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Full Length Research Paper

Further physicochemical characterization of *Parkia biglobosa* (Jacq.) Benth fruit pulp as a mineral supplement

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Fresh *Parkia biglobosa* fruit pulp was evaluated in terms of its water absorption, foam and emulsion capacities, gelatinization temperature, moisture content, microbial count, swelling and solubility profiles. The Scanning Electron Microscopy (SEM) and Differential Scanning Calorimetry (DSC) were carried out for morphological and thermal analysis. The release of its vitamin C in water at room temperature and that of commercial vitamin C supplements were monitored as a function of time. The pulp had the following properties: water absorption capacity of 466 mL/ 100 g pulp, foam capacity of 7.7%, emulsion capacity of 71.5%, gelatinization temperature of 63°C, and moisture content of 8.3%. The solubility and swelling profiles increased with increase in temperature. The SEM and DSC revealed the presence of an entirely amorphous substance. About 80% of the pulp's vitamin C was released in water within 20 min which is comparable to that of commercial vitamin C tablet (Mason natural vitamin C supplement). The above results show that the pulp can be granulated and utilized as a mineral supplement.

Key words: *Parkia biglobosa*, mineral, vitamin C, pulp, supplement.

INTRODUCTION

Parkia biglobosa (Fabaceae - Mimosoideae) commonly called African locust bean tree is a native, perenial, leguminous tree which grows principally in the savannah region of West Africa Countries stretching from Senegal to Cameroun and extending eastwards to Uganda. It is also an exotic plant in West Indies. The annual world production of the fruit from the tree is estimated at over 100 million metric tonnes and has not been utilized beyond the natives where such trees occur in spite of its medicinal and nutritional values (Omojola and Ihegwuau, 2010). In Nigeria alone, about 18 million metric tonnes of seed and 25.7 million metric tonnes of the fruit pulp are produced annually. The seeds can be roasted for the production of a tea, like infusion (called Soudan Coffee) or fermented to be used as spicy seasoning widely used in sauces and sometimes processed as stock cube. The seed is very rich in protein, lipid, phosphorus, calcium and the gummy matter is about 10%. The protein efficiency ratio, net protein retention, net protein utilization and true digestibility are comparable to those of groundnuts and palm kernel seeds (FAO, 1999).

The sweet, yellow floury pulp is eaten fresh by rural dwellers, which indicates its edibility and non – toxicity (Owoyale et al.,1987; Akoma et al., 2001). The pulp can also be fermented into alcoholic beverage. The chemical analysis shows that the pulp is very rich in glucids (80%), vitamins A, B and C. A small quantity of gummy matter is also present .The vitamin C content of 191.20 µg/100 g is adequate and comparable to the recommended daily

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Abbreviations: SEM, Scanning electron microscopy; **DSC,** differential scanning calorimetry.

intake of 30 mg/65 kg body weight. All anti nutritional factors and toxins analysed were found to be present in acceptable and safe levels (Gernah et al., 2007). The previous studies that are on the proximate and phytochemical analysis of the Parkia fruit pulp do not contain sufficient information required to fully explore its industrial utilization.

This study therefore covers its morphology, thermal analysis, swelling/solubility profiles, water absorption, foam and emulsion capacities and the release pattern of vitamin C in the sample which would further provide information on its industrial potential as mineral supplement to human beings.

MATERIALS AND METHODS

Sample collection and preparation

Fresh fruit pods were plucked directly from the trees in Abuja, Nigeria and taken to the Chemistry Advanced Laboratory of Sheda Science and Technology Complex where the husks were manually removed. The floury pulp were grated and the embedded seeds consecutively removed. The grated material was passed through a 25 mm sieve and kept in airtight container for further laboratory analysis. Commercial grade vitamin C tablet (made by Mason vitamins Inc. USA) was obtained from a pharmaceutical store. Other reagents were obtained from Chemistry Advanced Laboratory, Sheda Science and Technology Complex, Abuja.

