Phytoevaluation of the nutritional values of ten green leafy vegetables in South -Western Nigeria

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Abstract

Vegetable consumption has been associated with decreased risk of chronic diseases. In this work, ten green leafy vegetables were analysed for basic nutrients in the diet of man with a view to ascertaining their nutritional potentials. Samples of the fresh vegetables collected were separated into two and used in the wet and dry forms. Column chromatographic separation of the ethanol extract of the wet samples showed the protein, carbohydrate and fat contents. Spectrophotometric analysis of dried samples revealed the Calcium, Magnesium, Phosphorous, Iron and vitamin contents. Potassium and Sodium were determined using flame photometry. All the vegetables showed high moisture contents (75.0 – 91.5%). The highest carbohydrate and protein contents of 5.8 and 6.4g/100g respectively, were recorded in Telfairia occidentalis. Ascorbic acid contents were between 28.0 to 410.0mg/100g while vitamin A ranged from 8.00 to 6120 I.U. Potassium is generally the highest in the vegetables while iron is the lowest.

INTRODUCTION

Vegetables are important protective foods and highly beneficial for the maintenance of health and prevention of disease. Studies have repeatedly shown that increasing colon and stomach cancer correlate with low vegetable meals, and suggests that vegetables may help resist these types of cancers (Whitney et al., 1990, Gropper et al., 2005). They are valuable in maintaining alkaline reserve in the body and are valued mainly for their high vitamin, dietary fibre and mineral contents (Ball, 2006). The dark green leaves and deep yellow fruits provide a high amount of carotene, ascorbic acid and microminerals which play important roles in nutrient metabolism and slowing down of degenerative diseases (Yi-Fang et al., 2002). The wide variation in colour, shape, tastes and textures of various vegetables have added an interesting touch to meals (Fasuyi, 2006). There is increasing epidemiological evidence in favour of an association between nutrition and susceptibility to infection. Health disorders such as appendicitis, haemorrhoids, gallstones, heart diseases, obesity and constipation can be either corrected, or treated by copious consumption of vegetables (Whitney et. al, 2002). The awareness of the populace on the significance of nutrition in health has resulted to an increasing quest for biochemical knowledge of the composition of foods. The present study was conducted to evaluate the nutritional values of ten green leafy vegetables commonly consumed in South - Western Nigeria.

MATERIALS AND METHODS

Plant Material: The leafy vegetables examined were Telfairia occidentalis, Talinum Triangulare, Celosia argentea, Solanum nodiflorum, Basella alba, Solanum aethiopicum, Amaranthus caudatus, Amaranthus hybridus, Cucurbita pepo and Amaranthus spinosus. These vegetables were purchased fresh from local markets in Ibadan and Ogbomoso, South - Western Nigeria with the exception of Solanum aethiopicum, Basella alba and Curcubita pepo which were obtained from gardens in Igboho, South – Western Nigeria. The plants were identified in the Department of Biology, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

Methods: Samples of the fresh vegetables were separated into two and used in the wet and dry forms. The first part that was used in the wet form were washed under running water, kept in cool condition until all the water droplets have evaporated and used immediately. The remaining part which formed the bulk of the samples was spread on the laboratory bench for two weeks to dry. 50g of each of the wet samples were homogenised using an electric blender. 500ml of ethanol was then added to each sample in the ratio 1:10 (sample weight: solvent) and left for three days, after which it was filtered and the extract obtained by evaporating the

solvent over a water bath. Column chromatography was carried out on the ethanol extract of the wet samples to separate them into their constituents. The dried samples were pulverised and the calcium, iron, magnesium, phosphorous and vitamin contents were determined using atomic absorption spectroscopy (Spectrumlab 23A spectrophotometer, Techmel & Techmel, Texas, USA). Potassium and sodium were determined by flame photometry (Jenway digital flame photometer).

