

Evaluation of the Chemical Compositions of the Leaf of *Spondias Mombin* Linn from Nigeria

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Abstract: The phytochemical, proximate, minerals and vitamins A and C compositions of *Spondias mombin* leaves were determined using standard methods. The results of the phytochemical analyses showed the presence of saponins ($4.80 \pm 0.35\%$), alkaloids ($3.40 \pm 0.10\%$), flavonoids ($2.80 \pm 0.36\%$), tannins ($1.47 \pm 0.06\%$), oxalates ($0.92 \pm 0.09\%$), phytates ($1.73 \pm 0.19\%$) and cyanogenic glycosides ($0.01 \pm 0.00\%$). The findings showed that the leaves are rich in nutrients, especially total carbohydrate ($68.92 \pm 2.00\%$), moisture ($15.13 \pm 0.57\%$), crude protein ($11.04 \pm 0.71\%$), crude fibre ($10.51 \pm 0.84\%$) and crude fat ($4.82 \pm 0.34\%$), but with low ash content ($0.09 \pm 0.009\%$). The leaves also contain Ca ($10.85 \pm 0.14\text{mg}/100\text{g}$), K ($9.50 \pm 0.36\text{mg}/100\text{g}$), Na ($0.85 \pm 0.01\text{mg}/100\text{g}$), Mg ($0.39 \pm 0.03\text{mg}/100\text{g}$), P ($1.10 \pm 0.03\text{mg}/100\text{g}$), Se ($0.24 \pm 0.02\text{mg}/100\text{g}$), Fe ($0.09 \pm 0.009\text{mg}/100\text{g}$), Mn ($0.02 \pm 0.004\text{mg}/100\text{g}$) and Zn ($0.003 \pm 0.000\text{mg}/100\text{g}$) as well as vitamins C ($58.05 \pm 1.55\text{mg}/100\text{g}$) and A ($5.60 \pm 0.20\text{mg}/100\text{g}$). The findings indicate that *S. mombin* leaves is a potential source of highly nutritious feed stuff and phytomedicine. They are of nutritional, clinical and veterinary relevance considering the diverse ethnopharmacological uses of the plant in different parts of the world.

Key words: *Spondias mombin*, phytochemical, mineral, vitamin, proximate composition.

INTRODUCTION

Spondias mombin Linn is a fructiferous tree that belongs to the family Anacardiaceae. It grows in the coastal areas and in the rain forest into a big tree of up to 15–22m in height. It is readily common in Nigeria, Brazil and several other tropical forests of the world with high genetic variability among populations (Ayoka *et al*, 2008). It is called Hog plum in English, *akika* in Yoruba, *ijikara* in Igbo, *tsader maser* in Hausa, *chabbuli* in Fulani and *nsukakara* in Efik (Gill, 1992).

The leaves, bark and fruit juices of the plant have been widely used for both medicinal and non-medicinal purposes. The tree is commonly used for living fences, in farmlands and shelter by artisans. The fruits are edible. The extracted juice is used to prepare ice cream, cool beverages and jelly in Costa Rica and Brazil. In Amazon, the fruit is used mainly to produce wine sold as 'Vinho de Taperiba', while in Guatemala, it is made into a cider-like drink. It is used in Panama, Peru and Mexico in fairly large quantities as jams (Ayoka *et al*, 2008). Thus, it has been evaluated as an unconventional source of vitamins A and C (Keshinro, 1985).

All parts of the tree are ethnopharmacologically important. A tea of the flowers and leaves is taken to relieve various inflammatory conditions, stomachache and has wound healing potential (Villegas *et al*, 1997). In a recent review, Ayoka *et al* (2008) reported several activities that have been associated with the plant extracts. Some reported pharmacological activities include antibacterial (Corthout *et al*, 1994), antiviral (Corthout *et al*, 1992), anti-microbial (Abo *et al*, 1999), anti-malarial (Carabalo *et al*, 2004), anti-helmintic (Ademola *et al*, 2005), molluscicidal (Corthout *et al*, 1994), anti-diarrhoea (Akubue *et al*, 1983), anti-inflammation (Abad *et al*, 1996), haemostatic (Kone-Bamba *et al*, 1987), abortifacient (Offiah and Anyanwu, 1989), purgative (Akubue *et al*, 1983), hypnotic (Ayoka *et al*, 2005), wound-healing (Villegas *et al*, 1997), enzyme inhibition (Coates *et al*, 1994), increases capillary permeability (Villegas *et al*, 1997), and anti-free radical, anti-aging and reduces glutathione synthesis (Pauly and Fleury, 2002). It has also been reported to have blood lipid-lowering activity (Igwe *et al*, 2008).

