Comparative Study of the Nutritive Values of Tomato (*Solanum lycopersicum*), Onion (*Allium cepa*), Green Leaf (*Spinacia oleracea*) and Okra (*Abelmoschus esculentus*)

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ABSTRACT

This study attempt to investigate the comparative nutritive value of some selected edible vegetables, Tomato (Solanum lycopersicum), Okra (Abelmoschus esculentus), Green leaf (Spinacia oleracea) and Onion (Allium cepa) grown and consumed daily by all classes of the population in western Africa generally and Nigeria specifically. These vegetables are consumed fresh during its season and dried during off-season. In this study some nutritional content of the oven dried samples of tomato, okra, Green leaf (Spinacia oleracea) and onion were analyzed. The nutrient profile analyzed are carbohydrate, protein, fat, moisture, ash and fibre. The results showed that Green leaf (Spinacia oleracea) recorded the highest percentage of protein (41.3%), tomato (25.7%), Okra (13.1%) and Onion (6.3%) respectively,. Their mineral analysis shows the presence of Ca^{2+}, Zn^{2+}, K^{+}, P^{+}, Na^{+} and Fe^{2+} in varying proportions. This shows that these leafy vegetables are good sources of nutrient for bone, teeth and muscle growth and development for humans especially children.

Keywords: *Solanum lycopersicum, Abelmoschus esculentus*, Green leaf (*Spinacia oleracea*), Nutritional content and Mineral analysis.

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1. INTRODUCTION

Vegetables are desirable component of any diet because they provide range of required nutrients. However, production of these vegetables is seasonal. In Nigeria production and distribution is predominant between raining and harmattan period, in between these seasons there are shortages, which can result in varieties and nutrition content of the diet being restricted especially among the low-income group. Studies on the nutritional status in Nigeria have shown micronutrients (Vitamins and minerals) deficiency such as Vitamin A, Vitamin C, Calcium, Iodine, phosphorus, fructose, glucose and iron (Musa and Osunde *et al*., 2007). Tomato is one of the most important vegetables crops grown all over Nigeria. It is the world's largest vegetable crop after potato and sweet potato but it tops the list of canned vegetables. In Nigeria, tomato is regarded as the most important condiment in most diets and a very cheap source of vitamins. It also regarded as the most important vegetable after onion and pepper (Olaniyi *et al*., 2007). It contains a large quantity of water (%), Calcium (%) and Niacin all of which are of great importance in the metabolic activities of man. Tomato is a good source of vitamins A, C, and E including minerals that are very good for body and protect the body against diseases (African Journals of food Science, 2010).

Onions are one of the world's most widely cultivated vegetables with their culinary and medicinal uses spanning history and the globe. Equally varied are their health benefits, for they contain a range of phytochemicals with an array of biological effects, including antioxidant activity. There is evidence that they play an important role in protecting against major chronic diseases as well as health problems associated with ageing. Their antimicrobial activity, long recognized is folk remedies, has also now been scientifically validated (Hesges and Lister, 2007).

Green leaf (Spinacia oleracea) locally known called "Amunututu" is an extremely nutritious vegetables rich both in core nutrients and phytochemicals. The major nutrients in *Green leaf (Spinacia oleracea)* are Vitamin A (from β-Carotene), C, K and foliate, and the minerals, Calcium, Iron and potassium. *Green leaf (Spinacia oleracea)* also provides fibre and is low in calories. The phytochemicals of most important are the carotenoids, β-Carotene, lutein and Zeaxanthin and phenolic compounds. A number of studies have shown *Green leaf (Spinacia oleracea)* to have strong antioxidant activities and high levels of antioxidant compounds such as phenolics and carotenoids antioxidants activity is important as many chronic diseases and health issues associated with ageing as a result of excessive oxidative stress.

One of the major health benefits attributed to two major compounds in *Green leaf (Spinacia oleracea)*, lutein and Zeaxanthin, is that of protection against eye diseases such as macular degeneration (gradual loss of central vision associated with old age). Epidemiological and laboratory studies have also shown that *Green leaf (Spinacia oleracea)* extract and *Green leaf (Spinacia oleracea)* compounds may delay or retard age-related loss of brain function, reduce the extent of post-ischaemic stroke damage to the brain and protect against cancer through various different mechanisms. (New Zealand Institute of Crop and Food Research, 2007).

Okra (*Abelmoschus esculentus*) is known by many local names in different parts of the world. It is called lady's finger in England, ''gumbo'' in the United States of America, 'guino-gumbo' in spanich, 'gluberio' in Portuguese and 'bhindi' in India (Ndunguru *et al*., 2004 and Benchasr, 2012). Its origin is Ethiopia where it is called 'Kenkase' (Berta), Andeha (Gumuz), Bamia (*Oromical amharic*). The name Okra probably derived from one of Niger-Congo group of languages (the name for Okra in the Twi language is 'nkuruma' (Benjawan *et al*., 2007). It is a multipurpose crop due to its various uses of the fresh leaves, buds, flowers, pods, stems, and seeds (Mihretu *et al*., 2004). The Immature fruits of Okra (green seed pods) are consumed as vegetables, used in salads, soups and stews, fresh or dried, fried or boiled. It offers mucilaginous consistency after cooking. Often the extract obtained from the fruit is added to different recipes like soups, stews and sauces to increase the consistency. Okra mucilage has medicinal application when used as a plasma replacement or blood volume expander. The mucilage of okra bands Cholesterol and bile acid carrying toxins dumped into it by the liver (Maramag, 2013). Okra seeds are source of oil and protein. Okra seeds have been used in a small scale for oil production. It can also be used as non-caffeinated substitute for coffee(Cailsir, .,2005)

