

Nutrients Composition of Selected Green Vegetables Sold at Fruit Garden Market in Port Harcourt

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Abstract

*Green vegetables are incredible source of vitamins, minerals, and various nutrients needed for healthy health. Hence the need to determine the proximate, vitamin, and mineral composition of some green vegetables purchased at fruit garden market, Port-Harcourt. Proximate, vitamins, and minerals composition were determined using standard methods; (AOAC for proximate, APHA for minerals, and spectrophotometric method for vitamins). The result of the proximate composition showed that the percentage fibre (0.28 ± 0.05 - 1.37 ± 0.05) and protein content (1.12 ± 0.03 - 2.89 ± 0.12) were significantly higher in *Corchorus olitorius* than in other samples. Ash content of *Murray koenigii* was significantly higher. Also, percentage moisture content (51.67 ± 0.07 - 76.15 ± 0.11) was higher in *Allium fistulosum* while carbohydrate content (16.82 ± 0.09 - 40.20 ± 0.06) was significantly higher in *Ocimum basilicum*. The result of the vitamin composition showed that vitamins A, B1, B2, B6 and D were significantly higher in *Murray koenigii* when compared with other vegetables. Vitamins B3, B12, C and E values were significantly higher in *Corchorus olitorius* when compared with other vegetables. The result of the mineral composition showed that manganese was significantly higher in *Murray koenigiithan* in other vegetables while iron, zinc and lead values were higher in *Mentha xpiperita* when compared with others. Selenium value was significantly higher in *Ocimumbasilicum* when compared with other vegetables. Cadmium, cobalt and chromium values had no significant difference in the vegetables. This work showed that *Corchorus olitorius*, *Mentha xpiperita*, *Allium fistulosum*, *Ocimum basilicum*, and *Murray koenigiican* act as supplementary sources of essential nutrients such as minerals and vitamins.*

Key Words: *Vegetables, Proximate, Vitamins Minerals*

INTRODUCTION

Vegetables are annual and perennial horticulture crops. They are fresh parts of plants which either raw, cooked, canned or processed in some other way, provide suitable human nutrition [1]. Vegetables in the daily diet have been strongly associated with overall good health, improvement of gastrointestinal health and vision, reduced risk for some forms of cancer, heart disease, stroke, diabetes, anaemia, gastric ulcer, rheumatoid arthritis, and other chronic diseases [2]. A high vegetable diet has been associated with lower risk of cardiovascular disease in humans while a low vegetable intake, in unbalanced diets, has been estimated to cause about 31% of ischaemic heart disease and 11% of stroke worldwide. According to the 2007 World Health Report unbalanced diets with low vegetable intake and low consumption of dietary fiber are estimated to cause some 2.7 million deaths each year, and were among the top 10 risk factors contributing to mortality [2].

Green vegetables are an integral component of any nutritious diet, these vegetables are known to be packed with nutrients such as vitamins A, C and K. They are good sources of vitamins and minerals. The vegetables are rich in fiber, which is useful for maintenance of healthy digestive system. They are good source of antioxidant and low in calories, which makes them excellent choice for people who want to keep a healthy body weight. Due to their rich nature in nutrient and antioxidant, they offer a wide range of health benefits. Vegetables with high amount of potassium and magnesium reduce the risk of heart diseases by lowering blood pressure and improve heart health. The antioxidant and fibre components of vegetables protect cells from damage and reduce the risk of cancer and improve digestion respectively. The calcium and vitamin K content of these vegetables are essential for proper development of bones [3].

Spring onions (*Allium fistulosum*) belong to the Allium family and their close relatives include garlic and shallots. Because spring onions are often plucked before they reach full maturity, they have a milder taste than the regular onions [4]. Their leaves are very tasty when young, although they are not always ornamentally attractive. Like other members of the Allium family, spring onions contain antioxidants which may have health benefits [5]. Their leaves are widely used as vegetables in various dishes and as garnishes. They can either be consumed in raw or in cooked form. This vegetable is commonly used as a food additive in salads, stews and even soup. Western Countries have utilized the spring onions in folk medicine for treating numerous ailments such as abdominal pains, constipation, headache, gastrointestinal disorders and cardiac diseases [6].

