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Vitamin and Antinutrient Composition of Kale (*Brassica oleracea*) Grown in Delta State, Nigeria

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Abstract: The study examined the vitamin and antinutrient composition of Kale (*Brassica oleracea*) grown in Delta State, Nigeria. Fresh Kale leaves Fresh kale leaves were obtained at Ogbogonogo market in Asaba, Delta State, Nigeria. Random selection of leaves was done by purchasing from randomly selected sellers in the market. The purchased leaves were cleaned by washing with clean water to remove dirt and other contaminants and sent to the laboratory for analysis. Vitamins present in kale include vitamin C (23.43 mg/100 g), vitamin E (4.06 mg/100 g) and vitamin A (11.25 mg/100 g). Antinutrient content of kale was found to be in very minute amounts: Phytate (0.12 mg/100 g), oxalate (0.08 mg/100 g), tannin (0.15 mg/100 g). Based on the findings from this study, kale (*Brassica oleraceae*), though a lesser known vegetables, has enormous nutritional potentials. Therefore numerous homemakers and others who habitually cook with common vegetables are encouraged to see the need for diversification so as to tap into the benefits of other lesser known vegetable such as Kale.

Key words: Kale, vegetables, vitamins, antinutrional factor, kale, contents

INTRODUCTION

Vegetables are generally succulent parts of plants grown in gardens and consumed as a side dish with starchy staples. They are of special nutritional importance being sources of vitamins such as vitamin A precursors and ascorbic acid, minerals, dietary fibre and to a lesser extent protein (Guarino, 1995).

Green leafy vegetables occupy an important place among the food crops as they provide adequate amounts of many vitamins and minerals for humans. They are rich sources of carotene, ascorbic acid, riboflavin, folic acid and minerals like calcium, iron and phosphorus (Fasuyi, 2006). In addition, they contain antinutrents which reduce their bioavailability (Akindahunsi and Salawu, 2005). Aletor and Adeogun (1995) reported that some antinutritional phytochemicals exhibit protective effects, thus making them to serve a dual purpose of reducing some essential nutrients and protecting the body against a number of biochemical, physiological and metabolic disorders.

Kale is a green leafy vegetable that belongs to the brassica family, a group of vegetables including cabbage, collards and brussels sprouts that have recent widespread attention due to their health promoting, sulphur-containing phytonutrients. It is easy to grow and can grow in colder temperatures. The leaves can be curly and quite ornamental, but become too tough to eat fresh, as they mature. Kale is a member of the cabbage family and is susceptible to many of the pests that attack the cabbage family. Its Latin name is *Brassica oleracea*. The common name(s) is: Kale, Borecole. In Asaba, Delta State of Nigeria, kale is nick-named "hospital too far". This is because of the health benefits of kale. It is an annual crop, with sizes which varies with variety. Most are about 12-36 inches in width, 12-24 inches in height. The duration for its harvest is approximately 2 months depending on temperature (Damrosch, 2004). This work was undertaken to determine the proximate and mineral composition of kale grown in Delta State, Nigeria. This work understudied the vitamin and antinutrient composition of kale grown in Delta State, Nigeria.

MATERIALS AND METHODS

Sample preparation: The kale (*Brassica oleracea*) leaves were purchased at Ogbogonogo market in Asaba, Delta State, Nigeria. Random selection of leaves was done by purchasing from randomly selected sellers in the market. The green leafy vegetables were sorted to remove spoilt, low quality vegetables from the bulk. They were picked and removed from the stalk, trimmed, washed and shredded. Washing was done with clean water to remove dirt and other contaminants. The vegetables were rinsed thoroughly and packaged in polythene bags and sent to the laboratory for analysis. Fresh samples of the leaves were analyzed.

Laboratory analysis: Laboratory analysis was carried out to determine the vitamins (A, C and E) and

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antinutritional factors (phytate, tannin and oxalate) content of kale grown in Delta State, Nigeria. Vitamins A, C and E content of the vegetable were determined using AOAC (1995) method. Tannin was determined using the method described by Pearson (1976). Oxalate was determined using Ukpabi and Ejidoh (1989) method; phytate was determined by the method of James (1995).

Statistical analysis: The results generated from the analysis were subjected to statistical analysis using the Statistical Package for Social Science (SPSS) Version 15. Means were used for the analysis of the result.

