Studies on the Nutritional and Phytochemical Composition of *Amaranthus hybridus* Leaves

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Abstract

The nutrient, mineral element, phytochemical and amino acid composition of the leaves extract of Amaranthus hybridus were investigated. Quantitative phytochemical analysis on the leaves extract gave 3.00 ± 0.4% saponins, 7.50 ± 0.1% tannins, 10.28 ± 3.1% oxalates and 0.022 ± 01% cyanogenic glycosides but no flavonoids and alkaloids. Proximate analysis gave 5.85 ± 4.8% moisture; 1.60 ± 0.12% crude fats; 7.16 ± 0.40% ash; 19.61 ± 1.03%, crude fibre; 25.35 ± 0.02% protein and 29.50 ± 0.03% carbohydrate respectively. The leaves also proved a rich source of mineral elements containing the following in mg/100g dry weight: sodium 64.6 ± 1.24; potassium 11.55 ± 0.3; magnesium 23.68 ± 0.4; iron 78.75 ± 0.03 and phosphorous 0.99 ± 0.01 respectively. The study also show that the leaves extract contains the following amino acids; lysine, methionine, threonine, leucine, valine and phenylalanine. We therefore conclude that judicious consumption of Amaranthus hybridus leaves will not only supply our body with enough nutrients but also will supplement some necessary essential amino acids as well as mineral elements the body needs.

Keywords: *Amaranthus hybridus* leaves, Phytochemical, Proximate analysis, Nutrient composition, Mineral content

Introduction

Amaranthus hybridus as authored by Linn is a robust annual herb which belong to the family Amaranthaceae. It is a popular plant known for its nutritive value. Its protein and carbohydrate contents as well as mineral elements are quite high (Lehman, 1989). The vegetable has been rated equal to or superior, in taste to spinach and is considerably higher in calcium, sodium, iron and potassium (Makus, 1984), *Amaranthus hybridus* leaf protein contains more lysine than the best high - lysine corn and more methionine than soybean meal (Elias *et al.*, l997).

Attempts have been initiated to reduce nutritional stress factors, such as oxalate, nitrate and cyanogenic glycosides of the vegetable leaf through plant tissue and cell culture technique (Tomlineson *et al.*, 2000). Reduction of oxalate, nitrate and cyanogenic glycosides in *Amaranthus hybridus* could lead to a direct use of the plant biomass produced from cell and tissue culture as food product supplements where low levels of nutritional stress factor, small particle size and soft textured products are required especially in body foods. (Burkill, 1985).

The plant is widely cultivated and eaten as a vegetable in most parts of West Africa. Most works on the effects of processing on vegetables especially Amaranthus deals with the effects of various preparation methods. Fafunso and Bassir (2001) reported a loss of 80.3% of ascorbic acid from parboiling for five minutes. This increased to 91.5% after final cooking for five minutes. Cooking of fresh *Amaranthus hybridus* leaves resulted in a 35% loss of biochemical properties from 71% to 58%. Blanching of one gramme fresh weight portion of *Amaranthus hybridus* leaves for five minutes in ten milliliter of water resulted in a reduction of the total ascorbic content from 560 to 228 mg/100g dry matter. When boiling of whole leaves and boiling of finely chopped leaves were compared to steaming of leaves, steaming produced the least loss of nutrients such as ascorbic acid, iron and oxalate followed by boiling whole leaves (Piorreck *et al.*, 1984).

Cheeke and Bronson (1994) reported that high intake of Amaranthus vegetables can cause toxicity resulting from nitrates in forage plants, especially nitrates values above 1-3% dry weight. Poisoning may result from accumulation of nitrate and, or oxalates in plants growing under stress, especially if drought conditions occur during a period of heavy nitrate intake by plants (Vouch *et al.*, 2000).

Dietary intake of nitrate is converted to nitrite and then to ammonia by rumen bacteria. Toxicity occurs when the conversion of nitrate to nitrite is higher than the conversion of nitrite to ammonia. Once nitrite is in the blood, it binds to hemoglobin forming methemoglobin, which is less efficient in oxygen transport. Animals involved suffer ischemia (Vouch *et al.*, 2000).

Leading medical authorities, nutritionists and dieticians recommend consumption of two to three servings of leafy vegetables a day. No vitamin supplement or drug is a better substitute to fruits and leafy vegetables (Makus, 1984). The macro and micronutrients that are found in green leafy vegetables are so powerful and synergestic that no combination of synthetic medicines or supplements could match their abilities (Vouch *et al.*, 2000). We were prompted to investigate this vegetable leaf sample with a view to accessing its nutritive values and possible health hazards to consumers.

Materials and Methods

Collection and Preparation of Plant Material: Fresh green leaves of *Amaranthus hybridus* used for this study were purchased from Eke-Onunwa market Owerri, Imo State, Nigeria. The leaves were authenticated by Dr. S.E. Okeke of the Department of Plant Science and Biotechnology, Imo State University, Owerri, Nigeria.

The leaves were washed, air-dried and ground into fine powder using a domestic grinder. Portions of the powdered sample were extracted and the extract used for the various analyses.

Phytochemical analysis: Phytochemical analysis for the presence of alkaloids, saponins, flavoniods, tannins and cyanogenic glycosides were carried out according to the methods described by Harborne (1973) and Trease and Evans (1983). Oxalate contents were determined by the spectrophotometric methods of Hang and Lantzsch (1963).

Proximate analysis: The proximate analysis of the leaf extract for crude protein, fibre and fats contents were determined using the methods described by Pearson (1976). Crude protein determination was done using Kjedhal's method while crude fibre determination was done using Wende's method. Total ash content was determined by furnace incarnation using the method of James (1995). Moisture, fat and carbohydrate contents were determined using the methods described by the Association of Official Analytical Chemists (AOAC) (1990).

