Nutritional Composition and Fatty Acids Profile of *Ficus Exasperata* Fruit and Fruit Oil

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Abstract
The proximate compositions, mineral elements contents and fatty acids profiles of fruit oil of *Ficus exasperata* were studied with a view to investigating its nutraceutical potentials. The proximate analysis showed that the fruit contain valuable nutrients; (g/100g) crude protein (11.38 ± 0.02), crude fibre (16.78 ± 0.04), ash (9.68 ± 0.01), crude fat (4.28 ± 0.00), moisture content (7.58 ± 0.01), and carbohydrate (67.48 ± 0.01). The results of mineral analysis (in mg/100g) revealed the presence of potassium (3262.28 ±6.87), calcium (1721.00 ± 4.04), iron (330.81 ± 8.32), titanium (28.00 ± 0.01), manganese (18.08 ± 0.18), copper (14.04 ± 1.51), chromium (0.08 ± 0.02) and nickel (0.37 ± 0.11). The fatty acids profile showed that the fruit oil contains higher proportion of unsaturated fatty acids, linoleic acid (54.54 %) and oleic acid (18.89 %). The major saturated fatty acids detected include stearic acid (9.10 %), and palmitic acid (7.32 %). Thus the fruit could be another dietary source of nutraceuticals.
Keywords: Fatty acids, *Ficus exasperata* fruit, Mineral elements, Nutraceuticals, Proximate constituents.

Introduction

Ficus exasperata, a terrestrial Afro-tropical shrub or tree that grows up to about 20 m in height, belongs to *Moraceae* plant family (Berg, 1989). It prefers evergreen and secondary forest habitats. In Nigeria, over 45 different species which are primarily located in the rainforest, Savannah and besides rivers and streams were reported up-to-date (Odunbaku *et al*., 2008).

F. exasperata is a medicinal plant referred to as "sand paper plant" popularly known as *Ewe ipin* in Yoruba language of Western Nigeria. The whole plant is known to have several medicinal properties in African traditional medicine. The leaf extract has been used to treat high blood pressure, rheumatism, arthritis, intestinal pains and colics, epilepsy, bleeding and wounds (Irvine, 1961). The roots are also used to manage asthma, dyspnoea and venereal diseases (Chhabra *et al*., 1990). Woode *et al*., 2011 reported the anticonvulsant effects of the leaf extract while the young leaves are also prescribed as a common anti-ulcer remedy (Odunbaku *et al*., 2008). Various pharmacological actions such as anti-ulcer, anti-diabetic, lipid lowering and antifungal activities have been described for the its leaves (Sonibare *et al*., 2006). The anti-inflammatory, antipyretic and antinociceptive effects were reported (Poku *et al*., 2009). Antiarthritic and antioxidant effects of the leaf extract were also established (Abotsi *et al*., 2010). However, most researchers concentrate on the leaves of *Ficus exasperata* while scanty reports were available on the fruit as well as its oils. A report showed that its fruit is eaten against cough and venereal diseases while powdered dried seeds of the plant are added to porridge for the treatment of sterility in women and the seed powder (Niangadouma, 2010). When mixed with water, it is usually taken against the case of fever.

Despite this, the fruit part of the plant has not been investigated as a source of nutrients and its oil, as a source of essential fatty acids. Therefore, the present study investigates the fruits *Ficus exasperata* as a source of plant food with potential health benefits as a result of its nutraceuticals. Studies on ethnobotanical assessment and nutritive potential of other lesser known and wild plants are still ongoing in Nigeria, in comparison to that carried out in some provinces of Pakistan (Shad *et al*., 2013; Sher and Hussain, 2009; Sher *et al*., 2004).

Materials and Methods

Sample Collection and Preparation

Ficus exasperata fruits were collected in the premises of Chemistry Department, Ladoke Akintola University of Technology, Ogbomoso, Nigeria. The ripped fruit were identified by their soft texture and greenish-yellow appearance. The fruits were dried in the oven at 50^0C, pulverized using laboratory mortar and pestle, kept in a specimen bottle and stored in the refrigerator prior to analysis.

Proximate Analysis

The proximate composition of the sample was determined using the methods of the AOAC (1990). Moisture content was obtained by heating the samples to a constant weight in a thermostatically controlled oven at 105 ^{0}C. The ash content by igniting a 0.5g test sample in a muffle furnace at 550 °C until light grey ash results, protein was determined using the Kjedhal method (N X 6.25) The dried pulverized sample was extracted with petroleum ether (boiling point $40\text{-}60^0$C) using a Soxhlet apparatus to obtain the crude lipid content and carbohydrate was calculated by difference.