The chemistry of this plant has been reported, although in piece-meals (Njoku and Akumefula, 2007). Thus, the reported effects observed with the plant's extracts has been attributed to its constituent compounds

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of phenols, tannins, anthraquinones and flavonoids (Ayoka *et al*, 2008), as well as caffeoyl ester (Corthout *et al*, 1992), 6-alkenylsalicylic acids (Corthout *et al*, 1994), and alkaloids, proanthocyanins and saponins (Edeoga and Eriata, 2001). The associated link between the compositions of this world-wide cultivated plant and the reported medicinal and non-medicinal uses prompted this study aimed at evaluating the phytochemical, proximate and mineral contents of the leaves of *S. mombin* Linn grown in Nigeria.

MATERIALS AND METHODS

Sample Collection and Preparation:

Fresh leaves of *S. mombin* were collected from their natural habitat in Obinze – Owerri, Imo State of Nigeria, in the month of June, 2008. They were authenticated by Dr. S.E. Okeke, a plant taxonomist of the Department of Plant Sciences and Biotechnology, Imo State University, Owerri, Nigeria. The leaves were rinsed in clean water and air-dried for to a constant weight. The dried leaves were ground into a fine powder using a mechanical grinder, packaged in glass jars and stored at 4°C until analysis (Ojiako and Akubugwo, 1997).

Phytochemical Analysis:

Prior to quantitative phytochemical analyses, phytochemical screening was carried out on the plant's leaf extract using standard methods as described by Sofowora (1993) and AOAC (1990). The percentage compositions of saponins, tannins, alkaloids, flavonoids, phytate and cyanogenic glycosides were determined according to methods described by Harborne (1973) and Trease and Evans (1983). Oxalate content was determined by the spectrophotometric methods of Hang and Lantzsch (1983).

Proximate Analysis:

Crude fat was extracted by the Soxhlet method with petroleum ether (40-60°C) for 8 hours. Crude protein content was determined by the microkjeldahl method. These, as well as carbohydrate, crude fiber, ash and moisture contents were determined by standard methods as described by AOAC (1990).

Analysis for Minerals and Vitamins:

A portion, 2g of the ground sample was incinerated in a muffle furnace at 600°C for 3 hours. The ash obtained was cooled, dissolved in 5ml of 6N HCl and allowed to stand for 30 minutes. It was later filtered and its volume made up to 50ml with deionized water. The resulting extract was used for the determination of sodium, potassium, iron, calcium, magnesium, manganese, zinc and selenium by the use of an atomic absorption spectrophotometer (Alpha 4, Chem. Tech. Analytical, England). Phosphorous was determined as phosphate by the Vanadomolybdate colorimetric method (Pearson, 1976). Vitamins A and C contents were determined using the methods described by Ojiako and Akubugwo (1997).

Results:

Preliminary phytochemical screening revealed the presence of saponins, alkaloids, flavonoids, tannins, oxalate, phytate and cyanogenic glycosides, while their quantitative estimations (in percentages, %) gave saponins (4.80 ± 0.35), alkaloids (3.40 ± 0.10), flavonoids (2.80 ± 0.36), tannins (1.47 ± 0.06), oxalate (0.92 ± 0.09), phytate (1.73 ± 0.19) and cyanogenic glycosides (0.01 ± 0.00) (Table 1).

The quantitative estimations (in percentages) of the proximate compositions are shown in Table 2. The total carbohydrate content was 68.92 ± 2.00%, moisture 15.13 ± 0.57%, crude protein 11.04 ± 0.71%, crude fibre 10.51 ± 0.84%, crude fat 4.82 ± 0.34% and ash content 0.09 ± 0.009%.

Table 3 presents the results of mineral and vitamin analyses of *S. mombin* leaf extract. It shows that the leaf contains 10.85 ± 0.14mg/100g Ca, 9.50 ± 0.36mg/100g K, 0.85 ± 0.01 mg/100g Na, 1.10 ± 0.03mg/100g P, 0.39 ± 0.03mg/100g Mg, 0.24 ± 0.02mg/100g Se, 0.09 ± 0.01mg/100g Fe, 0.02 ± 0.004mg/100g Mn and 0.003 ± 0.000mg/100g Zn. The vitamins A and C contents were 5.60 ± 0.20mg/100g and 59.05 ± 1.55mg/100g respectively.

