

# Comparative Phytochemical, Nutrient and Anti-Nutrient of Stems of *Ipomoea Involucrata* Beauv, *Ipomoea. Triloba* L. and *Ipomoea Batatas* Lam

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**Abstract** The stems of *Ipomoea involucrata*, *Ipomoea triloba* and *Ipomoea batatas* were screened for their phytochemical constituents, nutritional and antinutritional properties. The phytochemical evaluation of these plant species revealed the presence of saponins, tannins, flavonoids, alkaloids, cardiac glycosides and phlobatannins. Anthraquinones and terpenes were absent in the studied plants. Proximate analysis revealed that moisture content of these plants were 8%, 12.1% and 10% respectively. Total ash of 7.7%, 2.6% and 7.2% respectively. Crude fibre of 1.9%, 8.3% and 5.05% respectively. Crude protein of 10.5%, 4.20% and 9.4% respectively. Lipid of 8%, 7.48% and 4.65% respectively. Carbohydrate of 71.9%, 77.42% and 73.7% respectively. The caloric value of the species were 401.6 kcal, 393.8 kcal and 374.25 kcal respectively. The anti-nutrients for hydrogen cyanide were 0.146 mg/100 g, 0.038 mg/100 g and 0.103 mg/100 g respectively. Total oxalate of 88.00 mg/100 g, 114.40 mg/100 g and 96.80 mg/100 g respectively. Oxalate soluble of 52.80 mg/100 g, 70.40 mg/100 g and 66.00 mg/100 g respectively. Phytate of 1.95 mg/100 g, 0.02 mg/100 g and 1.25 mg/100 g respectively and tannins of 2.46 mg/100 g, 1.72 mg/100 g and 4.51 mg/100 g in *I. involucrata*, *I. triloba* and *I. batatas* respectively. The result of this research thus, verify that the stems of the studied plants possess bioactive and nutritional compounds which could be a good dietary menu in human nutrition and medicine.

**Keywords:** *Convolvulaceae*, *Ipomoea* species, phytochemical screening, proximate

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## 1. Introduction

Herbal medicine is the oldest form of healthcare known to mankind. Herbs had been used by all cultures throughout history. It was an integral part of the development of modern civilization. Primitive man observed and appreciated the great diversity of plants available to him. The plants provided food, clothing, shelter, and medicine [1]. The World Health Organization (WHO) estimates that 4 billion people, 80% of the world population, presently used herbal medicine for some aspect of primary healthcare. Herbal medicine is a major component in all indigenous peoples' traditional medicine and a common element in Ayurvedic, homeopathic, naturopathic, traditional oriental, and Native American Indian medicine [2]. The Convolvulaceae comprise nearly 1650 predominantly tropical species. The genus *Ipomoea*, with approximately 500 – 600 species, comprise the largest number of species within the Convolvulaceae [3].

This family is dominated by twining or climbing woody or herbaceous plant that have heart-shaped leaves and funnel-shaped flowers. The genus *Ipomoea* occurs in the tropics of the world although some species also reach

temperate zones [4]. The species of this genus are mainly distributed throughout the south and central America countries and Tropical Africa Territories [3].

*Ipomoea involucrata* Beauv. belongs to the *Convolvulaceae* family. The species is commonly called 'morning glory weed' and locally known as mkpafiafian in Ibibio-Akwa Ibom. It is an annual or perennial twining herbs, with stem up to 4 cm long. Leaves broadly heart-shaped with a deeply cordate base, up to 13cm long, hairy on the surfaces. Flowers are funnel-shaped, whitish to pink, often darker in the throat, in heads arising from a distinct boat-shaped bract. Capsule is spherical, hairless [5].

