Nutritional evaluation of some staple leafy vegetables in Southern Nigeria

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Received 18 April 2012; accepted 21 May 2012

Abstract
Four different green leafy vegetables commonly consumed in southern parts of Nigeria were analyzed with a view to determine the nutrient composition of these vegetables. The vegetables are jute leaf (Corchorus olitorius), mint leaf (Ocimum gratissimum), water leaf (Talinum triangulare) and fluted pumpkin leaf (Telfaria occidentalis). The results revealed that Talinum triangulare had the highest amount of moisture (89.47 %) while Corchorus olitorius had highest ash, crude fibre, protein, lipid and carbohydrate content (0.83%), (0.33%), (6.21%), (5.08%) and (6.25%) respectively. The vitamin analysis also revealed that Telfaria occidentalis contained the highest ascorbic acid, niacin and thiamin content (356.11 mg/100 g), (0.74 mg/100 g) and (0.08 mg/100 g) respectively. Talinum triangulare had the highest amount of riboflavin (0.18 mg/100 g). The results obtained in this work clearly indicate that the four leafy vegetables are cheap and readily available source of the nutrients analyzed.

Key words: Proximate and Vitamin composition, Corchorus olitorius, Ocimum gratissimum, Talinum triangulare and Telfaria occidentalis.

Introduction
Most developing countries depend on starch-based food as the main staple food for the supply of both energy and protein. This accounts, in part, for protein deficiency which prevails among the populace as recognized by Food and Agricultural Organization (Ladeji et al., 1995). In Nigeria, as in most other tropical countries of Africa where the daily diet is dominated by starchy staple foods, vegetables are the cheapest and most readily available sources of important proteins, vitamins, minerals and essential amino acids (Thompson & Kelly, 1990). Vegetables are the fresh and edible portions of herbaceous plants, which can be eaten raw or cooked (Dheliot et al., 2006). They contain valuable food ingredients which can be used as energy sources, body building, regulatory and protective material. Vegetables are valuable in maintaining alkaline reserve of the body. They are valued mainly for their high carbohydrate, vitamin and mineral contents. Vegetables may be edible roots, stems, leaves, fruits or seed. Each group contributes to diet in its own way (Robinson, 1990). Vegetables also act as buffering agents for acidic substances produced during the digestion process (Fayemi, 1999). Vegetables contain both essential and toxic elements over a wide range of concentrations (Ajewole, 1999). The concentration of these elements is a function of the concentrations in the soil in which the vegetable is planted. Leafy vegetables are regular ingredient in the diet of the average Nigerian with their level of consumption; they can provide appreciable amounts of nutritive minerals (Ajewole, 1999). Vegetables contain low calories and negligible quantities of utilisable energy hence they are ideal for obese people who can satisfy their appetite without consuming much carbohydrate (Oke & Ojofehintimi, 1988).
Corchorus olitorius (jute) is a native plant of tropical Africa and Asia, and has since spread to Australia, South America and some parts of Europe. Its leafy vegetable is popularly used in soap preparation and folk medicine for the treatment of fever, chronic cystitis, cold and tumours (Oboh et al., 2009). The young shoot tips can be eaten raw or cooked and it contains high levels of protein and vitamin C (Shittu & Ogunmoyeola, 2001). Corchorus olitorius is usually recommended for pregnant women and nursing mother because it is believed to be rich in iron (Oyedele et al., 2006). Ocimum gratissimum L; family Leguminosae is grown in gardens and used as a tea leaf for fevers. It is widely distributed in tropical and warm temperature regions (Dalziel, 1937). Ocimum gratissimum is commonly used in folk medicine to treat diseases such as upper respiratory tract infection, diarrhoea, skin diseases, pneumonia and also cough and conjunctivitis (Dubey et al., 2000). Ocimum gratissimum is grown for the essential oils in its leaves and stems. Eugenol, thymol, citral, geraniol and limonool have been extracted from the oil (Sulistiarini et al., 1999). Essential oils from the plant have been reported to possess an interesting spectrum of antifungal properties (Dubey et al., 2000). The antinociceptive property of the essential oil of the plant has been reported (Rabelo et al., 2003). The whole plant and the essential oil are used in traditional medicine especially in Africa and India. The essential oil is also an important insect repellent. O.gratissimum is germicidal (Pessoa et al., 2003) and has found wide use in toothpastes and mouth washes as well as topical ointments. It is used as an excellent gargoyle for sore throats and tonsillitis. It is also used as an expectorant and a cough suppressant. The plant extract is used against gastrointestinal helminths of animals and man (Chitwood, 2003). In addition, O.gratissimum carminative properties make it a good choice for upset stomach. It is used as an emetic and for hemorrhoids. The plant is also used for the treatment of rheumatism, paralysis, epilepsy, high fever, diarrhoea, sunstroke, influenza, gonorrhea and mental illness (Sofowora, 1993). In addition, the plant is used as a spice and condiment in the southern part of Nigeria. Water leaf (Talinum triangulare), a leafy vegetable is among the various classes of vegetables that are grown in many parts of Nigeria. Oyolu (1978) reported that the leaves of Telfaria occidentalis, together with the edible shoots contain moisture; crude protein, carbohydrates, oils, ash and iron, while Longe et al. (1983) reported that the minerals namely: calcium, potassium, magnesium, iron, sodium and phosphorus are concentrated in the testa, pulp and husk. Oboh (2004) has reported that dietary intake of the leaf could prevent garlic-induced haemolytic anaemia in rats. The aqueous extracts of Telfaria occidentalis had been reported to reduce blood glucose level and also have anti diabetic effects in glucose induced hyperglycaemic streptozotocin (STZ) induced diabetic mice (Aderibigbe et al., 1999), while it did not alter the glucose levels in normoglycaemic mice. Recently, Dina et al. (2001) reported that the aqueous extract of Telfaria occidentalis leaf could assist in the purging of the gastrointestinal tract as revealed by the purgative effect of the aqueous extracts of Telfaria occidentalis leaf on isolated guinea pig ileum and he concluded that there are some pharmacological effects underlying their mode of action. Several works reporting compositional evaluation and functional properties of various types of edible wild plants in use in developing countries abound in the scientific literature (Ekop, 2007). However, much still needs to be done on the chemical composition of edible leafy vegetables grown in Nigeria.

