Research Article

Comparative Analysis of Proximate, Minerals and Functional Properties of *Tamarindus indica* pulp and *Ziziphusspina christi* Fruit and Seed

[1]Amoo Isiaka Adekunle and Jokotagba Oloruntobi Adenike*

Department of Chemistry, Federal University of Technology Akure, Ondo State, Nigeria
[1]E.mail: adisamoo@yahoo.co.uk,

*Corresponding Author. E.mail: tobi23_too@yahoo.co.uk

ABSTRACT

Proximate and mineral analysis, carbohydrate composition, functional properties and anti-nutritional factors of *Tamarindus indica* (L.) and *Ziziphus spina christi* seed and fruit were determined using standard methods. *Ziziphus spina christi* seed was found to be rich in protein (24.07%) than *Tamarindus indica* pulp (7.64%) and *Ziziphus spina christi* fruit (8.23%). The crude fat content of all the samples, *Tamarindus indica* pulp (1.03%), *Ziziphus spina christi* fruit (1.94%), *Ziziphus spina christi* seed (1.24%) were low. High carbohydrate values, 56.00%, 58.02% and 35.25% were obtained for *Tamarindus indica* pulp and *Ziziphus spina christi* fruit and seed respectively. Meanwhile, the functional properties of *Ziziphus spina christi* fruit was relatively higher than the seed and *Tamarindus indica* pulp. Values obtained for dextrose, fructose, maltose and other sugars showed that they all contain an appreciable amount of sugar. The anti-nutritional factors depicted that they all contained low amount of oxalate, tannic acid, phytin phosphorus except the phytic acid, 5.74, 6.56, and 8.24 (mg/100g for *Tamarindus indica* pulp and *Ziziphus spina christi* fruit and seed respectively. The mineral analysis showed that the Ca Mg, and Fe contents of these samples were relatively high with *Ziziphus spina christi* seed having the highest value of Fe (58.53 mg/100g) compared with *Tamarindus indica* pulp (27.36 mg/100g) *Ziziphus spina christi* (39.96 mg/100g). The results generally indicated that *T.indica* pulp and *Ziziphus spina christi* fruit and seed were good sources of protein, mineral and energy foods and can be used in food formulation.

Keywords: ***Tamarindus indica*** **pulp Fruit,** ***Ziziphusspina christi*** **Fruit**

INTRODUCTION

Tamarind (*Tamarindus indica* L), native to tropical Africa, widely grown in Sudan and adopted in India, is a slow-growing; long-lived massive tree with strong branches. The fruits are flattish, beanlike and are borne in great abundance along the new branches. As the pods mature, the acidulous pulp turns brown or reddish brown (Morton, 1987) while *Ziziphus spina christi* commonly called Jujube, also known as Kurna in Northern part of Nigeria and Dom/Christ thorn in English is a shrub, sometimes a tall tree reaching a height of 20 m, native to a vast area of Africa The fruits which taste like a mixture of dates and apples can be eaten raw or dried for later use (NAS, 1980). Research has shown that lesser work has been carried out on functional properties and the chemical composition of the fruits. Therefore this study aims at determining and comparing the nutritional value and other food benefits from these fruits which may be used as a supplement for protein and other mineral nutrient for the body.

Materials and Method

Pods of *Tamarindus indica* and *Ziziphus spina christi* fruits were purchased from SokotoState. Each sample was manually screened by removing dirt, stones and bad seeds and sun dried. The pulps of *Tamarindus indica* were separated from the seeds. Pulps of *Tamarindus indica*, fruits and seed of *Ziziphus spina christi* were further sun dried and blended into powder. The powdered samples were put in air tight polythene bags and kept in a refrigerator at 4^{o}C prior the analyses.