Determination of certain physicochemical properties

Swelling power

The method described by Daramola and Osanyinlusi, (2006) was used to determine the swelling power with slight modification. 0.1 g of the pulp sample was weighed into a test tube and 10 ml of distilled water was added. The mixture was heated in a water bath at a temperature of 50°C for 30 min with continuous shaking. Thereafter, the test tube was centrifuged at 1500 rpm for 20 min in order to facilitate the removal of the supernatant which was carefully decanted and the weight of the starch paste was taken. The swelling power was calculated as follows:

$$\text{Swelling power} = \frac{\text{Weight of pulp paste}}{\text{Weight of dry pulp sample}}$$

and expressed as a percentage. This was carried out over a temperature range of 50 to 100°C.

Solubility index

Solubility index was determined over a temperature range of 50 to 100°C as follows: 0.5 g of pulp sample was added to 10 ml distilled water in a test tube. This was subjected to heating in a water bath with a starting temperature of 50°C for 30 min. It was then centrifuged at 1500 rpm for 30 min. 5 ml of the supernatant was decanted and dried to constant weight. The solubility was expressed as the percentage (%) by weight of dissolved pulp from heated solution .

Gelatinization temperature

This was evaluated using the method of Attama et al. (2003). 1 g of the pulp sample was put in a 20 ml beaker and 10 ml of distilled water was added. The dispersion was heated on a hot plate until it gelled. The gelatinization temperature was then read with a thermometer suspended in the pulp slurry.

Water holding capacity

5% (w/v) of the pulp sample was dispersed in a pre-weighed centrifuge tube. The tube was agitated in a vortex mixer for 2 min. The supernatant was then discarded and the weight of the tube and hydrated sample taken. The weight was calculated and expressed as the weight of water bound by 100 g dry pulp.

Foam capacity

The method of Omojola et al. (2010) was used with slight modification. 1 g of pulp sample was homogenized in 50 ml distilled water using a vortex mixer (vortex 2 Genie set at shake 8) for 5 min. The homogenate was poured into a 100 ml measuring cylinder and the volume recorded after 30 s. The foam capacity was expressed as the percent increase in volume.

Emulsion capacity

The method of Omojola et al. (2010) was again used also with slight modifications. 1 g sample was dispersed in 5 ml distilled water using a vortex mixer for 30 s. After complete dispersion, 5 ml vegetable oil (groundnut oil) was added gradually and the mixing continued for another 30 s. The suspension was centrifuged at 1600 rpm for 5 min. The volume of oil separated from the sample was read directly from the tube. Emulsion capacity is the amount of oil emulsified and held per gram of sample.

Moisture content

This was determined according to AOAC (1990).

pH

20% (w/v) dispersion of the sample was shaken in water for 5 min and the pH was determined using a pH meter.

Vitamin C release

This was determined by a common laboratory method of determining vitamin C in fruit samples. 1 g of the fruit pulp was dissolved in 10 ml distilled water and filtered off after the appropriate time starting from 5 min. The filtrate was then titrated against standardized vitamin C (ascorbic acid) using iodine solution as indicator. The concentration and mass of vitamin C in the sample was then calculated from the known concentration and mass of ascorbic acid used. All the above parameters were determined in triplicates and the mean and standard deviations were recorded.

Microbial count

10 g of the parkia pulp was dissolved in 100 ml of sterile distilled water. It was then agitated for about 10 to 15 min. Using a micro

