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Original Article

ANALYSIS OF NUTRIENT CONTENTS OF CABBAGE IN MINNA, NIGERIA.

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ABSTRACT

The proximate and mineral composition of cabbage was analyzed using standard methods of food analysis. The leaves had the following proximate composition: Ash (18.17 ± 0.02%), Crude protein (8.67 ± 0.09%), Crude lipid (9.68 ± 1.05%) and Available Carbohydrate (98.78 ± 0.08%). Cabbage had high moisture content (96.00 ± 1.04% wet weight) with appreciable calorific value (454.82 ± 1.22 k cal/100g). The mineral composition in mg/100g dry weight are K (2590.25 ± 0.60), Na (53.30 ± 0.05), Ca(33.64 ± 0.05), P (11.03 ± 0.15), Mg (76.89 ± 0.01), Cu (2.53 ± 0.01), Fe (10.07 ± 0.01), Mn (3.11 ± 0.04) and Zn (4.15 ± 0.07).When the minerals detected were compared to US Recommended Dietary Allowances; K, Cu and Mn were found to be adequate for all categories of people while Fe was adequate for adult male and children (7 – 10 years). Nutrient density which is the index of nutritional quality was high for K, Mg, Cu, Fe, Mn and Zn, that is > 100% but low for Na, Ca and P, that is < 100% respectively.

Keywords: *Cabbage, Proximate Composition, Mineral Element, Recommended Dietary Allowance.*

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INTRODUCTION

Cabbage (*Brassica oleracea*) is a plant of the family Brassicaceae (or Cruciferae). The cabbage is derived from a leafy wild mustard plant, native to the Mediterranean region. The English name derives from the Normanno – Picard *Caboche* ("head"). The vernacular names include Kabeji (Hausa), Kabeji (Nupe) and Gbagba or Papantako (Yoruba) (Abdullahi *et al.*, 2003). It is a herbaceous, biennial, and dicotyledonous flowering plant with leaves forming a characteristic compact cluster. The only part of the plant that is normally eaten is the leafy head; more precisely, the spherical cluster of immature leaves, excluding the partially unfolded outer leaves. The so – called cabbage head is widely consumed raw, cooked, or preserved in a great variety of dishes.

Raw cabbage is usually sliced into thin strips or shredded for use in salads, such as coleslaw. It can also replace iceberg lettuce in sandwiches. Cabbage is an excellent source of vitamin C (Cabbage, 2008). It also contains significant amounts of glutamine (Cabbage, 2008), an amino acid, which has anti-inflammatory properties. It is a source of indol-3-carbinol, a compound used as an

adjuvent therapy for recurrent respiratory papillomatosis, a disease of the head and neck caused by human papillomavirus (Cabbage, 2008). The aim of this study was to investigate the proximate composition and some mineral contents and to evaluate its nutritional status of cabbage.

MATERIALS AND METHODS

Sample Collection and Treatment

The sample of Cabbage used in this study was collected from a farm site at Chanchaga in Minna town, Niger state, Nigeria. The chemicals used were manufactured by M & B and BDH chemicals of England.

Prior to analysis, the leaves were washed with distilled water. The residual moisture was evaporated in an open air at room temperature and thereafter the leaves were wrapped in large paper envelopes and oven dried at 60^0C until constant weight was obtained (Fasakin, 2004). The dried leaves were then ground in porcelain mortar, sieved through 2mm mesh sieve and stored in plastic container (Umar *et al.*, 2007), while the powdered sample was used for both proximate and mineral analysis. Moisture content was evaluated using fresh leaves.

Proximate Analysis

The moisture content of the leaves was determined by drying 5g of the leaves (in triplicate) in a Gallenkamp oven at 105^0C until a constant weight was attained (AOAC, 1990). Ash content was determined according to the method described by Ceirwyn (1995), which involved dry ashing in Lenton muffle furnace at 600^0C until grayish white ash was obtained. Crude protein content was calculated by multiplying the value obtained from kjeldahl's nitrogen by a protein factor of 5.3, a factor recommended for vegetable analysis (Bernice and Merril, 1975). Crude lipid was quantified by the method describe by AOAC (1990) using the soxhlet apparatus and n-hexane as a solvent. Available carbohydrate was determined by Clegg Anthrone method using Jenway 6100 spectrophotometer at 625 nm with glucose and maltose as the standards (Idris *et al.*, 2009). The sample calorific value was estimated (in Kcal) according to the formula:

Energy = (g crude protein x 2.44) + (g crude lipid x 8.37) + (g available carbohydrate x 3.57) (Asibey – Berko and Taiye, 1999).

