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# PROXIMATE, ELEMENTAL AND ANTI-NUTRITIONAL COMPOSITIONS OF THE PULP AND SEEDS OF *Zizyphus lotus L.* FROM MINNA METROPOLIS AND ITS ENVIRONS

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***ABSTRACT***
*Fruits have been recognized for their good nutritional role and significance in deficiency prevention. Zizyphus Lotus L. (Chinese date or Chineses Jujube or common jujube) is one of the fruits commonly consumed within Minna metropolis and its immediate environs. The nutritional and anti-nutritional potentials of the pulp and seeds of this fruit were assessed using standard analytical methods of food analysis. The proximate analysis results revealed that the seeds had higher percentage values for crude protein (12.25±0.04 %), crude fat (8.90±0.05 %) and carbohydrate (61.06±0.73 %) than obtained for the pulp. However, pulp had higher percentage contents than seeds in moisture (26.66±0.01 %), ash (5.00±0.16 %) and in crude fibre (7.21±0.08 %). The energy values (kcal/100g) were 250.62±1.72 and 373.56±1.25 for the pulp and seeds respectively. The anti-nutritional contents (mg/100g) determined revealed higher oxalate, tannins and phytate contents of 0.25±0.12, 7.46±0.27 and 8764.63±0.16 respectively for seeds, while pulp had higher cyanide content of 557.40±0.38. The mineral composition of both the pulp and seed of jujube shows that potassium, magnesium and calcium were predominant and the fruit may be considered a good source of minerals. The results revealed that this fruit presents a high nutritional value and could be incorporated in both animal and human diets.*

## INTRODUCTION

Man is blessed with several natural products from both plants and animals; some of these natural products from plants include vegetables and fruits. Vegetables and fruits include different groups of foods of plant origins such as Chinese date or jujube, date, tiger nut, orange, pawpaw, mangoes, guava and so on, that vary in energy and nutrient content (Bvenura and Sivakumar, 2017; Benmeziane-Derradji, 2019; Maldonado-Celis*et al.,*2019). Also, they provide dietary fibre which is known to lower the risks of cardiovascular disease and cases of obesity (Bvenura and Sivakumar, 2017; Shameh *et al.,*2019). In addition, they act as sources of phytochemicals that serve as antioxidants, anti-inflammatory agents and phytoestrogens (Benmeziane-Derradji, 2019). Consumption of fruits as part of diet helps to lower the risk of developing chronic diseases.

*Zizyphus lotus L*. also known as Chinese date or Chinese Jujube or common Jujube in English is from a deciduous shrub which belongs to *Rhamnaceae* family (DeFilipps and Krupnick, 2018). Its plant is called Sedra and it yields small fruits; as a tropical plant. *Zizyphus lotus L.* grows majorly in arid and semiarid regions and is widely found in China, Iran and Africa (Liu and Zhao, 2009; Dahlia *et al.,*2019). In Nigeria, *Zizyphus lotus L.* is found mainly in the Northern part of the country. *Zizyphus lotus L.* is used for nutrition, cosmetics and health purposes in various forms; for instance, it is added in the production of honey, jam, cake juice, tea and loaf (Abdoul-Azize, 2016). *Zizyphus lotus L.* fruit contains mineral, glutamic acid, tocopherols, sterols, vitamins, carbohydrate, amino acids, fibres, triacylglycerol, fatty acid, and antioxidant compounds (phenols and flavonoids) known for many health benefits such as hypoglycemic, , immune modulatory, antioxidant and gastro protective properties (Abdoul-Azize, 2016). *Zizyphus Lotus L*. has been reported to have an anti-age and anti-tumoral effects (Oh *et al.*, 2004), anti-diarrheic and anti-ulcerogenic (Adzu *et al.*, 2002), and the antibacterial effects (Ali *et al.*, 2001; Nazif, 2002).

Some fruits are consumed by man without an in-depth knowledge of the nutritional and anti-nutritional values which may cause malnutrition or increase various health hazards. The evaluation of

the pulp and seeds of *Zizyphus lotus L.* grown around Minna metropolis and its environs in this study provides relevant information on the nutritional and anti-nutritional composition of the fruit so as to make necessary recommendations.

