



## Assessment of folic acid and iron in cabbage consumed in Bauchi state

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### ABSTRACT

Cabbage have a variety of health benefits including treatment of constipation, stomach ulcers, headache, excess weight, skin disorders, eczema, jaundice, scurvy, rheumatism, arthritis, gout, eye disorders, heart diseases, ageing, and Alzheimer's disease. The aim of the study was to assess the iron and folic acid in cabbage (*Brassica oleracea*). The quantification of both the folic acid and iron was done by BLC-20 liquid chromatography and spectrophotometric determination respectively. The results indicated the level of folic acid to be 0.015mg/ml at 282nm and the level of iron was found to be 64.27Ng/g at 515nm. The Nigerian population is exposed to inadequate concentration of folic acid and iron incorporated in cabbage.

**Keywords:** Cabbage, Folic acid, Iron, HPLC, analysis

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### INTRODUCTION

Cabbage is a leafy green biennial vegetable of *Brassicaceae* family, round or oval in shape, consisting of soft light green or whitish inner leaves covered with harder and dark green outer leaves [1]. It is widely used throughout the world, eaten cooked or raw as salad and is a very popular vegetable [2, 3]. Cabbage (*Brassica oleracea* or variants) is grown as an annual vegetable for its densely-leaved heads. Closely related to other cole crops such as broccoli, cauliflower and brussels sprouts, it descends from *B. oleracea* var. *oleracea*, a wild field cabbage. Cabbage heads generally range from 1 to 8 pounds (0.45 to 3.6 kg), and can be green, purple and white. Smooth-leaved firm-headed green cabbages are the most common, with smooth-leaved red and crinkle-leaved savoy cabbages of both colors seen more rarely [4]. Cabbage is a good source of beta-carotene, vitamin C and fiber. It is a cruciferous vegetable, and has been shown to reduce the risk of some cancers, especially those in the colorectal group. This is possibly due to the glucosinolates found in cole crops, which serve as metabolic detoxicants, or due to the sulphoraphane content, also responsible for metabolic anti-carcinogenic activities. Purple cabbage also contains anthocyanins, which in other vegetables have been proven to have anti-carcinogenic properties [5]. Along with other cole crops, cabbage is a source of indole-3-carbinol, a chemical that boosts DNA repair in cells and appears to block the growth of cancer cells. Research suggests that boiling these vegetables reduces their anti-carcinogenic properties [6].

Cabbage have a variety of health benefits including treatment of constipation, stomach ulcers, headache, excess weight, skin disorders, eczema, jaundice, scurvy, rheumatism, arthritis, gout, eye disorders, heart diseases, ageing, and Alzheimer's disease [7].

**Detoxification by cabbage:** Cabbage is a good detoxifier i.e. it purifies blood and removes toxins (primarily free radicals and uric acid which is major cause for rheumatism, gout, arthritis, renal calculi, skin diseases, eczema, hardening and de-colorization of skin etc. This detoxifying effect of cabbage is due to the presence of vitamin C and sulphur [6].

**Other benefits of Cabbage:** Cabbage, being rich in iodine, helps in proper functioning of the brain and the nervous system, apart from keeping the endocrinal glands in proper condition. Thus, it is good for brain and treatment of neurotic disorders such as Alzheimer's disease [8]. The various other nutrients present in cabbage such as vitamin-E which keeps the skin, eye and hair healthy, calcium, magnesium, potassium, etc., are very useful for overall health. The cabbage can also be used for treatment of varicose veins, leg ulcers, peptic and duodenal ulcers etc [9].

Iron is a necessary trace element found in nearly all living organisms. Iron-containing enzymes and proteins, often containing heme prosthetic groups, participate in many biological oxidations and in transport. Examples of proteins found in higher organisms include hemoglobin, cytochrome and catalase [10]. Iron deficiency anemia is one of the most common nutrient deficiencies in the world [11]. It can be caused by a low dietary intake of iron, poor iron absorption, or excessive blood loss. Signs of anemia include: constantly feeling weak and tired; short attention span; irritability; decreased performance at work or school; delayed cognitive development in infants and young children; decreased immune function leading to increased illness; swollen and red tongue (glossitis) and difficulty maintaining body temperature [12].

Folic acid (also known as folate, vitamin M, vitamin B<sub>9</sub>, vitamin B<sub>c</sub> (or folacin), pteroyl-L-glutamic acid, and pteroyl-L-glutamate) are forms of the water-soluble vitamin B<sub>9</sub>. Folate is composed of the aromatic pteridine ring linked to para-aminobenzoic acid and one or more glutamate residues. Folic acid is itself not biologically active, but its biological importance is due to tetrahydrofolate and other derivatives after its conversion to dihydrofolic acid in the liver [13]. When consumed, food folates are hydrolyzed to the mono glutamate form in the gut prior to absorption by active transport across the intestinal mucosa. Passive diffusion also occurs when pharmaceutical doses are consumed [14]. Before entering the blood stream, the mono glutamate form is reduced to tetrahydrofolate (THF) and converted to either methyl or formyl forms. The deficiency of folic acid may results to many health problems, which includes; colorectal cancer, immense bleeding of gastro intestinal tract, macrocytic anaemia, and the most notable one being birth defects in developing embryos [15]. The main aim of the research was to assess the level of iron and folic acid in cabbage.

