbes for life processes (Okonwu & Ariaga, 2016; Zongo et al., 2019). Comparatively, the carbohydrate value revealed by *Neocarya macrophylla* fruit of this study is significantly higher than the one obtained in a study of *Neocarya macrophylla* obtained from Niger Republic and Guinea (Diaby et al., 2016). Also, it is a little bit higher than the results revealed by another study from Kebbi, Nigeria by Garba et al., (2022).

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Table 1, Proximate Compositions of *Neocarya macrophylla* fruit.

Parameters	Concentrations (%DW)
Moisture content	5.83 ± 0.57
Ash content	5.33 ± 1.54
Crude lipid	5.23 ± 0.15
Crude protein	2.70 ± 0.0057
Crude fiber	13.33 ± 4.48
Carbohydrate	67.56 ± 5.54

The values are mean ± standard deviation of triplicate determinations.

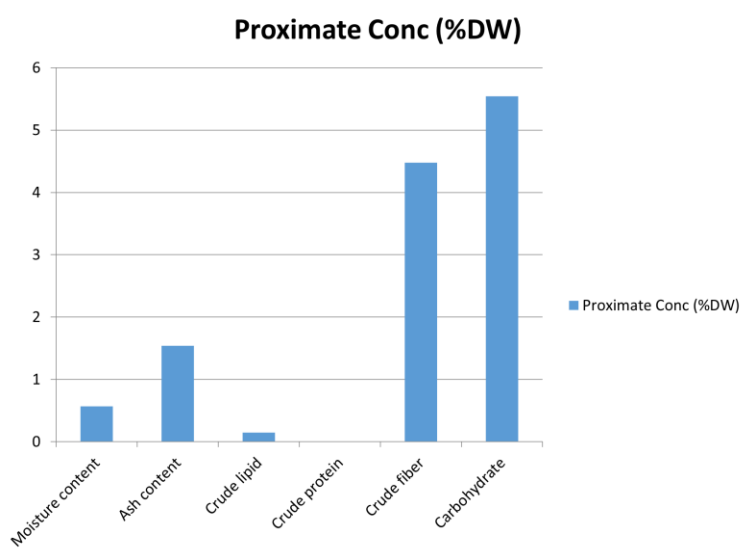


Figure 2. Concentration of detected proximate contents in *Neocarya macrophylla* fruit

3.2. Elements Compositions of Neocarya macrophylla fruit

The determined levels of mineral elements (calcium, magnesium, phosphorus, sodium, and potassium) reveal 30.2500 ppm, 4.9001 ppm, 40.563 ppm, 67.5601ppm, respectively (as shown in Table 2). The values obtained are in tandem with what was obtained in the fruit from Kebbi, Nigeria study (Garba et al., 2022). An observation that might be due to the fact that, Kebbi and Sokoto lies in the same region of North-western Nigeria; but the little variation that was noted might be as a result of differences in varieties, soil varieties, levels of soil fertilities etc. (Muhammad et al., 2015a; Muhammad et al., 2015b). The levels of elements observed were in the order of phosphorus, potassium, sodium, calcium, and magnesium in descending pattern; therewith, the least value obtained was found in magnesium (4.9001 ± 1.04 ppm). All these mineral elements determined revealed (in Table 2) considerable values ($P<0.05$) that can profoundly help the consumers in maintenance of health, growth, and development due to the diverse functions a combo of them or each one of them play (s) (Sarkingobir et al., 2020b; Gada & Ismaila, 2021). For example, potassium (the elevated element determined) is unavoidable for protein synthesis, modulation of body fluids, nerve and muscle activities, regulation of blood pressure, and regulation of glucose and glycogen metabolism (Garba et al., 2022). Phosphorus mineral and the calcium metals play a major function in bones, and teeth making. Likewise, all cells and tissues obtain potassium and calcium for existence. Calcium in particular term is required for nerve impulse transmission, cell permeability modulation, and blood clotting regulation (Akinwumi & Omotayo, 2016; Ahongshangbam & Devi, 2017). Potassium (the 2nd most elevated element assessed) and magnesium (the lowest element assessed); partake in the acid base, as well as electrolyte balance; that is why these levels are recommended for people to lower their hypertension risk, because magnesium reduces pressure, and is unavoidable in DNA synthesis (Muhammad et al., 2015a; Muhammad et al., 2015b; Akinwumi & Omotayo, 2016; Ahongshangbam & Devi, 2017). The sodium/ potassium ratio is a good value that must be regulated for optimum blood pressure maintenance (Aletan & Kwazo, 2019). Nerve signaling and muscle functions are also essential body activities that need sodium unavoidably (Farid & Neda, 2014). In a nutshell, the availability of good nutritional indicators in terms of proximate contents, and elements at a significant level found in this fruit gives a

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good source of food material that is cheap and accessible to the people especially in the region challenged by chronic, infectious diseases and malnutrition (Muhammad & Umar, 2015; Sarkingobir et al., 2020ab; Sarkingobir et al., 2022). The fruit can indeed act as a safe, nutritious food, that in turn help in growth and development of animals, and humans.

Table 2, Elements Compositions of *Neocarya macrophylla* fruit.

Parameters	Concentrations (%DW) ppm
Calcium	30.2500 ± 0.500
Magnesium	4.9001 ± 1.04
Phosphorus	90.1000 ± 0.13
Potassium	67.5601 ± 0.010
Sodium	40.5630 ± 4.48

The values are mean ± standard deviation of triplicate determinations.

4. Conclusion

Nowadays, in the Sokoto region, the semi-arid region there are issues such as food insecurity, climate problems, malnutrition, and double burden of diseases; therefore, it is utmost to utilize cheap, and accessible materials to curtail the worsening of these problems. That is why, proximate compositions (ash, moisture, and the likes) and the elements (sodium, magnesium, potassium, phosphorus, and calcium) were determined in the fruit *Neocarya macrophylla*. Since the fruit is being consumed by both rural and urban dwellers, it is recommended that further research should be carried out to evaluate the heavy metals, and vitamin of this fruit.

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