*Ipomoea triloba* L. is a species of *Ipomoea* morning glory known by several common names including littlebell and Alea morning glory. In Ibibio it is called 'Ediam Ikot'. The species belong to the *Convolvulaceae* family is an annual herbs where its stems are twining or prostrate, with a size measuring about 1 – 3 m long, hairless or sparsely hairy. The leaves are broadly ovate, measuring about 2.5 – 8 cm x 2-7 cm, cordate base. The basal lobes are rounded or angular to lobed. The apex is rounded, coarsely dentate to more or less deeply 3 – lobed margins, hairless or sparsely hairy. The petiole is measuring about 3-10 cm long and slender. The stem is

slender vine exceeding a stem diameter of 2 cm. The peduncle is measuring 1-10 cm long and with minute bracts. The pedicle is measuring 2.5-8 mm long. The sepals are slightly unequal, with a size of 7-8 mm long. The petal is funnel-shaped, with a size of 18-20 mm long, usually pink or pale red-purple in colour [6].

*Ipomoea batatas* Lam. is known by a common name 'sweet potato' and local name 'Ediam mbakara' belong to the Convolvulaceae family is a herbaceous perennial bearing alternate heart-shaped or palmately lobed leaves [7]. The edible tuberous root is long and tapered with smooth skin. The root colour ranges between red, purple, brown and white and root flesh colour ranges from white through yellow, orange and purple [8]. Stem forming a running vine up to 4 m long, usually prostrate and slender, with milk juice, lateral stem-branches arising from the short stem and usually not branched [9].

*Ipomoea involucrata* Beauv. locally called 'mkpafiafian' in Ibibio southern part of Nigeria and is commonly known as 'morning glory weed'. This species is popularly called 'Iehowa dua' in Ghana and is widely distributed throughout Ghana, tropical west Africa, Tanzania or East tropical Africa, Zimbabwe or South Tropical Africa, Africa and northern South Africa [10]. *Ipomoea triloba* L.: It is a native of tropical America, now a pantropical weed in Malaysia [11].

*Ipomoea batatas* L. is a native of tropical America and was domesticated 500 years ago. The crop was brought to Spain by Columbus and subsequently introduced to Africa and Asia [12]. The species of this genus are mainly distributed through the south and central America countries and tropical Africa territories [3].

*Ipomoea involucrata*, *Ipomoea triloba* and *Ipomoea batatas* stems have been in continuous use for different purposes, such as nutritional, medicinal, ritual and agricultural (Pereda-Miranda and Bah, 2003). These species are used for their nutritional purposes [13]. In Guinea, the leaves and stems of *Ipomoea involucrata* are eaten as food and are considered as a good talisman for fecundity [14]. In Ghana, the stems and leaves are used for treating anaemia cases by local herbalists [15].

*Ipomoea triloba* is considered a serious weed in Australia and the Philippines, a principal weed in Cuba, Hawaii, and Honduras, and a common weed in Argentina, Jamaica and Indonesia [16]. Like other morning glories, it competes with crop plants for nutrients and water. In Jawa, *I. triloba* is a weed of brush-woods, tiring fences, sugarcane plantation [9]. *I. triloba* is used in peninsular Malaysia in Poultice against headache [17].

The leaf and stem decoction of *I. batatas* is used in folk remedies for tumors of the mouth and throat [11,18]. The stem of this crop is a folk remedy for asthma, burns and fever [19]. The stem and leaf extract possesses strong antioxidant activity and has been shown to support health blood glucose level, blood pressure [20].

The use of plants as medicine predates written human history. The traditional human uses of plants is recognized as an effective way to discover future medicines. Many of the herbs and species etc used by human to season food also yield useful medicinal compounds. Plant products have for long been used in the treatment of a wide range of diseases.

Malalavidhane [21,22] reported on the aqueous extract of *I. involucrata* and *I. triloba* that showed as effective as

the oral hypoglycaemic drug tolbutamide in reducing the blood sugar level in rats. Pereda-Miranda and Bah [23] stated that chloroform extract of *I. triloba* has effective chemical properties for suppressing the growth of other plants. Pereda – Miranda and Bah [23] pointed out that crude extracts of *I. triloba* led to the identification of the glycoses mixture as the active fraction responsible for phytotoxicity. Madlon [16] reported that *I. triloba* is present with natural ergoline which is useful in the treatment of migraine headaches. Runnie *et al.* [24] reported that *Ipomoea batatas* leaves are a good source of polyphenols, antioxidants and displayed vascular relaxing properties and also reduces the risk of cardiovascular diseases. Cambie and Ferguson [25] reported that the roots and leaves of *I. batatas* contain coumarins, aesculetin, scopoletin and umbelliferone, which have anti-coagulation properties and inhibit HIV replication.

