EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 1
Issue: 3
22 - 34
Year: 2014

COMPARATIVE PHYTOCHEMICAL SCREENING, NUTRITIONAL AND ANTI-NUTRITIONAL POTENTIALS OF THE STEMS OF THREE NIGERIAN MEDICINAL PLANTS, *Ipomoea alba* Lam., *Ipomoea nil* Roth. *Ipomoea batatas* Lam.)

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Article Received on 14/09/2014 Article Revised on 06/10/2014 Article Accepted on 29/10/2014

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ABSTRACT

The mature stems of *Ipomoea nil*, *Ipomoea alba* and *Ipomoea batatas* were investigated for their phytochemical constituents, quantitative, nutritional and anti-nutritional values. The phytochemical screening revealed the presence of saponins, tannins, alkaloids and flavonoids in the mature stems of the three species. Cardiac glycosides was present in *I. nil* but absent in *I. alba* and *I. batatas*, free anthraquinone and combine anthraquinone was absent in *I. nil* but present in *I. alba* and *I. batatas*. Nutrient composition revealed lipids: 1.0%, 1.2%, 4.1%, crude fibre: 23%, 30%, 37%, crude protein: 16.01%, 7.0%, 4.0%, carbohydrate 60%, 57%, 40%, moisture content: 4.0%, 2.0%, 7.10%, ash content: 4.0%, 2.0%, 1.5%, sulphated ash: 0.7%, 0.5%, 1.0%, acid insoluble ash: 0.2%, 0.1%, 2.0%, for *I. alba*, *I. nil* and *I. batatas* respectively. Anti-nutrient composition for phytic acid: 0.0002 mg/100g, 0.0002 mg/100g, 0.0001 mg/100g, tannic acid: 0.003 mg/100g, 0.0004 mg/100g, 0.0007 mg/100g, oxalate: 0.12 mg/100g, 0.0021 mg/100g, 0.0007 mg/100g, cyanogenic glycoside: 0.001mg/100g, 0.0002 mg/100g, 0.0001 mg/100g for *I. alba*, *I. nil* and *I. batatas* stems respectively were low. This result reveals that the mature stems contain an appreciable amount of nutrient and low level toxicants and could be included in diet to supplement our daily allowance needed by the body. It also indicates that

the mature stem extract possess antioxidant, antibacterial and antitumor, antiviral activities which explains its use in human medicine.

KEYWORDS

Convolvulaceae, *Ipomoea,* species, phytochemical screening, proximate, mature stem.

INTRODUCTION

A medicinal plant is any plant, which in one or more of its organs contains active ingredients which can be used for the therapeutic purposes or contain lead compounds that can be used for synthesis of useful drugs [1]. Since the beginning of human civilization, people have used plants as medicine perhaps as early as Neanderthal man, plants were believed to have healing power [2]. The traditional society in Africa and elsewhere has always used herbs to promote healing [3]. The Convolvulaceae comprises nearly 1650 predominately tropical species. The genus *Ipomoea with* approximately 500 - 600 species comprises the largest number of species within the Convolvulaceae. The family is dominated by twinning or climbing woody or herbaceous plants that often have heart-shaped leaves and funnel-shaped flowers [4]. One most noticeable anatomical characteristic of the Convolvulaceae is the existence of cells which secrete resin glycosides in the foliar tissues and in the roots of the plants. These glycoresins constitute one important chemotaxonomic marker of this family. [5]

Sweet potato (*Ipomoea batatas* Lam.) is a tuberous-rooted perennial mainly grown as an annual. The roots are adventitious, mostly located within the top 25 cm of the soil. Some of the roots produce elongated starchy tubers. Tuber flesh colour can be white, yellow, orange and purple while skin colour can be red, purple, brown or white. The stems are creeping slender vines, up to 4m long. The leaves are green or purplish, cordate, palmately veined, borne on long petioles. Sweet potato flower are white or pale violet, axillary, sympetalous, solitary or in cymes. The fruits are round, 1 - 4 seeded pods. The seeds are flattened [6].