Elemental analysis: The minerals: sodium, potassium, iron, calcium and phosphorus were determined by atomic absorption/emission spectrophotometry using the Buck Scientific atomic absorption/ emission spectrphotometer 200A (AAES).

Amino acid content: The amino acid content of the leaves extract was determined by Ninhydrin reagent, using phenylalnine as standard and reading the developed purple colour at 570nm. Thin layer chromatogrphy (TLC) using silica gel and solvent BuOH/:HACl:H_2O in the ratio of (4:1:1) was used in the identification of the amino acids present in the sample extract. The estimation of amino acids present was carried out by determining their Rf values. The estimation of the phenylalanine concentration of the leaves extract was done by quantifying the phenylalanine content of the TLC spots against standard phenylalanine (5mg/ml), which was run in parallel (Ekeke *et al.*, 2001).

Results and Discussion

The summary of the result of the phytochemical, proximate analysis, elemental component and amino acid composition of the leaves extract of *Amaranthus hybridus* are given in Tables 1 to 3. Table 1 shows the phytochemical composition of the leaves extract which revealed the following: saponins 3.00 ± 0.4%, tannins 7.50 ± 0.1%, oxalates 10.28 ± 3.1% and cyanogenic glycosides 0.022 ± 0.01% respectively.

Table 1: Phytochemical Constituents of Leaves Extract of *Amaranthus hybridus*

Phytochemical	% Composition Unit Value ± S.D*
Saponins	3.00 ± 0.4
Tannins	7.50 ± 0.1
Oxalates	10.28 ± 3.1
Cyanogenic glycosides	0.022 ± 0.01

** Values are means of standard deviation of triplicate observations.*

Saponins are known to have hypocholestrolemia activities (Price *et al.,* 1989). This indicates that judicious consumption of this vegetable could help in the protection of the heart against coronary heart disease.

Tannins are polyphenols and have antimicrobial properties, the presence of tannins in the vegetable confers its chemoprotective benefits to users (Enechi and Odonwodo, 2003).

The presence of oxalate in the vegetable (10.28 ± 3.1%) makes the vegetable to appear harmful. The vegetable contains some macro and micronutrients capable of complexing with this antinutritional factor. Calcium complexes with oxalate to form calcium oxalate thus making calcium unavailable although steaming/boiling reduces oxalate to the lowest minimum (Piorreck *et* al., 984).

Cyanogenic glycosides which are known to pose some toxicological effects are present in the vegetable at a very low quantity (0.022 ± 0.01%). The level is unlikely to pose toxicity problem to consumers since it is much below the toxic levels recommended by World Health Organization (WHO) (Munro and Bassir, 1969) and (Enechi and Odonwodu, 2003).

The proximate composition of the vegetable extract are shown in Table 2. The vegetable contained high carbohydrate level of 29.50 ± 0.03% and that of protein 25.35 ± 0.02%. The protein content is high when compared to *Vernonia amygdalina* leaf with protein contents of 21.70 ± 0.70% and 23.10 ± 0.05% for the bitter and non-bitter varieties respectively (Ijeh *et al.,* 1996). The crude fibre and moisture contents deviated completely from the values reported for *Vernonia amygdalina* by (Ijeh *et al,* 1996), while the ash and fat contents compared closely. The *Amaranthus hybridus* leaves under investigation can serve as a rich source of proteins and carbohydrates in the diet.

Table 2: Nutrient Composition of *Amaranthus hybridus* Leaves Extract

Nutrient Composition	% Mean Composition ± S.D*
Crude protein	25.35 ± 0.02
Carbohydrate	29.50 ± 0.03
Fats	1.60 ± 0.12
Moisture	5.85 ± 4.8
Crude fibre	19.6 ± 1.03
Ash	7.16 ± 0.40

** Values are means of standard deviation of triplicate observations.*

The mineral composition (Table 3) showed that the leaves of *Amaranthus hybridus* is a rich source of sodium, potassium, calcium, iron and phosphorus. These minerals play very important roles in metabolic activities (Enechi, 2001). However, their bioavailability should be investigated since oxalate is capable of complexing with calcium, reducing calcium availability, although boiling/steaming reduces oxalate levels in the vegetable (Piorreck *et al.*, 1985).

The investigation further revealed that *Amaranthus hybridus* leaves contains amino acids such as lysine, methionine, leucine, phenylalanine valine and threonine. This study agrees with the works of Oguntona (1998). The presence of these essential amino acids indicates that the vegetable is a good source of protein.

Comparing the essential amino acids in *Amaranthus hybridus* leaves with the recommended FAO/WHO (1973) provisional pattern, the leaves are superior with respect to lysine, methionine, valine and phenyalanine.

Table 3: Mineral Composition of *Amarantthus hybridus* Leaves Extract

Mineral Element	Composition (mg/100g dry weight) ± S.D*
Sodium	64.6 + 1.24
Potassium	11.55+ 0.3
Magnesium	23.18 ± 0.4
Iron	78.75 ± 0.03
Phosphorus	0.99 ± 0.01

** Values are means of standard deviation of triplicate observations.*

Conclusion: The study has revealed that *Amaranthus hybridus* leaves is a good source of nutrient such as essential amino acids, carbohydrate as well as some important mnineral elements including, sodium, calcium, potassium, iron and phosphorus. The antinutritional components found in the leaves which includes oxalate, nitrate and cyanogenic glycosides are reduced by steaming/boiling. It therefore means that *Amaranthus hybridus* leaves is a good source of nutrient as well as some important mineral elements the body needs since it is readily avialible.

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