Available online at www.elixirpublishers.com (Elixir International Journal)

Applied Chemistry

Elixir Appl. Chem. 44 (2012) 7143-7146

ISSN: 2229-712X

Evaluation of Potentials of Two Uncultivated Plants Parts (*Artocarpus heterophyllus* and *Parkia biglobosa*)

Bello, M.O and Olawore, N.O

Department of Pure and Applied Chemistry, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

ARTICLE INFO

Article history:

Received: 30 January 2012;
Received in revised form:
17 February 2012;
Accepted: 28 February 2012;

Keywords

Uncultivated plants,
Fixed oils,
Essential oils,
Nutrition and industrial potentials.

ABSTRACT

The major component of wastes from uncultivated plants that constitutes environmental problems is seed. Artocarpus heterophyllus seed and Parkia biglobosa seed pulp were investigated for proximate composition, chemical and antibacterial properties of their oils with a view to exploiting their nutritional and industrial potentials. The crude protein, crude fibre and crude fat content were 14.02, 5.25; 1.23, 12.00; 26.5, 18.00 g/100g respectively. The high iodine value of the fixed oils; 1788, 1425 g iodine kg^{-1} oil respectively compared favourably with edible oils, while the high saponification values of 296.14 and 193.12 g KOH kg^{-1} suggested they are good feedstock for the soap industry. The seed and seed pulp essential oils could also find application as antibacterial agent to extend the shelf life of easily perishable food products.

Introduction

In developing nations, numerous types of edible wild plants which remain uncultivated are exploited as sources of food; hence they provide an adequate level of nutrition to the inhabitants (Aberoumand, 2009). Recent studies on some lesser known Nigeria fruits indicated that these plant resources play a significant role in nutrition, food security and income generation (Bello et al., 2008). In addition to the renewed interest in wild edible plant species as sources of food, there has been an increased awareness of their potential use in industries as a viable alternative to the non- renewable petroleum based fuels and lubricants (Falade et al., 2008, Jekayinfa and Waheed, 2008). Most of these wild edible species remain uncultivated and most times go to waste and create environmental problem. Such type of these plant species are Artocarpus heterophyllus (jackfruit) and Parkia biglobosa (African locust bean) seed pulp.

The jackfruit, (*Artocarpus heterophyllus* Lamk) Family:Moraceae; is a fruit bearing tree that contains seeds (between 100 and 500 per fruit) embedded in the pulp (Morton, 1987). In Southwestern Nigeria where the plant abounds, children used to collect and eat the seed boiled. However, this practice has stopped and the seeds now substantially go to waste. Also, *Parkia biglobosa* (Jacq.) Benth Family: Leguminosae is a savannah forest plant. The fermented seed is a protein and oil rich condiment locally known as iru (Omafuvbe *et al.*, 2004) while the fruit pulp serves as a fodder for livestock (Alabi, 2005). The bark, leaves, seeds and pulp are also known to have medicinal value and credited for the treatment of more than 40 ailments (Lemmich *et al.*, 1996; Quedrago, 1999). The pulp, which is the subject of this investigation, is mostly wasted despite its economic importance, because the *P. biglobosa*, is uncultivated (Amoo and Ayisire, 2004) and the seeds are extracted wherever they are found leaving the pulp scattered.

These two uncultivated edible plants parts were therefore investigated for proximate compositions, chemical properties of their fixed oils and anti-bacteria properties of their essential oils with a view to finding practical and economic uses for them.

Tele:
E-mail addresses: mobello427@yahoo.com

Materials and Methods

Sample collection: Ripe samples of jackfruit and African locust bean fruits were collected at and around the Ladoke Akintola University of Technology (LAUTECH), Ogbomoso. Voucher specimens (number 13535 and 3356 respectively) were deposited at the herbarium of the Department of Botany, Obafemi Awolowo University, Ile-Ife.

Preparation of samples: Seeds of *Artocarpus heterophyllus* were removed from the ripe pods, shelled and diced into pieces while *Parkia biglobosa* pod was carefully opened, the yellowish pulp scraped from the seed, both samples were separately dried at 50^{o} C and ground in a laboratory mortar and pestle and further ground to a fine powder using a Moulinex Turbo Blender Model D70, Cologne Germany.