Quantification of mineral elements

The sample mineral elements were analyzed using X-Ray fluorescence transmission emission technique (XRF - Model PX2CR Power Supply and Amplifier for the XR-100CR Si Detector) at the Centre for Energy Research and Development (CERD), Obafemi Awolowo University, Ile-Ife, Nigeria. The samples were first pulverised then pelletized and then irradiated with X-Ray for 1000 s, to obtain the characteristics spectra. Each spectrum was made up of a peak which was characteristics of certain element contained in the sample. The spectrum was checked on the computer system and then interpreted for quantitative determination of elements.

Fatty acids profile of fruit oil

Fatty acid profile was determined using gas chromatography with column dimensions 30 m x 0.25 mm x 0.25 µm, column type HP INNOWAX, initial temperature 60 ^{0}C using Flame Ionisation Detector (FID) and detector temperature 320 ^{0}C and Nitrogen as a carrier gas. A 50mg portion of the extracted oil (extracted with petroleum ether boiling point 40-60 ^{0}C using a Soxhlet apparatus) from the sample was esterified for five minutes at 95 ^{0}C with 3.4 ml of the 0.5M KOH in dry methanol. The mixture was neutralized by using 0.7M HCl and 3 ml of 14 % boron triflouride in methanol. The mixture was heated for 5 minutes at the temperature of 90^0C to achieve complete methylation process. The fatty acid methyl esters were thrice extracted from the mixture with redistilled n-hexane. The content was concentrated to 1ml for gas chromatography analysis and 1µl was injected into the injection port of GC. The fatty acids were identified by comparing their retention times with those of standards. The content of fatty acids was expressed as percentage of total fatty acids.

Data analysis

Results were expressed as mean and standard deviation of three determinations.

Results and Discussion

The proximate composition of *F. exasperata* fruit (on dry weight basis) was reported in Table1. The % moisture content was (7.57 ± 0.014). This was higher than in ginger (6.67 ± 0.01), in garlic (4.48 ± 0.13), in onion (4.10 ± 0.11) and in Ashanti Pepper (6.10 ± 0.15) as previously reported (Nwinuka *et al*., 2005). However, the moisture content is low to ensure prolonged shelf life and prevent deterioration due to microbial attack. The protein content of the fruit is higher than 3.2% in fruit pulp of baobab but lower than 18.4 % in baobab seed (Osman, 2004). The proportion could complement the protein need when used in mixed animal feed. The lipid content in F. Exasperata fruit is higher than 1.42 % reported for *Piliostigma thoningii* seed but very low when compared to 18% in soyabean and 43 % in groundnut (Jimoh and Oladimeji, 2005). However, fruits generally are not very good sources of fats and are usually recommended as part of weight reducing diets. Dietary fibre is an important factor in diet as it provides many physiological functions in human beings such as the regulation of intestinal motility, prevention of constipation and regulation of glucose and blood lipids levels (Theander *et al*., 1993). The crude fibre (CF) in *F. exasperata* may prove useful as a good source of dietary fibre. The level is higher than the CF in guava (5.2%), pineapple (0.5%), mango (0.7%), papaya (0.8%) and apple (1.0 %) (Nazarudeeen, 2010). The fruit contained 9.68% ash, thus it might not be suitable for compounding animal feeds, as the limit of 1.5 – 2.5% ash has been previously set for animal feed (Oshodi, 1993). The high ash content in the fruit indicates high amount of inorganic matter in the sample. The level of carbohydrate in the fruit compared favourably with that of some commonly consumed spices such as onion (76.71 ± 0.11), garlic (73.03 ± 0.06), Ashanti Pepper (67.59 ± 0.10) (Nwinuka *et al*., 2005). The value showed that *F. exasperata* fruit could be a good source of energy as carbohydrate constitutes a major class of naturally occurring compounds that are essential for the maintenance of plant and animal life and provide raw materials for many industries (Onyeike *et al*., 1995).

Mineral contents

Mineral elements are of interest due to their pro-oxidant activities and health benefits (Alphan *et al*., 1996). The results (Table 2) showed that the sample is an excellent source of potassium (3262 mg/100g), calcium (1721 mg/100g), iron (330.81 mg/100g) but poor sources of titanium (28.00 mg/100g), manganese (18.08 mg/100g), nickel (0.371 mg/100g) and chromium (0.0781 mg/100g). Potassium is a nutritional metal element that is required in diets, the intake has been reported to show positive association with bone density in elderly women and thus suggested that increasing consumption of food rich in potassium may play a role in osteoporosis prevention (Zhu et al., 2009).The level of potassium in the fruit could be of great physiological significance if included in feed formulations especially in part of the world where muscle weakness and increased neurons are relatively rampant (Iqhodaro *et al*., 2012). The fruit is also a good source of calcium, an increasing calcium intake throughout the life span has been reported to be beneficial to the skeleton (Nieves, 1998). An acceptable intake of 1300mg, 1000mg, 1200mg of calcium has been recommended for teenagers, adult between 20- 50, and adult above 50 respectively (FNB, 1997). The level in the fruit could complement other food sources to provide the acceptable intake.

