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CHEMICAL COMPOSITIONS OF IPOMEA AQUATICA (GREEN KANGKONG)

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ABSTRACT

Proximate analysis on *Ipomea aquatica* (green kangkong) was carried out using standard methods. The results revealed 51.36% moisture, 42.18% carbohydrate, 1.70% protein, 2.75% ash, 1.20% fiber and 0.81% fat. The investigation of mineral content in µg/ml showed that the vegetable was relatively high in iron, magnesium and calcium. Other minerals that were present include phosphate, manganese, sulphate and nitrates. The vitamin content was investigated using spectrophotometric methods and it revealed high contents in mg/100g of vitamins A, B_1, C and K. Relatively water-soluble vitamins were predominant over fat-soluble vitamins. Phytochemical screening of green kangkong revealed high concentrations of alkaloids, reducing sugar, soluble carbohydrate, flavonoids, while it contained lower concentrations of steroids, phenols, glycosides, β-carotene, saponins and tannins. The high carbohydrate, vitamin and mineral contents showed that the plant material can be a good source of nutrient for man and animal food. The natural endowments of phytochemicals showed that the plant has serious pharmacological and therapeutic effects apart from its nutritional essence.

KEYWORDS

Ipomea aquatica , green kangkong, mineral, vitamin , Phytochemicals

INTRODUCTION

Traditional societies have always exploited edible wild plants, including fruits and vegetables, to provide for themselves adequate food security and income generation (Edmonds and Cheweya, 1997). Fruits and vegetables generally form indispensable constituents of human diets supplying the body with minerals, vitamins and certain hormone precursors, in addition to small amounts of protein and energy (Akindahunsi and Salawu, 2005). However, many of these fruits and vegetables are yet to be adequately studied and utilized. An example is the green kangkong.

Consequently, it becomes imperative to investigate the proximate composition, mineral contents, vitamin compositions and phytochemical analysis, to evaluate the nutritional essence and other possible and useful application as well as provide a nutritional database that will include information on mineral nutrients. This has become necessary as only few vegetables are both nutritionally essential and medicinally important.

Industrial uses of plant products have mounted pressure on the food uses of some plants. Desert encroachment in some parts of the world where the land gets drier further from the oceans, has also wiped away some varieties of food crops and vegetables. These contribute to the global food crisis and have increased the search for safe plants that can provide most of the essential nutrients for human and animal feed. These nutrients include carbohydrates, proteins, lipids, minerals and vitamins. Most vitamins needed by animals cannot be produced in the body and therefore must be supplied in the diet (Gaby *et al.*, 2000). Some of the vitamins produced in the body are not synthesized in amounts adequate for its daily needs (Carr and Frei, 2006). Plants synthesize most of the vitamins and serve as primary sources of these dietary essentials (Brody, 1999).

The plant *Ipomea aquatica* belongs to the plant family Convoluvulacea, a moving glory family. It is a semi-aquatic tropical plant grown as a leaf vegetable (Oomem and Grubben, 1978). *Ipomea aquatica* is commonly called water convolvulus or water spinach and is highly invasive, forming dense mats over the surface of water bodies such as lakes, ponds, canals and ditches.

The green kangkong has green/white stem, green leaves with green/white petioles and white flowers (Siemonsma and Kasem, 1994). It is prolific in growth and can invade most cultivated areas such as rice and sugarcane fields and other areas with varying water levels (Schardt and Schmidt, 1990).

The young shoot (tender) and/or the whole plant (stem and leaves) are cooked or lightly fried in oil and eaten in a variety of dishes. The vines are used as fodder for cattle and pigs. In the south-eastern part of Nigeria, it is eaten, cooked with oil and spices are added to enhance the relatively bland flavor. It is also used as a sauce for tuber crops such as yam and potatoes or as leaf vegetable component of farm food. It is claimed to be a potent agent in the treatment of gastro-intestinal disorders as well anemia.

MATERIALS AND METHODS

Fresh leaves of *Ipomea aquatica* were harvested from a rice farm at the Democracy Estate, behind PRESCO Annex of Ebonyi State University, Abakaliki, Ebonyi State, Nigeria. The leaves were thoroughly washed with distilled water, ground to reduce particle size and to increase the surface area. All the reagents used were of analytical grade from May and Baker Ltd, England and BDH Chem. Ltd., England.

