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Phytochemical Analysis of Four Neglected Vegetables in Southern Nigeria

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Abstract

The Phytochemical, nutritional and vitamin composition of *Cleome viscosa, Cleome rutidosperma, Moringa oleifera,* and *Buchholzia coriacea* were investigated. These plants which are considered as neglected vegetables were investigated to ascertain their suitability as edible vegetables. Average yield of the chemical contents of the leaves of these neglected vegetable are as follows: Flavonoid (0.23- 0.55%), Tannins (0.25-0.79%), Alkaloids (0.13-0.65%), Saponins (0.47-1.09%), HCN (6.4-16.3mg). The crude protein of the leaves is (12.03-19.0%), Fibre (13.97-15.75 %), Carbohydrate (47.43-52.01%), Fat (4.19-5.82%), Vitamin A content (6.05-12Iu/100g), Vitamin C (68.05-197.12mg/100g). Generally, the results suggest the leaves of these plants to be nutritionally rich and hence their potentials for food and medicine could be harnessed.

Keywords: Neglected vegetables, phytochemical, proximate, nutrition, vitamin

1. Introduction

Vegetables for human use have been collected from the wild and as such, are significant component of the diet of most households throughout sub-Saharan Africa. Hundreds, if not thousands of these wild species are used as daily component of diet as well as for medicinal purposes (Jansen, 2004). The four selected leaves under phytochemical screening are best described as wild species because of the habitat in which they grow. Again, these leaves according to Shackleton *et al.*, (2009) are best described as neglected vegetables in Nigeria due especially in times of drought or famine. Regardless, there is little doubt that these species are extremely important for food security, nutrition, culture, poverty alleviation and in treatment of sickness because of the vitamins, minerals, nutrients and secondary metabolites in them. The nutritional importance of these vegetables arises from their high vitamins and minerals contents as well as the considerate amount of protein, fat and carbohydrate present in them. These vegetables are generally known to be composed of nutritional fibre that is either soluble or insoluble.

Katende *et al*., (1999) reports that the presence of fibre in diets helps to increase the colon transient time of food residues, helps to form bulk of stool, absorbs toxins and provide an ideal environment for growth of symbiotic bacteria. Some species (e.g. *Cleome* spp. and *Moringa oleifera)* have wide distribution while *Buchholzia coriacea*

is extremely localized and are hardly known by anyone other than the few communities who make use of it (Zinyama *et al.,* 1990). The role of these plants in traditional medicine stems from their alkaloid, flavonoid, phenols and its derivatives contents. Edeoga *et al.,* (2005) reported that these metabolites are known to have anti-microbial, antioxidant *and* anti-carcinogenic effects. Not long ago, the four species investigated belonged to the same family (Capparidaceae) according to Hutchison and Dalziel, (1954). Although there are different dichotomies on the classification of the studied species, current DNA analysis has helped in the separation of these plants in their various families. Taxonomically known as *Moringa oleifera* Lam. of the Moringaceae family, Moringa is tree, the leaves are bipinnate or commonly tripinnate. It is indigenous in Northern Nigeria where it is a common vegetable known as"Zogallangadi" while in Southern Nigeria, the tree is used in fencing by the rural people and the leaves are hardly eaten. In South-Eastern Nigeria, Moringa is called "Okweonyibo'' while in South-West it is called "Igbale"(Hawthorne & Jongkind 1962). Michel (2004) and Brisse (2005) reported that all partof Moringa has long been consumed byhuman. Recent studies have also shown that *Moringa* seed can be used in water purification. *Buchholzia coriacea* Engl. (Capparidaceae), named after Buchholzthe man who collected meplantinthe Cameroons in19th century, *B. coriacea* is a tree of about 7.5m in height, the leaves are 20-26cm long and 5-7cm across, fruit resembles *Avacado* pear. It is a scarcely distributed plant in West Africa. Known as "Uke" in South-East Nigeria, the seed is cooked overnight before they are eaten. The long cooking is to ensure that cyanide present is properly removed (Ajaiyeoba et *al.,* 2001). The twig bark decoction of the plant of *B. coriacea*is used in the treatment of rheumatism and kidney pain. Methanol extracts of leaves and stem showed anthelmintic activity *in-vitro. Cleome viscosa* L. and *Cleome rutidosperma* DC of the Cleomaceae family aresub-Sahara African weeds. *C.viscosa* is an annual erect herbaceous plant with sticky pods that grows up to 60cm height (Bulkill, 2000). The leaves are compound, alternate, palmately divided, rather variable normal five very rarely 3-6 leaflets, the terminal leaflet is always the largest (Akobundu and Agyakwa 1998; Hall 2008). Commonly called consumption weed, a paste of the root and leaf of *C. viscosa*is commonly applied to treat earache. In South-East Nigeria, the leaf was used as an alternative to 'okro' *(Abolmaschus esculenta)* during the Nigerian- Biafran war. The pungent seed can be prickled and used as mustard substitute in curries (Mali, 2010). *C. rutidosperma* equally one of the less used vegetables in Nigeria occurs as a weed in rice fields and occasionally cultivated as potherbs. The leaves are collected from the wild and eaten as a cooked vegetable or added to soup. They have bitter taste like mustard and in Uganda, clarified butter "ghee" is added to give more flavour while in Ghana, the leaf extract is used in treatment of irritated skin and in Nigeria it is used to cure convulsion, in Malaysia, planting of C. *rutidosperma*is considered as part of insect programme, diverting oviposition of diamond blackmoth *(Plutella xylostella)* away from cultivated field (Jansen, 2004).