Corchorus olitorius, popularly called Ewedu belongs to the malvaceae family which encompasses various plants with cultural and economic significance. It is an annual herbaceous plant with a thin stem and it can be found in tropical and sub-tropical regions of the world because it is used as a popular leafy soup. Ewedu is a great source of essential nutrients. It contains dietary fibre, minerals such as calcium and iron, and vitamins like vitamin A and vitamin C. These nutrients are necessary for a diet that is balanced and healthy, making ewedu a valuable addition to the Nigerian diet [7]. In addition to its cooking purpose, the leafy vegetable is also highly utilized as a herbal remedy for treating diseases like dysentery, fever, chronic cystitis and in the treatment of iron deficiencies as well as folic acid deficiency [8].

Curry leaf, scientifically called *Murray koenigi* belongs to the rutaceae family and is often referred to as "Efinrin" in Yoruba. It is a potently scented herb that is frequently used in Nigerian for cooking. It gives a variety of foods a unique flavor and aroma. Curry leaves offer vital nutrients and biologically active substances. Curry leaves contain fiber content which encourages a healthy digestive system and aids in the preventing constipation. Curry leaves are beneficial despite having a low vitamin C level due to their high mineral content [9]. This shrub is widely cultivated because of its aromatic leaves. In folk medicine, this shrub is useful in the treatment of diarrhoea, dysentery and stomach ache [10].

Mint leaves, also known as *Mentha x piperita*, are perennial herb belonging to the Lamiaceae family. They are aromatic herbs frequently utilized in teas, culinary dishes, and traditional treatments. They have strong sweetish odour and warm pungent taste with a cooling aftertaste. Along with being tasty, they also offer a number of important nutrients and potential health advantages. Their leaves are culinary herb and the flowers are usually dried and used to flavour candy, desserts, beverages and other foods. The digestive and respiratory advantages of mint leaves may be attributed to its essential oils, which include Menthol [11].

Popular in Nigerian Cooking is African basil known as scent leave. It is widely grown for both culinary and medicinal purposes in typically all villages and huts in West African countries. It belongs to the family of Lamiaceae and it is well-known for both its aromatic flavor and therapeutic benefits. African basil has antioxidant effects and may have digestive advantages due to the presence of fiber and Vitamin C [12]. It contains wide arrays of bioactive compounds such as flavonoids and polyphenols and it is used as a natural flavouring agent, condiment or vegetable in the preparation of fish, meat, soup and stew [13].

Previous studies have highlighted that it is crucial to understand the nutritional makeup of green vegetables, in order to address nutrient shortages and prevent chronic diseases [14]. Additionally, variations in soil quality, agricultural practices, and environmental factors may affect the nutrient composition of vegetables, highlighting the need for region-specific studies [15]. Therefore, it is crucial to investigate the nutrient composition of these green vegetables, to understand their potential health benefits and ascertain their suitability for meeting the nutritional needs of the local population. A number of green vegetables are known to contain vitamins, minerals, antioxidants, and other bioactive compounds that promote general health and may help fend off chronic diseases.

MATERIALS AND METHODS

Sample Collection: The Green vegetables were purchased at fruit garden market, D-line, Port Harcourt, Rivers State, Nigeria. The plant was identified by Dr. M.G. Ajuru of Plant Science and Biotechnology Department, Rivers State University, Oroworukwo-Nkpolu, Port Harcourt and the registration numbers were RSUPb0131 for *Allium fistulosum*, RSUPb0130 for *Corchorus oltorius*, RSUPb0132 for *Murray koenigii*, RSUPb0129 for *Mentha x piperita*, and RSUPb0133 for *Ocimum basilicum*. The samples were properly washed, oven dried for 5 hours, then grounded into powder using a manual grinder and preserved for analysis.