Proximate analysis was determined by AOAC (1990) method. Carbohydrate was determined by difference while nitrogen was converted to protein by multiplying it by a factor of 6.25.

Oil extraction: The fixed oils were extracted with petroleum spirit (40 – 60 ^{o}C boiling range, BDH, UK) using the soxhlet apparatus (Soxtherm 2000 automatic, Gerhardt Germany) (AOAC, 1990). The essential oils were extracted by hydrodistillation of the pulverized dried samples in an all glass Clevenger apparatus for 4hrs in accordance with the British pharmacopoeia specifications (1980).

Analysis of extracted oils: The refractive index of the oils was measured at room temperature using the Abbey refractometer (Prince Optical Works, Malka Ganj Delhi)while the chemical properties of the fixed oils were determined using AOAC (1990) methods.

Anti- bacteria activities of the essential oils and antibiotic sensitivity test: The anti- bacterial activities of the essential oils were determined using the paper disc method as described by Oloke (2000). The essential oils were dissolved in DMSO to obtain graded concentrations ranging from 6.25 to 50 %v/v. Sterile paper discs were dipped into different concentrations of the oils and then aseptically layered on nutrient agar plate already seeded with an 18hr-broth culture each of the test organisms (Staphylococcus aureus, Escherichia coli, Bacillus subtilis and Micrococcus luteus) in duplicate. Each plate was incubated at 37^0C for 24hrs and then examined for zones of inhibition. The lowest concentration of each test material, which inhibited growth, was taken as the minimum inhibitory concentration (MIC).The sensitivity of the bacterial to antibiotics was tested by means of M2-A6 disc diffusion method recommended by the National Committee for Clinical Laboratory Standards (NCCLS) using nutrient agar. The resistance of the test organisms to commonly dispensed antibiotics in Nigeria was evaluated as previously described (Lateef et al., 2005) using commercial disc (Abtek Biologicals Ltd, Liverpool) containing the following: Augmentin(Aug), 30µg; Amoxycillin (Amx), 25µg; Tetracycline (Tet),10µg; Cloxacillin (Cxc), 5µg; Gentamicin(Gen), 10µg; Cotrimoxazole(Cot), 25 µg; Erythromycin (Ery), 5µg; and Chloramphenicol, 30µg. The plates were incubated at 37^0C for 24hrs, after which the zones of inhibition were examined and interpreted accordinly (Chortyk et al., 1993) as resistant (< 10 mm), mild susceptibility(11- 15 mm) and susceptibility (> 15 mm) considering the appropriate breakpoints (Andrews, 2005).

Results and Discussion

The proximate composition of the seed and seed pulp of Artocarpus heterophyllus and Parkia biglobosa were reported in Table 1. The moisture content were low thus suggesting they could have longer shelf life; the crude protein content in A. heterophyllus was higher than that of P. biglobosa and thus could be a good source of amino acids. According to the Food and Nutrition Board (2001), food plants that provide more than 12 % of their calorific value of protein are a good source of protein therefore A. heterophyllus seed could complement protein from other conventional plant foods. Lipids are essential because they provide the body with energy approximately twice that of carbohydrate, the crude lipid compared favourably well with those reported for conventional oils such as cotton seed (14.1 %); soybean oil (19.1 %), locust bean (20.3 %); (Ayodele at al., 2000).This showed that these samples could be sources of vegetable oil if well annexed, hence could complement conventional vegetable oils, which are very expensive. Crude fibre content of A.heterophyllus seed is low, this may be desirable in its incorporation in weaning diets as emphasis has been placed on the importance of keeping fibre intakes low in the nutrition of infants and pre- school children (PAG, 1978) however the higher fibre content of P. biglobosa is desirable in incorporation into adult diet, high fiber food expands the inside walls of the colon, easing the passage of waste, thus making it an effective anti-constipation, it also lowers cholesterol level in the blood, reduce the risk of various cancers, bowel diseases and improve general health and well being (Eromosele and Eromosele, 1993).

Levels of antinutrients like tannin, phytate, trypsin inhibitor and oxalate reported earlier for A. heterophyllus and P. biglobosa were low to be of any nutritional importance (Bello et al., 2008) thus they could be good supplements to scarce cereal grains as sources of energy in feed formulations.