Meira *et al.* [26] reviewed the traditional, chemistry and biological activities of the genus *Ipomoea*. The result of their work showed that *Ipomoea* species are used in different parts of the world for the treatment of several diseases, such as diabetes, hypertension, dysentery, constipation, fatigue, arthritis, rheumatism, hydrocephaly, meningitis, kidney ailments and inflammations. Wallace *et al.* [57] had assessed the nutritional quality and antinutritional composition of *Ipomoea involucrata* along with other non-conventional leafy vegetables. Nutrients and Anti-nutrients Composition of two varieties of raw, cooked and sun-dried sweet potato was assessed by Nwani *et al.* [27]. Their results had that there was no significant difference ( $P > 0.05$ ) between the varieties in crude protein, crude lipid and moisture contents. Ejimadu and Ogbeide [28] reported on the effects of petroleum ether and ethanol extracts of *I. involucrata* on *klebsiella spp*, *Escherichia coli*, *pseudomonas aeruginosa* and *staphylococcus*. The results revealed that the extracts inhibited the growth of both Gram-positive and Gram-negative organisms. Antiviral activities of aqueous ethanolic extract of *I. involucrata* against herpes simplex virus [29].

The present study was undertaken to identify the different bioactive agents present in the stem of *Ipomoea involucrata*, *Ipomoea triloba* and *Ipomoea batatas* as well as relating the constituent to their possible pharmacological importance and to contribute useful information to the proper and easy identification of *Ipomoea involucrata*, *Ipomoea triloba* and *Ipomoea batatas* and providing a useful tool for collection and preservation of these species. The significance of this study is to justify and ascertain that *Ipomoea involucrata*, *Ipomoea triloba* and *Ipomoea batatas* has various therapeutic uses for the synthesis of drugs and medicinal plants.

## 2. Materials and Methods

### 2.1. Plant Collection

The fresh stems of *Ipomoea involucrata*, *Ipomoea triloba* and *Ipomoea batatas* were obtained from Abiakpo Ikot Essien, Ikot Ekpene Local Government Area of Akwa Ibom State on 22<sup>nd</sup> October, 2013. The plants were identified and authenticated by Dr. (Mrs) U. A. Essiett, Department of Botany and Ecological Studies, Faculty of

Science, University of Uyo, Uyo. Phytochemical screening, nutrient and Anti-nutrient quantitative evaluation and analysis for their elemental composition were then carried out on the plants.

## 2.2. Phytochemical Screening

The fresh stems were air dried and reduced to powder with the aid of a mortar and pestle. The powdered stems were accurately weighed and macerated cold in 50% ethanol and distilled water for 72 hours at room temperature following the method suggested by Sofowora [30]. The liquid extract were recovered by filtration using cotton wool and glass funnel. The filtrate obtained was concentrated in a vacuo at 40°C to yield semi-solid mass. The extract obtained was accurately weighed and then used for phytochemical screening. Basic screening was performed using suitable reagent to detect the presence or absence of secondary plant metabolites such as Alkaloids, tannins, saponins, anthraquinones, flavonoids, phlobatannins and cardiac glycosides in the extract. The method of Trease and Evans [31] and Sofowora [30] was used.

## 2.3. Quantitative Microscopy/Proximate Analysis

The moisture content of the powdered leaves was determined loss on drying method [32]. The ash value, acid insoluble ash, water-soluble ash and sulphated ash were determined as described by British Pharmacopoeia [33], African Pharmacopoeia [32]. The water and alcohol extractive values were obtained using the method outlined by Brain and Tuner [34], British Pharmacopoeia [33]. The fat (lipids), crude protein, crude fibre and carbohydrate were obtained using the method outlined by Pearson [35], Okon [36] and AOAC [37].