Proximate Analysis: The [16] methods were used to determine the moisture content, ash content, crude fibre and crude protein. Crude fat was determined by Soxhlet fat extraction method while carbohydrate was determined using differential method ($100 - [\% \text{Protein} + \% \text{Moisture} + \% \text{Ash} + \% \text{Fat} + \% \text{Fibre}]$).

Analysis of vitamins: Vitamin A was estimated by the method of [17]. Vitamin E was estimated in the sample by the Emmerie-Engel reaction as reported by [18]. Vitamin C was analysed by the spectrophotometric method described by [19]. Vitamin D was assayed according to the method of liquid chromatography (LC) with UV absorbance detection. Vitamins B1, B2, and B12 were analysed by spectrophotometric method, while B3 and 6 were analysed by titrimetric method.

Analysis of minerals: Heavy metal analysis was conducted to determine the mineral composition of the sample using Agilent FS240AA Atomic Absorption Spectrophotometer.

Statistical Analysis: All data were presented as mean standard deviation. Data were analysed with one-way analysis of variance (ANOVA) using the SPSS version 20.0. Results were compared among groups with the Scheffe's post hoc test and considered significant a confidence level ($p < 0.05$).

Result:

Table 1: Proximate Composition of selected Green Vegetables (%)

Samples	Allium fistulosum	Murray koenigii	Mentha x piperita	Corchorusolitorius	Ocimumbasilicum
Ash	0.56±0.08 ^{bdeh}	11.69±0.13 ^{*adfh}	1.85±0.16 ^{*bcfh}	0.48±0.04 ^{bdeh}	4.43±0.18 ^{*bdfg}
Fibre	0.28±0.05 ^{bdfh}	0.99±0.00 ^{*adfh}	1.21±0.08 ^{*bcfg}	1.37±0.05 ^{*bdeh}	1.21±0.08 ^{*bcfg}
Protein	1.46±0.08 ^{bdfh}	2.49±0.13 ^{*adfh}	1.99±0.01 ^{*bcfh}	2.89±0.12 ^{*bdeh}	1.12±0.03 ^{*bdfg}
Fat	5.07±0.07 ^{adfh}	5.38±0.21 ^{adfh}	6.20±0.07 ^{*bcfh}	4.45±0.11 ^{*bdeh}	1.76±0.13 ^{*bdfg}
Carbohydrate	16.82±0.09 ^{bdfh}	26.26±0.11 ^{*adeh}	19.92±0.11 ^{*bcfh}	26.58±0.59 ^{*adeh}	40.20±0.06 ^{*bdfg}
Moisture	76.15±0.11 ^{bdfh}	53.65±0.12 ^{*adfh}	69.23±0.17 ^{*bcfh}	64.93±0.10 ^{*bdeh}	51.67±0.07 ^{*bdfg}

Values are express as mean ± standard deviation of n=3.

The mean difference is significant at the 0.05 level. Values with different superscript (a,b) show significant difference when comparing Curry tree with others. Values with different superscript (c,d) show significant difference when comparing Peppermint with others. Values with different superscript (e,f) show significant difference when comparing Ewedu with others. Values with different superscript (e,f) show significant difference when comparing Scent leaf with others.

Table 2: Vitamin Composition of selected Green Vegetables (mg/100g)