Iron has been reported as an essential trace metal and plays numerous biochemical roles in the body, including oxygen binding in haemoglobin and acting as an important catalytic centre in many enzymes (Geisslar and Powers, 2005). It is estimated that two billion of the World's population; largely in developing countries have marked iron deficiency anaemia (WHO, 1997). This in turn limits work performance and leads to impaired performance in mental and motor test in children (Lockeett *et al*., 2000). The iron content in the fruit is much higher compared to the level in most of the popular fruits such as pineapple (2.42 mg/100g), mango (1.3 mg/100g), apple (0.66 mg/100g) and jackfruit (0.56 mg/100g) (Nazarudeen, 2010). Thus the level of iron in the fruit could provide the FAO/WHO recommended dietary allowance for males (1.37mg/day) and females (2.94mg/day) (WHO, 1997).

Fatty acids profile

Twelve fatty acid components were identified in the fruit oil of *F. exasperata* (Table 3). Seven were saturated fatty acids (21.25%); three were monounsaturated (22.14 %) while two were polyunsaturated (56.60%). The major saturated fatty acid detected were stearic acid (9.10%) and palmitic acid (7.32%).The unsaturated fatty acid detected were majorly linoleic acid (54.54%), oleic acid (18.89%) and linolenic acid (2.06 %).

Oleic acid (omega-9) is a monounsaturated fatty acid with many health benefits. These include ensuring free flow of blood without forming plaques that could block arteries and provision of rich antioxidants that help in fighting the devastating effects of free radicals in the body and lowering the level of cholesterol in the body thereby reducing the risk of cardiovascular diseases such as stroke, high blood pressure, angina pectoris (chest pain) and heart failure (Marlene, 2012). Thus, *F. exasperata* fruit could be a source of nutraceutical for the high level of oleic acid.

Linoleic acid (LA) and α-linolenic acid (ALA) present in the fruit are very essential fatty acids that are vital in the maintenance of some key physiological functions of the animal body. The nutritional value of linoleic acid is due to its metabolism at tissue levels which produce the hormone like prostaglandins that assists in lowering of blood pressure and constriction of smooth muscle (Aurand *et al*., 1987). Linoleic acid constituted 55% of the fruit oil. The oil due to the expressed high levels of LA could be valuable as a dietary supplement for the synthesis of icosanoids which assist in prevention of cardiovascular, renal, reproductive, gastro intestinal and immune systems dysfunction (Dupont and White, 1990). Also, ALA which constituted 2 % of the fruit oil of *F. exasperata* is the parent molecule of the omega- 3 essential fatty acid family and is converted in the body to other members of the omega -3 group; docosahexanoic acid, DHA, C22: 6n-3 and eicosapentanoic acid EPA, C20: 5n-3. Adequate intake of EPA and DHA is essential to prevent depression and the ALA in the fruit oil could be useful as a dietary supplement to arrest the development and progression of DHA deficiency triggered depression (Chivandi et al., 2009).

Conclusion

The present study showed that the fruit of *Ficus exasperata* is a good dietary source of protein, fibre and nutraceutical elements. The low oil yield is beneficial to individual requiring low fat diet and the fruit oil is a potential source of fatty acids that have tremendous health and medical benefits applications. The fruit could be exploited for more phytochemicals to enhance livelihood.

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Table 1: Proximate composition of *Ficus exasperata* fruit (g/100g)

Nutrient	Composition (%)
Moisture	7.58 ± 0.01
Ash	9.68 ± 0.01
Crude fat	4.28 ± 0.00
Crude fibre	16.78 ± 0.04
Crude Protein	11.38 ± 0.02
Carbohydrate	67.48 ± 0.01

Values are means ± standard deviations of triplicate analyses.

Table 2: Mineral element contents of *Ficus exasperata* fruit.

Element	Concentration (mg/100g)
K	3262.28 ± 6.87
Ca	1721.00 ± 0.04
Fe	330.81 ± 8.32
Mn	18.08 ± 0.18
Cu	14.04 ± 1.51
Ti	28.00 ± 0.01
Cr	0.08 ± 0.02
Ni	0.371 ± 0.11

Values are means ± standard deviations of triplicate analyses.

Table 3: Fatty acids profile of *Ficus exasperata* fruit oil.

Fatty acid	**Composition (%)**
SATURATED	
Lauric acid (12:0)	1.12
Myristic acid (14:0)	1.52
Palmitic acid (16:0)	7.32
Stearic acid (18:0)	9.10
Arachidic acid (20:0)	0.10
Behenic acid (22:0)	1.46
Lignoceric acid (24:0)	0.63
Total SFA	**21.25**
MONO UNSATURATED	
Palmitoleic acid (16:1)	2.50
Oleic acid (18:1)	18.89
Erucic acid (22:1)	0.75
Total MUFA	**22.14**
POLYUNSATURATED	
Linoleic acid (18:2)	54.54
Linolenic acid (18:3)	2.06
Total PUFA	**56.6**