Methods

The proximate analysis was carried out by using the methods described by Association of official analytical chemist (AOAC, 1990). The moisture content was carried out by heating 5 g of the samples in a thermostatically controlled oven to a constant weight at 105°C while the ash content was obtained by heating 1 g of the sample in a muffle furnace at 550°C until a light grayish residue was obtained. The crude fat content was determined by solvent extraction using petroleum ether at 60°C for 3 hours. The crude fibre was also determined by boiling the samples with dilute tetraoxosulphate (vi) acid and dilute sodium hydroxide and later treated with dilute hydrochloric acid, alcohol and ether, and finally ashed. The crude protein content was analysed by digesting the samples in hot concentrated tetraoxosulphate (vi) acid, distilled in an alkaline medium into boric acid and finally titrated with standard hydrochloric acid. The carbohydrate content was determined by difference.

The minerals were analysed by dry ashing the samples in a muffle furnace at 550 °C and then dissolving the ash in 0.1 M HCl solution. The resulting solution was then aspirated into atomic absorption spectrophotometer. The Phosphorus was determined by using the methods described by Murphey and Riley (1962). For the functional properties, the protein solubility was carried out by using the methods described by Oshodi and Ekperigin (1989) Water absorption capacity and the oil absorption capacity were determined by using the methods described by Sathe and Salunke (1982). The least gelation concentration, foaming capacity and foaming stability were determined by using the methods described by Coffman and Garcia (1977). The bulk density was determined according to the methods described by Okaka and Potter (1977). The procedure of Ige et al (1984) was used to determine the emulsion capacity and stability. For the anti-nutritional factors, the phytic acid content was determined by using the procedure described by Young and Greaves (1940). Tannins was determined by the method described by maker et al. (1993). The oxalate was determined using the methods described by Day and Underwood (1986). The sugar was analyzed using the methods described by Usoro et al. (1982). The sugar was determined by adding the solution of the sample to Fehling solution and the resulting solution was boiled with the sugar solutions added at intervals until the blue colour is nearly discharged. The solution is then titrated using 4 drops of methylene blue solution until the supernatant liquid becomes orange red in colour. The amount of sugar present is then calculated using the dilution factor and the titre value obtained.

All analyses were carried out in triplicate and the results were subjected to statistical analysis using Duncan multiple test range and Analysis of variance

Result and Discussion

Table I: Proximate Analysis (%) of *Tamarindus indica* pulp, *Ziziphus spina christi* fruit and seed.

Proximate Analysis	*Tamarindus indica* pulp	*Z. spina christi* fruit	*Z. spina christi* seed
Crude Protein	7.64 ± 0.03^{a}	8.23 ± 0.03^{b}	24.07 ± 0.04^{c}
Ash	1.69 ± 0.01^{a}	7.92 ± 0.01^{c}	5.82 ± 0.03^{b}
Moisture	14.81 ± 0.16^{a}	16.83 ± 0.03^{b}	14.89 ± 0.13^{a}
Crude Fat	1.03 ± 0.01^{a}	1.94 ± 0.05^{c}	1.24 ± 0.02^{b}
Crude fibre	18.83 ± 0.02^{b}	6.09 ± 0.02^{a}	18.73 ± 0.02^{b}
Carbohydrate	56.00 ± 0.17^{b}	58.02 ± 1.18^{c}	35.25 ± 0.06^{a}

Mean values with different superscripts in the same row are significantly different ($p>0.05$).

Table II: Mineral Composition (mg/100g) of *Tamarindus indica* pulp, *Ziziphus spina christi* fruit and seed.

Mineral composition	*Tamarindus indica* pulp	*Z. spina christi* fruit	*Z. spina christi* seed
Ca	454.74 ± 0.13^{c}	451.9 ± 0.19^{b}	347.59 ± 0.93^{a}
Mg	160.54 ± 0.10^{b}	35.71 ± 0.33^{a}	191.54 ± 0.40^{c}
Zn	29.60 ± 0.17^{b}	56.93 ± 0.29^{c}	22.31 ± 0.49^{a}
Fe	27.36 ± 0.60^{a}	39.96 ± 0.38^{b}	58.53 ± 0.47^{c}
Na	40.20 ± 0.10^{a}	55.01 ± 0.29^{c}	50.60 ± 0.15^{b}
K	38.93 ± 0.14^{a}	67.98 ± 0.19^{c}	44.73 ± 0.07^{b}
Mn	0.20 ± 0.01^{c}	0.19 ± 0.01^{b}	0.14 ± 0.01^{a}
Cu	1.45 ± 0.04^{b}	1.23 ± 0.01^{a}	2.57 ± 0.06^{c}
Pb	0.66 ± 0.01^{a}	0.67 ± 0.01^{a}	0.65 ± 0.02^{a}
P	16.34 ± 0.09^{a}	34.75 ± 0.22^{b}	42.74 ± 0.04^{c}

Mean values with different superscripts in the same row are significantly different ($p>0.05$).