Samples Preparation for Mineral Assay

Six grammes of the powdered sample was weighed into a crucible and gently heated over a Bunsen burner until it charred. The charred sample with the crucible was transferred into a Lento muffle furnace at about 600^0C, and the content ashed until grayish white ash was obtained. It was cooled first at room temperature and then in a desiccator. Five cm^3 of concentrated HCl was added and heated for 5 minutes on a hot plate in a fume cupboard. The mixture was then transfered into a beaker and the crucible washed several times with distilled water. The mixture was made up to 40 cm^3 with distilled water and boiled for 10 minutes over a bunsen burner. This mixture was then cooled, filtered into a 100cm^3 of volumetric flask and distilled water was used to rinse the beaker into the volumetric flask and solution made up the volume to 100 cm^3 (Ceirwyn,1995). The solution where

prepared in triplicates.

Mineral Quantification

Sodium (Na) and Potassium (K) were analysed by flame photometer with NaCl and KCl used for the standards. Phosphorus (P) was determined with Jenway 6100 spectrophotometer at 420 nm using vanadium phosphomolybdate (vanadate) colorimetric method with KH_2P0_4 as the standard (Ceirwyn, 1995). The concentrations of Calcium (Ca), Magnesium (Mg), Copper (Cu), Iron (Fe), Manganese (Mn) and Zinc (Zn) in the solutions were determined with a Unicam 969 model Atomic Absorption Spectrophotometer, with standard air – acetylene flame (AOAC, 1990). $CaCl_2$, Mg metal, Cu metal, Fe granules, $MnCl_2.4H_20$ and Zn metal were used to prepare the standards.

Nutrient Density (ND)

The nutrient density is the index of nutritional quality used to evaluate the nutritional significance of mineral elements (Hassan *et al.*, 2005).The sample nutrient densities were calculated using the equation reported in Hassan *et al.* (2008), which is:

$$= \frac{[Np/Ep]\ ND\ (\%)}{[Nr/Er]} \times 100$$

Where Np = nutrient concentration (mineral element in the food),

Ep = energy supplied by food,

Nr = recommended daily intakes of nutrient and

Er = recommended energy intake (3000 Kcal/day for an adult male given by WHO/ FAO (Cole, 1980).

Data Analysis

Data were generated in triplicates and the mean ± standard deviation determined according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

Proximate composition: As shown in Table 1, the moisture content (96.00 ± 1.04%) of sample was high compared with 85.75 ± 3.28% found in Nightshade (*Solanum americanum* L.) leaves (Lawal and Kabiru, 2008), 91% indicated in Vietnamese water spinach (*Ipomoea aquatica*) leaves (Ogle *et al.*, 2001) and 87.40 ± 2.40% reported for the leaves of *Gynandropsis gynandra* (Hassan *et al.*, 2005).

The ash content, which is an index of mineral contents, for cabbage, the value of 18.17 ± 0.02% dry weight was high compared with the values reported for edible leaves such as, Nightshade (*Solanum americanum* L.) leaves with 17.40 ± 1.2% dry weight (Lawal and Kabiru, 2008), 14.44% dry weight in *Ipomoea aquatica* leaves grown in Vietnam (Ogle *et al.*, 2001) and 2.60 ± 0.25 indicated in *Gynandropsis gynandra* leaves (Hassan *et al.*, 2005).

Table 1: Proximate composition of cabbage in Minna

Parameter	Concentration (%Dry weight)
Moisture content[a]	96.00 ± 1.04
Ash	18.17 ± 0.02
Crude protein	8.67 ± 0.09
Crude lipid	9.68 ± 1.05
Available carbohydrate	98.78 ± 0.08
Calorific value (Kcal/100g)	454.82 ± 1.22

The data are mean values ± standard deviation (SD) of three replicates.

[a]Value expressed as % wet weight.

The crude protein content (8.67 ± 0.09%) was high compared with 0.5-5.0% reported for fresh vegetables (Lintas, 1992) but low compared to 17.2 ± 0.1 – 27.03% dry weight indicated in some Nigerian leafy vegetables (Ifon and Bassir, 1980). However, despite the fact that the protein content of leaves of this plant is low, it can still make significant contribution to dietary intake.

