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Phytochemical, nutritional and medical properties of some leafy vegetables consumed by Edo people of Nigeria

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A systematic survey of green leafy vegetables from Edo State of Nigeria was carried out to evaluate their frequency of use in local meals. Twelve commonest ones out of the twenty nine green leafy vegetables encountered with frequency $\geq 1.5\%$ were selected for further evaluation to determine their nutritional and medicinal values. Fresh leaves were shredded and sun dried before milling into vegetable powder and then taken for qualitative and quantitative phytochemical analysis. The vegetables were a major source of ascorbic acid and the mean values ranged from 100 to 421.6 mg/100 g with the *Amaranthus* (408 mg100⁻¹g) and *Celosia* (421 mg100⁻¹g) species containing higher quantities. *Amaranthus* and *Talinum* recorded high mineral contents. The crude protein ranged from 3.8 to 27.7 g/100 g and carbohydrate contents ranged from 2.9 to 47.9 g/100 g. The analysis further showed presence of alkaloids, inulins, saponins and tannins which are known components of herbs used in traditional medicine. The ailments treated using the 12 selected leafy vegetables include common headaches, fevers, diarrhoea, anaemia, high blood pressure and female infertility.

Key words: Leafy vegetables, traditional medicine, Edo people of Nigeria.

INTRODUCTION

Vegetables are those herbaceous plants whose part or parts are eaten as supporting food or main dishes and they may be aromatic, bitter or tasteless (Edema, 1987). The utilization of leafy vegetable is part of Africa's cultural heritage and they play important roles in the customs, traditions and food culture of the African household. Nigeria is endowed with a variety of traditional vegetables and different types are consumed by the various ethnic groups for different reasons. The nutrient content of different types of vegetables varies considerably and they are not major sources of carbohydrates compared to the starchy foods which form the bulk of food eaten, but contain vitamins, essential amino acids, as well as minerals and antioxidants (Mnzava, 1997; Fasuyi, 2006). According to Okafor (1983), vegetables are the cheapest and most available sources of important proteins, vita-

mins, minerals and essential amino acids. Vegetables are included in meals mainly for their nutritional value; however, some are reserved for the sick and convalescence because of their medicinal properties. The aim of the present studies is to determine the nutritional and medicinal potentials of the vegetables commonly eaten in Edo State of Nigeria and thus understand the reason for their inclusion in local dishes and sensitize the people on the need for their consumption.

MATERIALS AND METHODS

A systematic survey was carried out to identify the common green leafy vegetables found in the markets and crop farms in ten towns in Edo State, Nigeria (Ekpoma, Uromi, Okpella, Jattu, Sabongida-Ora, Agenabode, Okada, Ehor, Ekhenwa, and Ekiadolor) using structured questionnaires, focus group discussion and an observation checklist guide. A total of 452 respondents comprising 240 housewives/experience mothers, 112 local herbalists and 100 locally based restaurant operators were interviewed to assess the frequency of use of these vegetables in meals in the ten selected

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towns and also to ascertain the vegetables they use in traditional treatment for common ailments. The plants were identified at the Herbarium in the Department of Botany, Ambrose Alli University, Ekpoma, Nigeria. A picture guide consisting of all vegetables available in the markets and crop farms was prepared and used by the researchers to help the respondents to identify the vegetables they consume and also used for folk medicine. Their responses were ranked in order of their percentage usage.

Twelve selected vegetables with high frequency of use ($\geq 1.5\%$) were harvested fresh or purchased directly from local farmers at farm gates located at the 10 towns. The fresh leaves were shredded and sun dried on arrival at the laboratory. They were then milled into powder form and stored in air tight plastic containers. Two grams of each powder was analysed for ascorbic acid (Bajaj and Kaur, 1981), protein (Yang, 2002), carbohydrate dry weight, mineral and water contents (AOAC, 1999). All analytical data were recorded in triplicates and mean values reported. One gram of powder was subjected to qualitative phytochemical tests for alkaloids (Myers Reagent), saponins (chloroform and H_2SO_4 tests), inulin (Molisch's Reagent) and tannins (Ferric salt tests) adopting the procedures described by Stephen (1970) and Parekh and Chanda (2007).