Moisture, ash, fibre, fat, proteins, carbohydrate were determined using AOAC, 1990. The analysis was repeated twice and the mean of the three values recorded.

RESULTS AND DISCUSSION

Vegetables play an important role in human nutrition, apart from the fact that we derive most of our recommended daily needs of minerals and vitamins from them, they also supply certain constituents in which other food materials are deficient. The wide variation in colour, tastes and textures of various vegetables have added an interesting touch to meals. The cultivation and consumption of green leafy vegetables cuts across different races (Schmidt, 1974) because of their nutritional and health benefits. They have been shown to reduce the risk of degenerative diseases such as cancer and cardiovascular disease. The profile of ten green leafy vegetables commonly consumed in South – Western Nigeria examined in this work is presented in Table 1. Leafy vegetables are generally not consumed alone but they are often consumed in combination with themselves and also in combination with other vegetables such as pepper, tomatoes, melon and onions. Other ingredients such as palm oil, fish or meat and seasonings used in the preparation of the vegetable meal are all contributing in one way or the other to the total nutritional value of the vegetable meal.

Figure 1

Table 1: Profile of the green leafy vegetables

Botanical Name	Family	Common English Name	Local Vernacular Name	Cultivation	Uses
Telfaria Occidentalis	Cucurbitaceae	Fluted pumpkin	Ugu	West Africa	Soup making
Talinum Triangulare	Portulacaceae	Water leaf	Gbure	Africa, Asia, South America	Soup making
Celosia argentea	Amaranthaceae	Green stem cockscomb	Soko	West Africa	Soup making
Solanum nodiflorum	Solanaceae	Egg plant	Odu/Ogunmo	Africa, North America	Leaf decoction is diuretic and derputative
Basella Alba	Basellaceae	Indian spinach	Amunututu	West Africa, China, India	Soup making
Solanum aethiopicum	Solanaceae	African egg plant	Gbagba/Osun	Native gardens in Africa	Juice extracts from young leaves are used as sedatives
Amaranthus caudatus	Amaranthaceae	Slim amaranth	Tete Oyinbo	Africa, America	Soup making. Leaves are applied as poultice to inflammation, boils and abscesses
Amaranthus hybridus	Amaranthaceae	Green amaranth	Tete	Africa	Soup making
Cucurbita pepo	Cucurbitaceae	Squash gourd	Gbooro	Africa	Young leaves are eaten as vegetables
Amaranthus spinosus	Amaranthaceae	Spring amaranth	Tete Adayeba	Africa, America	Soup making

The results of the biochemical analysis of the vegetables for macronutrients, moisture, fibre and ash are shown in Table 2. The carbohydrate contents of the vegetables are relatively higher in comparison with their lipid contents. The least carbohydrate content of 4.0g/100g was observed in C.argentea while the highest value of 6.2g/100g was observed in B.alba. The protein contents of the vegetables were between 2.1g/100g (in B. alba) and 6.4g/100g (in T. occidentalis). All the vegetables had low fat contents with the least value of 0.10g/100g in C.argentea and highest value of 1.80g/100g in A.spinosus.

The vegetables are generally very low in carbohydrates, fats and proteins and therefore contribute very little to the energy values of a meal. The moisture contents of the leafy vegetable studied are relatively high ranging from 75.0% in S. aethiopicum to 91.5% in T.triangulare. The high moisture content of vegetables makes them to aid the digestion of food. Their shelf life is very short because the high moisture facilitates bacterial action resulting into spoilage. The leafy vegetables are rich in fibre with values between 0.8g/100g in C. pepo and 9.5g/100g in A. caudatus. Fibre is useful for maintaining bulk, motility and increasing intestinal peristalsis by surface extension of the food in the intestinal tract (Mathenge, 1997). It is necessary for healthy condition, curing of nutritional disorders and for food digestion. The ash content of the vegetable ranges from 0.20g/100gin B.

alba to 3.9g/100g in A. spinosus. The higher values obtained for A. argentea (2.30g/100g), A. caudatus (2.20g/100g), Cucurbita pepo (2.10g/100g) and A.spinosus (3.9g/100g) suggests that they are rich in organic matter which is convertible to oxides and water on heating.