The properties of the fixed oil were reported in Table 2. The refractive index of the oil samples ranged between 1.457 and 1.475. This range was in close agreement with the values reported for some conventional oils such as palm oil (1.449 – 1.451), soybean oil (1.466 – 1.470) (De Bussy, 1975) and acacia oil - an unconventional oil (1.473 – 1.474) (Falade *et al.*, 2008). The high refractive index of these oils showed that the fatty acids in the oils will contain a high number of carbon atoms (Rudan-Tasic and Klofutar, 1999).

Iodine value ranged from 1424g iodine / kg oil for P. biglobosa seed pulp oil to 1780 g iodine / kg oil for *A. heterophyllus* seed oil. The degree of unsaturation of the oil, expressed as its iodine value, serves as an indicator of the uses to which it can be put. The iodine values of the oils compared favourably with those of cotton seed oil, sunflower seed oil and passion fruit seed oil with a range of 1050 - 1440, 1100 – 1430, and 1330 – 1410 g iodine / kg oil respectively (Nyanzi *et al.*, 2005)and higher than 1093 g iodine / kg oil reported for groundnut oil (Falade *et al.*, 2008). In this respect, the oils presently under investigation seem to be superior to the conventional oils from nutritional and health view points. Oils rich in unsaturated fatty acids have been reported to reduce the risk of heart diseases associated with cholesterol (Law, 2000). The high iodine value also indicates that the oils from these samples can be utilized in coating industries because they will have high drying property (Marvin, 1979).

Peroxide value (PV), used as a measure of oil quality, ranged between 7.2 meq / kg for *P. biglobosa* pulp oil and 13.1 meq / kg for *A. heterophyllus* seed oil. High peroxide values are associated with higher rate of rancidity. For oil to have acceptable storage stability, its PV should be less than 5 meq / kg (Rudan-Tasic and Klofutar, 1999); hence, both oils reported can be stored for too long unless they are adequately processed or preserved with antioxidant. However, 10.9 meq / kg PV has been reported for groundnut oil which is a conventional oil (Falade, *et. al.*, 2008), this may therefore indicates that these oils will be less liable to oxidative rancidity at room temperature compared to this conventional oil.

Saponification values ranged between 193.7 g KOH / kg oil for *P.biglobosa* seed pulp oil and 296.2 g KOH / kg oil for *Artocarpus heterophyllus* seed oil. The results compared favourably with saponification values of palm oil (196 – 205 g KOH / kg oil), olive oil (185 – 196 g KOH / kg oil), soya bean oil (193 g KOH / kg oil), cottonseed (193 – 195 g KOH / kg oil), butter (220 – 233 g KOH / kg oil) and linseed oil (193 – 195 g KOH / kg oil) (Baumer,1995). The value obtained for *P. biglobosa* agreed well with 198 g KOH / kg oil reported for groundnut oil (Falade, *et. al.*, 2008). This indicated that the oils under investigation could be used as a substitute for these established oils for instance in soap making. High saponification implies that the fatty acids in the oil have high number of carbon atoms (Rudan-Tasic and Klofutar, 1999). The high saponification value of oil of the samples would therefore suggest a preponderance of high molecular weight fatty acids.

Free fatty acid value ranged between 6.76 and 8.88 % in P.biglobosa pulp and A. heterophyllus seed oil respectively. These values were higher than 0.4 % reported for groundnut oils (Falade *et al.*, 2008). Since free fatty acids are more prone to lipid oxidation than the glycerides, it is then expected that all these oil samples will become rancid more easily and faster compared to some of the conventional oils (FAO / WHO, 1993).

The antibiogram of the essential oils of the seed of Artocarpus heterophyllus and seed pulp of Parkia biglobosa as well as the resistance pattern of the tests organisms were reported in Table 3. The minimum inhibitory concentration in % volume of essential oil of P. biglobosa pulp (6.25 %) is lower than that of A.heterophyllus (25 %) against S. aureaus while this organism shows resistance against seven tested antibiotics.

