NUTRITIVE AND ANTI-NUTRITIVE EVALUATION OF *CNIDOSCOLUS AURIFOLIA* LEAVES

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Abstract
The consumption of leaves of edible plants as food by human beings is as old as mankind. This is especially true for many homes in Africa since edible vegetables have continued to remain the cheapest means of affording the human body with adequate nutrients needed for proper functioning. In this study, leaves of Cnidoscolus aurifolia were analyzed for their chemical, antinutrients, proximate and mineral element compositions using standard procedures. Phytochemical screening revealed the presence of alkaloids, saponins, flavonoids, terpenes and tannins while anthraquinones, phlobatannins and glycosides were absent. Proximate analysis indicated high protein content (59.45 ± 0.07 %) with crude fibre and fat also present in appreciable quantities. Mineral elements determination (mg/100 g dry weight) showed the presence of calcium (96.30 ± 0.04), iron (34.10 ± 0.03), magnesium (63.50 ± 0.03), potassium (98.34 ± 0.02) and zinc (17.40 ± 0.01). Antinutrient analysis of the leaf extract of C. aurifolia indicated low levels of phytic acid and hydrocyanide well below the lethal doses. An unusually high oxalate level of 404.80 ± 0.11 mg/100 g (dry weight) was also obtained although still below toxic level. These results support the ethnomedicinal and nutritional uses of this plant and suggest that the consumption of leaves of C. aurifolia is not harmful nutritively.

Keywords: antinutrients, *Cnidoscolus aurifolia*, mineral elements, phytochemicals.

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1. INTRODUCTION

Vegetables are edible parts of plants that are consumed wholly or in parts, raw or cooked as part of main dish or salad (Uwaegbule, 1989). The consumption of leafy vegetables as food has remained the cheapest and commonest means of furnishing the body with adequate supplies of proteins, vitamins, minerals, fibre and other nutrients (Akan, *et al*, 2009). The nutritional value of some selected leafy vegetables of sub-Saharan Africa and their potential contribution to human health has been extensively reviewed elsewhere (Aletor and Adeogun, 1995 and Uusiku *et al*, 2010). These findings have given credence to the popular fact that most of these leafy vegetables are good and valuable sources of minerals, proteins, fat and oil.

One of such important edible leafy vegetables is *Cnidoscolus aurifolia* (family Euphobiaceae) which is commonly served as food in many homes in Nigeria. It is specially prescribed by traditional medicine practitioners to blood-deficient patients with the belief that it is capable of boosting their blood profile. To our knowledge, the proximate composition, levels of minerals, antinutrients of the leaves of *Cnidoscolus aurifolia* have not been reported despite its widespread use.

In the present study, we evaluate the phytochemical, proximate, mineral elements and antinutrients profile of the leaves of *Cnidoscolus aurifolia* from Nigeria using standard analytical methods.

2. MATERIAL AND METHODS

2.1 Plant material: The fresh leaves of *Cnidoscolus aurifolia* were collected from a farmland in Osongama Housing Estate in Uyo Local Government Area of Akwa Ibom State, Nigeria in the month of July 2015. Plant identification, authentication and specimen referencing were done by Dr. Margaret Bassey, a plant taxonomist in the Department of Botany and Ecological Studies, University of Uyo, Uyo, Nigeria. A voucher specimen (UUH

3423) has been deposited at the Herbarium of the Department of Botany and Ecological Studies.

2.2 Sample preparation: The leaves of *C. aurifolia* were thoroughly washed with distilled water to remove any trace of dirt sticking to the surface of the leaves. The leaves were chopped into small pieces and air-dried for 14 days. They were later homogenized to fine powder using a mechanical blender and stored in an air-tight plastic bag, properly labeled prior to analyses.

2.3 Extraction procedure: The dried pulverized plant leaves (450.0 g) were thoroughly macerated with ethanol (80 %) for 7 days. The sample mixture was filtered and the filtrate concentrated using a rotary evaporator to afford a green colored extract. The extracts were stored in a sealed container and kept in a refrigerator until use. All reagents and chemicals used in this work were of analytical (AnalaR) grade and were sourced from Sigma-Aldrich chemical company, United Kingdom.

2.4 Determination of proximate composition: The recommended standard methods of the Association of Official Analytical Chemists (AOAC, 1990) were used for the determination of moisture, ash, crude fibre and lipid, crude protein, carbohydrate and calorific value in the leaves of *Cnidoscolus aurifolia* studied.