Samples	Allium fistulosum	Murray Koenigii	Mentha x piperita	Corchorusolitorius	Ocimumbasilicum
Vitamin A	3.28±0.05 ^{bdfh}	38.54±0.11 ^{*adfh}	4.32±0.15 ^{*bcfh}	4.94±0.08 ^{*bdeh}	8.37±0.11 ^{*bdfg}
Vitamin B1	0.03±0.00 ^{bcfh}	0.09±0.00 ^{*adfh}	0.03±0.00 ^{bcfh}	0.01±0.00 ^{*bdeg}	0.01±0.00 ^{*bdeg}
Vitamin B2	0.05±0.00 ^{bcfh}	0.17±0.01 ^{*adfh}	0.06±0.00 ^{bcfh}	0.02±0.00 ^{*bdeg}	0.03±0.00 ^{*bdeg}
Vitamin B3	0.57±0.04 ^{ce}	0.56±0.07 ^{ce}	0.50±0.03 ^{cf}	0.67±0.09 ^{de}	0.61±0.04 ^{ce}
Vitamin B6	0.27±0.05	0.28±0.03	0.23±0.02	0.24±0.01	0.23±0.02
Vitamin B12	3.62±0.21 ^{bcfg}	2.79±0.13 ^{*adfh}	3.87±0.09 ^{bcfg}	4.49±0.09 ^{*bdeh}	3.62±0.11 ^{bcfg}
Vitamin C	65.73±0.07 ^{bdfh}	69.61±0.19 ^{*adfh}	80.27±0.09 ^{*bcfh}	80.64±0.09 ^{*bdeh}	79.41±0.03 ^{*bdfg}
Vitamin D	23.82±0.12 ^{bdfh}	18.67±0.07 ^{*acfh}	18.61±0.10 ^{*acfh}	10.42±0.12 ^{*bdeh}	12.60±0.02 ^{*bdfg}
Vitamin E	7.10±0.03 ^{bdfh}	3.67±0.10 ^{*adfh}	5.94±0.08 ^{*bcfh}	11.68±0.06 ^{*bdeh}	7.31±0.05 ^{*bdfy}

Values are express as mean ± standard deviation of n=3.

The mean difference is significant at the 0.05 level. Values with different superscript (a,b) show significant difference when comparing Curry tree with others. Values with different superscript (c,d) show significant difference when comparing Peppermint with others. Values with different superscript (e,f) show significant difference when comparing Ewedu with others. Values with different superscript (e,f) show significant difference when comparing Scent leaf with others.

Table 3: Mineral Composition of selected Green Vegetables (mg/100g)

Samples	Allium fistulosum	Murray koenigii	Mentha x piperita	Corchorusolitorius	Ocimumbasilicum
Mn	0.37±0.05 ^{bdeg}	0.60±0.09 ^{*acfh}	0.56±0.08 ^{*acfh}	0.22±0.02 ^{bdeg}	0.29±0.02 ^{bdeg}
Fe	0.80±0.01 ^{bcfh}	0.29±0.02 ^{*adfh}	0.81±0.05 ^{bcfh}	1.52±0.08 ^{*bdeh}	1.31±0.05 ^{*bdfg}
Cu	0.28±0.02 ^{bdfh}	0.21±0.02 ^{*aceh}	0.24±0.01 ^{*aceh}	0.20±0.01 ^{*aceh}	0.10±0.00 ^{*bdfg}
Zn	0.39±0.01 ^{aceh}	0.39±0.02 ^{aceh}	0.45±0.04 ^{acfh}	0.33±0.02 ^{adeg}	0.30±0.02 ^{*bdeg}
Co	0.02±0.00	0.05±0.01	0.03±0.00	0.17±0.07	0.02±0.00
Pb	0.01±0.00 ^{adeg}	0.02±0.00 ^{adeg}	0.04±0.00 ^{*bcfh}	0.02±0.00 ^{adeg}	0.01±0.00 ^{adeg}
Cd	0.01±0.00	0.02±0.00	0.01±0.00	0.01±0.00	0.01±0.00
Cr	0.01±0.00	0.01±0.00	0.05±0.01	0.05±0.00	0.01±0.00
Ni	0.01±0.00 ^{ah}	0.01±0.00 ^{ah}	0.02±0.00 ^{ag}	0.03±0.00 ^{*bg}	0.02±0.00 ^{ag}
Se	0.07±0.02 ^{bcfg}	0.04±0.00 ^{*adh}	0.08±0.00 ^{bcfg}	0.03±0.01 ^{*adeh}	0.08±0.01 ^{bcf}

Values are express as mean ± standard deviation of n=3.

The mean difference is significant at the 0.05 level. Values with different superscript (a,b) show significant difference when comparing Curry tree with others. Values with different superscript (c,d) show significant difference when comparing Peppermint with others. Values with different superscript (e,f) show significant difference when comparing Ewedu with others. Values with different superscript (e,f) show significant difference when comparing Scent leaf with others.