The crude lipid content of cabbage was 9.68 ± 1.05% dry weights. This value is within the range of 8.5 – 27.0% found in some wild green leafy vegetables of Nigeria and Republic of Niger (Ifon and Bassir, 1980; Sena *et al.*, 1998) but lower than 11.00 ± 0.50% in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.*, 2007). The result indicated that cabbage is a poor source of plant lipid, which is in agreement with general observation that leafy vegetables are low lipid containing food thus, advantageous health wise to avoid over weighting (Lintas, 1992).

The available carbohydrate content (98.78 ± 0.08%) in cabbage was higher than 31.82 ± 1.37% in Nightshade (*Solanum americanum* L.) leaves (Lawal and Kabiru, 2008), 54.20 ± 0.68% revealed in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.*, 2007) and 75.0% found in *Corchorus tridents* leaves (Asibey – Berko and Taiye, 1999). The main function of carbohydrate in the body is for energy supply. According to Ifon and Bassir (1980), leafy vegetables may not be important source of carbohydrate as they are eaten along with other carbohydrate rich food such as cereals.

The calorific values of most vegetables are low (30 – 50 Kcal/100g) (Umar *et al.*, 2007). The result obtained in cabbage in this study was remarkable (454.82 ± 1.22 Kcal/100g dry weight), which is much higher than 300.94 ± 5.31 Kcal/100g in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.*, 2007) and the values obtained for two varieties of *Gnetum africa*num leaves, Asutan (307.1 Kcal/100g) and Oron (303.2 Kcal/100g) (Isong *et al.*, 1999).

Mineral Content

Table 2 shows the results of the mineral concentrations of cabbage. The

concentration of potassium in cabbage was 2590.25 ± 0.60 mg/100g dry matter. This value is lower than the amount reported in some Nigerian leafy vegetables such as *Talinum trianglare* (8,000 mg/100g) and 6,500 mg/100gin *Crassocephalum biafrae* (Smith, 1983). The result indicated that cabbage is a rich source of Potassium. According to Yoshimura *et al.* (1991), increase of K/Na ratio in the diet assist in the prevention of hypertension and arteriosclerosis, and for normal retention of protein during growth stage, K/Na should be within the range of 3 – 4 (Guil – Guerrero *et al.*, 1998). The K/Na ratio in cabbage was (48.60) which is above the range reported by Guil – Guerrero *et al.* (1998). However, addition of common salt during cooking should bring this ratio within the range since Sodium is a component of common salt (NaCl). The Sodium concentration in cabbage was 53.30 ± 0.05 mg/100g. This value falls within the range of 2 – 150 mg/100g for vegetables (Lintas, 1992). The low Sodium content of cabbage makes it a good food source for hypertensive patients (Levin, 1998). Sodium, in combination with potassium in the body is involved in maintaining proper acid – base balance during nerve transmissions (Setiawan, 1996).

Table 2: Mineral composition of cabbage in Minna

Mineral element	Concentration (mg/100g matter).
K	2590.25 ± 0.60
Na	53.30 ± 0.05
Ca	33.64 ± 0.05
P	11.03 ± 0.15
Mg	76.89 ± 0.01
Cu	2.53 ± 0.01
Fe	10.07 ± 0.01
Mn	3.11 ± 0.04
Zn	4.15 ± 0.07
K/Na	48.60
Ca/P	3.05

The data are mean value ± standard deviation (SD) of three replicates

Calcium and Phosphorous are associated with each other for development and proper functioning of bones, teeth and muscles (Dosunmu, 1997; Turan *et al.*, 2003). The Calcium content in cabbage was 33.64 ± 0.05 mg/100g which is low compared with 142.00 ± 3.2 mg/100g in *Tribulus terrestris* leaves (Hassan *et al.*, 2005) and 416.70 ± 5.77 mg/100g in water spinach (*Ipomoea aquatica* Forsk)

leaves (Umar *et al.*, 2007). The Phosphorus content on the other hand was 11.03 ± 0.15 mg/100g. This value is low compared with 12 – 125 mg/100g found in vegetables (Lintas, 1992) and 109.29 ± 0.55mg/100g in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.*, 2007). According to Guil – Guerrero *et al.* (1998), for good Calcium and Phosphorus utilization, Ca/P ratio must be close to unity. Cabbage had a high ratio (3.05). This showed that cabbage is a good source of Ca over that of P. Consequently, the diets based on this leafy vegetable need to be supplemented with other food materials rich in Phosphorus.