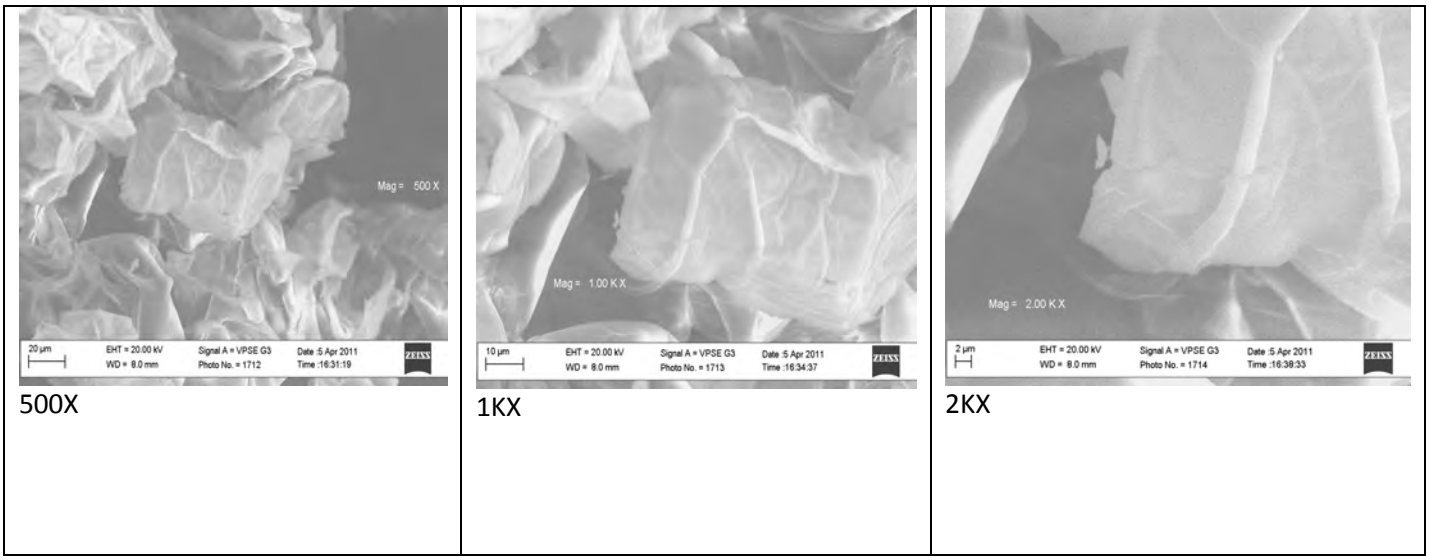

Figure 1. Photomicrograph of ***Parkia*** pulp at 500 X, 1 KX and 2 KX, respectively.

Table 1. Physicochemical properties of parkia pulp.

Parameter	Value
Water holding capacity (mL / 100 g)	466 ± 0.1
Foam capacity (%)	7.7 ± 0.3
Emulsion capacity (%)	71.5 ± 0.1
Moisture content (%)	8.3 ± 0.3
Gelatinization temperature (°C)	63 ± 0.0
pH	5.6 ± 0.0

Table 2. Release pattern of vitamin C in parkia fruit pulp and commercial vitamin C tablet at room temperature (26°C).

Time (Min)	Parkia pulp (%)	Vitamin C tablet (%)
5	67.7	76
10	70.3	78
15	78.1	84
20	85.9	84

pipette, 1000 µl (1 ml) of the extract was transferred into 2 sterile Petri-dishes . About 20 ml of the prepared nutrient and MacConkey agar were added, respectively. These were allowed to set and then incubated at 35°C for 24 h.

Scanning electron microscopy

A SEM model EVO/ MA 10 was used to determine the particle size at 500 X, 1 KX and 2 KX magnifications.

Differential scanning calorimetry

The sample was subjected to DSC 204 FI Phoenix (Netzsch, Germany) analysis to observe the thermal properties.

RESULTS AND DISCUSSION

The photomicrographs of the sample at various magnifications are depicted in Figure 1. Some physicochemical properties of the pulp are shown in Table 1. A comparative release pattern of vitamin C in the sample and commercial vitamin C tablet is given in Table 2. Figure 2 shows the DSC spectra while Figures 3 and 4 show the solubility and swelling profiles. The pH value of 5.6 and moisture content of 8.3% are within the range of earlier reported values (Gernah et al., 2007; Compaore et