Studies carried all over the world on these plants have added little or no impact in their usage as vegetables in Nigeria especially in Southern Nigeria. Hence, this study is aimed at evaluating their nutritional potentials and chemical contents to encourage the use of these leaves for food as well as contributing information to the biology of these leaves mostly used in folk medicine.

2. MATERIALS AND METHODS

Collection of Plant Materials.

The leaves of the different plant species were collected at various locations in southern Nigeria. *M. oleifera* leaves was collected at the Forestry Research Institute of Nigeria, Eastern Regional Station. *C. rutidosperma* leaves were collected from Umudike, Umuahia, Abia State, Nigeria. *B. coriacea* leaf was collected at a Cocoa plantation farm in Umuariaga, Abia State. The four leaves were identified

using the appropriate literature (Hutchison & Dalziel 1954; Akobundu & Agyakwa 1998).

Preparation *o*f the extract

The leaves were dried with air at normal room temperature. The dried materials were pulverized using an electric blender into a fine powdered form. About l00g of each leaf were kept and used for different repeated analysis.

Quantitative determination of phytochemicals

The quantitative contents of alkaloids, flavonoid, tannins, phenols, phytate and cyanide as contained in the leaves of *M. oleifera, C. viscosa, C. rutidosperma* and *B. coriacea* was determined according to the methods of Harbone (1973) and Trease and Evans (1989).

Proximate and Vitamin analysis.

The methods of AOAC (1999) and James (1995) were used in determining the proximate composition in the leaves of *M. oleifera, C. viscosa, C. rutidosperma*and *B. coriacea.* The crude protein, fibre, fat, ash, moisture contents of these leaves were obtained. The method used in determining the Vitamins A and C, Niacin, Thiamin and Riboflavin recommended by the Association of Vitamin Chemist.

3. Results

From the laboratory analysis carried out on the leaf extract of the various plant species, the following Tables (1-3) were obtained. Table 1 shows the phytochemical composition (%) of the various leaves studied. This reveals that all the test leaves contain flavonoid, alkaloid, tannin, phenol, phytate and cyanide. These bioactive chemicals are formed at the end of a long bioactive pathway and may be regarded as metabolic by-products. The considerate flavonoid contents in these leaves (0.45% in *B. viscosa,* 0.39% in *C. rutidosperma,* 0.23% in *M. oleifera* and 0.55% in *B. coriacea)* might be responsible for its usefulness in herbal drug.