METHODS

PROXIMATE ANALYSIS: The method of Pearson (1976) was employed for the determination of the proximate composition. The soxhlet method was also employed in the determination of the crude fat/oil in the sample using petroleum ether (40-60^{O}C). The Kjedhal method was used for protein estimation while the crude fiber and ash contents were also determined (AOAC, 1980).

MINERAL ANALYSIS: The method of Andrew and Fett (1941), which depends on the measurement of color developed in the reaction of α1-dipyridyl and ferrous ion at 520nm was employed in evaluation of iron content. The official methods (A.O.A.C., 1980) were used in the determination of copper and manganese concentrations. The calcium concentration of the sample was determined by precipitation as the oxalate (Pearson, 1976). Vanadomolybdophosphoric acid method as described by Rand *et al*., (1976) was used for phosphate determination while nitrate was estimated using the method of Hoather and Rackham, (1959).

VITAMIN CONTENT: Spectrophotometric methods as described by Pearson (1976) were employed in the determination of vitamins A, C, E, and K concentrations while the methods of Ball (1994) were used for the determination of vitamins B_1, B_2, B_6 and B_{12}.

PHYTOCHEMICAL ANALYSIS: Investigation of the secondary metabolites accumulated in the plant was carried out. The concentration of alkaloids was determined using the method of Haslam (1966). The methods of Harborne (1973) were employed in the determination of flavonoids, glycosides, phenol, tannin, β-carotene, cyanogenic glycosides, steroids, saponins, reducing sugars and soluble carbohydrate.

RESULTS

Table 1
Proximate composition of fresh leaves of Ipomea aquatica

COMPONENT	% COMPOSITION
Moisture	51.36±0.02
Crude fat/oil	0.81±0.01
Crude protein	1.70±0.02
Crude fiber	1.20±0.02
Ash content	2.75±0.01
Carbohydrate	42.18±0.02

Table 2
Mineral analysis on Ipomea aquatica.

MINERAL	CONCENTRATION (μg/ml)
Iron	6,925 ± 3.12
Magnesium	12,121 ± 3.21
Manganese	2,390 ± 6.38
Phosphate	1,096 ± 6.37
Sulphate	2,130.130 ± 49.52
Nitrate	693.30 ± 3.12
Calcium	18mg/100g

Table 3
Vitamin contents of Ipomea aquatica in mg/100ml.

Vit. A	Vit. B_1	Vit. B_2	Vit. B_6	Vit. B_{12}	Vit. C	Vit. E	Vit. K
13.14±0.25	6.35±0.33	13.08±0.04	8.87±0.88	0.78±0.02	83.57±2.52	0.07±0.01	25.99±0.37

Table 4
Phytochemical analysis on Ipomea aquatica (Green kangkong).

Phytochemical	Concentration in mg/100g
Alkaloids	7398.3 ± 118.7
Steroids	234.0 ± 32.1
Saponin	21.4 ± 3.6
Phenols	113.7 ± 8.64
Reducing sugar	1239.2 ± 112.2
Flavonoids	938.2 ± 28.9
Tannins	9.46 ± 0.1
β-carotene	26.4 ± 0.8
Glycosides	268.4 ± 12.4
Cyanogenic glycosides	17.2 ± 0.6
Soluble carbohydrate	1578.9 ±56.8

DISCUSSION

The results of the proximate analysis as seen in table 1 revealed that *Ipomea aquatica* (green kangkong) contains 51.36% moisture, 38.18% carbohydrate, 1.70% protein, 2.75% ash, 1.20% fiber and 0.81% fat. It was observed that it is not a good source of vegetable oil. The high carbohydrate content showed that the plant material can be a good source of food.