Morning glory (*Ipomoea alba* L.) is a climbing perennial vine with cordate, ovate, entire or slightly trilobed leaves, glabrous or nearly so, on long petioles (5 – 15 cm) blades mostly 6 - 20 cm and 3/4-4/5 as wide, acuminate or rarely obtuse, inflorescence axillary, several-flowered; flowers large, white, blooming only at night, withering in the dawn or early morning, rarely as late as 11am; corolla 7 – 15 cm long, 11 – 15 cm wide across the expanded, webbed lobes; sepals 5-15mm long, mucronate, ovary 2-celled, seeds glabrous [4]. Blue morning glory (*Ipomoea nil* L.) is an annual herb or sometimes short lived perennial,

with twining to decumbent-creeping, slender somewhat angular stem 2 – 5 m long; herbage sparsely to moderately hirsute with tawny, simple hairs 1 – 4 mm long, hair spreading slightly retrorse. Leaf blades are sub-orbicular, shallowly to moderately 3-lobed. Flowers are one to several on each peduncle. Sepal linear, 15 – 30 mm long, bases ovate, corolla are funnel form, colour of flowers ranges from pale blue to deep blue [4].

The genus *Ipomoea* since time immemorial have been in continuous use for different purposes such as nutritional, medicinal, ritual, and cultural. *Ipomoea* species which originated from Central America, was widely cultivated and consumed almost throughout the world [7]. *Ipomoea aquatica* Forsk is consumed as food in Sri Lank, Hong kong, Taiwan in china [8]. *Ipomoea aquatica* is one of the richest sources of carotenoids and chlorophylls. Several species of the genus *Ipomoea,* as well as, of the Convolvulaceae family have the property of phytotoxicity, which mean suppressing the growth of other plants including invasive weeds. The leaves of *Ipomoea aquatica* are an excellent source of bio-elements such as calcium, magnesium, iron, zinc and copper [9]. Other consumed species for nutritional purposes are *I. alba*, *I. I. involucrata* (P). Beav. and *I. leptophylla* Torr., *I. asarifolia* is used against itching. Sweet potatoes tops (*Ipomoea batatas)* are used as raw materials in India, the tops are used in the manufacture of alcohol, vinegar, tartic acid, yeast and acetone. The tops can be harvested three to four times a year, making it valuable resources [10]. *Ipomoea batatas* Lam., leaves decoctions are used as astringent, alterative, bactericide, laxative, aphrodisiac and tonic [6]. In Kagawa, Japan, a variety of white sweet potato was eaten raw to treat anaemia, hypertension and diabetes [11]. Various species of *Ipomoea* have been used extensively, in many countries, in the traditional medicine for the treatment of several diseases. The most common use of the roots of *Ipomoea* species is to treat constipation [12].

Sweet potatoes and the preparation made from sweet potato plants are powerful antioxidant. Also, preparation made from the leaves maybe effective in helping to boost the immune system and reduces fever [4]. Leaves of sweet potato plant can be used to make poultice and apply to minor burns or bug bites. Sweet potato (*Ipomoea batatas*) leaves are used as vegetables for cooking; the tuber is also fried and eaten as food. It has found its way into folk remedies. Sweet potatoes can be used fresh, dried or ensiled [13]. Like cereal grains, sweet potato root are rich in highly digestible starch and sugar and constitute a valuable energy source for ruminant.

Sweet potato is used to treat asthma, bug bites, burns, catarrh, ciguatera, convalescence, diarrhoea, fever, nausea, stomach distress, tumors and whitlows [6]. Dried potato roots could replace 100% of maize grain profitably without any adverse effect on the performance and blood characteristics of rabbit [14]. Hiroshi *et al*. [15] revealed the nutritional value of sweet potato leaf for the protein and crude fibre content which are important for the prevention of deficiency and colon diseases. The authors further revealed that both sweet potato (*I. batatas*) tuber and leaf contain micro nutrients necessary for healthy body. Sweet potato tuber and leaf also contain anti-nutrients such as phytate, oxalate and tannin. These anti-nutrient could affect the digestion and availability of the nutrient in the body. But if sweet potato is processed by cooking, it reduces the level of anti-nutrient content and renders it of no nutritional consequence to the body system. According to Udoh *et al.* [16], it was reported that the phytochemical screening of *Ipomoea batatas* showed the presence of secondary metabolites which possess multifaceted action including antioxidant, antimutagenity, anti-inflammation, anti-carcinogenesis and antifertility. The leaves of *Ipomoea batatas* are also used in the treatment of diabetes, hookworm, hemorrhagic and abscesses, while the tuber is used for treatment of asthma [17].

