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Comparison of the Nutraceutical Potential of *Ziziphus spina christi* and *Parkia biglobosa* Fruits

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Abstract

Consumption of Zizipus spina christi and Parkia biglobosa fruits in Kano state Northern Nigeria is increasing daily, due to their huge amount of some minerals, vitamins and antioxidant content. Comparative analysis of these minerals and proximate composition will showcase their health and nutritional benefits. This study aimed to compare the proximate composition of Z. spina christi and P. biglobosa fruits. The proximate analysis shows that some parameters (ash, crude fiber and moisture content) were significantly (p<0.05) higher in the fruit of P. biglobosa when compared to Zizipus spina christi fruit [(5.76±0.17 % and 3.15±0.12 %), (12.35±0.46 % and 5.59±0.16 %), (3.16±0.05 % and 1.99±0.02 %) respectively], while other parameters such as crude protein, crude fat and carbohydrate content were significantly (p<0.05) higher in the fruit of Z. spina christi when compared to P. biglobosa fruit [(13.23±0.60 % and 11.09±0.60 %), (75.80±0.10 % and 67.53± 0.09 %), (0.14±0.01 % and 0.13± 0.01 %) respectively]. Also, the mineral composition were also analyzed; potassium (250.72± 0.03 mg/kg), magnesium (47.04± 0.04 mg/kg), iron (12.77± 1.02 mg/kg), manganese (2.26± 0.55 mg/kg) and sulfur (1.92± 0.12 mg/kg) were found to be significantly (p<0.05) higher in the fruit of P. biglobosa when compared to Zizipus spina christi fruit, while calcium (177.72± 0.07 mg/kg), zinc (2.53± 0.08 mg/kg) and phosphorus (10.85± 0.13 mg/kg) were found to be significantly (p<0.05) higher in the fruit of Zizipus spina christi when compared to P. biglobosa fruit. The present study showed that the fruits of both trees contains important mineral and proximate composition; therefore, they could be utilized as raw materials in food and pharmaceutical industries.

Keywords: Comparative, Consumption, Fruits, Mineral, Proximate composition

INTRODUCTION

Ziziphus spina-christi is commonly known as the Christ's thorn jujube, it is an evergreen tree native to Northern and tropical Africa, Southern and Western Asia. (Bouamama *et al.*, 2006). It is a thorny shrub or tree which belongs to the family Rhamnaceae. To date, the family consists of about 55 genera and 950 species that fall within the broad categories of trees and shrubs. The tree is cultivated for its nourishing fruits, with highest tolerance to droughts and

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high temperatures of around 30 ºC, but can also grow in relatively wetter areas with temperatures as low as 19 ºC (Ng and Fong, 2000). The fruit is an edible drupe, yellow-brown, red, or black, globose or oblong, 1-5 cm long, often very sweet and sugary, reminiscent of a date in texture and flavor (Peter and Lucky, 2013). The fruit is widely used as food particularly due to its nutrient content, Koh et al (2011) reported rich mineral content in the fruits and the leaves have the lowering capacity of sugar content in the management of diabetes.

The use of *Pakia biglobosa* (family fabaceae) as food and in traditional medicine is popularly among the people in West African region. Additionally, it has a higher commercial value. Studies shows that it contains carbohydrate, protein, fats, mineral, vitamins and medicinal properties such as antimicrobial, antibacterial and antioxidant among others (Builders 2014). The fruit of *P. biglobosa* is a slightly curved, brown indehiscent pod, 30 to 40 cm long and 2 to 3 cm wide producing up to 20 seeds (Motamedi *et al.,* 2014). The most significant product from the African locust bean tree is food, and the tree's food products are vital due to their seasonality of maturation and availability. During period of food shortage and drought, it contributes to household food security, income and poverty reduction (Bouamama *et al.,* 2006*)*. It has been identified as one of the candidates with promising therapeutic potential in the prevention and management of a number of metabolic diseases including diabetes (Naghibi *et al.,* 2010*)*. Therefore, based on the increasing demand and consumption of these fruits in Kano State, Nigeria, there is need to evaluate and compare both their proximate and mineral composition.

MATERIALS AND METHODS

Chemicals and Equipment

All the chemical/reagents and standards used were of analytical grade and supplied from Sigma-Aldrich. The Equipment used are Fibertec 8000 (Auto fibre Analysis System), Carbolite, Kjeltec 8400 (Foss), Digestor, SR 210 Scrubber, Soxtec 8000 Extraction unit (Foss), Combustion calorimeter, Analytical Weighting Balance (OHAUS, PIONEER) and MP-AES (AGILENT 4210) Agilent Technologies.

Proximate Composition

Determination of Moisture

The percentage moisture of the fruits was determined using moisture analyzer (Ooi *et al*., 2012) and the results were recorded.