Discussion:

S. mombin leaves are among the forages given to domestic animals in SouthEastern Nigeria. The young leaves are also cooked as green vegetables (Ayoka *et al*, 2008). The present study shows that high contents of saponins, alkaloids and flavonoids were observed in the leaves of the plant. These phytochemicals exhibit various pharmacological and biochemical actions when ingested by animals. Saponin is a known anti-nutritional factor that can reduce the uptake of certain nutrients including cholesterol and glucose at the gut through intra-

Table 1: Phytochemical composition of *S. mombin* leaf

Phytochemical	*Composition (%)
Saponins	4.80 ± 0.35
Alkaloids	3.40 ± 0.10
Flavonoids	2.80 ± 0.36
Tannin	1.47 ± 0.06
Oxalate	0.92 ± 0.09
Phytate	1.73 ± 0.19
Cyanogenic glycosides	0.01 ± 0.00

*Values are mean ± standard deviation of triplicate determinations.

Table 2: Proximate composition of *S. mombin* leaf

Proximate parameter	*Composition (%)
Total carbohydrate	68.92 ± 2.00
Moisture	15.13 ± 0.57
Crude protein	11.04 ± 0.71
Crude fibre	10.51 ± 0.84
Crude fat	4.82 ± 0.34
Ash	0.09 ± 0.009

*Values are mean ± standard deviation of triplicate determinations

Table 3: Mineral and vitamin compositions of *S. mombin* leaf

Mineral/Vitamin	*Composition (mg/100g)
Macroelements	
Calcium	10.85 ± 0.14
Potassium	9.50 ± 0.36
Sodium	0.85 ± 0.01
Magnesium	0.39 ± 0.03
Microelements	
Phosphorous	1.10 ± 0.03
Selenium	0.24 ± 0.02
Iron	0.09 ± 0.009
Manganese	0.02 ± 0.004
Zinc	0.003 ± 0.000
Vitamins	
Vitamin C	59.05 ± 1.55
Vitamin A	5.60 ± 0.20

*Values are mean ± standard deviation of triplicate determinations

luminal physicochemical interaction or other yet unidentified activity (Price *et al*, 1987). This may account for the non-significant serum lipid-lowering effect observed with ingestion of *S. mombin* leave extract in our previous studies (Igwe *et al*, 2008). Alkaloids are beneficial chemicals to plants. They help in repelling predators and parasites. However, when ingested by animals, they affect glucagon, thyroid stimulating hormone and inhibit certain mammalian enzymic activities (Okaka *et al*, 1992). Steroidal saponins and alkaloids such as ergot alkaloids have been reported to elicit uterine muscle activity (Gwotmut and Nwafor, 2001). The content of these phytochemicals may be associated with the reported oxytocic and abortifacient activity of the plant's leaf extract (Offiah and Anywu, 1989). The plant leaves also contain flavonoids, which are phenolic compounds that serve as flavouring ingredients of spices and vegetables (Enwere, 1998). Flavonoids and other phenolic derivatives have been identified in *S. mombin* leaves with anti-herpes, antioxidant and anti-aging properties (Corthout *et al*, 1992). Furthermore, flavonoids, alkaloids and tannins observed in the plant had lower concentrations and have been associated with the observed antimicrobial effects in various studies involving plant extracts (Nwaogu *et al*, 2007). Their presence in *S. mombin* may account for the plant's reported anti-microbial, anti-bacterial and molluscicidal (Corthout *et al*, 1994), anti-viral (Corthout *et al*, 1992), anti-malarial (Carabolla *et al*, 2004) and anti-helminthic (Ademola *et al*, 2005) activities.

The major nutritional compositions of *S. mombin* leaves were found to include carbohydrates, moisture, proteins and crude fibre and vitamins C and A. the good distribution of nutrients in the leaves may explain its use as one of the forage feed given to domestic animals. When compared with some other common vegetables domestic animals graze on, *S. mombin* leaves contain fairly good quantities of carbohydrates (68.92%), proteins (11.04%) and fats (4.82%) than *Amaranthus hybridus* (29.50%, 25.35% and 1.60% respectively) (Nwaogu *et al*, 2006), *Boerhavia diffusa* (10.56%, 2.26% and 1.61% respectively) and *Commelina nudiflora* (5.67, 1.69% and 1.44% respectively) (Ujowundu *et al*, 2008). Furthermore, the plant's leaves containadequate concentrations of vitamins C and A when compared to the common vegetables cited above as well as *Vernonia amygdalina* (Ijeh *et al*, 1996). This may justify the earlier effort at evaluating the plant's use as an unconventional source of vitamins A and C in the production of juices, ice creams and jellies

