Asian Journal of Biological and Life Sciences | Original Research

Nutritional composition, phytochemical screening and antimicrobial properties of the leaf of *Ficus exasperata* (vahl)

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Submitted : 10.12.2011 Accepted :28.08.2012 Published : 31.12.2012

Abstract

The leaf of *Ficus exasperata* was studied for proximate , mineral , antinutrients, phytochemical composition and antimicrobial activity. Results obtained for proximate composition showed that the leaf was rich in carbohydrate (38.73%), crude protein (16.85%), crude fat (13.75%), ash (11.76%), Moisture (10.65%) and crude fibre (8.26%) which were within the range expected for dry leaf vegetable. Antinutrients screening revealed the level of bioactive compounds in the leaf comprising of phytate (112.82%), Oxalate (4.502mg/100g), flavonoids (3.21%), cyanide (0.543mg/kg) and tannins (0.207mg/ml). It contains mminerals such as Ca (500.00ppm), P (217.65ppm), mg (187.20ppm), Fe (168.20ppm). The phytochemicals present were flavonoids, saponins, ccardiac glycosides and aalkaloids. Suscetibility of *Salmonella typhi* , *Escherichia coli* ,*Enterococus feacalis* and *Klebsiella pneumonia* to ethanolic, ethyl acetate and aqueous-chloroform extracts of the leaf showed that the ethanolic extract contained bioactive substances.

INTRODUCTION

Ficus exasperata belong to the family *Moraceae*, with 800 species occurring in the warmer part of the world, chiefly in Indomalaysia and Polynesia [1]. Nigerian forests are replete with over 45 different species of ficus [2]. Some of them are *Ficus goliath, Ficus capensis, Ficus carica, Ficus sur and Ficus elastica.* They can be found in the savanna, rainforest, beside rivers and streams.

Ficus exasperata vahl is commonly known as sand paper tree ("Eweipin" in Yoruba) and is widely spread in West Africa in all kinds of vegetation types and particularly in secondary forest re-growth [3]. The leaves are used for haemostative optihalmia, coughs and haemorrhoid. It is also used for treating various infections and as sand paper for polishing woods [4]. In Nigeria, the young leaves of *ficus exasperata* are prescribed as a common anti-ulcer remedy. Various pharmacological actions such as anti-ulcer, anti-diabetic lipid lowering and antifungal activities have been described for *F. exasperata* [5] several other industrial uses such as stabilization of vegetable oils-suppression of foaming and supplement as feed stock have been reported for the plant. The ethanolic extract of this leaf had been used to monitor the effect on *Escherichia coli* and *staphylococuss albus*, but this study intended to know the minimum inhibitory concentration of ethanolic, ethylacetate and aqueous-chloroform extracts on *E-coli, Klebsiella pneumoniae, Salmonella typhi* and *Euterococuss Faecalis* at varying concentration; also to detect the nutritional composition and assay for the phytochemical constituents of the leaf.

MATERIALS AND METHODS

Extraction of plant material

Leaves of *F. exasperata* were collected from its tree at Olufemi Avenue Junction, Ilesa, Osun State and were air dried at room temperature. Identification of the specimen was carried out in the herbarium section of the Plant Science Department, Faculty of Science, Ekiti State University, Ado-Ekiti, Nigeria. Soxhlet apparatus was used for extraction.

Proximate analysis: The proximate composition analysis of leaf of *F. exasperata* was carried out using the methods of [6]. Moisture content was determined by heating 2.0g of leaf sample to a constant weight in a crucible placed in an oven maintained at 105^{0}C. The dry matter was used in the determination of the other parameters. Crude protein (% total nitrogen X 6.25) was determined by the Kjeldahl method, using 2.0g samples; crude fat was obtained by exhaustively extracting 5.0g of the leaf sample in a soxhlet apparatus using petroleum ether (boiling point range 40-60^{0}C) as the extractant. Ash was determined by the incineration of 10.0g samples placed in a muffle furnace maintained at 550^{0}C for 5h. Crude fibre was obtained by digesting 2.0g of sample with H_2SO_4 and NaOH and incinerating the residue in a muffle furnace maintained at 550^{0}C for 5h. Total carbohydrate was obtained by difference.