Discussion

The result obtained from the proximate composition of the green vegetables (Table 1) revealed that the ash content was significantly higher in curry, mint leaves and scent leaf when compared to spring onions. Scent leaf had the highest ash content while Ewedu recorded the least ash content. The result also revealed that the crude fibre and carbohydrate content of the green vegetables analysed were significantly higher in ewedu, curry, mint leaves and scent leaf than spring onions. The highest value of fibre was recorded in ewedu while the highest carbohydrate content was found in scent leaf. The result also showed that the protein content of curry, mint leaves and ewedu were significantly higher than spring onions and scent leaves. The highest protein content was recorded in ewedu while the least protein value was found in scent leaf. The table also revealed that the green vegetables analysed in this study contain appreciable fat content. The highest fat content was found in mint leaves while the least was recorded in scent leaf.

Ash content refers to the amount of the inorganic non-combustible material contained in a food substance. It is often used as measure of the mineral composition of various food substances [20]. The ash content of the green vegetables analysed in this study ranged from 0.48 ± 0.04 – 11.69 ± 0.13 with scent leaf having the highest composition and ewedu had the least percentage (%) composition. The high ash content of scent leaf indicates that the vegetable is very rich in organic matter which is convertible to oxides and water upon heating [20].

Crude fibre is a dietary component found in plant-based foods and it is important for dietary health. The crude fibre content of the green vegetables analysed in this study ranged from 0.28 ± 0.05 – 1.37 ± 0.05 with ewedu having the highest composition and spring onions had the least percentage (%) composition. Dietary fibre helps prevent against constipation, piles, and bowel problems. Dietary fibre, usually hemi cellulose and cellulose add bulk to the diet, reduce waste elimination and prevent absorption of excess starchy meals which protect metabolic conditions against hypercholesterolemia, diabetes mellitus and other related health complications [21].

Crude protein of the vegetables result was low when compared with standard [22]. Plant foods that provide more than 12% of their calorific value from protein have been shown to be good source of protein [22]. This shows that all the leafy vegetables investigated are not good sources of protein. Proteins are essential in the human diet for growth, repair and maintenance of tissues. They are a source of amino acids, the building blocks of protein [23].

Fats are essential for energy storage and are integral components of cell membranes. They play a pivotal role in protecting vital organs and enabling the absorption of fat-soluble vitamins. [24]

emphasized the significance of fats in overall health, highlighting their involvement in metabolic processes. The result obtained in this study showed that the vegetables contain appreciable fat content. The fat content of the green vegetables analysed in this study ranged from 1.76 ± 0.03 – 6.20 ± 0.02 with mint leaves having the highest composition and scent leaf had the least percentage (%) composition.

This study reveals that these green vegetables contain significant quantities of carbohydrates. It has highest values in the proximate analysis that was carried out. The highest content was obtained in scent leaf while the least was obtained from spring onion. Carbohydrates are the body's primary source of energy, providing fuel for various physiological processes including brain function and physical activities [23].

Result of the vitamin composition (table 2) shows that Vitamins A, B1, B2, B6 and D were significantly higher in curry tree when compared with other vegetables. Vitamins B3, B12, C and E was significantly higher in Ewedu when compared with other vegetables.

Vitamin A content of curry tree was significantly higher than that of the other green vegetables. The values are within the range reported for bush mallow, Garden egg leaf, African basil and Bush okro [21]. Vitamin A is a key player in maintaining vision, immune function, and cellular differentiation. It is vital for the integrity of epithelial tissues and is involved in gene expression and cellular communication emphasized the crucial role of vitamin A in visual health and immune function [25]. The substantial amount of vitamin A recorded in curry leaf shows that it can help in vision and immune functions.

Thiamine (vitamin B1) is found in a variety of dietary sources, including whole grains, nuts, seeds, and meat. The absorption of thiamine and its potential impact on health have been subjects of research. [26] investigated thiamine bioavailability from different food sources, providing insights into optimizing thiamine intake from diverse diets.