Table 1: Phytochemical Results

Leaf Sample	% Flavonoid	% Alkaloid	% Saponin	% Tannin	% Phenol	HCN mg/100g	% Phytate
C. viscosa	0.45 ± 0.02	0.57 ± 0.01	0.87 ± 0.01	0.38 ± 0.002	0.32 ± 0.001	11.21 ±0.08	0.32 ± 0.003
C. rutidosperma	0.39 ± 0.12	0.65 ± 0.02	0.66 ± 0.04	0.37 ± 0.001	0.33 ± 0.001	11.66 ±0.03	0.33 ± 0.004
M. oleifera	0.23 ± 0.01	0.13 ± 0.01	1.09 ± 0.04	0.26 ± 0.002	0.79 ± 0.75	6.41 ± 0.02	1.10 ±1.2
B. coriacea	0.55 ± 0.01	0.44 ± 0.02	0.47 ± 0.01	0.08 ± 0.001	0.11 ± 0.001	16.3 ± 0.02	0.2 ± 0.002

Values are expressed as means ± S.D

Table 2: Proximate Result

Leaf Sample	% Protein	% Fibre	% Ash	% Fat	% Moisture	% CHO
C.viscosa	13.50 ± 0.09	14.42 ± 0.4	4.08 ± 0.12	5.82 ±0.06	10.19 ± 0.14	52.01
C. rutidosperma	13.35 ±0.09	14.12 ±0.4	5.19 ± 0.08	5.54 ±0.6	9.95 ± 0.17	15.85
M. oleifera	19.03 ±0.11	13.97 ±0.8	6.14 ± 0.03	4.19 ±0.03	9.22 ± 0.04	47.43
B. coriacea	12.03 ±0.1	15.75 ±0.3	5.60 ± 0.05	5.25 ±0.3	10.73 ±0.41	50.66

Values are expressed as means ± S.D

Table 3: VITAMIN*S*

Leaf Sample	Vitamin A (Iu/100g)	Vitamin C (mg/100g)	Niacin (mg/100g)	Thiamin (mg/100g)	Riboflavin (mg/100g)
C. viscosa	6.05 ± 1.0	88.58 ± 1.0	0.13 ± 0.005	0.13 ±0.003	0.12 ± 0.003
C. rutidosperma	12.72 ±0.17	197.12 ± 1.7	0.08 ± 0.05	0.09 ± 0.02	0.07 ± 0.07
M. oleifera	9.95 ±0.3	111.5 ±1.1	0.28 ± 0.01	0.02 ±0.003	0.18 ± 0.04
B. coriacea	11.50 ±0.18	68.05 ±0.9	0.98 ± 0.03	0.14 ± 0.003	0.12 ± 0.01

Values are expressed as means ± S.D

4. DISCUSSION

Flavonoids as one of the most common phenolic plant constituents are naturally occurring plant products originating from the Phenylpanoid pathway (Ajaiyeoba *et al.,* 2001). Its presence in these leaves can be used treat certain physiological disorder; show antioxidant activity and combat carcinogenesis (Rice-Evans 1995). Alkaloid was found highest in *C. rutidosperma* (0.65%) and lowest in *M. oleifera* (0.13%). Edeoga*et al*., (2001) reports that alkaloid arenitrogen containing compounds and are the best known metabolite and are easily identified by their physicochemical property with powerful effect on animal physiology hence, their use in pharmaceutical industry for drug production. The observed low level of alkaloid in *M. oleifera* makes it an ideal vegetable. Tannins are known to inhibit pathogenic fungi (Ijeh *et al.,* 2001). At high concentration, as seen in the *Cleome* spp, tannin and alkaloid usually serve as deterrent to herbivores (Osuagwu *et al.* 2007; Edeoga and Eriata 2001). Similarly, Okwu (2004) reported that tannin at high concentration is responsible for the bitter taste found in some uncooked leaves. The present study reveals the percentage of tannin in the studied leaves as follows; *C.v iscosa* 0.38%, *C. rutidosperma* 0.37%, *M. oleifera* 0.26% and *B. coriacea 0.08%).* Phenols are known as important plant constituents that protects the plants from oxidant damage. The

percentage of phenols in these plants (0.38% in *C. viscosa*-0.11% in *B. coriacea)* may equally explain the rationale behind their uses in folk medicine. The saponin content of *M. oleifera* (1.0%) makes it useful in food industry where foam is needed such as ice cream production. High cyanide content was observed in *B. coriacea* (16.3%). Although below lethal level, caution must be applied in preparation of this plant for food. The low phytate content in these leaves (0.32 % in*C. viscosa,*0.33% in *C. rutidosperma,* 1.10% in *M. oleifera* and 0.2% in *B. coriacea)* makes them ideal for human diet. Phytateisa known anti-nutritional factor that reduces carbohydrate digestibility as well as uptake of cholesterol at the gut through intralumeral physicochemical interaction as reported by Mbabie *et al.,* (2010).