The seeds and leaves of *Ipomoea nil*, *Ipomoea alba*, *Ipomoea pes-caprae* and *Ipomoea purpurea* in the preparations that are offered to the adept of the religion, to attain a state of mind suitable for divination in the ceremonial religion [18]. Udoh *et al*. [16] reported on the effect of *Ipomoea batatas* leaf extract on the thyroid-genital axis of male wistar rats. The result reveals follicles hypertrophy and hyperplasia as well as reduction of colloid in the lumen of the follicles. The present study was undertaken to establish the chemical constituents of the mature stem of *Ipomoea alba, Ipomoea nil, Ipomoea batatas* which would eventually be useful in preparing a monograph of the plant and to determine the bioactive agents in the plant, and also the nutrient and anti-nutrient content. The significance of the study is to prove that *Ipomoea nil, Ipomoea alba* and *Ipomoea batatas* contain therapeutic agents useful for synthesis of drugs.

MATERIALS AND METHODS

Collection and Identification of Plant Material

I. alba, I. nil and *I. batatas* mature stems were collected from a farmland in Abak Ishiet village in Onna Local Government Area of Akwa Ibom State. The plants were identified by

Dr. (Mrs.) U. A. Essiett from the Department of Botany and Ecological Studies, University of Uyo, Nigeria.

Preparation of the Extract

The leaves were separated from the plants. The mature stems were cut into smaller pieces dried and weighed. It was macerated in 50% aqueous ethanol for 72 hrs at room temperature following the method suggested by Sofowora [19]. The liquid extract was recovered by filtration using cotton wool and glass funnel. The filtrate obtained was concentrated in a vacuo at 40^0C to yield semi- solid mass. The extract obtained was accurately weighed and then used for phytochemical screening.

Phytochemical Screening

Phytochemical screening was carried out on ethanolic extract for the qualitative determination of phytochemicals constituents using the procedures as described by Sofowora [19].

Quantitative Microscopy/Proximate Analysis

The moisture content of the powdered mature stem were determined by weight loss on drying method [20]. The ash value, acid insoluble ash, water-soluble ash and sulphated ash were determined as described by British Pharmacopeia [21], African Pharmacopeia [20]. The water and alcohol extractive values were obtained using the method outlined by Brain and Tuner [22] and British Pharmacopeia [21]. The fat (lipids), crude protein, crude fibre and carbohydrate were obtained using the method outlined by Pearson [23], Okon [24] and AOAC [25]. Oxalate was determined using the method of Day and Underwood [26]. Phytate as determined using the method of Wheeler and Ferrell [27] and AOAC [28]. Tannin was determined according to Official method of analysis described by AOAC [28]. Cyanogenic glycosides were determined using the method as described by Onwuka [29].

RESULTS

The result of phytochemical analysis of the mature stems of *Ipomoea nil, Ipomoea alba, lpomoea batatas* shows that tannins, saponins, alkaloids, flavonoids were found to be present in the three species. Free anthraquinone was present in *I. alba* and *I. batatas* in moderate quantity and absent in *I. nil*. Combine anthraquinone was present in *I. alba* in moderate quantity, in *I. batatas* in trace quantity and absent in *I. nil.* Cardiac glycoside was present in trace quantity in *I. nil* and absent in *I. alba* and *I. batatas* (Table 1). The result of the

proximate analysis (quantitative evaluation) of the mature stems of *I. alba, I. nil, I. batatas* shows moisture content 4.0, 2.1, 7.10%, ash content 2.0, 4.0, 1.5%, lipid 1.0, 1.2, 4.1%, protein 16.01, 7.0, 4.0%, nitrogen free extract 60, 57, 40%, crude fibre 23, 30, 37%, acid insoluble ash 0.2, 1.0, 2.0% and sulphated ash 0.7, 0.5, 1.05% (Table 2). The result of antinutrient analysis on *I. alba, I. nil,* and *I. batatas* revealed tannic acid 0.003, 0.0004, 0.0007 mg/100g, oxalate 0.12, 0.0021, 0.0007 mg/100g, phytic acid 0.0002, 0.0002, 0.0001 mg/100g, cyanogenic glycoside 0.001, 0.0002, 0.0001 mg/100g respectively (Table 4).