Table III: Sugar composition (%) of *Tamarindus indica* pulp, *Ziziphus spina christi* fruit and seed.

Sugar	*Tamarindus indica*	*Z. spina christi* fruit	*Z. spina christi* seed
Dextrose	0.15 ± 0.01 [a]	0.15 ± 0.01 [a]	0.15 ± 0.01 [a]
Fructose	0.17 ± 0.01 [a]	0.16 ± 0.02 [a]	0.15 ± 0.01 [a]
Hydrated maltose	0.25 ± 0.01 [a]	0.26 ± 0.02 [a]	0.25 ± 0.01 [a]
Anhydrous Lactose	0.21 ± 0.01 [a]	0.19 ± 0.01 [a]	0.20 ± 0.01 [a]
Hydrated Lactose	0.21 ± 0.01 [a]	0.23 ± 0.01 [a]	0.20 ± 0.01 [a]
Total reducing sugar	0.16 ± 0.01 [a]	0.15 ± 0.01 [a]	0.16 ± 0.01 [a]

Mean values with different superscripts in the same row are significantly different (p>0.05).

Table IV: Functional properties (%) of *Tamarindus indica* pulp, *Ziziphus spina christi* fruit and seed.

Functional Properties	*Tamarindus indica* pulp	*Z. spina christi* fruit	*Z. spina christi* seed
Water absorption Capacity	134.62 ± 0.70 [a]	182.61± 2.47 [c]	139.01 ± 0.77 [a]
Oil absorption Capacity	123.51 ± 0.71 [a]	197.27 ± 2.50 [c]	129.78 ± 0.66 [b]
Emulsion stability	42.70 ± 0.58 [a]	45.77 ± 0.67 [b]	44.96 ± 0.08 [b]
Emulsion capacity	49.31 ± 0.28 [b]	50.00 ± 0.00 [c]	43.69 ± 0.55 [a]
Least gelation Concentration	6.00 ± 0.00 [b]	4.00 ± 0.00 [a]	4.00 ± 0.00 [a]
Foaming capacity	11.67 ± 0.57 [a]	52.40 ± 0.53 [c]	14.00 ± 0.00 [b]
Foaming stability	3.60 ± 0.53 [a]	6.93 ± 0.12 [c]	3.94± 0.20 [b]
Bulk density (g/cm^3)	56.95 ± 0.75 [c]	36.27 ± 0.49 [a]	48.79 ± 0.29 [b]

Mean values with different superscripts in the same row are significantly different (p>0.05).

Table V: Anti nutritional factors (mg/100g) of *Tamarindus indica* pulp, *Ziziphus spina christi* fruit and seed.

Anti-nutritional Factor	*Tamarindus indica* pulp	*Z. spina christi* fruit	*Z. spina christi* seed
Phytin phosphorus	1.63 ± 0.02 [a]	1.87 ± 0.02 [b]	2.35 ± 0.03 [c]
Phytic acid	5.74 ± 0.04 [a]	6.56 ± 0.05 [b]	8.24± 0.17 [c]
Oxalate	1.55 ± 0.03[a]	8.82 ± 0.02 [b]	1.88 ± 0.02 [c]
Tannic acid (%)	0.27 ± 0.02 [a]	0.47 ± 0.02 [b]	1.37 ± 0.01 [c]

Mean values with different superscripts in the same row are significantly different (p>0.05).