## MATERIALS AND METHODS

### Sample Collection

The sample was obtained from Minna metropolis, Niger State and was identified to be *Zizyphus lotus L.* known as Kurna in Hausa and Jujube in English at the Department of Biological Sciences, Federal University of Technology Minna. Only reagents of analytical grade were used in this study.

### Sample Pre-treatment and Preparation

The sample was thoroughly washed, dried and the pulp was separated from the kernel. The kernel was broken in order to get the seeds. The pulp and the seeds were thoroughly washed, dried and ground into fine powder. These were kept in good, clean and dry polypropylene containers, covered and labelled appropriately.

### Proximate Composition

The proximate composition of the pulp and seeds of *Zizyphus lotus L.* fruit were determined using standard analytical methods for food analysis (AOAC, 2006).

### Determination of Moisture Content

The crucibles were washed, dried and weighed as $W_1$ with an analytical weighing balance. To each of the already weighed crucibles, 2.00 g of the pulp and seeds of *Zizyphus lotus L.* were separately added and re-weighed as $W_2$. Crucible and the content were then placed in an oven at 105 °C until constant weight (reading) was obtained. This was kept to cool in a desiccator and weighed as $W_3$.

% Moisture Content=$(W_2-W_3)/(W_2-W_1)$ x 100

Where: $W_1$ = mass of empty crucible; $W_2$ = mass of crucible plus sample; $W_3$ = mass of dried sample and crucible.

### Determination of Ash Content

A cool dried crucible was weighed as $W_1$ and 5.00 g of the sample was introduced into the crucible and re-weighed as $W_2$. This was transferred into a muffle furnace at 550 °C using a thong and allowed to fully ashes (the colour changed to grey) then weighed as $W_3$.

% Ash Content=$(W_3-W_1)/(W_2-W_1)$ x 100

Where: W1 = mass of the empty crucible; $W_2$ = mass of the crucible and sample; $W_3$ = mass of the ash and crucible.

### Determination of Crude Fat

Fat content of the sample was quantified using the soxhlet extraction method. 5.00 g of the sample was weighed and wrapped with a Whatman No. 1 filter paper, which was folded at the two ends. The filter paper containing the sample was placed into extraction thimble and returned into the soxhlet apparatus which was fitted with a weighed flat bottom flask filled with petroleum ether to about three quarter of its volume and allowed to boil at a boiling point of about 40 °C to 60 °C. The extraction was done over a period of 6 hours. Petroleum ether was then evaporated on water bath and the remainder was removed together with water through drying at 80 °C in an oven for 30 minutes. This was allowed to cool in a desiccator and weighed. The percentage crude fat was calculated as:

$$\% \text{ Crude fat} = \frac{Weight\ of\ extracted\ fat}{Weight\ of\ sample} \times 100$$

### Determination of Crude Fibre

Defatted sample of 2.00 g was weighed into a 500 $cm^3$ conical flask, 200 $cm^3$ of 1.25 % $H_2SO_4$ was added using a measuring cylinder and allowed to boil for 30 minutes on a heating mantle, after which it was allowed to cool then filtered using a Whatman No. 1 filter paper placed in a conical flask. The residue was collected and transferred into a previously washed conical flask, 200 $cm^3$ of 1.25 % NaOH was added then boiled for another 30 minutes and the solution was filtered. The residue was washed with 10 % HCl then with ethanol. The resulting residue was poured on an already dried and weighed crucible, dried at 105 °C for an hour in an oven then kept to cool at room temperature in a desiccator. The dried residue was ashed using the furnace at 550 °C for 30 minutes, allowed to cool and reweighed. The loss in weight after it was ashed was determined and expressed as percentage crude fibre.

$$\% \text{ Crude fibre} = \frac{\text{Weight of defatted sample} - \text{weight of ashed sample}}{Weight\ of\ defatted\ sample} \times 100$$