This study was designed to determine the nutrient contents of Corchorus olitorius, Ocimum gratissimum, Talinum triangulare, and Telfaria occidentalis and if they could be used as supplement to other scarce or non available source of nutrients.

Materials and methods

Reagents

All the chemicals and solvents used were of analytical reagent grade and used without further purification. Ethanol, and petroleum ether were purchased from BDH Chemicals, England, Trichloroacetic acid was obtained from E. Merck, Germany, Concentrated sulphuric acid and hydrochloric acid were obtained from BDH Chemicals, England.

Source of samples

Samples of different fresh leaves of four vegetables were purchased randomly from different locations in Okada market, Okada at Ovia North East Local Government Area Edo State. The samples include Corchorus olitorius, Ocimum gratissimum, Talinum triangulare, and Telfaria occidentalis. The samples were identified and authenticated by a taxonomist at the Biological Sciences Department, Igbinedion University, Okada, Nigeria.

The leaves were removed from the stem and damaged ones excluded. Samples of fresh edible leaves were used for moisture determination at 105°C in an air-oven, drying to constant weight. Edible leaves of the remaining fresh vegetables were dried to a constant weight at 90°C (to retain volatile constituents for analysis). For each sample, all dried sub-samples were collected together and ground into a composite powder. These composite powders were packaged in air-tight plastic containers and stored in a freezer for further analysis.

Preparation of fat free sample

2.0 g of the sample were defatted with 100 ml of diethyl ether using a soxhlet apparatus for 2 h.