Discussion

The proximate composition (%) of *Tamarindus indica, Ziziphus spina christi* fruit and seed are shown in table I. The results show that the moisture content of *Tamarindus indica* pulp is similar to that of *Ziziphus spina christi* seed, but values are lower than 42.23 reported for *Nauclea latifiolia* fruit by Amoo and Lajide (1999). The Ash content of *Ziziphus spina christi* fruit and seed are higher compared with 3.49 reported by Oshodi (1992) for *Adenopus breviflorus*. However, the crude protein values obtained for all the samples are lower than 28.60 that was reported for *Adenopus breviflorus* by Oshodi (1992). Values obtained for crude fat in all the samples show that they have low fat content compared with 15.60 reported by Adeyeye and Agesin (1999) for *Chrysophyllum albidum* indicating that these fruits cannot be used as fat food formulation. The crude fibre of *Z. spin- christi* fruits is lower compared with values obtained for *T. indica* pulp and *Z. spina christi* seed which makes the useful in fibre diet for aiding weight loss normalizing bowel movement. Moreover, slightly similar carbohydrate values are obtained for *T. indica* pulp and *Z. spina christi* fruit indicating that they can be consumed as an alternative source of energy are higher than 35.25 obtained for *Ziziphus spina christi* seed. These values are similar to 36.12 reported by Amoo and Moza (1999) for *Bauhinia racemosa* seed.

Mineral analysis as depicted in Table II shows that both *Tamarindus indica* pulp and *Zizyphus spina christi* fruit have relatively similar higher value of Ca than *Z. spina christi* seed. The values obtained for Mg shows that *Z. spina christi* seed has the highest value than those obtained for *Tamarindusindica* pulp and *Ziziphus spina christi* fruit respectively. However an appreciable amount of Zn, Na, K, P, and Fe is obtained in all the samples making them good for bone and blood building. These values are higher compared with Ca (16.00), P (3.00), and Fe (0.90) reported by Oyenuga (1968) for *Psidiumguajava* fruits. Moreover, low content of Mn and Pb was recorded in all the samples except in Z. spina christi seed, which has a relatively high content of Cu compared with *Ziziphus spina christi* fruit and *Tamarindus indica* pulp. This implies that the fruits may not be injurious to the body when eaten.

Sugar composition of *Tamarindus indica* pulp and *Ziziphus spina christi* fruit and seed as depicted in Table III shows that closely related values were obtained for Dextrose, Fructose, Hydrated maltose, Anhydrous lactose, Hydrated lactose and Total reducing sugar but these values are lower compared with those reported by Adeyeye and Agesin (1999) for red and green *Maluspumila*. Therefore the consumption of these fruits can prevent excessive breakdown of body, ketosis and involuntary dehydration in the body. NAS (1974)

The Functional properties of *Tamarindus indica* pulp and *Ziziphus spina christi* fruit and seed are shown in Table IV. Values obtained for Water absorption capacity and Oil absorption capacity (182.61 and 197.27) of *Ziziphus spina christi* fruit indicate that it is the most hydrophilic and lipophilic of all while the Emulsion stability (45.77) and Emulsion capacity (50.00) of *Z. spina christi* fruit are slightly higher than that of T. indica pulp (42.70), (49.31) and *Z. spina christi* seed (44.96), (43.69) .The Bulk density of *T. indica* pulp (56.95) is higher than that of *Z. spina christi*seed (48.79) and fruit (36.27). However, values obtained for least gelation concentration are lower compared to 14.00 reported by Sathe and Salunke (1981) for Lupin seed. Moreover, results obtained for Foaming capacity and Foaming stability compare well with that reported by Oshodi (1992) for *Adenopus breviflorus* protein concentrate.

From Table V showing the results obtained for **Anti nutritional factors**, *Tamarindus indica* pulp has the lowest Tannic acid and Phytic acid contents but these values are higher than 0.73 reported for *Acacia nilotica* by Balogun and Fetuga (1989). This low content of Tannic and phytic enhances the absorption of Fe and other minerals in the body. Furthermore, the Oxalate content of *Ziziphus spina christi* fruit (8.82) is very high compared to that of the seed (1.88) and *T. indica* pulp (1.55) while the Phytin phosphorus obtained are (1.63), (1.87) (2.35) for *T. indica pulp, Z.spinachristi* fruit and seed respectively, but these values are higher than 0.25 reported for *Bauhinia Monandra* by Balogun and Fetuga (1989).