## 3. Results

The result of phytochemical screening of *Ipomoea involucreta*, *Ipomoea triloba* and *Ipomoea batatas* stems revealed that saponins were abundantly present in *I. triloba* and were found in trace amount in *I. involucreta* and *I. batatas*. Tannins were moderately present in *I. involucreta* and *I. batatas* and abundantly present in *I. triloba*. Flavonoids were found in traces in *I. involucreta* and *I. batatas*, and abundantly present in *I. triloba*. Phlobatannins were moderately present in the three species of the *Ipomoea*. Cardiac glycosides was found in trace amount in *I. involucreta* and were absent in *I. triloba* and *I. batatas*. Alkaloids was found moderately in *I. batatas* and were absent in *I. involucreta* and *I. triloba*. Anthraquinones and terpenes were absent in the three species of the *Ipomoea* (Table 1)

The nutritional analysis of the powdered stems of the three species of the *Ipomoea* were: moisture (8%), (12.1%), and 10% respectively. Total ash (7.7%), 2.6% and 7.2%. Crude fibre (1.9%), 8.3% and 5.05% protein 10.5%, 4.20 and 9.4%; lipid 8%, 7.48% and 4.65%, carbohydrate 71.9%, 77.42% and 73.7%, and energy respectively (Table 2).

The anti-nutritional analysis of the powdered stems of *I. involucreta*, *I. triloba* and *I. batatas* as shown in Table 3 were hydrogen cyanide (0.146 mg/100 g), (0.038 mg/100 g) and (0.103 mg/100 g) respectively. Total oxalate (88.00 mg/100 g), 114.40 mg/100 g and (96.80 mg/100 g) respectively. Oxalate soluble (52.80 mg/100 g), 70.40 mg/100 g and 66.00 mg/100 g respectively. Phytate 1.95 mg/100 g, 2.02 mg/100 g and 1.25 mg/100 g; and tannins (2.46 mg/100 g), (1.72 mg/100 g) and (4.51 mg/100 g) respectively.

**Table 1. Results for the phytochemical screening of *Ipomoea involucreta*, *Ipomoea triloba* and *Ipomoea batatas* stems**

Compound	Test	<i>I. involucreta</i>	<i>I. triloba</i>	<i>I. batatas</i>
Saponins	Frothing test	+	+++	+
Flavonoids	Shinda reaction	+	+++	+
Phlobatannins		++	+++	+
Tannins	Ferric chloride test	++	+++	++
Alkaloids	Dragendroff	-	-	++
Cardiac glycosides	a. salkowski's test	+	-	-
	b. keller killiani test	+	-	-
	c. Lieberman's test	+	-	-
Anthraquinones		-	-	-
Terpenes		-	-	-

Legend: - = Absent, + = Trace, ++ = Moderate, +++ = Abundance

**Table 2. Result of Proximate composition of *Ipomoea involucreta*, *Ipomoea triloba* and *Ipomoea batatas* stems**

Parameters	<i>I. involucreta</i>	<i>I. triloba</i>	<i>I. batatas</i>
Moisture (%)	8	12.1	10
Total ash (%)	7.7	2.6	7.2
Crude fibre (%)	1.9	8.3	5.05
Crude protein (%)	10.5	4.20	9.4
Lipid (%)	8	7.48	4.65
Carbohydrate (%)	71.9	77.42	73.7
Energy (Kcal)	401.6	393.8	374.25

**Table 3. Result of Antinutrient of *Ipomoea involucreta*, *Ipomoea triloba* and *Ipomoea batatas* stems**

Parameters	<i>I. involucreta</i> (mg/100g)	<i>I. triloba</i> (mg/100g)	<i>I. batatas</i> (mg/100g)
hydrogen cyanide (HNC)	0.146	0.038	0.103
Total oxalate	88.00	114.40	96.80
Oxalate soluble	52.80	70.40	66.00
Phytate	1.95	0.02	1.25
Tannins	2.46	1.72	4.51