Mineral content determination: The mineral content of the leaf sample was determined by Atomic absorption spectrophotometry after dry ashing of the sample. The ash sample was transferred quantitatively into a conical flask and dissolved in 10ml of 3N HCl and the mixture was heated on a hot plate. The solution was then filtered into a 100ml volumetricc flask and made up to the mark with distilled water. The mineral content (K, Ca, Mg, Fe,Zn, Mn, P, Na and Cu) were determined using atomic absorption spectro-photometer. Phosphorus was determined by vanadobmolydem method [7].

Phytochemical Analysis

The photochemical analysis of the leaf were carried out following the methods of [8-11]

Antinutrients Analyses

Tannins and phytate determinations were according to [12]. Other antinutrients analyses were according to the method used by [13].

Determination of the Minimum inhibitory concentration

The determination of minimum inhibitory concentration

Table 1. Proximate composition

Parameters	% composition
Crude fat	13.75 ±0.50
Crude protein	16.85 ± 0.43
Crude fibre	8.26 ±0.29
Ash content	11.76 ±0.61
Moisture content	10.65 ±0.02
Carbohydrate	38.73 ±0.54

Values are means of three determinations±S.D

Table 2. Antinutrients

Parameters	
Tannins (g / 100g)	0.21 ± 0.01
Phytate (mg / 100g)	112.82 ±3.90
Cyanide (mg / kg)	0.54 ±0.02
Flavonoids (mg/100g)	3.21 ±0.01
Oxalate (mg /100g)	4.50 ±0.01

Table 3. Minimum Inhibitory concentration of the leaf extracts of *Ficus exasperata* .

Test Micro-organism	A	B	C
Salmonella typhi	_	28.05	8.16
Escherihia coli	14.0	28.05	8.16
Klebsiella pneumoniae	_	28.05	8.16
Enterococcus faecalis		28.05	8.16

'A' signifies - Aqueous chloroform extract, 'B' signifies - Ethylacetate extract, 'C' signifies - Ethanolic extract.

Table 4. Mineral composition of *ficus exasperata*

MINERALS	(PPM)
P	217.65 ± 0.02
K	41.40 ± 0.05
Na	16.70 ± 0.02
Ca	500.00 ± 3.67
Mg	187.20 ± 2.92
Fe	168.20 ± 6.78
Cu	11.50 ± 0.08
Zn	66.30 ± 0.48
Mn	124.30± 5.67

Table 5. Phytochemicals Screening of *Ficus exasperata*

PHYTOCHEMICALS	BIOASSAY
Tannins	-
Phlobatannins	-
Flavonoids	+
Saponins	+
Cardiac glycosides	+
Alkaloids	+
Steroids	-

"+" signifies the presence of the compound
"-"signifies the absence of the compound

(MIC) was carried out on the extract to know the sensitivity of the various leaf extract against the growth of the test organisms. The medium used was nutrient agar solution which was prepared according to the manufacturer's standard of 28g / 1000ml. the determination was carried out according to the method used by [14].

RESULTS AND DISCUSSION

Results obtained in Table 1 showed the proximate composition of the leaf under study. Protein content was high (16.85%) compared to other common Nigerian foods used as soup condiment, like Bitter leaf (3.8%), Ewedu leaf (1.3%) and water leaf (2.0%) [15]. The health implication of protein consumption include the involvement of its essential and non-essential amino acids as building blocks for protein synthesis, not only for the growth of infants and children, but also for the constant replacement of turnover of the body protein in adult. Amino acids are also precursors of hormones, porphyrins and many other biomolecules in humans [16].