### Determination of Crude Protein

Protein content was quantified based on the nitrogen contents of the sample using micro kjeldahl apparatus for distillation. Using an analytical weighing balance, 0.25 g of the dried sample was weighed into a clean 100 $cm^3$ kjeldahl

flask, 5.00 $cm^3$ concentrated sulphuric acid ($H_2SO_4$) and a pinch of copper catalyst were added. The mixture was digested on a kjeldahl digestion block in a fume cupboard at 420 °C for about 3 hr. Complete digestion was indicated by a colour change from brown to colourless (a very clear digest). The flask was removed from heat and left to cool. The digest was filtered using Whatman No. 1 filter paper into 50 $cm^3$ volumetric flask and made up to the mark using distil water.

The kjeldahl distillation apparatus was set up, 10.00 $cm^3$ of the digest was pipetted into the distiller, 10.00 $cm^3$ of 40 % NaOH solution was carefully transferred into the distiller and it was properly closed. The solution was allowed to steam and ammonia was liberated. A receiving flask containing 10.00 $cm^3$ of boric acid with 2-3 mixed indicators was connected to the distillation chamber under the tip of the condenser. The ammonia liberated was collected by the receiving flask having the solution of boric acid until it reaches 50 $cm^3$. A colour change from pink to purple was observed, which developed for 5 minutes. The distillate was titrated with 0.01 $moldm^{-3}$ HCl solution with the observation of colour change from purple to pink and the volume of acid used was taken and recorded. The titre values obtained were used to calculate the total nitrogen content, which was converted to percentage protein using the formula:

Total nitrogen (N) = (a-b)×0.01 × 0.014 × D×100)/(W×V)

% Crude protein = N × 6.25

Where: a = titre value of the digested sample; b = titre value of blank; V = volume of sample used; W = mass of dried sample; D = dilution factor.

**Determination of Carbohydrate**

Percentage carbohydrate content was estimated by difference using the equation below:

Carbohydrate (%) =

100-%(crude protein+crude fat+ash+crude fibre+moisture).

**Determination of Energy Value**

Energy value was quantified by multiplying the percentages of crude protein, crude fat and available carbohydrate with recommended factors as shown in the equation below:

Energy (kcal) = [(%CHO×4) + (%CP×4) + (CF×9)]

Where: CHO = Carbohydrate; CP = Crude protein; CF = Crude fat.

**Procedure for Digestion**

2.00 g of the oven dried sample was weighed into a crucible. This was mineralized at 550 °C for 3 hr and allowed to cool in a desiccator. The ash was transferred into a beaker, 10.00 $cm^3$ concentrated $HNO_3$ and 10.00 $cm^3$ of distilled water were added. The mixture was heated at a temperature of 90 °C for 1 hour, allowed to cool and filtered into a 100 $cm^3$ volumetric flask which was made up to mark.

**Determination of the Essential Minerals**

Calcium, magnesium, iron and phosphorus were determined using colorimeter, while flame photometer was used to determine the potassium and manganese content.

**Determination of Anti-nutritional Content**

Anti-nutrients were determined using standard analytical methods for food analysis (AOAC, 2005).

**Determination of Tannins**

0.20 g of the sample was weighed into a 50 $cm^3$ beaker, 20.00 $cm^3$ of 50 % methanol was added to the sample and covered with Para film, then placed in a water bath at 77 °C for 1 hr. This was shaken vigorously to obtain uniform mixture. The extract was filtered into a 100 $cm^3$ volumetric flask using a double layer Whatman No. 1 filter paper, 50% methanol was used to rinse it. Volume was made up to mark using distilled water. 1.00 $cm^3$ of the sample extract was homogenized into a 50 $cm^3$ volumetric flask, 20.00 $cm^3$ distilled water, 2.50 $cm^3$ Folin Denis reagent and 10.00 $cm^3$ of 17 % $Na_2CO_3$ were added and thoroughly mixed. The mixture was made up to mark with distilled water, mixed well and allowed to stand for 20 minutes for the development of a bluish green colour. The absorbances of the tannic acid standard solutions as well as sample were read after colour development on a UV spectrophotometer (Model 752) at a wavelength of 760 nm.