## 4. Discussion

The phytochemical screening of *I. batatas* stem revealed the presence of alkaloid in moderate quantity, but alkaloids was absent in *I. triloba* and *I. involucrata*. It had been reported that the presence of alkaloid in plants part serves as a feeding repellent and toxin to herbivores since it directly interacts with special molecules at target sites within the nervous system [38,39]. Rattan [40] also reported that alkaloids are toxic to man. The presence of alkaloids in the stem of *I. batata* is in consonance with the reports of Meira *et al.* [28] that some members of this genus (*Ipomoea*) contain alkaloids. Saponins were present in all the three species of *Ipomoea* studied but in varying quantities. Saponin was abundantly present in *I. triloba* but only trace quantities of this phytochemical was found in *I. batatas* and *I. involucrata*. Sofowora [30] reported that saponins exhibit a wide range of biological activities like anti-fungal, anti-inflammatory, anti-viral, anti-parasitic and anti-tumor activities. He further confirmed that these properties authenticates its usefulness in traditional medicine practice. The presence of saponins in the plant stems suggests that it can be used as antifungal and antiviral drugs.

Flavonoids have been reported to be water soluble anti-oxidant and are free radical scavengers. They prevent oxidative cell damage and are anti-carcinogenic [41]. Okwu [42] also opined that its presence in the intestinal tract reduces the risk of heart diseases while preventing inflammation. This bioactive ingredient was abundant in *I. triloba* but trace in *I. batatas* and *I. involucrata*. These therapeutic activities of flavonoids had been confirmed by Essiett *et al.* [43]. The presence of flavonoids in the present study could be attributed to its use in treating migraine headaches, tumor, anaemia [14,16].

The study also revealed the presence of tannins in the three species. It was observed that tannins were abundant in *I. triloba* but trace in both *I. batatas* and *I. involucrata*. Trease and Evans [31], Bruneton [44] and Bouquet *et al.* [45] have reported the astringent and detergent properties of tannins, suggesting that this properties could be linked with its anti-fungal activity. The presence of this compound could be useful in the antifungal activity.

The role of cardiac glycosides in the correction of heart disorders as well as the slowing and strengthening effect it possess on failing hearts has been well documented [31]. This phytochemical was absent in *I. triloba* and *I. batatas* but was found in trace quantity in *I. involucrata*. The presence of this compound in *I. involucrata* stems could be useful in the treatment of diseases associated with the heart [31,46]. Anthraquinones and terpenes were absent in the three plants screened. Phlobatanins were found in moderate quantities in *I. triloba*, *I. batatas* and *I. involucrata*.

Generally, the presence of these bioactive compounds in these species of *Ipomoea* thus suggest a scientific verification to its usage in traditional medicine. The quantitative determination of the nutritional value of *I. triloba*, *I. batatas* and *I. involucrata* stems revealed that in terms of moisture content, *I. triloba* (12.1%) had the highest value, followed by *I. batatas* (10%), *I. involucrata* (8%) respectively. Though the disparities in this regard were small, it follows that the higher the moisture content

of a food or drug material, the more its chances of perishability and microbial spoilage [47]. However, the moisture content of these plants fell within the permissible limits (14%) proposed by the British Pharmacopeia [33] for drug materials and since it was normal, it implies that the plants can be stored for a longer period with lower chances of microbial attack and growth.

The total amount of the plant residual substance not volatilized when it is ignited with heat is its total ash content. The physiological ash, which is the ash obtained from the plant tissue itself added to that which is obtained from the extraneous materials like sand adhering to the surface of the plant is known as its total ash content [32]. The results of this work showed that ash content of *I. triloba* (2.6%), *I. batatas* (7.2%) and *I. involucrata* (7.7%) were low. Generally, a high ash content value is indicative of adulteration, contamination or carelessness in preparing plant samples. Therefore the low ash content is indicative of low contamination.