2. MATERIALS AND METHODS

Collection of sample

The fresh samples of the vegetables, *Tomato (Solanum lycopersicum), Okra (Abelmoschus esculentus), Green leaf (Spinacia oleracea) and Onion (Allium cepa)* were locally sourced in Offa central market, Kwara State.

Preparation of samples for analysis.

The samples purchased from Owode market Offa, Kwara State were thoroughly washed with distilled water, the vegetables were cut into shreds using a blunt knife and then dried in an air circulating oven in the laboratory, grind manually into a fined powered, using a manual grinder.

Proximate composition of vegetable samples
The proximate composition of the sample was determined using the methods of the AOAC (2003). Thermal drying was used in the determination of the moisture content of the samples.

Mineral profile determination of the samples
Three (3) grams of the samples were weighed into a crucible and was subjected to ashing in furnace for 6 hour at 500°C and cooled in the dessicator. After cooling, 2.5 mL of 6N HNO_3 was added to the crucible and gently heated on the hot plate until brown fumes disappeared. The extract remaining in each crucible after digestion was heated with 5 ml of de-ionized water until a colorless solution was obtained. The mineral solution in each crucible was thereafter transferred into a 100 ml volumetric flask by filtration through filter paper and the volume was made to the mark with de-ionized water. The extracts were prepared in triplicates. The samples were analyzed for Ca, Na, K, Fe, Zn, and P was determined using Atomic Absorption Spectrophotometer (GBC, SensAA, Dual, USA).

3. RESULT AND DISCUSSION

The results of the nutrient composition of *Tomato (Solanum lycopersicum), Okra (Abelmoschus esculentus), Green leaf (Spinacia oleracea) and Onion (Allium cepa) are* presented in the table 1 below. *Green leaf (Spinacia oleracea)* and tomato had higher mean value in nutrient likes protein (41.3%, 25.7%) respectively, mineral such as iron (60.0%,30.4%) respectively, while calcium was higher (206.0mg/100g,181.5mg/100g) in tomatoes and onions respectively which helps to prevent anaemia and stimulates the metabolic activity of human body (Qhuresh, 2007). Okra and *Green leaf (Spinacia oleracea)* are fibrous vegetables which are rich in fibre as name also suggest, thus, it enhances peristaltic movement in the body, removes toxins and also improve immune system. *Green leaf (Spinacia oleracea)* and okra contain high amount of fibre (Benchasr, 2012).

Onion which can be eaten raw is a low calories source of carbohydrate and fibre, also rich in water content. It also helps in preventing disease like cancer and helps in lowering the cholesterol, reduces blood pressure (Heges and Liester, 2007). There are numerous vegetables which help in growth and development of our body. Not only animal protein (meat and chicken or eggs) can help in development of body, vegetables and fruits also do. Vegetables and fruits are recommended for individual attempting to shed some weight owning to their high fibre content. Consuming vegetables and fruits aid in living a healthy life (Admin. Steven Health foods, 2013).

Mineral analysis
The results of the mineral contents of *Tomato (Solanum lycopersicum), Okra (Abelmoschus esculentus), Green leaf (Spinacia oleracea) and Onion (Allium cepa) are* presented in the table 2. Green leaf (*spinach oleracea*) although not well known leafy vegetables in some part of the world, has enormous nutritional and anti-nutritional properties and thus can be used as a substitute for most of the commonly consumed vegetables. This spinach is nutritious and provides sufficient amount of nutrients for normal body function, maintenance and reproduction. Raw fresh green leaves contains lesser amount of carbohydrate and fat, hence, it is found to be an excellent choice of leafy vegetable for patients with medical conditions such as diabetes and obesity. Spinach is a good source of vegetable fiber in raw fresh form so it helps to reduce high cholesterol levels and thus can prevent medical conditions like atherosclerosis. The protein content of fresh spinach was higher (60mg/100g), hence, it could be recommended for the children with hidden hunger such as iron deficiency anaemia (Adetuyi *et al.,* 2011). Onion contributes meaningful amount of $Ca^2$to dietary intake this enhance structural functions, energy provision, osmotic regulation and catalytic functions (Adetuyi, *et al.,* 2011).