RESULTS AND DISCUSSION

The common green leafy vegetables available in the field and markets as well as their frequency of use have been summarized in Table 1. In all 29 different green leafy vegetables were identified in ten open markets and fifteen fields located in the study area. The frequency of use ranged from 0.2 to 19.3%. Two species of *Amaranthus* (*hybridus* and *cruentus*) are commonly eaten as vegetables and the indigenous people consider them as the same. Similarly two variants of *Celosia argentea* (soko green and red) were encountered. The priority leafy green vegetables based on consumption and distribution in Edo State of Nigeria are *Amaranthus*, *Celosia*, *Telfaria* and *Talinum*. The high ranking of these species was mainly based on taste and availability. The amaranths (*Celosia* and *Amaranthus* spp.) are easily obtained from home gardens and backyards near the villages/towns. They are easy to prepare, palatable, and the first to appear during the rainy season. *Telfaria* (fluted pumpkin) tastes good and is ranked high by consumers despite its slightly higher cost.

The use of green leafy vegetables for the preparation of soups cuts across different cultures within Nigeria and other parts of West Africa with similar cultural and socio-economic background. For example, about 20 major species of leafy vegetables are commonly consumed in Southern Ghana (Blay, 2004) and 12 of these are listed in the present study. Adebooye et al. (2003) have also reported that 24 indigenous leafy vegetables are eaten in Southwestern Nigeria. In Senegal, 38 species have been listed as leafy vegetables (Chweya and Eyzaguirre, 1999). The leaves of certain crops such as okra, black pepper, cassava, pawpaw, garden eggs, cocoyam and cotton are grown for their fruits, roots or tubers but the leaves are also harvested and consumed as vegetables.

The nutritional value of 12 out of the 29 commonly used leafy vegetables in the study area was evaluated further

and the results are presented in Tables 2 and 3. All the leafy vegetables under study contain ascorbic acid and the concentrations varied from 110 mg/100 g in *Gongronema latifolium* (bush buck) to 421 mg/100 g in *C. argentea* (green soko). Ascorbic acid (vitamin C) is an antioxidant which helps to protect the body against cancer and other degenerative diseases such as arthritis and type II diabetes mellitus. It also strengthens the immune system. *Talinum triangulare* (water leaf) contained low concentrations of dry matter (4 g/100 g) while relatively higher values of 33.7 and 47.9 g/100 g dry matter were obtained for *Telferia occidentalis* and *Vernonia amygdalina*, respectively. The carbohydrate contents ranged from 2.9 g/100 g in *Basella rubra* to 47.9 g/100 g in *Vernonia*. This result showed that leafy vegetables are usually not used in soups for their carbohydrate requirements when these values are compared to traditional carbohydrate sources such as rice, maize, cassava, yam, plantain, etc. Protein values were low to moderate. Low values were recorded in *Basella rubra* (1.6 g/100 g) while relatively higher values were recorded in *Corchorus* (27.7 g/100 g). Leaves with high protein values are recommended for patients with protein deficiency diseases. Further analysis revealed that the fresh leaves of bitter leaf contained about 21.6% water while that of *T. triangulare* was in excess of 90%; and this may be responsible for its use as a diuretic in traditional herbal preparations. Major mineral components of the leaves include calcium (1.22 - 4.13 mg/100 g), potassium (0.08 - 6.10 mg/100 g), sodium (0.03 - 6.84 mg/100 g) and iron (0.01-0.12 mg/100 g). Calcium is a major factor sustaining strong bones and plays a part in muscle contraction and relaxation, blood clotting, synaptic transmission and absorption of Vitamin 12. The relatively high content of calcium in *Gryllotalpa africana* (4.13 mg/100 g), *T. triangulare* (7.44 mg/100 g), *A. cruentus* (2.05 mg/100 g), *Celosia* sp. (2.66 mg/100 g) and *V. amygdalina* (2.25 mg/100 g) suggest that they may be of therapeutic value in hypocalcaemic state like osteoporosis and in fact potentially risky in hypercalcaemia. Potassium and magnesium are known to decrease blood pressure. Potassium plays a role in controlling skeletal muscle contraction and nerve impulse transmission. Patient with soft bone problems are usually placed on high calcium and potassium vegetable meals. High magnesium content in *A. cruentus* (2.53 mg/100 g), *T. triangulare* (2.22 mg/100 g), *Celosia* (1.41 mg/100 g) and *G. latifolium* (1.32 mg/100 g) may explain their blood pressure lowering properties. Green leafy vegetables also contain iron needed in haemoglobin formation (Latindo-Data, 1990) and hence recommended for anaemic convalescence. *T. triangulare*, *A. cruentus* and *Psidium guineense* have relatively higher iron (Fe) contents and are recommended for iron deficiency anaemia. Various minerals are also co-enzymes in certain biochemical reactions in the body which underscores the importance of leafy vegetables in metabolic reactions.