Chemical analysis of nutrients

Moisture content

The moisture content was determined according to the method of Osborne and Voogt (1978). Porcelain crucibles...
were properly washed and allowed to dry in an air-oven at 110°C for 10 min to a constant weight. The crucibles were allowed to cool in a desiccator for 30 min, then labeled and weighed \((W_1)\). 2.0 g of each sample were accurately weighed into the crucibles and reweighed \((W_2)\). The crucibles containing the samples were placed in an oven maintained at 105°C for 14 h. They were removed and transferred to desiccators to cool, finally weighed \((W_3)\). The percentage moisture content was calculated.

**Ash content**

The Association of Official Analytical Chemists (1980) method was used. Porcelain crucibles were washed and dried in an oven to a constant weight at 110°C for 10 min. They were allowed to cool in a desiccator, and weighed \((W_1)\). 2.0 g of each sample were weighed into the porcelain crucibles and reweighed \((W_2)\). The crucibles containing the samples were transferred into a muffle furnace, which was set at 550°C for 8 h to ensure proper ashing. They were then removed and allowed to cool in the desiccators then finally weighed \((W_3)\). The percentage ash content was calculated.

**Crude fibre**

Crude fibre was analyzed following the procedure of AOAC (1980). 2.0 g of each sample were weighed into separate 500 ml round bottom flasks. 100 ml of 0.25 M sulphuric acid solutions was added to each sample in the flask, and the mixtures were boiled under reflux for 30 min. The hot solutions were quickly filtered under suction. The residues were thoroughly washed with hot water until acid free. Each residue was transferred into the round bottom flasks and 100 ml of hot 0.3 M sodium hydroxide solutions was added and the mixtures were boiled again under reflux for 30 min and filtered quickly under suction. Each insoluble residue was washed with hot water until it was base free. They were dried to a constant weight in an oven at 100°C for 2 hours, cooled in desiccators and weighed \((C_1)\). The weighed samples were then incinerated, and reweighed \((C_2)\). Percentage crude fibre content was calculated.

**Crude protein**

Micro-Kjeldahl method as described by AOAC (1980) was used. Briefly, 0.5 g of each sample were weighed and placed on each nitrogen free filter paper, then folded and dropped into a Kjeldahl digestion tubes. 3.0 g of digesting mixed catalyst \((\text{CuSO}_4 + \text{Na}_2\text{SO}_4)\) and 25 ml of Conc. \text{Na}_2\text{SO}_4 were added to each sample in the digestion tubes. The mixtures in the digestion tubes were transferred to the Kjeldahl digestion apparatus; the heater was regulated at a temperature below the boiling point of the acid until frothing ceased. The mixtures boil vigorously as temperature was increased, until clear (light) green color was obtained. The digests were allowed to cool and then transferred into separate 100cm³ volumetric flasks and diluted with distilled water to make up 100cm³. 10ml aliquot of each digest was introduced into the distillation jacket of the micro-steam distillation apparatus that was connected to the main, as the water in the distiller flask boils. 20 ml of 40% NaOH was added to each digest in the distillation jacket. 50 ml of 40% boric acid was measured into separate conical flasks, four (4) drops of methyl red indicator was added to each. The conical flasks containing the mixture were placed onto the distillation apparatus with the outlet tubes inserted into each conical flask and \(\text{NH}_3\) was collected through the condenser. The distillation continued until 25 ml of the distillate were trapped into the boric acid solution and colour changes from red to yellow. The distillates were then titrated with 0.02 M HCL and the titre values were recorded. Percentage nitrogen was first calculated and crude protein was determined by multiplying the percentage nitrogen with a factor of 5.3 for vegetables (Bernice & Merril, 1975).