Riboflavin (vitamin B2) is a key player in energy metabolism, acting as a precursor for coenzymes involved in redox reactions. It is essential for the function of various enzymes that support cellular growth and development. [27] emphasized riboflavin's significance in metabolic pathways and its critical role in energy production.

Vitamin B3, also known as niacin is essential for energy metabolism, acting as a precursor for coenzymes involved in various redox reactions. It is a critical component in cellular respiration and DNA repair. [28] emphasized niacin's significance in metabolic pathways and its role in maintaining cellular health.

Vitamin B6, also known as pyridoxine is found in a variety of dietary sources, including poultry, fish, bananas, and whole grains. The absorption of pyridoxine and its potential impact on health have been subjects of research. [29] investigated factors influencing pyridoxine absorption and provided insights into optimizing pyridoxine intake from different food sources.

Cobalamin (vitamin B12) is essential for DNA synthesis, nerve function, and the formation of red blood cells. It plays a pivotal role in maintaining neurological health and cognitive function. [30]

emphasized cobalamin's significance in overall health and its impact on various metabolic pathways.

The ascorbic acid (vitamin C) is essential for the proper functioning of the immune system [31]. It enhances the production and activity of immune cells, contributing to the body's defense against infections. Research has indicated that adequate vitamin D levels may be associated with a lower risk of certain types of cancer, such as colon, breast, and prostate cancer [32]. Vitamin E is involved in immune function and may help the body defend against infections [33].

Table 3 showed that manganese was significantly higher in curry tree when compared with other vegetables while iron, zinc and lead was higher in peppermint when compared with others. Copper was significantly higher in spring onion when compared with other vegetables while nickel was significantly higher in ewedu when compared with other vegetables. Selenium is significantly higher in scent leaf when compared with other vegetables while cadmium, cobalt and chromium have no statistical difference when comparing the vegetables with each other.

Manganese is an Important Micronutrient. This study showed that the highest value of manganese was obtained in curry tree while ewedu had the least value. Manganese plays a vital role in human physiology as an essential trace element involved in enzymatic reactions. It is a cofactor for several enzymes, such as manganese superoxide dismutase (MnSOD), which helps protect cells from oxidative stress [34].

Iron is a vital micronutrient with a multifaceted impact on human health. This study showed that the highest value of iron was obtained in ewedu while curry tree had the least value. Adequate iron intake is essential to prevent iron-deficiency anemia, a condition characterized by fatigue, weakness, and reduced cognitive function [35].

Copper is an essential trace element with a multifaceted impact on human health, influencing various physiological processes. This study showed that the highest value of copper was obtained in spring onion while scent leaf had the least value. Emerging research suggests that copper is important for normal neurological function and that its deficiency may lead to neurological disorders [36].

Zinc, an essential trace element, is integral to various physiological processes in the human body. This study showed that the highest value of zinc was obtained from peppermint while scent leaf was the least value. Zinc has been used in dermatology to treat conditions like acne and eczema, highlighting its importance in maintaining healthy skin [37].

Lead is a heavy metal with various applications, but it is important to note that its use has significantly decreased due to health and environmental concerns associated with lead toxicity. Lead ranges from 0.01 to 0.04. The highest value was obtained from peppermint. Lead has been historically used in a variety of applications, including pipes and plumbing, solder, batteries, paints, and as an additive in gasoline [38].

Selenium is an essential trace element influencing various physiological processes in the human body. This study showed that the highest value highest was gotten from peppermint and scent leaf

while the least was gotten from ewedu. Selenium plays a role in the conversion of thyroid hormone thyroxine (T4) to its active form, triiodothyronine (T3), thus supporting proper thyroid function [39].

Conclusion

The result of this research work showed that green vegetables such as *Corchorusolitorius*, *Mentha xpiperita*, *Allium fistulosum*, *Ocimumbasilicum*, and *Murray koenigiican* act as supplementary sources of essential nutrients such as minerals and vitamins. Their consumption as part of the diet is justified by the results of this study.

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