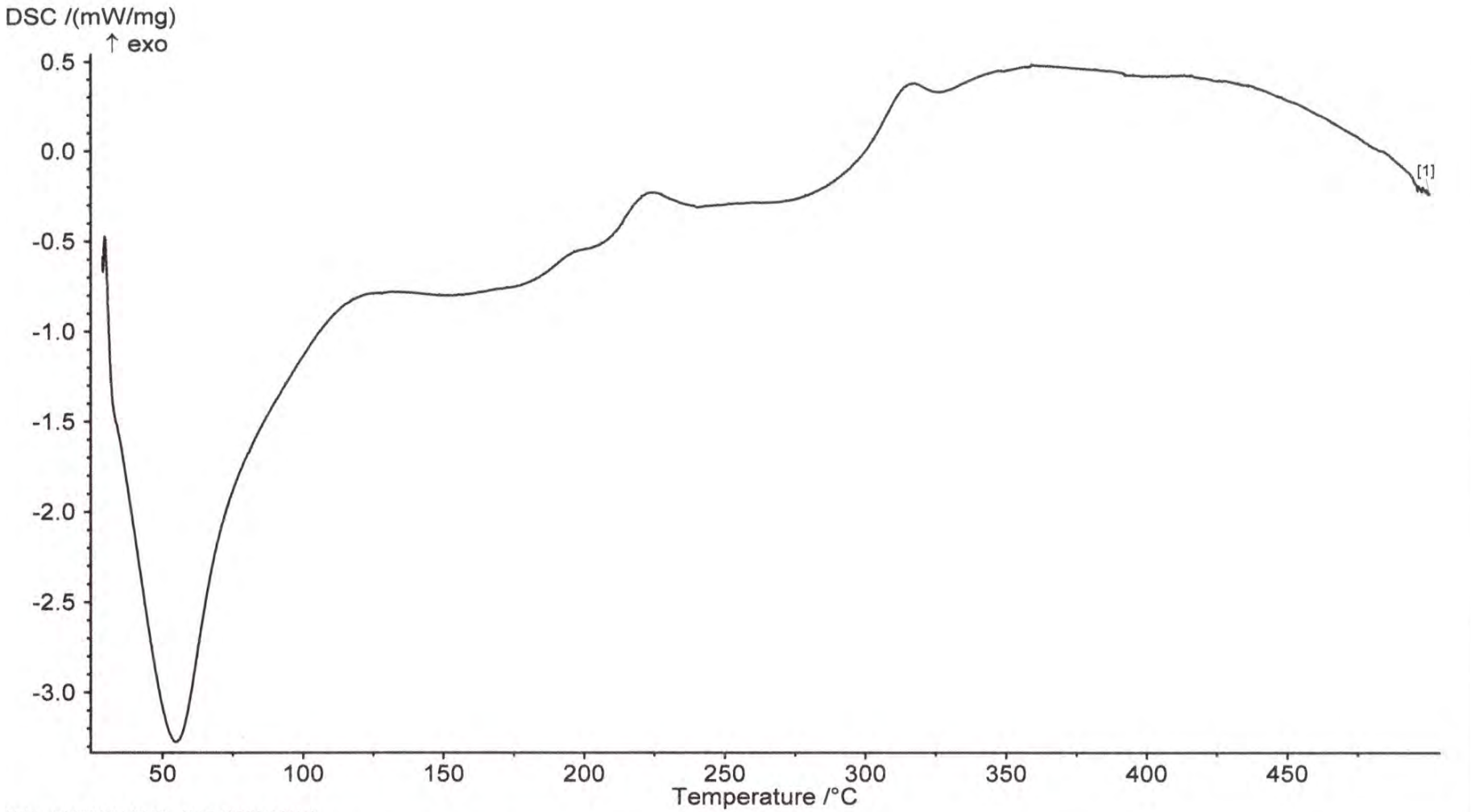

Figure 2. DSC profile of ***Parkia*** pulp.