**Determination of Phytate**

1.02 g of the sample was weighed into 250 $cm^3$ conical flask, soaked with 50.00 $cm^3$ of 2 % concentrated HCl for 3 hr and then filtered using Whatman No. 1 filter paper. 25.00 $cm^3$ of the filtrate was measured into a conical flask and 10.00 $cm^3$ of distilled water was added in order to give normal acidity. 10 $cm^3$ of 0.30 % ammonium thiocyanate solution was also added and titrated using standard iron chloride solution containing 0.00195 g iron/ $cm^3$ and the end point was observed to be brownish-yellow colour that occurred for 5 minutes.

% Phytic acid = y×1.19×100

where y=titre value×0.00195

**Determination of Cyanide**

Cyanide was quantified using alkaline picrate method as described by Onwuka (2005). About 5.00 g of the powdered sample was dissolved in 50.00 $cm^3$ of distilled water in a corked conical flask; the extract was left to stand throughout the night and then filtered. 1.00 $cm^3$ of the filtrate was mixed with 4.00 $cm^3$ alkaline picrate in a test tube, corked and incubated for 5 minutes in a water bath. After colour development (reddish brown colour), absorbance was measured at 490 nm, the absorbance of the blank containing 1.00 $cm^3$ distilled water and 4.00 $cm^3$ alkaline picrate solutions was also measured and recorded. The cyanide content was extrapolated from cyanide standard curve prepared from different concentration of KCN solution.

Cyanide (mg/g) = (Absorbance × F×DF)/(Sample weight)
Where GF = gradient factor and DF = dilution factor

**Determination of Oxalate**

Oxalate was determined using the permanganate titrimetric method described in AOAC (2005). 2.00 g of the sample was weighed and suspended in 190.00 $cm^3$ of distilled water in a 250 $cm^3$ volumetric flask. 10.00 $cm^3$ of 6 $moldm^{-3}$ HCl was added before being digested at 100 °C for 1 hr. The digest was allowed to cool, made up to mark before filtration. 125.00 $cm^3$ of the filtrate was measured into a beaker and 4 drops of methyl red indicator was added. This was followed by the addition of $NH_4OH$ solution dropwise until the test solution changes from salmon pink to faint yellow colour. Each portion was heated to 90 °C, allowed to cool then filtered to remove precipitate containing ferrous ion. The filtrate was heated again to 90 °C followed by the addition of 10.00 $cm^3$ of 5 % $CaCl_2$ solution while being stirred continually. After heating, it was cooled and kept overnight at 5 °C. The solution was then centrifuged at 2500 rpm for 5 minutes, the supernatant was decanted and the precipitate dissolved in 10.00 $cm^3$ of 20 % $H_2SO_4$. Total filtrate obtained from the digestion was made up to 300 $cm^3$. Aliquots of 125.00 $cm^3$ of the filtrate was heated to near boiling then titrated against 0.05 $moldm^{-3}$ standardised $KMnO_4$ solution until a faint pink colour which remained for 30 seconds is obtained. Calcium oxalate content was determined using the expression:

$$\text{Oxalate content} = \frac{T \times (Vme)\,(Df) \times 10^5}{(ME) \times Ms}$$

Where: T = titre value of $KMnO_4$; Vme = the volume-mass equivalent (1$cm^3$ of 0.05 $moldm^{-3}$ $KMnO_4$ solution is equivalent to 0.00225g anhydrous oxalic acid); Df = dilution factor (2.5) ($Df = V_T/A$); $V_T$ = total volume of titrate (300 $cm^3$); A= Aliqout used (125 $cm^3$); ME= molar equivalent of $KMnO_4$ in oxalate; Ms= Mass of sample.

**Statistical Analysis**

Results were presented as simple means, standard deviations and percentages of triplicate analysis.