Fibre cleanses the digestive tract, by removing poten-

Table 1. Vegetables and frequency of use by respondents from Edo State, Nigeria.

S/N	Name of vegetable	Common names	Frequency	Usage (%)	Family
1	<i>Amaranthus cruentus</i> L.	Amaranth	91	19.7	Amaranthaceae
2	<i>Telferia occidentalis</i> Hook F.	Fluted pumpkin	84	18.6	Cucurbitaceae
3	<i>Celosia argentea</i> L.	Soko	65	14.4	Amaranthaceae
4	<i>Talinum triangulare</i> (Jacq.) Wild.	Water leaf	32	7.1	Portulacaceae
5	<i>Vernonia amygdalina</i> L.	Bitter leaf	31	6.9	Amaranthaceae
6	<i>Gongronema latifolium</i> L.	Bush buck	26	5.8	Asclepiadaceae
7	<i>Cochorus olitorius</i> L.	Jute mallow	20	4.4	Tiliaceae
8	<i>Ocimum grattissimum</i> L.	Scent leaf	19	4.2	Laminaceae
9	<i>Gnetum africana</i> Welw.	Okazzi	17	3.8	Gnetaceae
10	<i>Piper guineense</i> Schum and Thonn	Black pepper	14	3.1	Piperaceae
11	<i>Piper umbellatum</i> L.	-----	14	3.1	Piperaceae
12	<i>Basella rubra</i> L.	Indian spinach	6	1.5	Basellaceae
13	<i>Jatropha tanjorensis</i> L.	Catholic Vegetable	5	1.1	Euphobiaceae
14	<i>Ficus congensis</i> Engl.	-----	4	0.9	Moraceae
15	<i>Boerhaavia diffusa</i> L.	Hog weed	4	0.9	Nyctaginaceae
16	<i>Erigeron floribundus</i> H.B.K Sch. Bip.	Fleasane	4	0.9	Asteraceae
17	<i>Albelmoschus esculentus</i> L.	Common Okra	3	0.7	Malvaceae
18	<i>Ficus exasperata</i> Vahl.	Sand paper leaf	1	0.2	Moraceae
19	<i>Ephorbia hirta</i> L.	-----	1	0.2	Euphobiaceae
20	<i>Ipoemea batatas</i> (L.) Lam.	Sweet potato	1	0.2	Convolvulaceae
21	<i>Manihot esculenta</i> Krantz	Cassava	1	0.2	Euphobiaceae
22	<i>Theobroma cacao</i> L.	Cocoa	1	0.2	Sterculaceae
23	<i>Carica papaya</i> L.	Pawpaw	1	0.2	Caricaceae
24	<i>Solanum nigrum</i> L.	Garden egg	1	0.2	Solanaceae
25	<i>Triplochiton scleroxylon</i> K. Schum.	White wood	1	0.2	Sterculaceae
26	<i>Xanthosoma sagittifolium</i> (L.) Schott	Cocoyam	1	0.2	Araceae
27	<i>Gossypium hirsutum</i> L.	Cotton	1	0.2	Malvaceae
28	<i>Momordica charanta</i> L.	Bitter gourd	1	0.2	Cucurbitaceae
29	<i>Albizia zygia</i> (DC.) Macbr.	Siri	1	0.2	Fabaceae

tial carcinogens from the body and prevents the absorption of excess cholesterol. Fibre also adds bulk to the food and prevents the intake of excess starchy food and may therefore guard against metabolic conditions such as hypercholesterolemia and diabetes mellitus. The presence of mucilage in some vegetables makes their soups more tasty and palatable (Smith, 1985). For example, when fresh leaves and tender shoots of *Corchorus* are mixed with soda and cooked, a soup of slimy and slippery consistency is produced. The resultant soup is easy to take with thick pastes of locally prepared carbohydrate dishes from rice, cassava, maize or yam. This explains why *Corchorus* soup is used in traditional medicine to open up the bowels and thus prevent constipation.