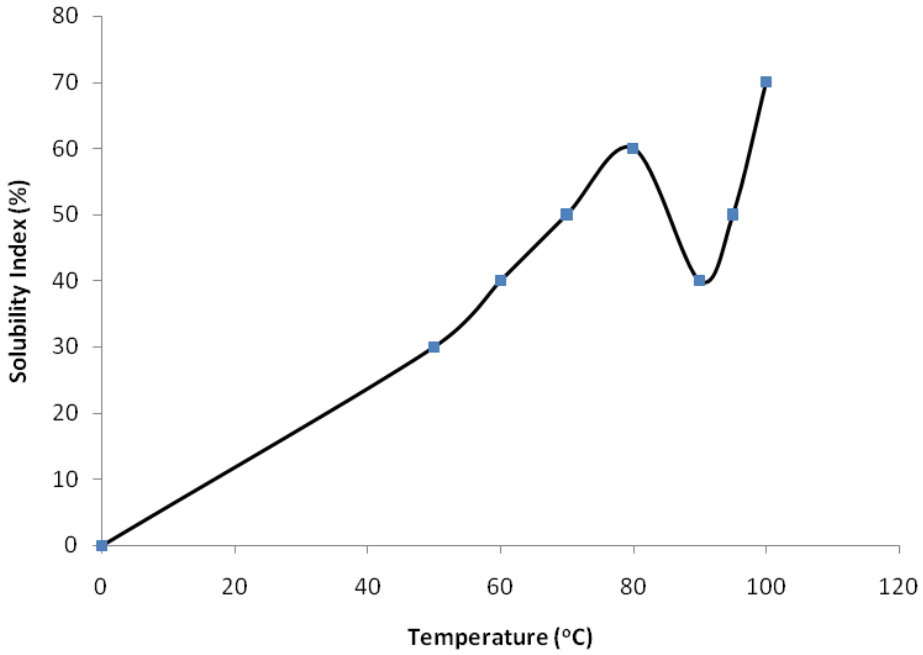

Figure 3. Solubility curve for ***Parkia*** pulp.

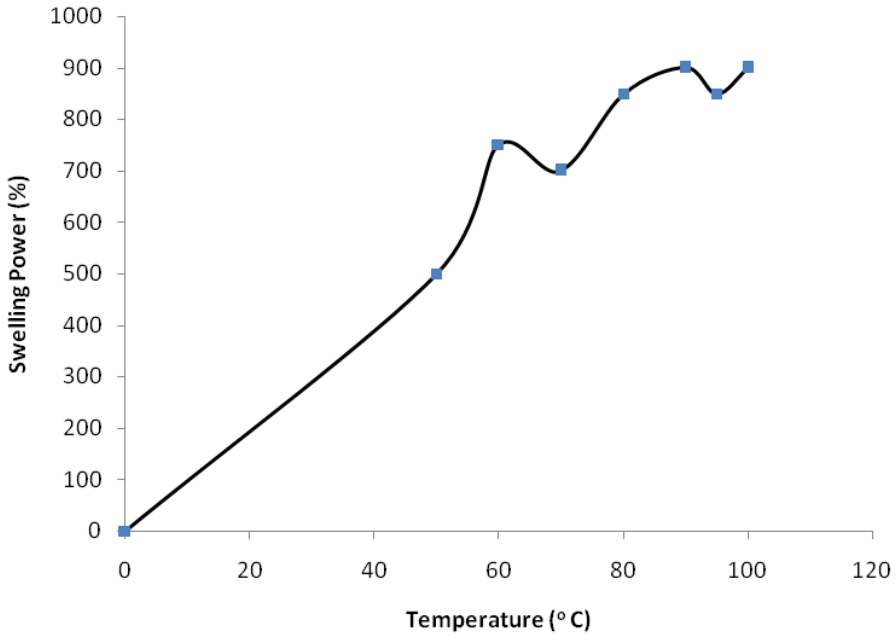

Figure 4 . Swelling power of ***Parkia*** Pulp.

al., 2011).

Morphology

The electron micrographs at different magnifications (Figure 1) show absence of any crystalline granules but a uniform amorphous substance. The DSC thermograph (Figure 2) also confirms the absence of any crystalline granules. The high water holding capacity is also a reflection of the amorphous nature of the parkia fruit pulp. His water holding capacity is also an indication that the granules can expand slightly without collapsing (Ihegwuagu et al., 2009). The high water holding capacity

also corroborates the high swelling profile of the sample. Materials with high water absorption capacity have been reported useful in the baking industry (Watson,1984).

Gelatinization temperature

A gelatinization temperature of 63°C was observed which is a reflection of the type of molecular association found in the pulp. It was observed that the gel formed dissolved absolutely in water.