Table 1: **Result of the phytochemical analysis of the ethanolic extract of *I. alba, I. nil* and *I. batatas.***

Test	Inference		
	I. alba	***I. nil***	***I. batatas***
Saponins (frothing test)	++	+++	+
Tannins	+++	+++	++
Alkaloids	++	+	++
Flavonoid	+	++	+
Free anthraquinone	++	-	++
Combine anthraquinone	++	-	+
Cardiac glycoside	-	+	-

Legend: - = Not detectable, + = Trace, ++ = Moderate, +++ = Abundance

Table 2: Result of proximate evaluation of the mature stems of *I. alba, I. nil* and *I. batatas*

Parameter	Percentage composition (% $^{W}/_{W}$)		
	I. alba	***I. nil***	***I. batatas***
Moisture content	4.0	2.1	7.10
Ash content	2.0	4.0	1.5
Sulphated ash	0.7	0.5	1.0
Acid-insoluble ash	0.2	1.0	2.0

Table 3: Result of the nutritional analysis of the mature stems of *I. alba, I. nil* and *I. batatas*

Parameter	Percentage composition (% $^{W}/_{W}$)		
	I. alba	***I. nil***	***I. batatas***
Lipid	1.0	1.2	4.1
Crude fibre	23	30	37
Crude protein	16.01	7.0	4.0
Carbohydrate	60	57	40

Table 4: Result of the antinutritional composition of the mature stems of *I. alba, I. nil* and *I. batatas*

Parameter	Composition mg/100g)		
	I. alba	*I. nil*	*I. batatas*
Tannic acid	0.003	0.0004	0.0007
Oxalate	0.12	0.0021	0.0007
Phytic acid	0.0002	0.0002	0.0001
Cyanogenic glycoside	0.001	0.0002	0.0001

DISCUSSION

The phytochemical screening revealed the presence of saponins in abundant quantity in *I. nil,* moderate quantity in *I. alba* but trace quantity in *I. batatas* for mature stem, which are known to have anti-inflammatory, anti-yeast, anti-fungal, anti-tumour and antiviral activities that supports its usefulness in tradomedicine [1,5,30]. The presence of saponins in the mature stem of these species indicate that these species could have antifungal, antiviral and anti-tumour properties.

Tannins which have astringent were also present in abundant quantity; tannins hasten the healing of wounds and inflamed mucous membranes. This is due to their ability to bind to protein of exposed tissues and precipitating the protein. This then forms a mild antiseptic protective cost under which regeneration of new tissues takes place leading to wound healing [31]. This was in abundant in *I. alba* and *I. nil* but in *I. batatas* it was present in moderate quantity. The presence of tannins in *I. batatas* strongly supports their use in burns, catarrh, whitlow [6], and this is in agreement with reported works of Bruneton [32], Trease and Evans [33]. Alkaloid was present in moderate quantity in *I. alba* and *I. batatas* but in traces quantity was present in *I. nil.* Alkaloid acts as feeding deterant and toxins to insects and other herbivores [34, 53] and are toxic to mammals [35].

Flavonoids exhibit broad range of biological activities such as antimicrobial, anti-inflammatory, antiviral, anticancer, anti-allergic as well as anti-tumour properties [36]. On the other hand, flavonoids are potent water-soluble antioxidant and free radical scavengers, which prevent oxidative cell damage, they have strong anticancer activity [37]. Flavonoids in intestinal tract lowers the risk of heart disease and it provides anti-inflammatory activity [38,39]. Flavonoids were present in *I. alba* and *I. batatas* in trace quantity and in moderate quantity in *I. nil.* The presence of this compound in the three species can be equally applied to treat diseases and this confirms the use of *I. nil* in the treatment of cancer [40].