E.coli is resistant to essential oil of A.heterophyllus but showed mild susceptibility to essential oil of P. biglobosa at 50 % concentration. 7 tested commercial antibiotics were however resistance to E. coli. P. biglobosa pulp essential oil at 25 % concentration showed susceptibility to B. subtilis meanwhile five commercial antibiotics were resistance to the microorganism. At 6.25 % and 12.5 % concentration of A. heterophyllus and P. biglobosa respectively growth of M. luteus was inhibited but five commercial antibiotics showed resistance to the organism.

It could be seen from these results that the test bacteria in this study showed various degree of resistance to commercial antibiotics, while showing appreciable susceptibilities to the essential oils. It could be inferred that these essential oils could find application as antibacterial agent to extend the shelf life of easily perishable food products when incorporated.

Conclusion

The data reported show that these wild edible species which remain uncultivated and most times go to waste thus creating environmental problem could be harnessed as food supplements and preservatives, raw materials in soap and cosmetics industries and thus components of the much- needed agro- based industrial revolution in Nigeria.

References

Aberoumand A. Nutrition Evaluation of Edible Portulaca Oleracia as Plant Food. Food Anal. Methods. 2009 (2), 204-207.

Alabi DA, Akinsulire OR and Sanyaolu MA. Qualitative Determination of Chemical and Nutritional Composition of *Parkia Biglobosa* (Jacq.) Benth. African J. of Biotech. 2005 4(8), 812 – 815.

Amoo SO and Ayisire BE. Callus Induction from Epicotyl and Hypocotyls Explants of *Parkia biglobosa* (JACQ) Benth. Ife J. of Sci. 2004 6(2) 95- 100.

Association of Official Analytical Chemists (AOAC), 1990. Official Methods of Analysis. 15th edition. Washington, D.C.

Andrews JM. BSAC Standardized Disc Susceptibility Testing Method (version 4). J. of Antimicrobial Chemotherapy. 2005 (56): 60 – 76.

Ayodele JT, Alao OA and Olagbemiro TO. The Chemical Composition of *Sterculia setigera.* Trop J Anim Sci. 2000 3 (2), 69 – 76.

Baumer M. Food Producing Trees and Shrubs of West Africa.Serie-Etudes-et-Recherches, Senegal, 1995. Pp. 168-260.

Bello MO, Falade OS, Adewusi SRA and Olawore NO. Studies on the Chemical Compositions and Antinutrients of Some Lesser known Nigeria Fruits. African J. of Biotech. 2008 7(21): 3972 – 3979.

British Pharnacopia, (1980). Vol 11, H.M. Stationary Office, London, P 109.

Chortyk TO, Severson RF, Cutler HC and Siesson VA. Antibiotic Activities of Sugar Esters Isolated from Selected Nicotiana Species. Biosci, Biotech, Biochem 1993 57: 1355- 1356).

De Bussy JH Material and Technology Encyclopedia, Vol. 8, Longman, Harlow, UK, 1975 Pp.1-39.

Eromosele IC and Eromosele CO. Studies on the Chemical Composition and Physio-chemical Properties of Seeds of Some Wild Plants: Plant Fd. for Human Nutri. (Netherland) 1993 43:251-258.

Falade OS, Adekunle SA, Aderogba MA, Atanda OS, Harwood C and Adewusi SR. Physicochemical Properties, Total phenol and Tocopherol of Some Acacia Seed Oils. J Sci Food Agric 2008; 88: 263-268.

Food and Nutrition Board, Dietary Reference Intake: Elements. Institute of Medicine. National Academy of Sciences, Washington, D.C. 2001

FAO/WHO, Composition and Selected Uses of Fats and Oils in Food, in Report of the Joint FAO/WHO Expert Consultation on Fats and Oils in Human Nutrition, Rome, 1993 Pp. 5-27

Jekayinfa SO and Waheed MA .Selected Fuel Properties of Biodiesel Produced from Shea Butter Oil and Palm Kernel Oil. Alexander von Humboldt Conference on Food, Health and Environmental Issues in Developing Countries: The Nigerian Situation. (Obafemi Awolowo University, Ile ife, 2008, 326- 334.

Lateef A, Oloke JK and Gueguimkana EB. The Prevalence of Bacterial Resistance in Clinical, Food, Water and Some Environmental Samples in Southwest Nigeria. Environ. Monitoring and Assess. 2005; 100: 59- 69.

