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Nutraceutical and health benefits of some vegetables eaten in Enugu State Nigeria

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Little or nothing is known about the nutritional and medicinal values of some of the vegetables eaten in Enugu state of Nigeria. This study aimed to quantify the total antioxidants as phenols, total flavonoids, vitamin C content and reducing properties of six vegetables [*Teltaria occidentals* (ugu), *Gnetum africanum* (ukase), *Piper quineense* (uziza), *Gongronema latifolium* (utazi), *Achyranthes spendens* (awa), *Occimum grattissimum* (nchegnwu)]. Colorimetric method was performed using Gallic acid and rutin standard reagents for total antioxidants (phenols) and total flavonoids, respectively. The vitamin C and reducing properties contents were also determined using 2, 6-dichilorophenol indophenols (titrimetric) and trichloroacetic acid colorimetric methods, respectively. The result reveals that *G. africanum* (ukazi) ranked the best of all the vegetables assayed for total flavonoids (0.58 mg/g), total antioxidants (49 mg/g) as phenols, vitamin C (0.91 mg/100 mL) and reducing property (64 mg/g) followed by *A. spendens* (awa) (total flavonoids, 1.57 mg/g; total antioxidants; 50 mg/g; vitamin C; 0.43 mg/100 mL and reducing property. 81 mg/g), *T. occidentalis* (ugu), (total flavonoids, 0.58 mg/g; total antioxidant; 49 mg/g; vitamin, C 0.69 and total reducing property 64 mg/g), *O. grattissimum* (nchanwu) (total flavonoids, 0.36 mg/g; total antioxidant, 45 mg/g; vitamin C, 0.60 mg/100 mL; and total reducing property 80 mg/g) while *P. guineense* (uziza) (total flavonoids, 0.71 mg/g; total antioxidants, 36 mg/g; vitamin C, 0.40 mg/100 Ml and total reducing property, 42 mg/g) and *G. latifolium* (utazi) (total flavonoids, 0.36 mg/g; total antioxidant, 8 mg/g; vitamin C, 0.33 mg/100 Ml and total reducing property, 81 mg/g) are the least. However, the result of the study have highlighted the nutritional and medicinal richness of these vegetables and encourages the increased consumption of them to compensate nutrient deficiency and therefore could be a useful source to prevent or attenuate damages such as lipid peroxidation, glycation of proteins and inactivation of enzymes caused by free radicals.

Key words: Vegetables, total antioxidants, flavonoids, vitamin C, reducing properties.

INTRODUCTION

Vegetables are low in fat but contain good amounts of vitamins and minerals. All the green- yellow - orange vegetables are rich sources of calcium, magnesium, potassium, iron, beta- carotene, vitamin B - complex, vitamin C, vitamin A, and vitamin K. Vegetables are home for many antioxidants that help protect the human body from oxidant stress, diseases and cancer, and also help the body develop the capacity to fight against these by

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boosting its immunity (Umesh, 2014)

Today awareness is increasing among consumers regarding foods and the therapeutic properties of nutrients. Some people assert that it is misguided to assume that rapid technological and pharmaceutical developments are good for our health (Higdon, 2005).

In order to improve immune system, vitamins, minerals and antioxidants are essential. Most vegetables are very rich in phytonutrients (vitamins A, B, C, K, beta carotene and a host of anti-oxidants which assure a normal progression of the metabolic processes of the body. The nutrient composition of different types of vegetables varies considerably and contains vitamins, essential amino acids as well as minerals and antioxidants that play several roles in the body (Fasuyi, 2006; Mnzava, 1997; Segal et al., 1983; Watson, 2001).

Anti-oxidant are the nutritional equivalent of man's best friend. They are loyal protectors and nurturers of our cells, repelling disease, and promoting good health (Rani et al., 2004; Karadeniz et al., 2005). Antioxidants can be derived from healthy foods or in the form of supplements and they include a family of naturally occuring compounds like vitamins A, C and E, beta-carotene, lycopene, flavonoids, and more (Enemo et al., 2010; Hamzah et al., 2013; Oyewole et al., 2013; Venter et al., 2014). These antioxidants are believed to protect cells from free radicals, harmful oxygen molecules which are thought to cause the cell damage that contributes to the development of cancer, atherosclerosis, Alzheimer's disease, and rheumatoid arthritis. Free radicals may be the underlying reason for aging (Cherubini et al., 2005; Christen, 2000; Di Matteo and Esposito, 2003; Hitchon and El-Gabalawy, 2004; Kham et al., 2010; Larsen, 1993; Nakabeppu et al., 2006; Nunomura et al., 2006; Rhee, 2006; Sohal, 2002; Stadtman, 1992; Valko et al., 2007; Wood-Kaczmar et al., 2006)

Free radicals are formed in the body, but their production is increased by factors such as smoking, alcohol consumption, air pollution, infection, stress, excessive sunlight and toxin like radiation, heavy metals and asbestos (Bannister and Rottiliog, 1987; Beck et al., 2000; Ignatowicz et al., 2013; Johnson and Giulivi, 2005; Stohs and Bagchi, 1995; Valko et al., 2005; Wozniak et al., 2012).