2.5 Mineral element analysis: Mineral digestion was done following the method of Egan *et al* (1981). The concentrations of calcium, magnesium, iron and zinc were determined using an atomic absorption spectrophotometer (AAS Unicam 919) in conjunction with reference mineral standards from Unicam Limited, United Kingdom. The flame photometer (Jenway Limited, UK) was used for determination of potassium concentration in the extract.

2.6 Qualitative determination of phytoconstituents: Qualitative tests to identify the constituents of the extract were performed using standard procedures outlined by Harborne (1984) and Trease and Evans (1996). Precisely, screening of alkaloids was carried Dragendroff's and Mayer's reagents, saponins by Frothing and Fehling's tests. Cardiac glycosides were detected by Liebermann's and Keller-Killiani's tests, tannins by the Ferric chloride test and phlobatannins by hydrochloric acid test. Flavonoids were detected by the magnesium metal/hydrochloric acid test, triterpenes by the chloroform/acetic anhydride/sulfuric acid test and anthraquinones by the benzene/ammonia solution test.

2.7 Determination of antinutrient composition: The composition of oxalate was determined using the method outlined by Sanchez-Alonso and Lachica (1987) and hydrocyanic acid by that of AOAC (1990). Phytic acid was determined by the method of McCance and Widdowson (1953). The Folin-Denis Spectrophotometric method described by Pearson (1976) was used for determination of tannins.

2.8 Data Handling: All analyses were done in triplicate and values were expressed as mean ± standard error of mean (i.e. Mean ±SEM).

3.. RESULTS AND DISCUTION

3.0 Result and Discussion

3.1 Results

The result of the qualitative phytochemical analysis of leaf of *Cnidoscolus aurifolia* is shown in Table 1, while that of mineral element determination is shown in Table 2. The levels of antinutrients and that for proximate composition of the leaf of *C. aurifolia* are shown in Table 3 and 4 respectively.

3.2 Discussion

3.2.1 Phytochemical analysis: The result of phytochemical analysis of leaves of *Cnidoscolus aurifolia* is given in Table 1. This result indicates the presence of alkaloids, flavonoids, saponins, terpenes and tannins while anthraquinones, glycosides and phlobatannins were not present.

Table 1: **Contents of phytochemicals in *Cnidoscolus aurifolia* extract**.

Phytochemicals	*Test/reagents*	*Detection*
Alkaloids	Dragendroff's Mayer's	+ +
Anthraquinones	Benzene/ammonia solution	-
Flavonoids	Magnesium metal, HCl acid	+
Cardiac glycosides	Liebermann's Keller-Killiani's	- -
phlobatannins	HCl acid solution	-
Saponins	Frothing, Fehling's tests	+ +
Tannins	Ferric chloride solution	+
Terpenes	Chloroform, H_2SO_4 acid	+
Protein	Biuret solution	+
Carbohydrate	Fehling's	+

Key: (+) *present* (-) absent

Table 2: **Levels of mineral elements in *Cnidoscolus aurifolia***

Minerals (mg/100 g DW)	*Mean ± SEM*
Calcium	96.30 ± 0.04
Iron	34.10 ± 0.03
Magnesium	63.50 ± 0.03
Potassium	98.34 ± 0.02
Zinc	17.40 ± 0.01

Values are mean ± SEM calculated as mg/100 g dry weight analyzed individually in triplicate.

Table 3: Levels of antinutrients in *Cnidoscolus aurifolia*

Antinutrients (mg/100 g DW)	*Mean ± SEM*
Hydrogen cyanide	0.32 ± 0.01
Oxalate	404.80 ± 0.50
Phytate	6.67± 0.01
Tannin	0.21 ± 0.01

Values are mean ± SEM calculated as mg/100 g dry weight analyzed individually in triplicate.

Table 4: Result of proximate composition of *Cnidoscolus aurifolia*

Parameter	*Mean ± SEM*
Moisture content (%)	12.24 ± 0.02
Ash (%)	6.64 ± 0.04
Crude fibre (%)	11.80 ± 0.08
Crude lipid (%)	7.60 ± 0.11
Carbohydrate (%)	2.27 ± 0.01
Crude protein (%)	59.45 ± 0.07
Calorific value (Kcal/KJ)	315/1320

Each value represents mean ± SEM of three determinations on dry weight (DW) basis.