## RESULTS AND DISCUSSION

**Proximate Composition**

Results of proximate composition of Pulp and Seeds of *Zizyphus Lotus* L. Fruit are presented in Table 1. The moisture content of 26.66±0.01 % was high in the pulp than the 11.11±0.40 % found in the seeds. This high moisture content in the pulp would result in rapid deterioration due to microbial activities than on the seeds and so reduces its shelf-life(Xiao *et al*., 2017; Amit *et al*., 2017). The moisture content as obtained in this study was higher than that of the dry tiger nut (8.08±0.07 %) and lower than was in the fresh tiger nut (53.67±0.15 %) as reported by Mairiga *et al*. (2016). Also, the moisture content for this study was higher than 1.16±0.16 % for date fruit as reported by Elijah *et al*., (2015). In addition, the value for the pulp was higher than the moisture content values reported by Fawzi *et al*. (2018) in different varieties of dates.

Ash content which gives indication of mineral content (Rehman *et al*., 2014) was 5.00±0.16 % and 3.38±0.60 % for the pulp and seeds respectively. This is an indication that the pulp will have more mineral stuffing when compared with the seeds and therefore can speed up metabolic processes which in turn improves growth and development (Monti *et al*., 2008). The ash content obtained was higher than the 1.05±0.06 % reported by Chouaibi *et al*. (2012). This could be due to the environments, time, location, longevity and maturity of the fruit. Also, the ash contents were higher than that obtained in both the fresh and dry tiger nut in keffi, Nasarawa State reported by Mairiga *et al*. (2016).In addition, the ash content of *Zizyphus lotus* L. in this study was higher than the 1.88±0.03% obtained by Elijah *et al*.(2015).

**Table 1: Proximate Composition of Pulp and Seeds of *Zizyphus Lotus L.* Fruit**

| Parameter | Pulp | Seed |
|---|---|---|
| Moisture (%) | 26.66±0.01 | 11.11±0.40 |
| Ash (%) | 5.00±0.16 | 3.38±0.60 |
| Crude Protein (%) | 1.93±0.05 | 12.25±0.04 |
| Crude Fat (%) | 1.2±0.19 | 8.90±0.06 |
| Crude fibre (%) | 7.21±0.08 | 3.09±0.10 |
| Carbohydrate (%) | 58.01±0.07 | 61.06±0.73 |
| Energy value (kcal/100g) | 250.62±1.72 | 373.56±1.25 |

Results are mean values of triplicate analysis ± standard deviations

Crude protein had values of 1.93±0.05 % and 12.25±0.04 % for pulp and seeds respectively. The higher protein content of the seeds as compared with the pulp makes it a good source of plant protein that could be a supplement to animal protein. The values of the crude protein in this study were lower than that reported by Chouaibi *et al.* (2012). Also, the value (12.25±0.04 %) for the seeds obtained in this study was higher than that found in both fresh and dry tiger nut (*Cyprus esculentus L.*) with values of 3.18±0.24 % and 5.62±0.21 % respectively as reported by Mairiga *et al.* (2016). Furthermore, values obtained were higher than value reported for dates (Elijah *et al.,* 2015). Protein is an essential component of diet required for the survival of human and animals as they supply the adequate amount of amino acids needed for nutrition(Lopez and Mohiuddin, 2021). This implies that *Zizyphus lotus L*. seeds could serve as a better source of amino acid when compared to the findings of Mairiga *et al.* (2016) and Elijah *et al.*(2015).

Crude fat is very vital for normal growth and development, absorption of some vitamins and carotenoids, maintaining of cell membranes, providing taste, consistency and stability of foods (Antonio and María, 2000; Ravisankar *et al.,* 2015; Rafeeq *et al.,* 2020). Crude fat had values of 1.2±0.19 % and 8.90±0.06 % for pulp and seeds respectively. This is an indication that the seeds of the fruit are comparatively a good source of oil. The pulp could be recommended as a weight reducing diet since low fat fruits reduce the level of cholesterol and obesity due to its low level of fatty acids and cholesterol (Swinburn *et al.,*2004). Crude fat contributes significantly to the energy value of food which implies that the energy value of the seed will be higher when compared to that in the pulp. More so, the crude fat in this study was lower than the 32.92±0.29 % in the seeds of *Zizyphus lotus* L. reported by Chouaibi *et al.* (2012). The crude fat value in this study was lower when compared with tiger nut reported by Suleiman *et al.,* (2018) and Adam *et al.* (2017). However, the crude fat contents of *Zizyphus lotus* L. was higher than those of dates (Elijah *et al*., 2015;Yahaya *et al.,* 2015; Alghamdi *et al.,* 2018; Ibrahim *et al.,* 2019; Rambabu *et al.,* 2020).