Figure 2

Table 2: Results of proximate analysis of the vegetables

Vegetable	Moisture (%)	Carbohydrate (g/100g)	Protein (g/100g)	Fat (g/100g)	Fibre (g/100g)	Ash (g/100g)
Telfaria occidentalis	78.2	5.8	6.4	1.0	1.3	1.2
Talinum triangulare	91.5	5.6	2.5	0.8	2.1	1.8
Celosia argentea	89.4	4.0	2.9	0.1	3.7	2.3
Solanum nodiflorum	87.8	5.2	4.4	0.4	1.2	1.6
Basella alba	88.0	6.2	2.1	0.5	3.0	0.2
Solanum aethiopicum	75.0	5.0	5.1	0.7	1.5	1.5
Amaranthus caudatus	87.1	5.1	5.8	0.5	9.5	2.2
Amaranthus hybridus	86.5	5.2	5.6	0.8	8.1	1.9
Cucurbita pepo	80.0	5.7	6.0	0.2	0.8	2.1
Amaranthus spinosus	81.8	4.9	5.7	1.8	6.8	3.9

Table 3 shows the vitamin contents of the leafy vegetables. Vitamin A is a component of rhodopsin, the visual pigment in the mammalian eye. All the leafy vegetables are rich in vitamin A but B.alba and T.occidentalis are exceptionally rich in the vitamin with values of 8100 I.U and 6120 I.U respectively. They would therefore be very beneficial for good vision. The green leafy vegetables are rich in ascorbic acid as revealed by the high values recorded; only B.alba had a little lower value of 28mg/100g. However, C.argentea and T. occidentalis are richer than the others with values of 410mg/100g and 358mg/100g, repectively. The human body cannot produce ascorbic acid, so it must be obtained entirely through the diet. In this connection, C.argentea and T. occidentalis would serve as good dietary sources of the vitamin. Ascorbic acid is essential for the healthy formation of bones and teeth. It is a powerful antioxidant (Szeto et. al, 2002) whose deficiency results in scurvy with swelling of the joints and gums, loosening of the teeth and haemorrhages of the skin and mucous membranes. Niacin, thiamine and riboflavin play very important roles in nutrient metabolism. The leafy vegetables are moderately rich in these micronutrients. The highest niacin value of 0.90mg/100ml was obtained in T.occidentalis; that of thiamine (0.16mg/100ml) in A. spinosus while T. triangulare gave the highest riboflavin value of 0.24mg/100ml. Niacin has the ability to lower blood lipids and is sometimes used in treating hyperlipidaemia. Thiamine is intricately involved with metabolising glucose in the body while riboflavin is required to release energy from proteins, carbohydrate and fat.

Figure 3

Table 3: Vitamin Contents of the Green Leafy Vegetables

Vegetable	Vitamin A (I.U)	Ascorbic Acid (mg/100g)	Riboflavin (mg/100ml)	Niacin (mg/100ml)	Thiamine (mg/100ml)
Telfaria occidentalis	6120	358	0.08	0.90	0.11
Talinum triangulare	3100	260	0.24	0.60	0.08
Celosia argentea	400	410	0.15	0.30	0.03
Solanum nodiflorum	300	205	0.12	0.50	0.06
Basella alba	8100	28	0.30	0.02	0.03
Solanum aethiopicum	1300	240	0.07	0.80	0.08
Amaranthus caudatus	2900	118	0.13	0.20	0.07
Amaranthus hybridus	3000	150	0.22	0.70	0.04
Cucurbita pepo	3400	198	0.04	0.50	0.03
Amaranthus spinosus	3200	182	0.09	0.10	0.16