The role of antioxidants in vegetables and other foods is to mop up excessive free radicals in the human body that lead to oxidative stress and thereby slowing or preventing diseases and aging. The study aims to quantify the total flavonoids, total antioxidants (phenols), vitamin C and total reducing properties of the six vegetables under study.

MATERIALS AND METHODS

Sample collection and preparation

Fresh leaves of six popularly eaten vegetable in Enugu metropolis namely: *T. occidentals* (ugu), *O. grattismum* (ewa), *G. latifolium* (utazi) *P. guineense* (uzuza), *G. Africanum* (ukazi) and *A. splendens* (nchanwu) were bought from a commissioned farmer in Ogbete Main Market on July 18, 2013 and authenticated by Prof. J. C Okafor of Applied Biology and Biotechnology Department, Enugu State University of Science and Technology. The leaves were washed with distilled water and 10 g ground with an electric blender and stored in well labeled polypropylene films placed in a clean well-dried black container.

Determination of total anti-oxidant content

The Gulcin et al. (2003) method was employed to assay the total antioxidant content of the six vegetables. About 100 mL of 70% (v/v) ethanol was added into the ground samples in the ratio of 1:5, stirred and left for 24 h at room temperature. The extract was separated from the residue by filtration through Whatman No. 1 filter paper. The remaining residue was re-extracted and then the extracts were combined. The extract was concentrated to 100 mL under reduced pressure at 40°C using a rotary evaporator. One milliliter of the extract and standard Gallic acid solution (10, 20, 30, 40, 50 and 100 mg/L) was added to 9 mL of water. Then 1 mL of Folin Ciocalteus reagent was added to the mixture and vortexed twice. After 5 min 10 mL of 7% sodium carbonate was added to the mixture and incubated for 90 min at 25°C. The absorbance against a reagent blank was determined using UV/visible spectrometer at 750 nm.

Determination of total flavonoids

Aluminum chloride colorimetric method was used for total flavonoid determination (Zhishen et al., 1999; Ghasemi et al., 2009). Rutin was used as a standard for the calibration curve. Hundred milligram of rutin was dissolved with 84 mL of 60% ethanol (v/v) and the volume made up to 100 mL with 30% ethanol (v/v). The standard curve was constructed by diluting 0,0.1, 0.2 0.3, 0.4 and 0.5 mL rutin to 1 mL with water to obtain 0,10, 20, 30, 40 and 50 mg/mL of rutin. To this, 0.5 mL of 5% $NaNO_2$ was added alongside with 1 mL of the sample extract (extracted with 5 ml of 95% ethanol in the ratio of 1:10 for 30 min with constant stirring and shaken for 5 min). Then, 0.5 mL 10% $AlCl_3$ was also added and the test tube shaken for 5 min. Four milliliter of 4% NaOH was then added and the test tube shaken for 15 min. The absorbance was determined at 510 nm using test tube 0 to zero the UV/visible spectrometer.

Determination of total reducing properties

The ground vegetable was soaked in methanol in the ration of 1:5 for 48 h. Twenty five milliliters of methanol extract of the vegetable sample was mixed with 2.5 mL of 0.2 M sodium phosphate buffer and 2.5 mL of 1% potassium forricyanide, and incubated at 50°C for 20 min then 2.5 mL of 10% trichloroactic acid was added and the mixture centrifuged at 1000rpm for 10 min. The upper layer (2.5 mL) was mixed with 2.5 mL of glass distilled water and 0.5 mL of 0.1% ferric chloride and its absorbance measured spectrophotometrically at 700 nm against a blank. Ascorbic acid was used as the reference standard (Sarah et al., 2013).

Extraction and determination of vitamin C

Ten grams of vegetable sample was ground using mortar and pestle with the aid of 2 g of 2 M hydrochloric acid washed sand to facilitate the breakdown of the sample until a fine paste was obtained. The vitamin C content of the sample was extracted with 5

Table 1. Total anti-oxidant, Flavonoid, reducing property and Vitamin C content in vegetable sample.

Sample	Total anti-oxidant (mg/g)	Total flavonoids (mg/g)	Total reducing properties (mg/g)	Vitamin C (mg/100 mL)
Telfaria occidentalis (ugu)	49	0.58	64	0.69
Gnetum africanum (ukazi)	51	0.82	64	0.91
Piper Guineense (uziza)	36	0.71	42	0.40
Gongronema latifolium (utazi)	8	0.36	81	0.33
Achyranthes spondens (awa)	50	1.57	81	0.43
Occimum grattissimum (Ncheanwu)	45	0.36	80	0.60

mL of 2% HCl into a 100 mL measuring cylinder through a pad of cotton wool. The extraction was repeated three times and the extract combined and the volume made up to 100 mL with distilled water.