The investigation of mineral contents in table 2 showed that it contained in µg/ml 6,925±3.12 iron, 12,121±3.21 magnesium, 2,399±6.38 manganese, 1,096±6.37 phosphate, 693.60±3.12 nitrate, 2,130.130 ± 49.52 sulphate and 18.32mg/100g of calcium. These minerals play significant roles in several biological processes. Bone growth and turnover are influenced and regulated by the metabolism of calcium, phosphate and magnesium while iron is important in the formation of haemoglobin (Burtis and Ashwood 2003).

The investigation of the vitamin contents revealed 13.14±0.00 of vitamin A, 6.35±0.33 vitamin B_1, 13.08±0.00 vitamin B_2, 8.87±0.88 vitamin B_6, 0.78±0.02 vitamin B_{12}, 83.57±9.52 vitamin C, 0.07±0.01 vitamin K (the anti coagulant vitamin) and 25.99±0.37 for vitamin E. Vitamin A is essential in vision as the precursor for the visual purple, rhodopsin, as well as plays a role in immunity. Vitamin B_2 (riboflavin) is essential for energy production and in its coenzyme forms (FMN and FAD), it serves as hydrogen transport systems (Mayes 2000); vitamin C an antioxidant, facilitates wound healing, production of collagen, formation of red blood cells and boosts immune system (Monsen, 2000); vitamin E is an antioxidant and plays a role in cellular respiration (Burtis and Ashwood, 2003); niacin (nicotinic acid) is converted to NAD and NADP, which are coenzymes for various oxidoreductases (Burtis and Ashwood, 2003). Thus it contains both fat-soluble and water-soluble vitamins which are essential for normal healthy growth.

Ipomea aquatica contains some vital phytochemicals as shown in table 4. Phytochemical screening of green kangkong revealed concentrations in mg/100g of 7398.3±118.7 alkaloids, 234.0±32.1 steroids, 21.4±3.6 saponins, 113.7±8.64 phenols, 1239.2±112.2 reducing sugar, 938.2±28.9 flavonoids, 9.46±0.1 tannins, 26.4±0.8 β-carotene, 268.4±12.4 glycosides, 17.2±0.6 cyanogenic glycosides and 1578.9±56.8 soluble carbohydrate.

Phytochemicals are naturally occurring substances found in fruits, vegetables and grains. Unlike vitamins and minerals, they have no nutritional value. They can however influence various body processes. They work together with nutrients and dietary fiber to protect the body against diseases, slow the aging process and reduce the risk of many diseases such as cancer, heart disease, stroke, high blood pressure, cataracts, osteoporosis and urinary tract infection. Alkaloids have analgesic effects (Okwu and Ndu, 2006). Morphine alkaloids are powerful pain relievers and narcotics (induces sleep or drowsiness). Many plant glycosides are used as medications. In animals including humans, poisons are often bound to sugar molecules of glycosides in order to move them from the body. Tannins prevent urinary tract infection by preventing bacteria from adhering to the walls. A combination of tannin and anthocyanins can breakdown cholesterol in the bloods stream and in atherosclerotic plaques. Tannins, along with vitamin C help build and strengthen collagen (Okuda *et al*., 1991). Saponins serve as natural antibiotics, which help body to fight infections and microbial invasions. They also enhance the effectiveness of certain vaccines, lower cholesterol and knock out some tumor cells, particularly lung and blood cancers (Okwu and Ndu, 2006). Flavonoids have antioxidant activity in biological systems and protect the body against allergies, inflammation, free radicals, platelet aggregation, microbes, ulcers, hepatoxins, viruses and tumors (Okwu and Ndu, 2006). The flavonoid quercetin is known for its ability to relieve hey fever, eszema, sinusitis and asthma while certain flavonoids also can protect low-density-lipoproteins from being oxidized, thereby playing an important role in atherosclerosis (ILSI, 2005). Thus with the presence of vitamin C, little amount of vitamin E and carotenoids, which are the precursors of vitamin A, *Ipomea aquatica* is a plant with good antioxidant properties that can protect the body cells against the damaging effects of reactive oxygen species such as singlet oxygen, superoxide, peroxyl radicals and peroxynitrite. The activities of these reactive oxygen species often lead to oxidative stress, which has been linked to cancer, aging, atherosclerosis, ischemic injury, inflammation and neurodegenerative diseases.

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