Current information on the nutritive and medicinal value of leafy vegetables is scanty. In most cases, this knowledge is not well documented and disseminated. Traditional leafy vegetables have a proven nutritive value in terms of having more protein, minerals, carbohydrate and vitamins than some exotic vegetables (Schipper and

Budd, 1994; Schipper, 2004). Leafy vegetables are said to be an invaluable substitute for meat and therefore form important part of daily diets of rural communities in particular, especially in the study area. Findings from the present study could be useful in addressing some of the problems of nutritional deficiencies in rural Edo State communities and hence may also be useful in strengthening current community-based health services.

Qualitative analyses of the phytochemical components of medicinal importance in the common leafy vegetables studied are presented in Table 4. The medicinal properties of these components have been documented by a number of researchers (Ayitey-Smith and Addae-Mensah, 1977; Gill, 1992; Banson and Adeyemi, 2007). The importance of alkaloids, saponins, tannins and inulins in various antibiotics used in treating common pathogenic strains has recently been reported by Kubmarawa et al. (2007). It is noteworthy that alkaloids were recorded in all the 12 leafy vegetables studied and that they all have nutritive and medicinal values; eight (66.7%) contained saponins, 10 (83.3%) contained tan-

Table 2. Nutritional value of 12 common leafy vegetables (Edo State, Nigeria).

S/N	Name of vegetable	Ascorbic acid (mg/100 g DM)	Carbohydrate (g/100 g DM)	Protein (g/100 g DM)	Moisture (%)	Fiber (g/100 g DM)
1	<i>Amaranthus cruentus</i>	408	7.0	4.6	86	1.8
2	<i>Telferia occidentalis</i>	341	6.5	4.3	88	2.3
3	<i>Celosia argentea</i>	421	3.6	5.8	80	0.7
4	<i>Talinum triangulare</i>	280	4.4	4.6	89	1.0
5	<i>Vernonia amygdalina</i>	345	47.9	14.6	21.6	9.7
6	<i>Gongronema latifolium</i>	110	34.4	14.7	76	18.5
7	<i>Cochorus olitorius</i>	165	26.6	27.7	27.0	8.5
8	<i>Ocimum grattisimum</i>	183	3.2	4.7	31.5	10.8
9	<i>Gnetum africana.</i>	113	37.4	15.2	73	25.5
10	<i>Piper guineense</i>	175	4.2	3.8	76	2.9
11	<i>Piper umbellatum</i>	181	3.8	3.9	80	2.2
12	<i>Basella rubra</i>	65	2.9	1.6	93.4	0.6

Table 3. Mineral contents of some green leafy vegetables from Edo State of Nigeria (mg/100 g).

Vegetable	Ca	K	Mg	Na	Fe
<i>Amaranthus cruentus</i>	2.05	4.82	2.53	6.84	0.12
<i>Telferia occidentalis</i>	1.73	2.45	0.65	1.17	0.03
<i>Celosia argentea</i>	2.66	3.93	1.41	5.22	0.05
<i>Talinum triangulare</i>	2.44	6.10	2.22	0.28	0.43
<i>Vernonia amygdalina.</i>	2.25	3.75	0.45	0.03	0.02
<i>Gongronema latifolium</i>	1.45	2.86	1.32	0.82	0.03
<i>Cochorus olitorius</i>	1.26	3.83	0.59	0.33	0.04
<i>Ocimum grattisimum</i>	1.22	2.34	0.43	0.75	0.03
<i>Gnetum africana</i>	4.13	0.08	0.30	1.50	0.01
<i>Piper guineense</i>	2.10	3.92	1.01	0.07	0.08
<i>Piper umbellatum</i>	2.36	4.1	0.88	0.12	0.05
<i>Basella rubra</i>	2.32	5.8	0.06	5.11	0.04

nins, and 9 (75%) contained inulin. In this locality, hypertensives are usually placed on diet containing large quantities of *Vernonia* (bitter leaf) which is high in ascorbic acid (345 mg/100 g), dry matter (47.9 g/100 g), carbohydrate (47.9 g/100 g), potassium (3.75 mg/100 g) and also contained alkaloid, saponnin and inulin. Ayitey-Smith (1989) had earlier recorded that bitter leaf contains an alkaloid, vernomine, which is capable of reducing headaches associated with hypertension. The therapeutic relevance of bitter leaf has also been reported by Gill

(1992), Odugbemi (2006) and Okoli et al. 2007. *Ocimum* species are also important sources of alkaloids with medicinal properties and are used in the management of cold, chronic catarrh, persistent headaches and migraine (Gill, 1992). The use of *Celosia* which contains alkaloids, and relatively higher concentrations of sodium and potassium ions, in the treatment of diarrhoea by local inhabitants has also been documented by Odugbemi (2006) among the Yorubas of Western Nigeria. The medicinal importance of tannins, saponins, and inulins which

Table 4. Phytochemical analysis of 12 common leafy vegetables consumed by Edo People, Nigeria.