**Crude lipid**

Crude lipid was determined by using the method described by Osborne and Voogt (1978). 2 g of each sample were placed into separate extraction thimbles and then covered with cotton wool. The extraction thimbles containing the samples were placed in the extraction jacket. Clean dried 500 ml round bottom flasks containing few anti-bumping granules were weighed \((W_1)\) and 300 ml of petroleum ether was poured into each flask fitted with soxhlet extraction units. The round bottom flasks and the condenser were connected to the soxhlet extractor and cold-water circulation was put on. The heating mantle was switched on; the heating rate was adjusted until the solvents were refluxing at a steady rate. Extraction was carried out for 6 h. The solvents were recovered and the oil was dried in the oven at 70°C for 1 h. The round bottom flask and oil were cooled and then weighed \((W_2)\). The lipid content was calculated.

**Total carbohydrate**

The total carbohydrate content was determined by subtracting the sum of the percentage moisture, ash, crude lipid, crude protein and crude fiber from 100%, that is, Carbohydrate = 100 - (% moisture + % ash + % protein + % lipids + % fiber) (Eyeson & Ankrah, 1975).

**Vitamin analysis**

*Ascorbic acid (Vitamin C)*

5.0 g of the sample was weighed into an extraction tube and 100 ml of EDTA/TCA (2:1) extracting solution were mixed and the mixture shaken for 30 min. This was transferred into a centrifuge tube and centrifuged at 3000 rpm for about 20 min. It was transferred into a 100 ml volumetric flask and made up to 100 ml mark with the extracting solution. 20 ml of the extract was pipetted into a volumetric flask and 1% starch indicator was added. These were added and titrated with 20% CuSO₄ solution to get a dark end point (Baraket et al., 1973).

*Niacin*

5.0 g of the sample was treated with 50 ml of 1 N sulphuric acid and shaken for 30 min. 3 drops of ammonia solution were added to the sample and filtered. 10 ml of the
filtrate was pipette into a 50 ml volumetric flask and 5 ml potassium cyanide was added. This was acidified with 5 ml of 0.02 N H₂SO₄ and absorbance measured in the spectrophotometer at 470 nm wavelengths (Okwu & Josiah, 2006).

**Riboflavin**

5.0 g of the sample was extracted with 100 ml of 50% ethanol solution and shaken for 1 h. This was filtered into 100 ml flask; 10 ml of the extract was pipette into 50 ml volumetric flask. 10 ml of 5% potassium permanganate and 10 ml of 30% H₂O₂ were added and allowed to stand over a hot water bath for about 30 min. 2 ml of 40% sodium sulphate was added. This was made up to 50 ml mark and the absorbance measured at 510 nm in a spectrophotometer (Okwu & Josiah, 2006).

**Thiamin**

5.0 g of the sample were homogenized with ethanolic sodium hydroxide (50 ml). It was filtered into a 100 ml flask. 10 ml of the filtrate was pipetted into a 100 ml flask and the colour developed by addition of 10 ml potassium dichromate and read at 360 nm. A blank sample was prepared and the colour also developed and read at the same wavelength (Okwu & Josiah, 2006).

**Statistical Analysis**

Three analytical determinations were carried out on each independent replication for every parameter. Three independent replicates (n = 3) were obtained from each treatment and the results presented in tables and are reported as means ± standard deviation (SD). Data were analyzed by ANOVA (P < 0.05).

**Results**

The results of the proximate and chemical analysis of four different vegetables (Corchorus olitorius, Ocimum gratissimum, Talinum triangulare and Telfaria occidentalis) are shown in Table 1. From the experimental results, moisture content ranges from 89.47 % in Talinum triangulare to 79.98% in Corchorus olitorius. Ash content ranges from 0.83% in Ocimum gratissimum to 0.49% in Telfaria occidentalis. Crude fibre ranges from 0.33% in Corchorus olitorius to 0.21% in Talinum triangulare. Protein ranges from 6.21% in Corchorus olitorius to 2.20% in Ocimum gratissimum. Lipid ranges from 5.08% in Corchorus olitorius to 2.57% in Talinum triangulare while carbohydrate ranges from 6.25% in Corchorus olitorius to 3.17% in Talinum triangulare.