Free anthraquinone was present in moderate quantity in *I. alba* and *I. batatas* and was absent in *I. nil.* Combine anthraquinone was present in moderate quantity in *I. alba,* absent in *I. nil,* present in trace quantity in *I. batatas*. *Ipomoea alba* and *I. batatas* possess anthraquinone which play important role in the treatment of diseases associated with the heart. Cardiac glycoside was absent in *I. alba* and *I. batatas* but present in trace quantity in *I. nil.* The presence in this species make it useful for the treatment of heart disease [33]. Total ash content is particularly important in the evaluation of purity of drugs i.e. the presence or absent of foreign inorganic matter such as metallic salt and or silica and this affirms the claims of Harborne [41]. A high ash value is indicative of contamination, substitution, adulteration or carelessness in preparing the drug or drug combination for marketing [42]. In this work, the total ash values of 2.0%, 4.0%, 1.5% for *I. nil, I. alba* and *I.* batatas mature stem were found to be reasonably low, indicating low contamination when stored, since the accepted range was 22% [21].

Crude fat of *I. nil, I. alba* and *I. batatas* were 1.2%, 1.0%, 4.1% respectively, values of *I. nil* and *I. alba* were lower than that of *I. batatas* and this indicates that *I. batatas* mature stem is a source of higher energy than *I. alba* and *I. nil* and high energy are needed by growing animals. By definition, fat is the material soluble in certain organic solvent, but the presence of bound fat such as lipoprotein creates problem [24]. In comparing the values of the three *Ipomoea* species, *I. batatas* has high fat content. Dietary fat functions in the increase of palatability of food by absorbing and retaining flavour. A diet providing 1-2% of its caloric energy as fat is said to be sufficient in human diet as excess fat consumption is implicated in certain cardiovascular disorder such as cancer and aging [43].

I. alba contains protein (16.01%) quite high when compared to *I. nil* (7.0%) and *I. batatas* (4.0%), therefore *I. alba* stems are richer in protein than *I. nil* and *I. batatas.* Increase in moisture content could be as a result of water absorption by the fibres and other natural chemical component of the vegetables and mature stems. Moisture content in *I. batatas* (7.10%) was higher than that of *I. nil* (2.1%) and *I. alba* (4.0%). Moisture content that is not too high indicates less chances of microbial degradation of the drug during storage. The low moisture content of the mature stem would hinder the growth of microorganisms and the storage life would be high [44]. The moisture content in a crude drug should not more than 14% [21] thus the value obtained in this research work is within the accepted range and this is an agreement with Antia *et al*. [43]. Fibre content of 30% for *I. nil,* 23% for *I. alba,* and 37%

for *I. batatas* indicates that *I. batatas* has more excessive woody materials than *I. nil*. High dietary fibre speeds up the passage of faeces through the large intestine and reduces the risk of cancer of the colon [45] and carbohydrate for *I. alba* (60.0%) is higher than that of *I. batatas* (40.0%) and *I. nil* (57%).

Tannic acid is known to be bitter and forms high polyphenol complexes with protein thereby making it unavailable in the diet. Tannic acid may decrease protein quality by decreasing digestibility and palatability. Tannic acid in fruits impacts an astringent taste that affects palatability, reduces food intake and consequently body growth. They are known to inhibit the activities of digestibile enzymes and nutritional effect. Tannin protein complexes are insoluble and the protein digestibility is decreased [46,47]. Phytic acid can also affect digestibility by binding with substrate or proteolytic enzymes [48]. Oxalates are regarded as undesirable constituent of the diet, reducing assimilation of calcium, favouring the formation of renal calculi [49]. Apart from genetic factors, the chemical constituent of vegetables including the content of compound both beneficial and undesirable in the diet, is significantly affected by agrotechnical measure, soil fertility as well as weather condition [50,51] and this could be equally applicable to the mature stems. There are indications that small doses of cyanogenic glycosides in the food can help reduce cell crises and also prove useful in schistosomiasis and neoplasma through selective destruction of affected cells [52].

CONCLUSION

The data obtained in this study indicated that mature stems of the three *Ipomoea* species contain appreciable amount of protein, fat, fibre, nitrogen free extract, caloric. The plants could serve as supplements for food and also have the potential to improve the health status of its users as a result of the presence of various compounds vital for good health. Since their anti-nutrient content is appreciably low, it can therefore be suggested that *I. nil, I. alba* and *I.* batatas can contribute significantly to the nutrient requirement of man.

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