S/N	Name of vegetable	Alkaloid	Saponin	Tannin	Inulin
1	<i>Amaranthus cruentus</i> .	+	+	+	+
2	<i>Telferia occidentalis</i>	+	-	+	-
3	<i>Celosia argentea</i>	+	-	+	+
4	<i>Talinum triangulare</i>	+	+	+	-
5	<i>Vernonia amygdalina</i>	+	+	-	+
6	<i>Gongronema latifolium</i>	+	+	-	+
7	<i>Cochorus olitorius</i>	+	+	+	+
8	<i>Ocimum grattisimum</i>	+	+	+	+
9	<i>Gnetum africana</i>	+	-	+	+
10	<i>Piper guineense</i>	+	+	+	+
11	<i>Piper umbellatum</i>	+	+	+	+
12	<i>Basella rubra</i>	+	-	+	-
Total		12 (100%)	8 (66.7%)	10 (83.3%)	9 (75%)

+ : Present.

- : Absent.

Table 5. Medicinal uses of some leafy vegetables from Edo State, Nigeria.

S/N	Plant	Medicinal uses
1	<i>Amaranthus cruentus</i>	Tapeworm, expellant, relief of respiratory disease.
2	<i>Telferia occidentalis</i>	Anemia.
3	<i>Celosia argentea</i>	Diuretic, cough, diarrhea.
4	<i>Talinum triangulare</i>	Diuretic, gastro-intestinal disorder.
5	<i>Vernonia amygdalina</i>	Pile, stomachic, diarrhoea, hypertension.
6	<i>Gongronema latifolium</i>	Stomach ache, rubbed on joints of children to develop strong bones.
7	<i>Cochorus olitorius</i>	Laxative, blood purifier.
8	<i>Ocimum grattisimum</i>	Fever, diarrhea, cold.
9	<i>Gnetum africana</i>	Pile, hypertension.
10	<i>Piper guineense</i>	Stomach ache, gonorrhoea, fertility enhancement in women.
11	<i>Piper umbellatum</i>	Stomach ache.
12	<i>Basella rubra</i>	Fertility enhancement in women

are components of traditional herbal preparations used in managing various common ailments has been reported by Addae-Mensah (1992), Okoegwale and Olumese (2001), Okoegwale and Omezezi (2001). The antibacterial properties of tannins have been documented by Banso and Adeyemo (2007). *P. guineense* is an important medicinal plant, and it is used to treat gonorrhoea. The leaves, eaten in soups, are thought to assist conception in women in this locality, and this has also been reported by Addae-Mensah (1992) in Ghana. The fruits are used as a curative for rheumatism, syphilis, common cold, and herpes zoster while the stem and fruits are used for treating cough. Phytochemical investigation of this plant has yielded more than twenty different compounds; mainly amide alkaloids (Okogun and Ekong, 1974; Okogun et al., 1977; Ayitey-Smith and Addae-Mensah, 1977) and some of these alkaloids have been found to

possess antimicrobial activity against organism such as *Klebsiella pneumoniae*, *Mycobacterium smegmatis*, and *Candida albicans* (Addae-Mensah, 1992). The medicinal uses of the leafy vegetables studied in this report are as documented in Table 5.

Conclusion

The phytochemical contents of the leafy vegetables serve as supplements for food and also have the potential to improve the health status of its users as a result of the presence of various compounds vital for good health. Their fiber content provides bulk in the diet and this helps to reduce the intake of starchy foods, enhances gastrointestinal function, prevents constipation and may thus reduce the incidence of metabolic diseases like maturity

onset diabetes mellitus and hypercholesterolemia. Some of the vegetables are also potent antibiotics, anti-hypertensives and blood building agents and also improves fertility in females when eaten in soups.

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