(Keshinro, 1985). Vitamin has anti-infective properties, promotes wound-healing, may boost the immune system and help to ward off infections, while vitamin A helps to maintain good sight and prevents certain diseases of the eye. Both vitamins also have antioxidant properties and may protect against some forms of cancer (Wright, 2002). The presence of these vitamins may explain the reported use of this plant's extract for treatment of eye ailments, as well as its wound-healing (Villegas *et al*, 1997), antioxidant and anti-infective (Ayoka *et al*, 2008) activities. Thus, the results of this study confirms the high nutritional value of *S. mombin* and that it may help essentially in the control physiological oxidative stress because of its high content of vitamins A and C as well as flavonoids content (Wright, 2005).

S. mombin leaf contains generally low ash content. However, it contains more concentrations of Ca and K than the other minerals determined. This finding corroborates those of Njoku and Akumefula (2007), although they evaluated only a few minerals. However, the mineral contents we observed in this plant are low when compared to the previously cited common vegetables. The high content of Ca and K may contribute to the plant's extract uterine muscle contracting activity which elicits the reported oxytocic and abortifacient effects (Offiah and Anyanwu, 1989).

In conclusion, the study has revealed that leaves of *S. mombin* are potential source of pharmacologically active phytochemicals. It has also shown the leaves as an important source of nutrients for domestic animals.

REFERENCES

- Abad, M.J., P. Bermejo, E. Carretero and C. Martinez-Acitores, 1996. Anti-inflammatory activity of some medical plant extracts from Venezuela. *J Ethnopharmacol.*, 55(1): 63-68.
- Abo, K.A., V.O. Ogunleye and J.S. Ashidi, 1999. Antimicrobial potential of *Spondias mombin*, *Croton zambesicus* and *Zygotritonia crocea*. *Phytotherapy Res.*, 13: 494-497.
- Ademola, I.O., B.O. Fagemi and S.O. Idowu, 2005. Anthelmintic activity of extract of *Spondias mombin* against gastrointestinal nematodes of sheep: studies *in vitro* and *in vivo*. *Trop Anim Health Prod.*, 37(3): 223-235.
- Akubue, P.I., G.C. Mittal and C.N. Aguwa, 1983. Preliminary pharmacological study of some Nigerian medicinal plants. *J Ethnopharmacol.*, 8: 53-63.
- AOAC., 1990. Official methods of analysis of the association of analytical Chemists, Washington D.C. pp: 12-13.
- Ayoka, A.O., R.O. Akomolafe, O.S. Akinsomisoye and O.E. Ukponmwan, 2008. Medicinal and Economic value of *Spondias mombin*. *Afri J Biomed Res.*, 11: 129-136.
- Caraballo, A., B. Caraballo and A. Rodriguez-Acosta, 2004. Preliminary assessment of medicinal plants used as antimalarials in the south-eastern Venezuelan Amazon. *Revista-da-Sociedade-Brasileira-de-Medicina-Tropical.*, 37(2): 186-188.
- Coates, N.J., M.L. Gilpin, M.N. Gwynn, D.E. Lewis, P.H. Milner, S.R. Spear and J.W. Tyler, 1994. SB-202742 a novel beta-lactamase inhibitor isolated from *Spondias mombin*. *J Nat Prod.*, 57: 654-657.
- Corthout, J., L.A. Pieters, M. Claeys, D.A. Vanden-Berghe and A.J. Viletinck, 1992. Antiviral caffeoyl: esters from *Spondias mombin*. *Phytochem.*, 31: 79-81.
- Corthout, J., L.A. Pieters, M. Claeys, D.A. Vanden-Berghe and A.J. Viletinck, 1994. Antibacterial and molluscicidal phenolic acid from *Spondias mombin*. *Planta Medica.*, 60: 460-463.
- Edeoga, H.O. and D.O. Eriata, 2001. Alkaloid, tannin and saponin contents of some Nigerian Medicinal plants. *J Med Aromatic Plant Sci.*, 23(3): 344-349.
- Enwere, N.J., 1998. *Foods of Plant Origin*. Afroorbis Publications, Nsukka, pp: 153-168.
- Gill, L.S., 1992. *Ethnomedical uses of plants in Nigeria*. UNIBEN Press, Nigeria, pp: 220.
- Gwotmut, M. and A. Nwafor, 2001. Agents of contraction or relaxation of the uterus and alcohol extraction of *Xylopiya aethiopicum*. *J Crude Drug Res.*, 30: 62-70.
- Hang, W. and H.J. Lantzsch, 1983. Comparative methods for the rapid determination of oxalate and phytate in cereal products. *J Sc Food Agric.*, 34: 1423-1426.
- Harborne, I.B., 1973. *Phytochemical methods: A guide to modern techniques of plant analysis*. 2nd ed. Chapman and Hall, New York, pp: 88-185.
- Igwe, C.U., AO. Ojiako, L.A. Nwaogu and G.O.C. Onyeze, 2008. Lipid lowering effect of aqueous leaf extract of *Spondias mombin* Linn. *The Internet J Pharmacol.*, 6(1): 1-9.
- Ijeh, I., V.O. Nwugo, O. Obidoa, 1996. Comparative studies on the nutritive, phytochemical and antimicrobial properties of two varieties of *Vernonia amygdalina*. *Plant Pros Res Comm.*, 1: 71-75.