Cabbage contained 76.89 ± 0.01 mg/100g of Magnesium. This value is high compared with 30.00 ± 0.60 mg/100g in *Tribulus terrestris* leaves (Hassan *et al.*, 2005) but lower than 79 – 107 mg/100g found in *Ipomoea batatas* leaves (Ishida *et al.*, 2000). Magnesium is essential for energy production, protein synthesis and cellular replication (eg. DNA, RNA).

The concentration of copper (2.53 ± 0.01 mg/100g) in this sample was high compared with 0.36 ± 0.01 mg/100g in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.*, 2007) and 1.28 mg/100g revealed in *Tribulus terrestris* leaves (Hassan *et al.*, 2005) but lower than 3.34 – 3.95 mg/100g found in *Ipomoea batatas* leaves (Ishida *et al.*, 2000). From the result, cabbage has appreciable amount of Copper relative to the recommended dietary allowance (RDA) of 1.5 – 3 mg/day for adult male and female, pregnant and lactating mothers and 1-3 mg/day for children (7-10years) as set by the United State of America National Research council, NRC (1989).

The iron content in cabbage was 10.07 ± 0.01 mg/100g. This value is high compared to 2.80 ± 07 mg/100g in *Tribulus terrestris* leaves (Hassan *et al.*, 2005) but lower than 110 – 325 mg/100g in some green leafy vegetables consumed in Sokoto (Ladan *et al.*, 1996). Iron is essential for metabolism, DNA synthesis, growth, wound healing, proper immune functions, and reproduction as a cofactor in many enzymatic reactions. Cabbage is therefore a good source of iron compared with the RDA for iron which is 10 – 15 mg/day (NRC, 1989).

Manganese acts as activator of many enzymes. The Mn content of 3.11 ± 0.04 mg/100g in cabbage is high compared with 2.14 ± 0.22 mg/100g in water spinach (*Ipomoea aquatica* Forsk) leaves (Umar *et al.*, 2007) and lower than 9.68 ± 0.57 showed in *Melochia corchorifolia* leaves (Umar *et al.*, 2007). This results clearly indicated that cabbage is a good source of manganese compared with the RDA for Mn which are 2-5 mg/day for adult male and female, pregnant and lactating mother, 2-3 mg/day for children (7-10years) (NRC, 1989).

Zinc is involved in normal functioning of the immune system. The study shows that the Zinc content of 4.15 ± 0.07 mg/100g in cabbage was low compared with 6.3-25.5 mg/100g indicated in some non- conventional vegetables grown in Yola, Nigeria (Barminas *et al.*, 1998). From the results, cabbage is a moderate source of Zinc compared with the RDA for this element of 12-15 mg/day (NRC, 1989). Thus, adequate consumption of this plant leaves may supply enough (Zn) minerals for preventing adverse effects of dietary deficiencies of these micronutrients. Inadequate intake of micronutrients is recognized as an

important contributor to the global burden of disease (Black, 2003).

The contribution of cabbage to the dietary intake of essential elements is presented in table 3. Cabbage is a good source of Potassium, Copper, Iron and Manganese, moderate source of Zinc and Magnesium and poor sorce of Sodium, Calcium and Phosphorus when compare with their respective recommended dietary allowances. This revealed that cabbage may supplement other dietary sources of Potassium, Copper, Iron, Zinc, Manganese and Magnesium.

Table 3: Contribution to the dietary intake and nutrient density to some essential mineral element by Cabbage.

Mineral	RDA (mg)	Contribution to RDA(%)	ND(%)
K	2000	130	854
Na	500	11	70
Ca	1200	3	18
P	1200	1	6
Mg	350	22	145
Cu	1.5-3	84-169	556-1113
Fe	10-15	67-101	443-664
Mn	2-5	62-156	410-1026
Zn	12-19	22-35	144-228

RDA= recommended dietary allowance (NRC,1989).

ND= Nutrient density

The nutrient densities (ND) of cabbage was evaluated and the result presented in Table 3.Food materials with nutrient density of 100% supply the nutrient needed in the same proportion as the caloric needs. Those with ND less than 100% will not provide proportionate amount of the nutrients. Thus, based on this, cabbage is a good source of K, Mg, Cu, Fe, Mn and Zn.

CONCLUSION

The result of this study indicated that cabbage is a good source of plant carbohydrate and energy, as well as minerals such as Potassium, Copper, Iron, Manganese, Magnesium and Zinc. Thus, optimal utilization of the plant will help toward realizing a better nutritional standard of the inhabitants who eat the plant. Furthermore, as Potassium depresses blood pressure while Sodium enhances, based on the results of this study, cabbage could be recommended for hypertensive patients.

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