Solubility and swelling

The swelling behaviour is an indication of the water absorption characteristics of a material during heating. From Figures 3 and 4, it can be seen that there was a temperature dependent increase in both swelling and solubility. The swelling shows a steady increase between 50 to 90°C followed by a very small decline at 95°C and a further increase at 100°C. Also, the solubility increased between 50 to 80°C, dropped at 90°C and further increased between 95 to 100°C. The high solubility and swelling profile observed is a relflection of the amorphous nature of the pulp. These two patterns may not exclusively rule out two sets of internal bonding forces that relax at different temperatures. A little crystalline region may also be present. The high swelling power observed for the pulp at all temperatures is an indication of the fact that it will be very suitable for granulation and will disintegrate well when granulated.

Microbial count

After 24 h incubation, two colonies of bacteria were seen on the nutrient agar plate (2 cfu / ml) cfu = colony forming unit while the MacConkey agar plate showed no growth. Absence of any growth on the MacConkey agar plate eliminates the presence of coliforms for example, ***salmonella***, ***shigella***, ***Escherichia coli***, etc. The two colonies of bacteria seen on the nutrient agar plate fell within the WHO safety limits. This is in accordance with the report by Owoyale et al. (1987). The low microbial count is a reflection of the low fat and moisture contents of the fresh pulp which is an indication that the pulp can be stored in a tight container for a long time without spoilage (Gernah et al., 2007).

Release pattern of vitamin C content

From the equivalent amount of vitamin C in the parkia pulp and the commercial vitamin C tablet (Table 2), it can be observed that the release pattern of vitamin C in the materials as a function of time follows the same trend; that is, within 20 min of dissolution, over 80% of vitamin C was released from the pulp. This further corroborates that the material is loosely bound and contains highly soluble components as shown in the high solubility profile.

Conclusion

The ***Parkia biglobosa*** fresh fruit pulp is mainly an amorphous material with very low gelatinization temperature and high water absorption, swelling and solubility profiles. These properties coupled with high glucids, vitamins and mineral contents and absence of microbes with over 80% of its vitamin C being released on dissolution in water within 20 min strongly suggests that the pulp can be granulated as food/mineral supplements for human consumption.

REFERENCES

Akoma O, Onyoha SA, Akoma AO, Ozigis AA (2001). Physico – chemical attributes of wine produced from the yellow pulp of ***Parkia biglobosa*** using traditional juice extraction technique. Nig. Food J. 19: 76–79.

AOAC (1990). Official methods of Analysis.15th Ed, Association of official analytical chemists. Washington D.C, 808: 831-835.

Attama AA, Nnamani PO, Mbonu IK, Adiku MU. (2003). Effect of hypochlorite oxidation on the physicochemical properties of gladiolus starch. J. Pharm. Appl. Sci. 1(1): 28-35

Daramola B, Osanyinlusi SA (2006). Investigation on modification of cassava starch using active components of ginger roots (Zingiber officinale Roscoe). Afr. J. Biotechnol. 5: 917-920

FAO (1999). FAO Conservation guide 34.

Gernah DI, Atolagbe MO, Echegwo CC (2007). Nutritional composition of the African locust bean (***Parkia biglobosa***) fruit pulp. Nig. Food J. 25(1): 190-196

Ihegwuagwu NE, Omojola MO, Emeje, MO, Kunle OO (2009). Isolation and evaluation of some physicochemical properties of ***Parkia biglobosa*** starch. J. Pure Appl. Chem. 81: 97 –104

Omojola MO, Ihegwuagu NE (2010). Exploiting the industrial potentials of ***Parkia biglobosa*** (Jacq.). Benth. Proceeding of RMRDC 2nd International Conference on Natural Resources and Development and utilization in Nigeria.

Omojola MO, Akinkunmi YO, Olufunsho KO, Egharevba HO, Martins EO (2010). Isolation and physico-chemical characterization of cola starch. Afr. J. Food Agric. Nutr. Dev. 10(7): 2884– 2900.

Owoyale JA, Shok M, Olagbemiro T (1987). Some chemical constituents of the fruit pulp of ***Parkia clappertoniana*** as a potential industrial raw material. Savanna, 9(2): 24-27

Watson SA (1984). Starch. Chemistry and Technology, 2nd ed., Academia Press, New York pp. 461– 462.