Dietary fibre influences digestion and absorption of food in the small intestine (Chater *et al*., 2015; Grundy *et al.,* 2016). It decreases the absorption of cholesterol from the gut, delays digestion and conversion of starch to simple sugars; this is important in the management of diabetes. It is evident in the reduction of the risk of coronary heart diseases (Capuano, 2017), hypertension, diverticulosis, obesity, colon and breast cancer (Carrera-Bastos *et al.,* 2011). The values for the crude fibre for this study were 7.21±0.08 % and 3.09±0.10 % for the pulp and seeds respectively; these were lower than that of Mairiga *et al.* (2016) and Suleiman *et al.* (2018) for dry tiger nut. This implies that the dry tiger nut has better potential in the lowering of cholesterol level. Although, the fibre content in this study was higher than that obtained in dates as reported by other researchers (Yahaya *et al.*, 2015; Ibrahim *et al.,* 2019; Elijah *et al.,* 2015), thus indicating that *Zizyphus lotus L.* has better potential for the cure of diabetes, hypertension, coronary heart diseases, diverticulosis, obesity, colon and breast cancer.

Carbohydrates are vital source of energy for human body and can be changed into glucose (blood sugar) by human digestive system in order to enhance the performance of cells, tissues and organs in the body (Jéquier, 1994). The carbohydrate content of 61.06±0.73 % in the seeds was higher than 58.01±0.07 % found in the pulp, which further gave rise to higher calorific (energy)

value of 373.56±1.25 kcal/100 g for the seeds than 250.62±1.72 kcal/100 g recorded for the pulp. This indicates that the seeds and pulp are good sources of energy and will provide considerable calorific energy to their consumers. The 61.06±0.73 % carbohydrate content in the seeds was higher than the 40.87±0.39 % reported by Chouaibi *et al.* (2012) which could be due to difference in location and climate that can antagonistically impact the quality and nutritional values of fruits (Hornick, 1992). Also, the carbohydrate contents in this study was higher than the 17.82 % and 28.2 % obtained in tiger nut reported by Suleiman *et al.* (2018) and Adam *et al.* (2017) respectively. Furthermore, these were lower than those obtained in date fruit (Al-Hariasi *et al.,* 2014; Elijah *et al.,* 2015; Alghamdi *et al.,* 2018).

**Mineral Content**

Minerals are required in human nutrition. Activities of enzymatic and electrolyte balance of the blood fluid are related to adequacy of Na, K, Mg and Zn (Dhondup and Qian, 2017).

The results of the mineral content of pulp and seeds of *Zizyphus lotus L.* fruit are shown in Table 2. The values for Manganese in the pulp and seeds were 6.00±0.06 mg/100g and 2.10±0.04 mg/100g respectively. The result showed that the value of manganese in the seeds was lower than that of the pulp. Manganese is a trace element that plays a dynamic role; glucose metabolism, normal body growth and reproductive function in human body (Li and Yang, 2018). It is evident that the consumption of the pulp will be of immense benefit. However, high level intake of manganese in diet leads to abnormal glucose utilisation in the body (Li and Yang, 2018), thus consumption of the pulp of *Zizyphus lotus L*. should be in moderation. The manganese contents in this study were lower than that obtained in date fruit (Elijah *et al.,* 2015).

