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Nutraceutical qualities of *Cucurbita, Vernonia amygdalina Del and Ocimum gratissimum* leaves vis-à-vis- vitamins A and C: a source of health benefits

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Abstract

The inadequate information on the nutritional values associated with the consumption of vegetables by the people in our communities demands from the researchers to evaluate the benefits and recommend the highly nutritious vegetables to the host communities. The study was aimed at quantifying the vitamins A and C contents of the three selected indigenous vegetables widely consumed in Akure, Nigeria. Three vegetables were obtained from a local market in Akure, the leaves were processed into powdered form by drying and blending using laboratory scale grinder (Sumeet CM/L 2128945) and sifted through 300 µm sieve. Vitamin C and A were determined according to the recommended procedure. The vitamin A contents were in the range (8.03±0.10 to 21.55±0.04 mg/100 g) with the composite being the highest. The vitamin C contents were recorded in the descending order of composite (10 g of mixture of powdered leaves), *Cucurbita*, *Vernonia amygdalina Del* and *Ocimum gratissimum.* It was interesting to uncover that the composite formulation was highly rich in vitamins A and C and this mixture of vegetables for consumption should be encouraged.

1. Introduction

Vitamins are essential building blocks for various pharmacological activities in the human body system and their roles in human health cannot be overemphasized. Vitamins are organic compounds essentials for the physiological functions of human systems and can be classified as soluble or insoluble. Nutritionists have placed a high premium on diets high in vegetables and fruits because of the prevalence of vitamins especially vitamins A and C and they are recommended for their health-promoting properties (Slavin and Lloyd, 2012). The nutritional qualities and health benefits of vegetables have been well reported and this includes among others, sources of provision of vitamins (C, A, B_1, B_6, B_9, E) and mineral elements such as iron, zinc (Quebedeaux and Eisa, 1990; Craig and Beck, 1999; Wargovich, 2000; Dias and Ryder, 2011). Furthermore, vegetables have been found to be rich in phytochemicals, their function as strong anti-oxidants and they have the potentials to reduce the risk of chronic diseases (Craig and Beck, 1999; Wargovich 2000; Southon, 2000; Herrera *et al.*, 2009; Dias and Ryder, 2011). Other health benefits associated with the consumption of vegetables include reducing risk for some forms of cancer, heart disease, stroke, diabetes, anaemia, gastric ulcer, rheumatoid arthritis, and other chronic diseases (Prior and Cao, 2000; Hyson 2002; Golberg, 2003; IFAVA, 2006; Keatinge *et al.*, 2010). A vegetable is common and affordable to humans of all categories. Vegetables are locally cultivated either at subsistence or mechanized levels and available throughout the season period in Akure, Nigeria, as the plants can be grown in swampy areas and irrigation can be adopted.

Bitter leaf (*Vernonia amygdalina Del*) belongs to the family called Asteraceae, it is described as a small shrub with dark green leaves growing in tropical and subtropical Africa (Igile *et al*., 1994; Erasto *et al*., 2006; Erasto *et al*., 2007a; Erasto *et al*., 2007b; Tsado *et al*., 2015). It is a perennial plant with a height between 1 m and 6 m (Nwosu *et al*., 2013). Tsado *et al.* (2015) had reported that fresh *V. amygdalina* grew in Baddegi, Niger state, Nigeria to have high vitamin C and low Vitamin A contents. In addition, Bob *et al.* (2019) reported the high vitamin C content and low vitamin A of *V. amygdalina* purchased in Calabar, Nigeria and other nutritional qualities have been reported by (Igile *et al*., 1994; Okafor, 2005). In addition, Ogunlesi *et al.* (2010) had reported high vitamin C content in *V. amygdalina* obtained from the Nigerian Institute of Horticulture (NIHORT). The difference in the vitamin

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contents may not be unconnected to various conditions such as soil nature, planting season, amount of rainfall and other climatic conditions.

Furthermore, Scent leaf (*Ocimum gratissimum*) (African basil) belong to the group called *Lamiaceae* and it is a herbaceous perennial plant available in tropical Africa and Asia. The plant has a special aroma which has made it useful as spice and condiments (Akinmoladun *et al*., 2007) and the essential oil present has been found useful industrially (Lachowicz *et al.*, 1996; Machale *et al.*, 1997). Bob *et al.* (2019) found a low level of vitamin A content in African basil leave and a moderate level of vitamin C contents harvested from local farms in Cross River State, Nigeria.