Generally, from all the results obtained, it can be deduced that *Tamarindus indica* pulp and *Ziziphus spina christi* fruit and seed can be used as an alternative source of energy because of its high carbohydrate content. High mineral content like Fe found in the Z. spina christi seed can make it suitable for blood building. Furthermore, lesser quantity of tannins and phytic acid indicates that the samples may not be harmful when consumed.

REFERENCES

Adeyeye EI, Agesin OO (1999). Nutritional Composition of *Chrysophyllum albidum, mallus pumilla and Psodium guajava* fruits. Bangladesh J.sci.ind. Res. 34 (3-4): 452 - 458.

Amoo IA, Lajide L (1999).Chemical Composition and Nutritive Significance of The Fruits of *Nauclea latifolia*, Larivista, Talianadelle. Sustanzeb.Grasse. Vol LXXVI. Pp. 331 – 332.

AmooIA, Moza L (1999). Extraction and Physicochemical Properties of Oils from *Bauhinia Racemosa* Seeds. La rivistatalionaclevesostanzegrasse. Vol LXXVI. Pp. 399 – 400.

AOAC (1990): Official Methods of Analysis (15thedn), Association of official analytical chemists. WashingtonD.C.USA, pp. 85 – 89'

Balogun AM, Fetuga, BL (1985): Antinutritional Components in Some Lesser Known Leguminous Crop Seeds in Nigeria. Biological wastes, elsevier science publishers. Ltd, 28, pp. 303 – 308.

Coffman CW, Garcia VV (1977): Functional Properties and Amino Acid Content of a Protein Isolate from Mung Bean Flour. J. of food tech. 12, 473 – 477.

Day RA (Jnr), Underwood AC (1986): Quantitative Analysis, 5thedn. Prentice Hall publication, pp 701.

Ige MM, Ogunsua AO, Oke OL (1984): Functional Properties of the Proteins of Some Nigerian oil seeds. Conophor seeds and three varieties of melon seeds J.Agric and food chem.. 32, 822 – 825.

Lin MJY, Humbert ES, Sosulski FN (1974): Certain Functional Properties of Sunflower Meal Products. J. Food sci 39, 368 – 370.

Marker HPS, Blunmel M, Borowy NK, Becker K (1993): Gravimetric Determination of Tannins and Their Correlations with Chemical and Protein Precipitation Methods. J. sci. Food Agric. 61, 161 – 165.

Morton JF (1987): Tamarind, Fruits of Warm Climates, Miami, pp 115 – 121.

Murphey J and Riley JP (1962): Analytical chemistry Acta 2, 27, 31 – 36.

NAS (1980): Firewood crops, National Academy of Sciences, National academy press, WashintonDC. 138 – 144.

NAS (1974): Recommended Dietary Allowances, National academy of science. National research council, Washington D.C. 8th edition, 25-26.

Okaka JC, Potter NN (1977): Functional and Storage Properties of Ten Legume Flour, institute of food science and technology. Pp 66 – 69.

Oshodi AA (1992): Proximate Composition, Nutritionally Valuable Minerals and Functional Properties of *Adenopus breviflorus* benth seed flour and protein concentrate. food chemistry. 45, 79 – 83.

Oshodi AA, Ekperigin MM (1989): Functional Properties of Pigeon Pea (*Cajanuscajan*) flour, food chemistry. 34, 187 – 191.

Oyenuga VA (1968): Nigeria's foods and feeding stuffs, IbadanUniversity press, Ibadan, 34 – 38.

Sathe SK, Salunke DK (1982): Functional Properties of The Great Northern Bean (*Phasedus vulgaris* L.) Proteins: Emulsion, foaming, viscosity and gelation properties J food sci 47, 491 – 497.

Usoro EU, Suejam SE, SanniGA (1982): Manual of Chemical Methods of Food Analysis. Bencox international ltd, Lagos.Pp 81 - 82.

Young SM, Greaves JS (1940): Influence of variety and the treatment of phytic acid content of wheat food Res. 5, 103 – 105.