In this study, crude fibre was least in *I. involucrata* (1.9%), moderate in *I. batatas* (5.05%) but highest in *I. triloba* (8.3%). The high fibre content found in *I. triloba* make it a favourable choice since it has been reported that diet fibre present in food materials assist in proper digestion of other food materials and prevent colon cancer [48,49]. Non-starchy plant materials are the richest sources of dietary fibre and are helpful in the treatment of obesity, gastro-intestinal disorders and diabetes [50].

Protein is an essential plant molecule containing nitrogen in food samples is used as a criteria of protein termed "crude protein" as separate from true protein [46]. The values for crude protein were *I. triloba* (4.2%), *I. batatas* (9.4%) and *I. involucrata* (10.5%) respectively. This points to the fact that *I. involucrata* is a rich source of protein than the other species. Lipids have been reported to function in increasing palatability of food and in flavour retention [51]. However, a diet providing 1-2% of its caloric energy is sufficient to human beings as consumption of excess fat yields undesirable results as cardio-vascular disorders, atherosclerosis aging and cancer [52,53], the lipid profile of this plant species are generally low.

Carbohydrate contents of *I. involucrata* (71.9%), *I. batatas* (73.7%) and *I. triloba* (77.42%) is relative high. The high carbohydrate in the stems show that they could be employed as good energy sources in our food diets. There is a relationship between caloric and carbohydrate contents of plant. The caloric values of plant species increase with increased carbohydrate contents. This is evident in this work as the energy content is observed to be high when compared to some medicinal vegetables like pumpkin, tomatoes and mushroom [54].

The results of this study revealed that there were anti-nutrients present in these species of *Ipomoea* and that there were slight variability in the quantity of this anti-nutrients. Total oxalates were highest in *I. triloba* (114.40), moderate in *I. batatas* (96.80 mg/kg) but least in *I. involucrata* (88.00 mg/kg). Also, soluble oxalates followed the same trend. It has been reported that oxalates act as chelating agents which binds calcium effectively and in high concentrations they produce an acute metabolic calcium deficiency syndrome (hypocalcaemia) when fed as main feed to livestock [55]. Also, tannins were found in these species but in low quantities. Tannin

is known to cause a growth depressing effect in living systems [56]. Therefore, the low tannin content is not unrelated with high protein content of these species. Phytates were also present in the plants studied. Phytates have been implicated in the chelation of certain metal ions, such as calcium, magnesium, zinc, copper and iron forming insoluble complexes that are not readily broken down and may pass through the digestive tract unchanged leading to non-availability of these ions [58]. Again, phytates are associated with the formation of strong complexes with proteins leading to reduce digestibility of proteins and subsequently, its deficiency. Phytates were generally low in the *Ipomoea involucreta*, *Ipomoea triloba* and *Ipomoea batatas* studied. Hydrogen cyanide is a chemical compound that contains a cyano group  $-C\equiv N$ , which consists of carbon atom triple bonds – bonded to a nitrogen atom. It is toxic to human health when found in greater quantity. The hydrogen cyanide contents of *I. involucreta* (0.146 mg/100 g), *I. triloba* (0.038 mg/100 g) and *I. batatas* contain low levels of toxicants (0.103 mg/100 g) and consumption of these plants would not result in any deleterious effect on the health of man.

## 5. Conclusion

The stems of *Ipomoea involucreta*, *Ipomoea triloba* and *Ipomoea batatas* revealed that the plants contain an appreciable amount of proteins, crude fibre, lipid, carbohydrate and caloric value (energy) and low levels of toxicants and consumption of this plant would not result in any deleterious effect on the health of man. Phytochemical constituents saponins, tannins, flavonoids, alkaloids, cardiac glycosides and phlobatannins were also found in the plants whose presence serve for different therapeutic uses. Since the plant species contain substantial amount of nutrients, anti-nutrients and bioactive constituents, it can therefore be concluded that the stems of these three *Ipomoea* species could be a good dietary menu in human nutrition and medicine.

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