The level of fat detected was higher than that of okazi leaf (6.0%) and water leaf (0.3%) [15]. This indicated that *Ficus exasperata* leaf is a potential source of dietary fat and oleo chemicals. Though, the current food and nutrition Board's Recommended Dietary Allowances did not specify any definite allowance for fat in the diet [17]. the Canadian Dietary standards favour a level of 25% of the total calories. The result obtained here suggested that adequate consumption of *Ficus exasperata* leaf would satisfy this requirement. Despite the possible relationship between dietary fat and cardiovascular disease, fat lends palatability to the meal, slows emptying time of the stomach, decreases intestinal motility and ensures dietary supply of essential fatty acids and fat-soluble vitamins [18]. Fats are essential carbon sources for the biosynthesis of cholesterol and other steroids. The provision of essential fatty acids by plant triacylglycerol is also well known and documented [16].

The crude fibre content of the leaf was high (8.26%) when compared to *Capscium annum* (1.40%) and *Manihot esculenta* leaf (4.2%) [15, 19]. but lower to *Ficus asperifolia* (20.27±0.17%) and *Ficus sycomorus* (17.24 ± 0.71%) [20]. This suggests that this species of Ficus is a good source of dietary fibre. Fibre in human diets helps to prevent overabsorption of water and the formation of hard stools which can result in constipation. Besides, fibre lowers the body cholesterol level, thus reducing the risk of cardiovascular diseases [21, 22].

The amount of carbohydrate detected showed that the leaf could be consumed as a 'carbohydrate food'. The level of carbohydrate (38.73%) exceeded the levels in *Lycopersicon esculenta* i.e. Tomatoes (4.00%) and *Glycine max* i.e. soybean (34.8%) [19]. In the tropics where carbohydrate contributes up to 80% of daily caloric need [18]. the leaf of *Ficus exasperata* would certainly prove useful in the diet of this population. In humans, carbohydrates are utilized as major sources of biological energy through their oxidation in the cells. They also function as organic precursors for the biosynthesis of many cell components [15, 19].

Table 4 shows the mineral composition of the leaf. The concentration of potassium in the leaf was 41.40ppm which in comparison with the concentration of potassium in Lettuce leaf (1.0g / 100g = 10,000ppm) and Bitter leaf (4.0g /100g = 40,000ppm) [15] was very low. Physiologically, potassium functions as an electrolyte in body fluids alongside with sodium and chloride. They help to maintain osmotic pressure and regulate acid- base equilibrium. Potassium is the principal intracellular cation. It functions as a co-factor in several enzyme systems involved in the transmission of nerve impulses and in the regulation of heart beat [23].

Calcium in *Ficus exasperata* (500ppm) was more than the amount found in *Alium cepa* i.e. Raw onions (32ppm), *Cucumesopsis manni* i.e. Melon (17ppm) and *Lycopersicon esculenta* (11ppm) [19]. Calcium like phosphorus forms the major part of the mineral content of bone. Calcium is very abundant in the human body. Non-skeletal calcium plays important role in a wide variety of essential functions in body metabolism [24].

The zinc content of *Ficus exasperata* was found to be higher (66.30ppm) compared to 0.02mg/100g in *Diospyros mespiliformis* [25]. Zinc plays a vital role in gene expression, regulation of cellular growth and participates as a co-factor in several enzymes responsible for carbohydrates, proteins and nucleic acids metabolism [26].

Iron was higher (168.2ppm) in *Ficus exasperata* leaf than in the local variety of *Manihot esculanta* (105ppm) [27] but lower in cocoyam leaf (100ppm) [15]. Iron helps in blood formation. It is present in several enzymes (cytochromes) responsible for electron transport.

Phosphorus content was lower in *Ficus exasperata* (217.65ppm) but higher in local variety of *Manihot esculanta* (600ppm) [27]. Phosphorus, as phosphate, plays a major role in structure and function of all living cells. It circulates as free ion and is present in hydroxyapatite, a major component of bone [28]. Magnesium content in *Ficus exasperata* was 187.2ppm but for Ewedu leaf, it was 1.2g /100g = 12,000ppm [15]. It is an active component of several enzymes systems in which thiamin pyrophosphate (TPP) is a cofactor [29].

Sodium concentration of the leaf was 16.70ppm but in bitter leaf, it was1.0g / 100g and fluted pumpkin leaf 1.0g /100g [15]. Sodium plays a major role in the transmission of nerve impulse and in maintaining proper muscle and heart contraction. It plays essential roles in the control of the passage of nutrients into the cells and waste products out. Sodium ions must be present in the lumen of the small intestine for absorption of sugars and amino acids [30].