Contained in Table 2 is the result of proximate analysis carried out on the leaves. The result from the analyzed leaves showed that the fibre content range of 15.73% in *B. coriacea*down to 13.97%. In *M. oleifera* were normal for most edible vegetables. This result is in tandem with the recommendations of the National Research Council (1975) on the daily needs of fibre for the prevention of chronic diseases, cancer and diabetes mellitus. The moisture contents of *C. viscose* 10.19%, *C. rutidosperma* 9.95%, *M. oleifera* 9.22% and *B. coriacea* O.73% were obtained. It is worthy to mention that these moisture contents were determined on the processed leaves (air-dried). Generally, most plant parts contain more than 70% moisture under unprocessed (fresh) state. Other major nutritional composition of the leaves studied includes fat, crude protein, ash and carbohydrates. Crude protein was highest in *M. oleifera* (19.03%) followed by *C. viscosa* 13.50% and least in *B. coriacea* (12.0%). This therefore, portrays these leaves as good source of protein needed in the rural areas where food insecurity is ravaging. The proximate analysis of ash content was not significantly different. *M. oleifera* contains 6.14% followed by *B. coriacea* 5.60% and 5.19% in *C. rutidosperma.* Similarly, the carbohydrate contents of the studied leaves (52.01% in *C. viscosa*to47.43% in *M. oleifera).* The leaves equally showed good food energy yield due to their contents of 5.82% in *C. viscosa,* 5.54% in *C. rutidosperma,* 4.19% in *M. oleifera* and 5.25% in *B. coriacea).* In general, the distribution of nutrients in these leaves should encourage its use both human dietary and in pastoral fanning.

The vitamin contents in the studied leaves as presented in Table 3 shows that a substantial amount of vitamin and its derivatives is available for human and other uses. The vitamin A content of these leaves is highly encouraging to be used as a vegetable. *C. rutidosperma* has the highest vitamin A content (12.72 Iu/100g) closely followed by *B. coriacea* (11.50 Iu/100g) while *C. viscosa* had the least(6.05Iu/100g). In contrast to high vitamin A and C, the Niacin, Riboflavin and thiamine contents in these leaves could be described as low (niacin range 0.08mg/100g-0.98mg/100g, thiamine range 0.02mg/100g-0.14mg/100g and riboflavin o;07mg/100g-0.18mg/100g) although normal for most leafy vegetables. As a neglected vegetable, the vitamin C contents of the leaves especially *C. rutidosperma* (197.12mg/100g) makes it ideal for supplementing Vitamin C requirement in rural diets. Okunrobo *et al., (20*10) reports that leave with these vitamin content ranges are good for boosting antibodies and improving eyevision.

From the results obtained, it is inferred that the various chemical composition of the leaves was close with insignificant variations. This could explain why they were originally grouped in the same family (Capparidaceae). The members of this group are known to be useful in traditional medicine as observed in their phytochemical contents. The alkaloid and flavonoid contents of these leaves has been reported to be a major antioxidant, anti-inflammatory and analgesic active principle while tannin and phenols have been reported to have wound healing properties. Moreover, the leaves were found to be nutritionally rich in essential vitamins

and other nutrients (protein, fat and carbohydrates) hence, should be exploited for food. The result of this study scientifically validates the rationale behind the use of these leaves as a vegetable and in treatment of various ailments. However, with the cyanide range, caution must be observed in their intake as raw vegetables and in dosage when used in

traditional medicine. The result of this study when combined with the gross morphology of these plants could help field workers in resolving the confusion in identification of these economically important leaves. It is therefore imperative that these plants should be cultivated to avoid extinction since they are almost neglected. In the same vein, they should be incorporated into our diet while more light should be thrown on their morphology to enable researchers to easily identify and carry further analysis on them.

5. Conclusions

A conclusion section is necessary. The conclusion should summarize the key points of the paper without simply repeating the abstract. It should also discuss the significance

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