Law M. Dietary Fat and Adult Diseases and the Implication for Childhood Nutrition: an Epidemiologic Approach. Am J Clin Nutrition. 2000; 82 (1) 41 -44.

Lemmich E, Adewunmi CO, Furu P, Kristensen A, Larsen L and Olsen CE. 5- dieoxyflavones from *Parkia clappertonina*. Phytochemistry. 1996 ; 42, 1011 – 1013.

Marvin JA. Drying Properties and Iodine Values of Vegetable Oil Products. J Am Oil Chem Soc 1979; 56:721A 723A.

Morton J. Jackfruit. In: Fruits of Warm Climates. Creative Resources Systems, Inc. 1987; Pp. 58-63.

Nyazi ZA, Carstensen A and Schwank W. A Comparative Study of Fatty Acid Profiles of Passiflora Seed Oils from Uganda. *JAOCS.* 2005; 82(1), 41-44.

Oloke, JK. Activity Pattern of Natural and Synthetic Antibacterial Agents Among Hospital Isolates. Microbios. 2000; 102:175 – 181.

Omafuvbe OB, Falade, OS, Osuntogun BA and Adewusi SRA. Chemical and Biochemical Changes in African Locust Bean (*Parkia biglobosa)* and Melon (Citrullus vulgaris) Seeds During Fermentation to Condiments. Pakistan J. of Nutri. 2004; 3(3): 140 – 145.

Protein Advisory Group (PAG). Guideline on Protein- rich Mixtures for Use as Supplemented Foods ‘The Part Compedium role, worldmark press Ltd. John Wiley and Sons, New York. 1979.

Quedrago AS. Genetic variation conservation and use of *Parkia biglobosa* in Western Africa. Forest Gen. Res. 1999; 23, 23-27.

Rudan- Tasic D and Klofutar C. Characteristic of Vegetable Oils of Some Slovene Manufacturers. Acta Chim Slov 1999; 46: 511- 521.

Table 1. Proximate Composition of the Samples

Species name	Moisture	Ash	Crude protein	Crude lipid	Crude fibre	Carbohydrate
Artocarpus heterophyllus	8.25 ± 0.10	2.83 ± 0.10	14.02 ± 0.32	26.5 ± 1.20	1.23 ± 0.03	65.44 ± 0.35
Parkia biglobosa pulp	4.00 ± 0.22	3.88 ± 0.23	5.25 ± 0.04	18.00 ± 2.60	12.00 ± 1.20	60.75 ±0.48

Table 2. Properties of the Fixed Oils

Species name	Refractive index	Iodine value g iodine Kg oil	Saponification value (mgKOH/g)	Peroxide value (meq/kg)	% Free fattyacid as oleic
Artocarpus heterophyllus	1.475 ± 0.007	1780.00 ± 6.52	296.15 ± 1.44	13.05 ± 0.22	8.88 ± 0.06
Parkia biglobosa pulp	1.457 ± 0.007	1424.00 ± 1.10	193.71 ± 1.24	7.16 ± 0.13	6.76 ± 0.12

Table 3. Antibacteria Activity of the Essential Oils and Antibiotic Resistance Pattern Among the Bacterial Isolates

Bacterial Isolates	Zone of inhibition (mm) 6.25* 12.5* 25* 50* Artocarpus heterophullus	6.25* 12.5* 25* 50* Parkia biglobosa	Resistance Pattern of Antibiotics
S. aureaus	11 13 **18 20	**15 18 22 25	Aug Amx Ery Tet Cxc GenCot
E. coli	- - - 10	- 11 13 15	Aug Amx Ery Tet Cxc CotChl
B. subtilis	- - - 11	11 12 18** 20	Aug Amx Ery Tet Cxc Cox
M.luteus	13 15 18** 22	-- 16** 18 18	Aug Amx Ery Tet Cxc Cot

* - % (v/v) using DMSO as diluent ** MIC for each bacterium. MIC – Minimum inhibitory concentration (lowest concentration of each test material which inhibited growth) resistant (< 10mm), mild susceptibility (11-15mm) and susceptibility (> 15mm) (Chortyk et al., 1993).