Cucurbita moschata generally called pumpkin belongs to the species of plants *Cucurbitaceae* and very common in the Andes and Mesoamerica (Burrows and Tyrl, 2008). It is also widely grown in African countries, Nigeria inclusive. There are five various species cultivated worldwide and their fruits are edible, and the leaves are good sources of nutrients such as vitamins A and C, Aruah *et al.* (2011) reported low vitamin C contents for various *Cucurbita* species investigated across five states in Nigeria. The three selected vegetables are widely common in Akure, Nigeria and inadequate information on the health benefits associated with the consumption necessitated the study.

2. Materials and methods

2.1 Laboratory

The samples were analyzed in the chemistry laboratory, Afe Babalola University Ado Ekiti, Nigeria between the periods of 20th February 2020 to 30th April 2020.

2.2 Sample preparation

Three different vegetables were purchased from local market in Akure, Ondo state, Nigeria on the 19th of January, 2020. The leaves were separated from the stock, washed and air dried for 8 days at room temperature. The dried leaves were powdered using a laboratory scale grinder (Sumeet CM/L 2128945) and sifted through 300 µm sieve to obtain the powdered samples. For the composite (uniform single sample); 10 grams of the powdered samples each were blended together to obtain a single uniform sample.

2.3 Reagent preparation for the analysis

2.3.1 5% Metaphosphoric acid-10% acetic acid

Fifteen grams of solid metaphosphoric acid (E. Merck) were dissolved in mixture of 40 mL of glacial acetic acid (BDH) and 450 mL of distilled water in a 500 mL volumetric flask. The solution was filtered and collected.

2.3.2 Standard vitamin C (ascorbic acid) solution

Standard crystalline ascorbic acid (0.05 g) was dissolved in 100 mL of distilled water to prepare 500 ppm standard stock solution.

2.3.3 Sample preparation for estimation of vitamin C

Approximately 10 g of sample was homogenized with 50 mL of 5% metaphosphoric acid-10% acetic acid solution. Then it was quantitatively transferred into a 100 mL volumetric flask and was shaken gently until a homogeneous dispersion was obtained. Then it was diluted up to the mark by the 5% metaphosphoric acid-10% acetic acid solution. Then the solution was filtered and the clear filtrate was collected for the determination of vitamin C in that sample.

2.4 Estimation of vitamin C

Few drops of bromine water were added to the filtrate sample until the colour changes (to confirm the completion of the oxidation of ascorbic acid to dehydroascorbic acid). This was followed by the addition of few drops of thiourea to remove the excess bromine and cleared solution was obtained. To the colourless solution, 2, 4- dinitrophenyl hydrazine dye solution with vitamin C standard were added and reaction completed (Rahman Khan *et al.*, 2006). A Shimadzu spectrophotometer (model UV-1800) with a pair of 1 cm quartz cells was used for the reading.

2.5 Vitamin A determination

2.5.1 β-carotene extraction and analysis

The β-carotene was determined by soaking 1 g of sample in 5 mL of methanol for 2 hours at room temperature under dark condition in order to get a complete extraction. The β-carotene layer was separated using hexane through separating funnel. The volume was made up to 10 mL with hexane and then this layer was again passed through sodium sulphonate through a funnel to remove any moisture from the layer. The absorbance of the layer was measured at 436 nm using hexane as a blank (Ranganna, 1999). The beta carotene was calculated using the formula:

$$\text{Beta-carotene (µg/100 g)} = \text{Absorbance (436 nm)} \times V \times D \times 100 \times 100/W \times Y$$

Where V = Total volume of extract, D = Dilution factor, W = Sample weight, Y = Percentage dry matter content of the sample.

2.6 Statistical analysis

The analyses were done in triplicates and ANOVA

statistical method was used to determine the mean and standard deviation (SD).