RESULTS AND DISCUSSION

Composition of some vitamins in kale was determined and the result is represented in Fig. 1. Vitamin C content (23.43 mg/100g) of kale recorded in this study was found to be lower than that (41 mg/100g) reported by Hall (1998). Ukam (2008) also recorded vitamin C values of *Gnetum africanum* ("Afang") (113.20mg/100g), *Xanthosoma sagitifolium* ("Afia Nkukwo") (32.80 mg/100g), *Lasianthera africana* ("Editan") (32.61mg/100g) and *Heinsia crinita* ("Atama") (22.95mg/100g).

Though the result of this study showed lower vitamin C content of kale Pattison *et al.* (2004) noted that kale is an excellent source of vitamin C - just one cup of this cooked vegetable supplies 88.8% of the daily requirement of vitamin C. Vitamin C is the primary water-soluble antioxidant in the body, eliminating free radicals and preventing damage in the aqueous environment both inside and outside cells. This is why a good intake of vitamin C is associated with a reduced risk of colon cancer (Pattison *et al.*, 2004).

Free radical damage to other cellular structures and other molecules can result in painful inflammation, as the body tries to clear out the damaged parts. Vitamin C, which prevents the free radical damage that triggers the inflammatory cascade, is thus also associated with reduced severity of inflammatory conditions, such as asthma, osteoarthritis and rheumatoid arthritis (Cohen and Kristal, 2000). Since vitamin C can neutralize free radicals, it can help prevent the oxidation of cholesterol.

Vitamin E content of kale was observed to be 4.06 mg/100 g. Vitamin E plays significant biological and biochemical roles in the body when included in the diet. As a fat soluble nutrient, vitamin E is particularly important in protecting cell membranes from oxidative damage. In effect, as an antioxidant, it protects other nutrients or parts of the cell from attack by oxidizing agents (Wardlaw and Insel, 1995).

Mental performance normally declines with age. People who eat at least 2.8 servings of vegetables a day slow their rate of cognitive decline by roughly 40% (Morris *et al.*, 2006). It was therefore hypothesized that reduction in cognitive decline may be due to the fact that vegetables contain high amounts of vitamin E, which helps lower the risk of cognitive decline. Also, vegetables are typically consumed with a little fat, such as olive oil or salad dressing, which increases the body's ability to absorb vitamin E (Morris *et al.*, 2006).

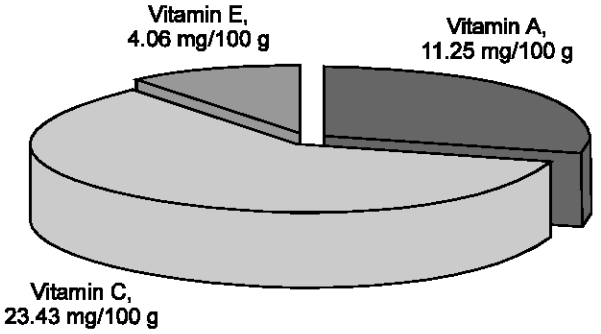

Fig. 1: Vitamin content of Kale (*Brassica oleraceae*)

Vitamin A content of kale was also high (11.25 mg/100 g). According to Baybutt *et al.* (2000), kale is ranked as an excellent source of vitamin A on account of concentrated beta carotene content. Once inside the body, beta carotene can be converted into vitamin A, so when kale is eaten, it is like getting both these beneficial nutrients at once. Baybutt also reported that one cup of kale provides 192.4% of the daily value for vitamin A.

Beta-carotene may help to protect against certain forms of cancer since it belongs to the family of phytonutrients known as carotenoids. In population studies, consuming foods high in carotenoids is consistently found to be associated with a lower risk for various epithelial cancers. In one study of 176 Australian men, researchers examined the diets of a group treated for skin cancer and a group without cancer. The researchers found that men, who ate more foods rich in beta-carotene, had a statistically lower risk of developing skin cancer (Baybutt *et al.*, 2000).

The antinutritional contents of kale (*Brassica oleraceae*) are represented in Fig. 2. The phytate (phytic acid) content of kale was low (0.12 mg/100 g). Phytic acid combines with some essential elements such as iron, calcium, zinc and phosphorus to form insoluble salts called phytates which are not absorbed by the body, thereby reducing the bioavailability of these elements (Ukam, 2008).