Table 2 and 5 are the results of antinutrients and phytochemicals respectively. *Ficus exasperata* leaf contained 0.207g/100g of tannin. Reasonable content of tannins has been found to be present in the fresh green vegetable [31] with the values ranging 0.13g/100g to 0.28g/100g. Tannin was present in *Vernonia amygdalina* having a value of 0.22g/100g while *Ocimum gratissium* had a value of 0.08g/100g [32]. According to [33], tannins (water soluble polyphenols that are present in many plant foods) have been reported to be responsible for decrease in feed intake, growth rate, feed efficiency, net metabolizable energy and protein digestibility in experimental animals. However, tannins can act as anti-nutritional factor by provoking an astringent reaction in the mouth and by making food unpalatable. They can complex with and thus precipitate proteins in the gut reducing the digestibility or inhibiting digestive enzyme and microorganisms. It also interferes with dietary iron absorption [34].

The presence of saponins, flavonoids and glucosides in *Ficus exasperata* leaf which was confirmed by the report from [14] is an indication that this plant is of pharmacological importance [35]. Flavonoids content was 3.21mg/100g. *Clerndendron splendens* leaves contained 0.70mg/100g of flavonoids [13]. This

significant amount of flavonoids is appreciable because flavonoids behave as a powerful protective agent against inflammatory disorders. They reduce odema formation and inhibit the synthesis of prostaglandin E_2, prostaglandin F_2 and thromboxane B_2 [36]. It was reported that saponins and flavonoids present in plant extracts have varied uses as antiulcerogenic, anti-inflammatory, fibrinolytic, antipyretic, analgesic and anti-edematous [37].

Phytate in the leaf was very high (112.82mg/100g) and almost the same content as the amount present in local variety (ege-oda) of *Manihot esculenta* (107.3mg/100g) [27]. Since *Manihot esculenta* would undergo various processes before consumption which would reduce the level of phytate, the level of phytate in *Ficus exasperata* could inhibit the absorption of divalent element in the body unless taken with other leaves or food that contained phytase (an enzyme that breaks phytate). The calculated Ca: phytate / Zn molar ratio was higher than the standard value 0.5mol/kg .This showed that the leaf may cause bone loss.

Table 3 showed that *Escherichia coli, Enterococcus faecalis, Klebsiella species* and *Salmonella typhi* were inhibited at the same concentration of ethanolic extract. This was in contrast with the report from [1] that *E. coli* was inhibited by ethanolic extract of *Ficus exasperata* at 300mg/ml. The wide difference could be environmental, methods of extraction and method of microbial inhibition. The result showed that ethanolic extract of leaf could be potent at lower concentration against disease caused by these four organisms.

The minimum inhibitory concentrations (MIC) of Ethyl Acetate extract of the leaf on the test bacterial was 28.05mg/ml. This suggested that ethanol could have extracted more bioactive agents from the leaf than ethylacetate.

The Aqueous-chloroform extract could not inhibit *Salmonella typhi* and *Enterococcus faecalis*. Report from the work of [14] showed that *Salmonella typhi* was inhibited by the methanolic extracts of *Ficus exasperata* leaf at 1.0mg/ml, *Ficus exasperata* stem bark at 1.0mg/ml and *Ficus exasperata* root at 1.0mg/ml. This suggested that the difference in the extractants used has appreciable impact on the concentration of bioactive constitution which also affects the growth inhibition of the test medicinal plants.

CONCLUSION

The plant extracts have antimicrobial potentials and therefore justifies its ethnobotanical uses for the treatment of disease caused by *Salmonella typhi*, *E*scherichia *coli*, *Klebsiella pneumoniae* and *Enterococcus faecalis,* especially the ethanolic extract. The proximate composition showed that it contains nutrient required in humans. The presence of saponins and flavonoids showed its anti-inflammatory, anti-ulcerogenic, fibrinolytic and analgesic effects.

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