3. Results and discussion

From the results of Table 1, the vitamin A content of composite (powdered mixture of the leaves) was the highest (21.55±0.04 mg/100 g) and *Ocimum gratissimum* was the lowest (8.03±0.10 mg/100 g). However, the vitamin A content of *Cucurbita* (18.15±0.12 mg/100 g) was higher than that of *Vernonia amygdalina* (11.27±0.03 mg/100 g). The vitamin A contents of these vegetables when compared to the previously studied plants as reported by Bob *et al.* (2019), it was observed that they were higher. The vitamin A content of *V. amygdalina* (11.27±0.03 mg/100 g) was higher than that reported by Bob *et al.* (2019) (1.2±0.9 mg/100 g) for the same vegetable. Also, the Vitamin A content of *Cucurbita* (18.15±0.12 mg/100 g) was higher than that reported by Mohammed *et al.* (2013) for the seed of *Cucurbita* (0.76.2±0.00 mg/100 g). Furthermore, the vitamin C content of *Cucurbita* leaves (43.47±0.10 mg/100 g) was higher than *V. amygdalina* (31.89±0.16 mg/100 g) and *Ocimum gratissimum* (23.28±0.13 mg/100 g) respectively. However, the composite had the highest (58.63±0.21mg/100 g). Bob *et al.* (2013) had reported the vitamin C content of *V. amygdalina* to be (43.4±0.10 mg/100 g) which was higher than that of the current study (31.89±0.16 mg/100 g). Past studies had also shown the rich content of vitamins C (197.5 mg/100 g) and A (13.41 mg/100 g) of *V.amygadlina* (Odukoya *et al.*, 2007; Aregheore, 2012). The vitamin C content of *Ocimum gratissimum* in the study was lower when compared to the previously studied vitamin C content for the various *Ocimum gratissimum* collected from five different locations in the south-east part of Nigeria and the vitamin C contents recorded were in the range of (182.45- 188.91 mg/100 g) as reported by Emeka and Chimaobi (2012). However, Aluko *et al.* (2012) had reported the vitamin C content of *Ocimum canum Sims* to be (0.05 g/kg).

Table 1. showing the vitamins, A and C of *Cucurbita*, *Ocimum gratissimum* and *Vernonia amygdalina Del*

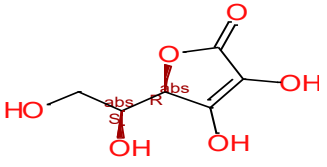
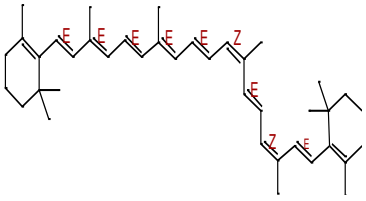
Vegetable	Vitamin A (mg/100 g)	Vitamin C (mg/100 g)
Ocimum gratissimum	8.03±0.10	23.28±0.13
Vernonia amygdalina	11.27±0.03	31.89±0.16
Cucurbita	18.15±0.12	43.47±0.10
Composite	21.55±0.04	58.63±0.21

Values are expressed as mean ± standard deviation of triplicate determinations

The selected vegetables were all rich in vitamins and the various values recorded by different scholars may be due to varying climatic conditions. Health benefits associated with vitamins A and C have been well elaborated on and plants have been found to be a good reservoir of vitamins and minerals (Godber, 1990). Furthermore, studies have revealed a huge majority of vitamins with antioxidant activities from vegetables such as vitamins A and C (Godber, 1990). The role played by vitamins A and C cannot be over-emphasized as previous investigations had shown that they perform various functions in the human system. Mensah *et al.* (2008) had reported the physiological functions of vitamin C as anti-oxidant which serves as body defence against cancer, arthritis and type 2 diabetes mellitus and also serves as an immune booster. Moreover, Charttejea *et al.* (2005) had enumerated the functions of vitamin C to include the facilitation of iron absorption by its ability to lower ferric ions to the ferrous form. Ismail (2017), Cao *et al.* (1996) and Odukoya *et al.* (2007) had shown various protective actions and health benefits associated with the consumption of fruits and vegetables due to the presence of vitamins that have antioxidant properties.

From the result of Table 2, showing the drug properties of the vitamins examined, the vitamin C

Table 2. Showing the chemistry of vitamins

Vitamins	Drug likeness	Mutagenic	Tumorigenic	Irritability	Reproductive effect	SP^3 bond	Chemical structure
Vitamin C	0.023806	none	none	none	none	8	
Beta-Carotene	-3.3519	none	none	none	none	18	

Source: Sanders *et al.* (2015)

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which was present in the highest composite had shown to have positive drug-likeness, an indication that it is a drug also and possess no toxicity, furthermore, vitamin A (β-carotene) had no toxicity and drug-likeness of -1.8704.

4. Conclusion

With the numerous health benefits associated with the consumption of vegetables such as *V. amygadlina, Ocimum gratissimum* and *Cucurbita*, the study had revealed the rich contents of vitamins A and C present and that of the composite. It is recommended that selective vegetables as composite are better for consumption for their health benefits than only one vegetable.

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