- Keshinro, O.O., 1985. The unconventional sources of ascorbic acid in the tropics. *Nutrition Reports International.*, 31(2): 381-387.
- Kone-Bamba, D., Y. Pelissier, Z.F. Ozoukou and D. Kouao, 1987. A study of the haemostatic activity of fifteen medicinal plants of the traditional pharmacopoeia of Ivory Coast. *Plantes-Medicinales-et-Phytotherapie*, 21(2): 122-130.
- Njoku, P.C. and M.I. Akumefula, 2007. Phytochemical and Nutrient evaluation of *Spondias mombin* leaves. *Pakistan Journal of Nutrition*, 6(6): 613-615.
- Nwaogu, L.A., C.S. Alisi, C.O. Ibegbulem and C.U. Igwe, 2007. Phytochemical and antimicrobial activity of ethanolic extract of *Landolphia owariensis* leaf. *Afri J Biotech.*, 6(7): 890-893.
- Nwaogu, L.A., C.O. Ujowundu, A.I. Mgbemena, 2006. Studies on the nutritional and phytochemical composition of *Amaranthus hybridus* leaves. *BioResearch.*, 4: 28-31.
- Offiah, V.N. and I.I. Anyanwu, 1989. Abortifacient activity of an aqueous extract of *Spondias mombin* leaves. *J Ethnopharmacol.*, 26: 317-320.
- Ojiako, O.A. and E.I. Akubugwo, 1997. *An Introductory Approach to Practical Biochemistry*. CRC Publishers, Nigeria, pp: 46-85.
- Okaka, J.C., N.J. Enoch and N.C. Okaka, 1992. *Human nutrition: An integrated approach*. ESUT Publications, Enugu, pp: 57-58.
- Pauly, G. and M. Fleury, 2002. Cosmetic containing plant extracts. *Official Gazette of U.S. Patents and Trademark Office*. Patents, 1259(3).
- Price, K.R., L.I. Johnson and H. Feriwick, 1987. The chemical and biological significance of saponins in foods and fading stuffs. *CRC Critical Revigar in Food Sci Nutr.*, 26: 127-135.
- Sofowara, E.A., 1982. *Medicinal plants and traditional medicines in Africa*. John Wiley and Sons Ltd, Nigeria, pp: 64-79.
- Trease, G.E. and W.C. Evans, 1989. *Pharmacognosy*. 13th ed. Bacilliere Tinall Ltd, London, pp: 5-9.
- Ujowundu, C.O., C.U. Igwe, V.H.A. Enemor, L.A. Nwaogu and O.E. Okafor, 2008. Nutritive and anti-nutritive properties of *Boerhavia diffusa* and *Commelina nudiflora* leaves. *Pakistan J Nutr.*, 7(1): 90-92.
- Villegas, L.F., T.D. Fernadz, H. Maldonado, R. Torres, A. Zavaleta A.J. Vaisberg and G.B. Hammond, 1997. Evaluation of wounds healing of selected plants from Peru. *J Ethnopharmacol.*, 55: 193-200.
- Wright, K., 2002. *Healing foods*. Geddes and Grosset, Scotland, pp: 8-31.