Kale is among a small number of foods that contain measurable and negligible amounts of oxalates (0.02 mg/100 g), naturally-occurring substances found in plants, animals and human beings. Chima and Igyor (2007) reported higher oxalate content for 'Oha' (*Pterocarpus mildbreadii*) (0.92 mg/100 g), 'Ukazi' (*Gongronema ofericanum*) (1.56 mg/100 g), 'Nchuanwu' (*Ocimum viride*) (2.70 mg/100 g), 'Uziza' (*Piper guinenses*) (1.48 mg/100 g), Inene (*Amaranthus spinosus*) (2.10 mg/100 g) and Utabanzi (*Gongronema ratifola*) (1.88 mg/100 g) respectively.

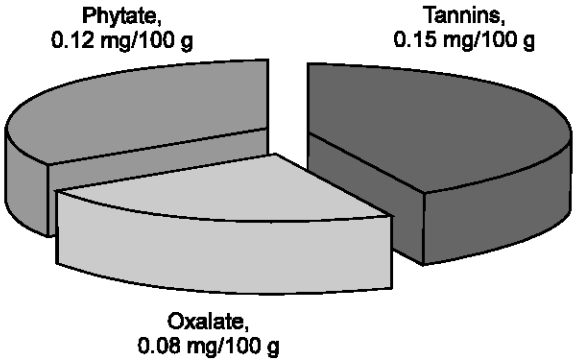

Fig. 2: Antinutrient contents of kale (*Brassica oleraceae*)

When oxalates become too concentrated in body fluids, they can crystallize and cause health problems. For this reason, individuals with already existing and untreated kidney or gallbladder problems may avoid eating kale. Laboratory studies have shown that oxalates may also interfere with absorption of calcium from the body. Yet, in every peer-reviewed research study it was discovered that the ability of oxalates to lower calcium absorption is relatively small and definitely does not outweigh the ability of oxalate-containing foods to contribute calcium to the meal plan. If the digestive tract is healthy and the individual could chew and relax while eating food, he will get significant benefits - including absorption of calcium - from calcium-rich plant foods that also contain oxalic acid. Ordinarily, a healthcare practitioner would not discourage a person that want to ensure that he meets his calcium requirements from eating these nutrient-rich foods because of their oxalate content (Gates, 1984).

From the findings of this study, 100 g of kale was found to contain 0.15 mg tannin. This concentration is however low and thus negligible. However, tannins can act as anti-nutritional factor by provoking an astringent reaction in the mouth and by making food unpalatable. They can complex with and thus precipitate proteins in the gut, reducing the digestibility or inhibiting digestive enzyme and microorganisms. It also interferes with dietary iron absorption (Onwuka, 2005).

Reasonable content of tannins was has been found to be present in the fresh green vegetables (Onyeka and Nwambekwe, 2007) with the values ranging from 0.13 g/100 g to 0.28 g/100 g. Tannin was present most in Onugbo leaf (*Vernonia amygdalina*) having a value of 0.22 g/100 g, while nchanwu (*Occinum gratissmum*) had the lowest tannin content of 0.08 g/100 g. Various levels of tannin was also present in Oha (*Pterocarpus mildbreadii*) (0.18 g/100 g), Ugu (*Telferia occidentalis*) (0.13 g/100 g) and Okazi (*Gnetum africanum*) (0.11 g/100 g) respectively (Onyeka and Nwambekwe, 2007). It has been said that the bitter pigment of 'onugbo' leaf is contributed by its high content of tannin and resin (Okafor, 1983).

According to Shils *et al*. (2006), tannins, (water soluble polyphenols that are present in many plant foods) have been reported to be responsible for decrease in feed intake, growth rate, feed efficacy, net metabolizable energy and protein digestibility in experimental animals. Therefore foods rich in tannins are considered to be of low nutritional value. Incidences of certain cancers, such as oesophageal cancer, have been reported to be related to consumption of tannin-rich foods, suggesting that tannins may be carcinogenic (Shils *et al*., 2006).

Conclusion: Vitamin C content of kale is high. The vitamin C can meet the body's requirement from birth to 12 years of age (Report of a Joint FAO/WHO Expert Group, 1970). Kale was also found to be low in antinutritional factors and hence, is safe for consumption at any level without fear of toxicity. Based on the findings from this study, kale (*Brassica oleraceae*), though a lesser known vegetables, has enormous nutritional potentials. Therefore numerous homemakers and others who habitually cook with common vegetables are encouraged to see the need for diversification so as to tap into the benefits of other lesser known vegetable such as Kale.

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