The green leafy vegetables are good sources of minerals as shown in Table 4. The highly soluble minerals calcium (Ca), magnesium (Mg), phosphorus (P), iron (Fe), and potassium (K) help in the maintenance of acid base balance of the hydrogen ion concentration of the body tissues. They help complete the absorption of vitamins, proteins, fats and carbohydrates of the food (Islam et al., 2004). Ca and Fe furnish all the cells and tissues of the body with the elements and the nutritional enzymes which they need. The higher calcium contents of C.pepo (4.20mg/100g) and S. nodiflorum (5.60mg/100g) suggests that they would be more advantageous to the body in the functions associated with the mineral. Calcium is required for bone and teeth formation and in the proper functioning of the nervous system. It has long been suggested that commonly consumed leafy vegetables are a superior source of calcium to milk (Miller et al., 1947; Oke, 1966). Deficiency of calcium can lead to malformation of bones in young animals and formation of shelless eggs. Magnesium and potassium are needed for the acid – base and electrolyte balance in the body. The amaranthus species A. caudatus, A. spinosus and A. hybridus are exceptionally rich in magnesium with values of 3.20mg/100g, 3.80mg/100g and 4.60mg/100g, respectively. They are therefore recommended for hypertension patients since magnesium is useful in the reduction of blood pressure. Magnesium is an obligate cofactor for DNA synthesis and the proportion supplied by green leafy vegetables can be used to supplement low magnesium based staple foods such as cassava in Nigeria. Potassium is required in muscle and nerve function. A.

hybridus gave the highest value of 6.54mg/100g.

Figure 4

Table 4: Mineral Contents of the Green Leafy Vegetables (mg/100g)

Vegetable	Ca	Mg	P	Fe	Na	K
Telfaria Occidentalis	1.10	1.62	3.60	2.80	1.41	6.12
Talinum Triangulare	2.10	1.20	2.60	1.18	0.80	2.10
Celosia argentea	2.21	1.62	1.83	1.72	4.52	3.82
Solanum nodiflorum	5.60	2.93	2.10	2.10	3.20	6.10
Basella alba	1.70	2.21	2.60	1.80	4.63	3.54
Solanum aethiopicum	2.20	2.50	2.80	0.90	2.10	5.60
Amaranthus caudatus	1.80	3.20	3.14	0.60	4.30	3.10
Amaranthus hybridus	1.54	4.60	4.42	2.90	6.12	6.54
Cucurbita pepo	4.20	1.80	3.60	0.70	5.34	3.36
Amaranthus spinsus	1.68	3.80	3.50	1.00	5.80	3.83

Phosphorus is important in the energy transfer of nucleic acids. Its value ranged from 1.83mg/100g in C. argentea to 4.42mg/100g in A. hybridus. Iron is important in the formation of haemoglobin of the blood. The iron contents of the leafy vegetables were lower for A. caudatus (0.60mg/100g), C. pepo (0.70mg/100g) and S. aethiopicum (0.90mg/100g). T. occidentalis and A. hybridus with higher values of 2.80mg/100g and 2.90mg/100g respectively would be beneficial for anaemic patients. It is interesting to note that the highest mineral content with the exception of calcium was found in A. hybridus. This vegetable would therefore serve as an excellent source of minerals in the diet of man.

CONCLUSION

The carbohydrate, protein and fat contents of these vegetables are not enough to satisfy the recommended dietary allowances (RDAs) for these macronutrients. They therefore cannot be considered a total substitute for the staple food we consume daily but rather they can be used as sources of additional organic nutrients in our daily meals. The loss or lack of these organic nutrients in the diet of man can be averagely taken care of by generous consumption of green leafy vegetables. The vegetables are however rich sources of vitamins and minerals. The relatively high value of these micronutrients in the leafy vegetables makes them a much needed cheap source of these nutrients which are missing from our commonly consumed staple foods. Their high consumption is therefore recommended because of their invaluable health benefits.

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