Determination of Crude Fat

The measurement of fat content was conducted using Soxtec method previously described by Noureddini and Byun 2010, with a SoxtecTM 8000 automated analyzer. Petroleum ether was used for the extraction, whereas the percentage of fat was obtained using the formula below;

$$\%\ \text{Fats} = \frac{\text{Weight}_{\text{extraction cup+residue}} - \text{Weight}_{\text{extraction cup}}}{\text{Weight sample}} \times 100$$

Determination of Crude Protein

The nitrogen content in each sample was determined according to the method Ng *et al* (2008) using Kjeltec 8400 Auto Distillation Unit (FOSS Tecator Line), and the protein content was obtained using conversion factor of 6.25.

Determination of Ash Content

The method described by AOAC (2000) was used to measure the ash content of the fruit samples. The samples were incinerated in a furnace (CARBOLITE) at 550 °C, and the remaining inorganic material was cooled, weighed and the ash content was determined.

Determination of Crude Fibre

The method described by Noureddini and Byun (2010) was used to determine the crude fibre content of the fruit samples using a Fibretec 8000 auto fibre analysis system.

Determination of Carbohydrate and Caloric Value

The total carbohydrate content in the samples was calculated by difference method, while the caloric value was calculated by sum of the percentages of proteins and carbohydrates multiplied by a factor of 4 (kcal/g) and total lipids multiplied by a factor of 9 (kcal/g).

Determination of Mineral Composition

The mineral content was estimated using Agilent Microwave Plasma Atomic Emission Spectrometer (MP-AES Model: AGILENT 4210) as described by Bashir et al (2021).

Sample Preparation for Mineral analysis (Using Advanced Microwave Digestion System)

The fruit samples were prepared as programmed by the equipment; briefly: Two hundred milligram (200 mg) of samples were weighed and transferred into 90ml microwave digestion vessels. Ten millilitres (10 mL) mixture of 15.9 N trace metal grade Nitric acid, hydrogen peroxide and perchloric acid (7:2:1) was added to each vessel. After standing for one hour (1h), the samples were processed by microwave digestion system as follows: ramp temperature from ambient to 200 ^{o}C over 20 minutes, then hold at 200 ^{o}C for 20 minutes, after digesting, they were allowed cool to approximately 50 ^{o}C or lower before handling. The digest was transferred to 50 ml volumetric flask, the solution volume was adjusted to 50 ml with deionised water and filtered for instrumental analysis.

The sample was introduced through PVC peristatic pump tubing (white/white and blue/blue), and pass to cyclonic spray chamber and the oneNeb nebulizer. The Agilent MP Expert software was used to measure the intensities and automatically subtract the background signal from the analytical signal. A background spectrum from a blank solution was recorded, and the values was automatically subtracted from both standard and sample. The pressure of nebulizer was optimized using the software and position for each wavelength selected to maximize sensitivity was viewed, and a standard reference solution was used Bashir *et al.* (2021).

Statistical Analysis

All determinations were carried out in triplicates, and data was expressed as mean ± standard deviation (SD).

RESULTS

The proximate composition of *Z. spina christi* and *P. biglobosa* fruits were presented in Table1. All the parameters generally differ significantly ($p<0.05$) among the two fruits. The moisture content of *Z. spina christi* and *P. biglobosa* were 1.99 ± 0.02 and 3.16 ± 0.05% respectively, the total ash contents obtained from these fruits were 5.76 ± 0.17 and 3.15 ± 0.12 % for *Z. spina christi* and *P. biglobosa* respectively, crude protein content of 11.09 ± 0.60 and 13.33 ± 0.06 % were obtained from *Z. spina christi* and *P. biglobosa* respectively. The values obtained for crude fat were 0.13 ± 0.01 and 0.14 ± 0.01 % for *Z. spina christi* and *P. biglobosa* respectively.

Also. the mineral composition of *P. biglobosa* and *Z. spina christi* fruits were determined and the results were presented in Table 2;

Table 1: Proximate Composition of *Parkia biglobosa and Z. spina christi* Fruits

Parameters Tested	*P. biglobosa Fruits* (% ± SD)	*Z. spina christi* Fruits (% ± SD)
Ash	5.76±0.17	3.15±0.12
Crude fibre	12.33±0.46	5.59±0.16
Crude fat	0.13±0.01	0.14±0.01
Moisture	3.16±0.05	1.99±0.02
Crude Protein	11.09±0.60	13.33±0.60
Carbohydrate	67.53	75.80
Energy (Kcal/g)	314.48	356.52

All values were mean ± standard deviation of triplicate determinations

Table 2: Mineral Composition of *P. biglobosa* and *Z. spina christi* Fruits

S/N	Mineral	Concentration (mg/kg)	
		P. biglobosa	*Z. spina christi*
1	Phosphorous (P)	8.78±0.82	10.86±0.12
2	Sulfur (S)	1.92±0.12	1.54±0.16
3	Zinc (Zn)	1.37±0.03	2.53±0.07
4	Iron (Fe)	12.77±1.02	8.42±1.12
5	Copper (Cu)	0.93±0.44	0.70±0.07
6	Potassium (K)	250.73±0.07	215.83±0.02
7	Magnesium (Mg)	47.04±0.04	31.77±1.60
8	Manganese (Mn)	2.26±0.54	0.95±0.28
9	Sodium (Na)	23.05±0.03	23.30±1.57
10	Calcium (Ca)	157.36±0.02	177.69±0.01