**Table 2: Mineral Composition (mg/100g) of Pulp and Seeds of *Zizyphus lotus L.* Fruit**

| Element | Pulp | Seeds |
|---|---|---|
| Manganese (Mn) | 6.00 ±0.06 | 2.10 ±0.04 |
| Magnesium (Mg) | 21.90 ±0. 1 1 | 2.70 ±0. 1 2 |
| Calcium (Ca) | 17.10 ±0.15 | 10.10 ±0.10 |
| Potassium (K) | 80.4 0±0.04 | 36.4 0±0.05 |
| Phosphorous (P) | 0.20 ±0.07 | 0.10 ±0.10 |
| Iron (Fe) | 2.20 ±0.04 | 0.50 ±0.08 |
| Zinc (Zn) | 6.10 ±0.01 | 2.70 ±0.02 |

The concentrations of magnesium in the samples were 21.90±0.11 mg/100g and 2.70±0.12 mg/100g for the pulp and for the seeds. Magnesium, a macronutrient is essential for various biochemical reactions in the body. It plays important biochemical roles which include enzymes activation, functioning of the muscle and nerve, blood coagulation and building of blood sugar levels. The content of magnesium in the seeds was lower than 153.92±0.05 mg/100g reported by Chaouaibi *et al.* (2012). More so, the contents of magnesium in this study were lower than that in date fruit (Elijah *et al.,* 2015; Ibrahim *et al.,* 2019; Rambabu *et al.,* 2020).

Calcium contents of the pulp and seed were 17.10±0.15 mg/100g and 10.10±0.10 mg/100g respectively. This shows that the pulp has higher calcium content than the seed and could be as a result of the higher value of oxalate in the seeds which might have resulted to complex development with the divalent metals, and could have impact on natural action of the metal particles in the body (Elijah *et al.,* 2015). Calcium is required for building up strong bones, blood coagulation and promoting muscle activity. The content of calcium in the seeds was lower than 110.58±0.04 mg/100g reported by Chaouaibi *et al.* (2012). More so, the contents of calcium in this study were lower than that in date fruit (Elijah *et al.,* 2015; Ibrahim *et al.,* 2019; Rambabu *et al.,* 2020).

Potassium is a macro nutrient needed by plants and animals for various metabolic activities (Hasanuzzaman *et al.,* 2018). Potassium is linked to nerve transmission in the body (White *et al.,* 1992). It is also required for the maintenance of

osmotic pressure, activation of enzyme and muscular activities, hormonal secretion, signal and immune response (Curran, 1998). The recommended dietary intake of potassium is 66 - 32mg/kg per day (ESPGHAN, 1997).The potassium content of the pulp and seeds were 80.40±0.04 mg/100g and 36.40±0.05 mg/100g respectively. The content of potassium in the seeds was lower than 92.41±0.03 mg/100g reported by Chaouaibi *et al.* (2012). More so, the contents of potassium in this study were lower than that in date fruit (Elijah *et al.,* 2015; Rambabu *et al.,* 2020).

Phosphorus is known to prompt quick release of energy in the body and could combine with calcium for bone and teeth development as well as for development of ATP which is the energy currency of our body. The phosphorous content of the pulp and seeds were 0.20±0.07 mg/100g and 0.10±0.10mg/100g respectively. The contents of phosphorous in this study were lower than that in date fruit (Elijah *et al.,* 2015; Rambabu *et al.,* 2020).

Iron deficiency leads to anaemia and affect brain functioning (Georgieff, 2011). Iron is considered to be the most abundant trace element in human body (Bhattacharya *et al*., 2016). Fe is also an important part of haemoglobin in oxygen transport (Abbaspour *et al.,*2014), oxygen storing in muscle tissues (myoglobin), and as a constituent of enzymes (catalase, peroxide and cytochromes). The concentrations of iron in the samples were 2.20±0.04 mg/100g and 0.50±0.08 mg/100g for the pulp and seeds respectively. The content of iron in the seeds was lower than 1.21±0.01 mg/100g reported by Chaouaibi *et al.* (2012). More so, the contents of iron in this study were lower than that in date fruit (Elijah *et al.,* 2015) and within the same range as reported by Rambabu *et al.*(2020).