Ten milliliter of the extract was titrated with 0.001 M of 2, 6-dichlorophenol indophenols solution until a pink coloration persist for 30 s (Amadi et al., 2004).

RESULTS AND DISCUSSION

The assay of total anti-oxidants, flavonoids reducing properties and vitamin C content of the vegetables T. accidentalis (ugu), G. africanum (utkazi), *P. guineense* (uziza), *G. latifolium* (utazi), *A. spondens* (awa), *O. grattissimum* (ncheanwu), popularly eaten in easthern Nigeria were analyzed using UV/visible spectrometer and titrimetric method for vitamin C.

The results revealed that *G. afrianum* (ukazi), *A. sponders* (awa) and *T. occidetalis* (ugu) are very rich in anti-oxidants (51, 50 and 49 mg/g), respectively. This may be the underlying reason why people who eat natural and whole foods are healthier and live longer than those who mostly eat processed foods (Nakabeppu et al., 2000). *G. latifelium* (utazi) is not very rich in anti-oxidants. Anti-oxidants mostly come from the fresh vegetables and fruits we eat. They prohibit and sometimes prevent the oxidation of other molecules in the body. The benefits of antioxidants are very important to good health because if free radicals are left unchallenged they can cause a wide range of illnesses and chronic diseases (Rui, 2003; Joao, 2012).

The result of the total falvonoids content determination (Table 1) showed that *A. spendens* (awa) has twice as much flavonoids (1.57 mg/g) as *G. africanum* (Ukazi, 0.82 mg/g) and *P. guineense* (uziza, 0.71 mg/g). This is followed by *Telfaria occidentalis* (ugu 0.58 mg/g) while *O. grattissimum* (Ncheanwu, 0.36 mg/g) and *G. latifolium* (utazi, 0.36 mg/g) had the least total flavonoids content. This result supports the claim that diets rich in fruits and vegetables are beneficial to health and that dietary flavonoids are key drivers in anti-allergic, anti-cancer, anti-oxidants, anti-inflammatory, anti-viral, anti bacterial, anti-leukemic and vasodilator activity (Beenu and Rajni, 2012; Lisa, 2013; Shrma, 2006; Yao et al., 2004).

The reducing properties of a vegetable are due to phytochemicals such as steroidal saponins, insulin-like peptides and alkaloids (Khanna et al., 1981; Sandra, 2011; Singh et al., 2004). These chemicals probably may be responsible for the bitter taste and high reducing properties of *G. latifolium* (utazi, 81 mg/g), *A. sponders* (awa, 81 mg/g) and *O. gratissimum* (ncheanwu, 80 mg/g), (Khanna et al., 1981; Sandra, 2011; Singh et al., 2004)

Results of the vitamin C content of the six vegetables showed that *G. Africanum* (ukazi) has the highest content of vitamin C (0.91 mg/mL) followed by *T. occidentalis* (ugu, 0.69 mg/mL), *O. grattissimum* (Ncheanwu, 0.60 mg/mL), while *A. spondens* (awa, 0.43 mg/mL), *P. guineense* (uziza, 0.40 mg/mL and *Gongronema latifolium* (utazi, 0.33 mg/mL) have the least vitamin C content. Vitamin C is the single most important vitamin that has an anti-oxidant property, an important factor in collagen production and useful in wound healing of all types. Vitamin C may protect the skin from free radical damage after exposure to ultraviolet (UV) rays. It is a popular remedy for common cold. It helps to prevent cataracts and lower one's risk of heart disease and strokes. Vitamin C can help regulate blood sugar levels in people with diabetes and it also acts as an oxidative modifier of low density lipoprotein (LDL) (Levin, 1986; Douglas et al., 2000; Shukla, 1969; Steinbrecher et al., 1990; Neu et al., 1997). The increased consumption of these vegetables rich in Vitamin C will be of great health benefit.

Conclusion

Vegetables are low in fat but contain good amount of vitamins such as Vitamin C, antioxidants, flavonoids and reducing agents. Vegetable nutrition has widely drawn the attention of fitness- conscious individuals and food scientists because of their proven health benefits. The increased consumption of *A. spondens* (Awa), *G. Africanum* (ukazi), *T. occidentalis* (ugu), *O. grattissimum* (ncheanwu) and *P. guineense* (Uziza) has beneficial

effects such as anti-allergic, anti-cancer, anti-oxidants, anti-inflammatory, anti-viral, anti-bacterial, and anti-leukemic and vasodilator activities. It can be concluded that *G. africanum* (ukazi) ranked the best of all the vegetables assayed followed by *A. spondens* (awa) and *T. occidentalis* (ugu).

Conflict of Interests

The authors did not declare any conflict of interests.

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