All values were mean ± standard deviation of triplicate determinations

DISCUSSION

The present study showed that both samples had low moisture content; and this is an indication of easier attention when it comes to preservation as higher moisture content would be prone to microbial contamination and chemical degradation (Ooi *et al*., 2012), as it provides access for many reaction processes to occur such as water-soluble enzymes and co-enzymes involved in metabolic activities of these fruits (Iheanacho and Ubebani, 2009). The higher ash content of *P. biglobosa* fruits is an indication of good quality of the fruits which is directly proportional to the mineral composition, and the values obtained in this study were within the ranges (0.56 ± 0.06-8.26 ± 0.01 %) reported by Termote *et al* (2022), even though the fruits could be subjected to many processing methods particularly *P. biglobosa* fruits. The study also showed that the fruits of both trees had appreciable amount of protein; fruits with higher protein content are recommended most especially to protein deficient persons Termote *et al*. (2022), thus, consumption of these fruits would serve as remedy to the protein deficiency. However, it was observed that the fruits of both trees have very low crude lipid content; fruits with lower lipid content are recommended for individuals suffering from obesity (Kris-Etherton et al., 2002). The crude fibre content of *P. biglobosa* fruit (12.35 ± 0.46%) was significantly ($p<0.05$) higher than *Z. spina christi* fruit (5.59 ± 0.16%), however, the value obtained for *Z. spina christi* fruit agreed with the value reported by Termote *et al*. (2022). The Carbohydrates content of *Z. spina christi* fruit was significantly ($p<0.05$) higher (75.80%) than that of *P. biglobosa* fruit (67.53%), however, both samples are rich in carbohydrate content, thus, the fruits can be used as sources of carbohydrate. The calories values obtained from *P. biglobosa* (356.52 kcal/100g) was significantly ($p<0.05$) higher compared to *Z. spina christi* fruit (314.48 kcal/100g), and these values were within the range reported by Termote *et al*. (2022).

Nutritionally, mineral elements are very important in human system for different metabolic activities (Grosvernor and Smolin, 2002). The higher concentration of phosphorus (10.86 ± 0.12 mg/kg) was recorded in the fruit of *Z. spina christi*, while the highest concentration of magnesium (47.04 ± 0.04 ppm) was observed in the fruit of *P. biglobosa.* Magnesium is important in decreasing blood pressure by dilating arteries and preventing abnormal heart rhythm **(**Wardlaw *et al*., 2004), it is also vital in cellular proliferation, contributing to DNA and RNA synthesis by acting as a catalyst to enzymes involved in metabolic function (Okezie *et al*., 2017). Additionally, magnesium protect soft tissues from hardening and prevent the lining of the arteries from stress due to fluctuations in blood pressure (Okezie *et al*., 2017). The concentration of zinc (2.53±0.07 mg/kg) was higher in *Z. spina christi* fruit; zinc is another vital mineral and was found in all the fruits under investigation, it is required in the synthesis of protein and collagen formation (Okezie *et al*., 2017). Deficiency of zinc results in a decrease sense of smell and taste, thin brittle nails, hair loss, and increase susceptibility to illness and infection (Sander, 2013), therefore, consumption of these fruits should be encouraged considering the presence of zinc.

P. biglobosa fruit contain higher amount of manganese (2.26±0.54 mg/kg) when compared with *Z. spina christi* fruit (0.95±0.28 mg/kg), however, all the values were within the range reported by Termote *et al* (2022). Manganese is helpful in central nervous system and skeletal anomalies among children (Mohammed and Sharif, 2011). The concentration of copper in *Z. spina christi* and *P. biglobosa* were 0.70 ± 0.07 and 0.93±0.44 mg/kg respectively. Copper is very useful in haemoglobin formation, red blood cells and energy metabolism (FAO, 2001). Iron (Fe) is another very important mineral that plays a vital role haemoglobin formation, control of infection and cell mediated immunity (Bhaskaran, 2001). *P. biglobosa* fruit showed higher concentration of iron (12.77±1.02 mg/kg) compared to *Z. spina christi (*8.42±1.12 mg/kg). Also, calcium was found to be present in all the fruits tested with the highest concentration in *Z. spina christi* fruits (177.69 ± 0.02 mg/kg). Other minerals element detected include sodium with concentration of 23.05 ± 0.03 mg/kg and 23.30 ± 1.57 mg/kg in *P. biglobosa* and *Z. spina christi* fruits respectively, potassium with concentration of 250.73 ± 0.07 mg/kg and 215.83 ± 0.02 mg/kg in *P. biglobosa* and *Z. spina christi* fruits respectively. The study showed that both fruits could be useful as supplements in both human and animal nutrition (Okezie *et al*., 2017).

CONCLUSION

The present study showed that the fruits of *P. biglobosa* and *Z. spina christi* contains important mineral and proximate composition; therefore, they could be utilized as raw materials in food and pharmaceutical industries.

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