Zinc concentrations in the pulp and seeds were 6.10±0.01 mg/100g and 2.70±0.02mg/100g respectively. Zinc is considered one of the most abundant elements found mostly in muscle and bones. It is a component of many enzyme and insulin (Norouzi *et al*., 2018). Zinc is an integral part of hormones and is vital in several metabolic processes and plays important role in the metabolism of alcohol, immunity development and reproduction. The contents of zinc in this study were higher than that reported by Chaouaibi *et al.* (2012). Furthermore, the contents of zinc in this study were lower than that in date fruit (Elijah *et al.,* 2015).

**Anti-nutritional Properties**

Anti-nutritional content of the pulp and seed are presented in Table 3.Oxalate contents present were 0.23±0.15 mg/100g and 0.25±0.12 mg/100g for the pulp and seeds respectively. The obtained values show that both the pulp and seeds contain oxalate in an insignificant amount. Oxalate poisoning poses a nutritional challenge because calcium and some elements in diets are made partly or completely unavailable (Norwood and Fox, 1982). The oxalate contents in this study were closely within the same range of 0.26±0.02 – 1.18±0.14 mg/100g for date fruit reported by Rambabu *et al.* (2020). However, these values were lower than the 7.57±0.04 % obtained in date fruit as reported by Elijah *et al.* (2015). More so, the values in this study were lower than 22.40±0.36 mg/100g and 78.40±0.55 mg/100g for both fresh and dry tiger nut respectively reported by Mairiga *et al.*(2016).

**Table 3:Anti- nutritional Properties (mg/100g) of Pulp and Seeds of *Zizyphus lotus L.* Fruit**

| Parameter | Pulp | Seeds |
|---|---|---|
| Oxalate | 0.23 ±0.15 | 0.25±0.12 |
| Cyanide | 557.40 ±0.38 | 440.0 0 ±0.42 |
| Tannin | 5.93±0.23 | 7.46±0.27 |
| Phytate | 6168.19 ±0.19 | 8764.63±0.16 |

The cyanide content of the pulp was 557.40±0.38 mg/100g and that of the seeds was 440.00±0.42 mg/100g. The cyanide in the pulp is higher than that of the seeds. Cyanogenic glycosides, an effective cytochrome oxidase inhibitor is known to interfere with aerobic respiratory system (Habtamu and Ratta, 2014). However, since cyanide does not occur free, its toxicity can be reduced; it combines with sugar to form a non-toxic compounds (cyanogenic glycosides) in which the respiratory chain at the cytochrome oxidase levels could be lost during soaking and cooking so that its presence in fruit does not pose danger of toxicity (Habtamu and Ratta, 2014).

The tannin concentrations of *Zizyphus lotus L*. pulp and seed were 5.93±0.23 and 7.46±0.27 mg/100g respectively. This implies that the fruit when consumed may not lower the availability of protein and minerals in the body or clothing with red blood cell as caused by excess tannin and saponins in human body. Tannin is known to inhibit activities of enzymes such as trypsin, amylase and lipase, and also interfere with the absorption of dietary iron (Samtiya *et al*., 2020). However high content may lead to calcium and iron deficiencies in the body and often cause osteoporosis and anaemia (Samtiya *et al*., 2020).

The concentrations of phytate in *Zizyphus lotus L* pulp and seeds were 6168.19±0.19 mg/100g and 8764.63±0.16 mg/100g respectively. The concentration of phytate in the seeds was higher than those in the pulp. The negative effect of the presence of phytate on mineral uptake is of major concern (Greiner and Konietzny, 2006). Phytate is reported to interact with carbohydrate which retards its bioavailability and digestion (Dost and Tokul, 2006).

## CONCLUSION

The results obtained from this study showed that *Zizyphus Lotus* fruit is a good source of carbohydrate, protein, fibre, fat and energy value. *Zizyphus Lotus* fruit is also a good source of calcium, magnesium, iron, zinc, phosphorus and manganese. Moreso, the study revealed that *Zizyphus Lotus* fruit contains anti-nutritional factors such as tannins, cyanide, oxalate and phytate which when consumed in large quantity may result in serious health challenges. Furthermore, high nutritional value found in *Zizyphus Lotus* could make it a good source of nutrients for man and animals.

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