The results of the vitamin analysis of all the leafy vegetables showed that the vegetables are rich in vitamins (Table 2). Ascorbic acid (vitamin C) ranges from 356.11mg/100g in Telfaria occidentalis to 215.63mg/100g in Talinum triangulare. Niacin ranges from 0.74mg/100g in Telfaria occidentalis to 0.29mg/100g in Ocimum gratissimum. Riboflavin ranges from 0.18mg/100g in Talinum triangulare to 0.06mg/100g in Corchorus olitorius.
while thiamin ranges from 0.08mg/100g in *Telfaria occidentalis* to 0.03mg/100g in *Ocimum gratissimum*.

**Discussion**

The results obtained in this study show a close agreement with those found in literatures (Oke, 1986; Saidu & Jideobi, 2009). Some of the differences in the percentage composition might be linked to factors like climate, species, and nature of soil, growing conditions, application of natural or artificial manure and the period of analysis. All these vegetables have high percentage of moisture content, this is an indication that they possess large number of cell saps. Water is clearly the most important nutrient and the most abundant substance in the human body. Water comprises about three quarters of the human mass and is a major component in every cell. In addition water is needed to separate (by a process called hydrolysis) a phosphate group from adenosine triphosphate (ATP) or guanosine triphosphate (GTP) to get energy (Robinson, 1990). It was also reported by Mepha *et al.* (2007) that water is the containing medium for electrolytes and all other ions throughout the human body.

The substantial amount of fibre in all the vegetables shows that they can help in keeping the digestive system healthy and functioning properly. Fibre aids and speeds up the excretion of waste and toxins from the body, preventing them from sitting in the intestine or bowel for too long, which could cause a build-up and lead to several diseases (Hunt *et al.*, 1980). All the vegetables studied contain appreciable amount of protein which indicates that the vegetables can be used for building and repairing of body tissues, regulation of body processes and formation of enzymes and hormones. Proteins also aid in the formation of antibodies that enable the body to fight infection. Proteins serve as a major energy supplier (Brosnan, 2003).

These vegetables are good sources of lipids. Lipids are essential fats that play a very important role in the human body (Saidu & Jideobi, 2009). Lipids help with brain function, joint mobilization and even energy production. They also help the body to absorb fat-soluble vitamins such as vitamins A and E (Osborne & Voogt, 1978). The percentage of carbohydrate in all the vegetable studied is an indication that the leafy vegetables can be used to regulate various metabolic processes in the body as key molecules in the central metabolic pathways of the body. Carbohydrate also serves as stored forms of energy as glycogen in liver and muscles. It also provides major source of energy and responsible for breaking-down of fatty acids and preventing ketosis (Hassan & Umar, 2006).

These vegetables are also good sources of ascorbic acids, niacin, riboflavin and thiamin (Table 2). Natural ascorbic acid is vital for the body performance (Okwu, 2004). Lack of ascorbic acid impairs the normal formation of intercellular substances throughout the body, including collagen, bone matrix and tooth dentine. A striking pathological resulting from this defect is the weakening of the endothelial wall of the capillaries due to a reduction in the amount of intercellular substances (Hunt *et al.*, 1980). Therefore, the clinical manifestations of scurvy hemorrhage from mucous membrane of the mouth and gastrointestinal tract, anemia, pains in the joints can be related to the association of ascorbic acid and normal connective tissue metabolism (Okwu, 2004). This function of ascorbic acid also accounts for the requirement for normal wound healing. As a result of the availability of ascorbic acid in all the vegetables, they can be used in herbal medicine for the treatment of common cold and other diseases like prostrate cancer (Okwu, 2004). In conclusion the study has showed that the leafy vegetables contain appreciable level of nutrients which are readily available. Hence they could be consumed to supplement the scarce or non-available sources of nutrients.

**References**


Source of support: Nil; Conflict of interest: None declared