Dietary (exogenous) antioxidants have been reported to exhibit protective roles against multiple medical conditions like cancer, anaemia, diabetics and cardiovascular diseases. They counteract (scavenging) the oxidizing effects of free radicals generated in the body on nucleic acid and lipids. Adetuyi *et al.,* 2011, reported vitamin C, E, flavonoids, lycopene and β-carotene are the major exogenous antioxidants from plant food sources and this are the major sources of these invaluable antioxidants. Therefore, indispensable regular intake of these vegetable foods is highly recommended to attaining good health, fitness and general well-being. Potassium is a principal cation in the intracellular fluid which functions in many ways including, influencing acid-base balance, maintenance of osmotic pressure, water retention, contraction of smooth, skeletal and cardiac muscles. The potassium content in this study (Table 2) is lower when compared with 300 to 600 mg/100 g as the daily requirement of potassium by a healthy adult except in green leaf. Onion has low content of potassium ions. K plays a structural role in building up bones and teeth.

The recommended daily allowance for phosphorus is in the range of 400 to1200 mg/100 g which is very high (NRC, 2001) in comparison to the phosphorus content (Table 2) of this study. It shows that onion is not rich in phosphorus content. Comparison to the phosphorus content (Table 2) of this study. It shows that onion is not rich in phosphorus content. The recommended dietary allowance (RDA) for Na+ is 500 mg which means that onion provides 10.46% of RDA for an adult. Na^+ and K^+ are important in our diets due to their role in blood pressure regulation Na+/K+ ratio of less than one in our diet is recommended, hence, onion bulb with Na+/K+ ratio as 0.64 is good, and therefore, adequate use of the spice in the diets of hypertensive patients could help in blood pressure control (Qhuresh, 2017). The value for Fe^{2+} is 26.5 mg From Table 2, Fe^{2+} content of onions was seen to be higher when compared with the RDA value and 0.7 mg/100 g in lettuce, 0.3 mg/100 g in cabbage but lower to 60 mg/100 mg in spinach (NRC, 2001). Therefore, onion can provide about 17.3 to 26.0 % of Iron to the RDA thereby helping in boosting the blood level especially in anemic conditions.

4. CONCLUSION AND RECOMMENDATION

The information presented here shows the potential nutritional importance of Okra and its role in improved nutritional and health. It is an affordable source of protein, carbohydrate, minerals and vitamins, dietary fibre and health promoting fatty acids. Scientific studies provide some evidence to support the potential beneficial effects of Okra components in lowering the risk for various chronic diseases, although information pertaining to the role of edible plant parts of okra in disease prevention and the mechanisms of action are limited to date. Onion contains some anti-nutrients that do not pose any trace of toxicity upon consumption, because of their low concentrations.

It also showed the rich mineral composition hence it can be recommended for people with medical conditions such as ricket, osteomalacia and hypertension. The onion family appears to be as useful to human health as it is in the kitchen. Its bioactive compounds are being found to provide a wide range of protective properties across the major chronic western diseases of the 21st century, as well as established antimicrobial activity. As more research is undertaken on Allium species and their constituent compounds, it is highly possible that stronger scientific evidence will emerge to justify their prominence in traditional remedies throughout history and around the globe.

This is due to the complex nature of disease aetiology and various factors impacting their occurrence. It is imperative the scientific community continues to unravel the mechanisms involved in disease prevention and determine how food bio-actives from such food as Okra can influence human health. *Green leaf (Spinacia oleracea)* and its constituent compounds have received a good amount of research attention, which can substantiate *Green leaf (Spinacia oleracea)*'s reputation as a highly nutritious vegetable. Tomato is a fruit of good value as it is fairly rich in vitamins (Vitamin C), and other minerals like calcium, phosphorous, and iron. Considering its low cost, it qualifies for inclusion in the daily diet of young and growing children.

Consumption of tomato may lead formation of gall bladder stones due to presence of purine and oxalic acid in the fruit. Chemical analysis of tomato shows that it contains purine (11 mg/100 g) than carrots (17mg) potatoes (16 mg), Cabbages (32 mg) and other vegetables (Adetuyi *et al.,* 2011). Experts now recommend inclusion of tomatoes in the diets of gall bladder patients. It may aggravate gout problems and uric acid diseases. In fact, tomato is included in the diet as it has uric acid lowering effect (Adetuyi *et al.,* 2011).

Table 1: Nutritional Values of Some Nigerian Vegetables

Vegetables	Moisture %	Ash %	Fat %	Fibre %	Protein %	Carbohydrate %
Green Leaf	10.5	5	11.2	6	41.3	26
Onion	7.5	4	9.5	3.5	6.3	69.2
Tomato	18.5	1.5	3.5	6	25.7	44.8
Okra	11.5	6.5	9.5	10.6	13.1	48.8

Values obtained are in triplicates. The mean of the values are recorded.

Table 2: Mineral contents of some Nigerian vegetables

Minerals mg/100g) / Vegetables	Ca	Fe	Zn	P	Na	K	VIT. A	VIT. C	VIT. E
Green leaf	78	60	5.1	122	193	300	165	28.2	3.0
Onion	181.5	26.74	4.21	47.8	5.31	127	53.46	22.3	6.5
Tomato	206	30.40	1.65	75.0	65.8	23.00	0.92	2.34	5.60
Okra	170	8.10	0.19	19.54	13.11	299	15.34	20.3	0.35

Values obtained are in triplicates. The mean of the values are recorded. The results were statistically analyzed at 95 % confidence level.

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