The medicinal properties of these secondary metabolites are quite numerous and have been well documented elsewhere (David, 1983; Frantisek, 1998; Price *et al*, 1987*;* Banso and Adeyemo, 2007 and Akpan *et al*, 2012). The presence of these bioactive compounds in the leaves of *C. aurifolia* corroborates the various pharmacological activities of this plant and supports its widespread use in traditional medicine.

3.2.2 Mineral element composition: The mineral element composition of leaves of *Cnidoscolus aurifolia* is given in Table 2. This result indicates *C. aurifolia leaves* to be a cheap source of calcium, magnesium, potassium, iron and zinc.

The calcium content was found to be 96.30 mg/100 g. this value is comparable to 100 mg/100 g earlier reported for Indian *Solanum tubirosam* (Okaka *et al*, 2006) and 101 mg/100g in Vietnamese *Ipomea aquatia* leaves (Ogle and Grivetti, 1985).

The iron content was estimated to be 34.10 mg/100 g. The concentration of iron in *C. aurifolia* leaves is quite comparable to 34.92 mg/100 g reported for *Telfaria occidentalis* leaves grown in South West Nigeria (Asaolu *et al*, 2012) but lower than 156 mg/100 g reported for *Anisorus mannii* (Aliyu *et al*, 2009).

The magnesium content of *C. aurifolia* leaves was found to be 63.50 mg/100 g. This value is slightly higher than 61.08 mg/100 g reported for *veronia amygdalina* but lower compared to *Gongronema latifolium* (92.51 mg/100 g), *Ocimium grastissimum* (88.25 mg/100 g) and *Amaranthus hybridus* (249.92 mg/100 g) reported by Asaolu *et al*, (2012).

The potassium content in the leaves of *C. aurifolia* was found to be 98.34 mg/100 g while the zinc content was 17.40 mg/100 g. minerals have been reported to play significant roles in many health-promoting functions within the human body (Aremu and Udoessien, 1989 and Gbolahan, 2001) and thus, consumption of *C. aurifolia* leaves might play useful roles on optimizing their availability and utilization.

3.2.3 Antinutruent composition: Levels of hydrogen cyanide, oxalate, phytic acid and tannins in the ethanol extract of *Cnidoscolus aurifolia* is given in Table 3. The content of hydrogen cyanide (0.322 mg/100 g) was far below the lethal dose of 35 mg/100 g (Munro and Bassir, 1969).

Also, the quantity of total oxalate in the extract (404.80 mg/100 g DW) was below the toxic level of 2-5 g/100 g (Onwuka, 2005) although its value was unusually high. This is unusual when its value is compared to 10.0 mg/100 g obtained for older leaves of *Telfaria occidentalis* (Akwaowo *et al*, 2000). An unusually high oxalate content of 308 mg/100 g has also been reported for *Ipomea batatas* leaves (Antia *et al*, 2006). Oxalates are known to complex with calcium to form calcium crystals which get deposited as stones which are associated with blockage of renal tubules (Banso and Adeyemo, 2007).

However, processing methods such as proper cooking of the leaves is known to significantly reduce total oxalate content in vegetables (Akwaowo *et al*, 2000). Based on our investigation, it could be safely speculated that the danger of toxicity associated with the relatively high oxalate content in the plant under study could be significantly reduced by properly cooking the *C. aurifolia* leaves before consumption. Contents of tannins and phytic acid were found to be low.

3.2.4 Proximate composition: The proximate composition of the leaves of *C. aurifolia* is given in Table 4. This result shows a protein content of 59.45 % which is quite appreciable. This makes *C. aurifolia* a rich protein source. The moisture content was found to be 12.24 %, while ash content was 6.64 %. Crude fibre level was found to be 11.80 % while the crude fat content was found to be 7.60 %.

Lipids provide very good sources of energy and aids in transport of fat soluble vitamin, insulates and protects internal tissue and contribute to important cell processes (Pamela, *et al*, 2005). The level of carbohydrate present in the leaves of *C. aurifolia* (2.27 %) was low and the calorific value was found to be 1320 KJ.

4. CONCLUSIONS

The result of this study has shown that the leaves of *Cnidoscolus aurifolia* contain an appreciable amount of protein, fibre and fat in addition to some mineral elements. The amount of carbohydrate was low. The low levels of anti-nutrients suggest that the consumption of leaves of *C. aurifolia* is not harmful nutritively and therefore not expected to produce any adverse health effects. The presence of some phytochemicals supports the ethnomedicinal use of this plant in treatment of diseases. This study therefore concludes that *C. aurifolia* leaves can contribute significantly to the human nutritional requirements while also offering adequate protection against diseases.

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