## EXPERIMENTAL SECTION

### *Equipments and Reagents*

GBC UV-visible central 101/202/303/404 spectrophotometer was used for measuring the absorbance of the sample (iron determination). High performance liquid chromatography (BLC-20) centrifuging machine and mechanical shaker (folic acid determination). All chemicals and reagents used were of analytical grade.

### **Sample Preparation for folic acid determination**

The sample (3g of jute leaves) were extracted with 50ml of 0.1mol/L phosphate buffer pH 7.0 and 0.1% (V/V) of 2-mercaptoethanol was added. The mixture was shaken for 30 minute in a vortex shaker, and centrifuged at 3500rpm for 15 minute and filtered through a Millipore filter paper before chromatography analysis.

### **Solid phase extraction**

The stationary phase was flushed with 5mL methanol and 5mL deionized water to actuate the stationary phase, the sample extract was passed through with a flow rate of 2-3 drops and the sample was eluted with 5mL NaOH (0.005 mol/L) pH 10.0 prior to HPLC analysis. All samples were filtered through a Millipore filter and then injected into the chromatograph.

### **Procedure**

The elute was passed through the column monitored with a photodiode array detector at 282nm for folic acid. The mobile phase (pH 7.0; 90:10) KH<sub>2</sub>PO<sub>4</sub>: Methanol was filtered through a 0.5µm membrane and degassed by sonication. The flow rate was 0.7ml/min. The column was operated at room temperature.

### Iron Determination

#### Preparation of reagents

- HCl: H<sub>2</sub>O = 1:1 (36% HCl and distilled water used for the preparation of 1:1 ratio).
- 10% NH<sub>2</sub>OH.HCl solution: 10% NH<sub>2</sub>OH. HCl was prepared by dissolving 25gm NH<sub>2</sub>OH. HCl in 25ml distilled water.
- NH<sub>4</sub>OH. H<sub>2</sub>O = 1:1 (14.3N NH<sub>4</sub>OH were used for the preparation of 1:1 ratio).
- Buffer solution: Buffer (pH=5) was prepared by water containing 15ml of 1M HCl and diluted with distilled water to 250mL.
- Orthophenanthroline solution: Orthophenanthroline solution was prepared by dissolving 0.13gm Orthophenanthroline powder in a 25mL volumetric flask and diluted up to mark with distilled water. The powder was fully dissolved by shaking.
- Congo red paper: 0.1gm congo red powder was dissolved in 10ml ethanol and dried.
- Ferric ammonium sulphate solution: 0.216gm A.R. ferric ammonium sulphate was dissolved in one litre volumetric flask with distilled water and 1.25ml conc. HCl was added. The total volume was made 250ml with distilled water in this solution 1mL contains = 0.1mg Fe<sup>3+</sup> this solution was kept as stock solution and was used for the preparation of calibration curve.

### Procedure

The level of iron was determined by orthophenanthroline method. Two grams (2g) of the sample was dissolved in 2mL conc. HCl in a 250ml beaker and the solution was diluted with 100ml of distilled water. To the 20mL stock solution, 1mL of 10% NH<sub>2</sub>OH.HCl solution was added to reduce Fe<sup>3+</sup>.

5mL ortho phenanthroline solution (W/V) and one congored paper were added to the solution and the color of the paper changed from red to blue. NH<sub>4</sub>OH solution was added drop wise until it turned alkaline i.e. congored paper becomes red. 5ml of Buffer (pH=5) solution was added to the solution and filtered using whatmann – 42 filter paper, the solution was diluted with 100ml distilled water. An orange red color developed and its absorbance was measured in spectrophotometer within 10 to 20 minutes at 515nm. A blank solution was prepared by using the entire reagent by similar procedure and was used for calibration of the spectrophotometer.

## RESULTS AND DISCUSSION

**Table 1: Amount of iron (Fe) (Microgram/g) in the Cabbage**

Sample	Orthophenanthroline method			Absorbance
	A	B	C	
Cabbage	64.2	64.0	64.6	515 nm
Mean	64.27			

**Table 2: Linearity and detection limits of folic acid**

Vitamin	Linear range (mg/L)	Detection limit (mg/L)
Folic acid	0.2 – 100	0.015

**Table 3: Mean and standard deviation of folic acid (mg/l) in cabbage**

Vitamin	N	Mean±S.D (mg/L)
Folic acid	5	3.62±0.06

Cabbage had been found to be one of the vegetables that contain a proportion of iron and folic acid which helps in the treatment of constipation, stomach ulcers, headache, excess weight, skin disorders, eczema, jaundice, scurvy, rheumatism, arthritis, gout, eye disorders, heart diseases, ageing, and Alzheimer's disease [16]. Folic acid has been identified as one of the most important vitamins for normal human metabolic function, when it naturally occurs in foods; it is a B vitamin that is essential for the healthy development of a baby's spine, brain and skull during the early weeks of pregnancy [17]. Folic acid has been proven to help reduce the risk of NTDs by as much as 70% if taken before pregnancy, and has also been shown to reduce the risk of other birth defects, including cleft palate and heart abnormalities [18]. Iron is vital to the health of the human body, and is found in every human cell, primarily linked with protein to form the oxygen-carrying molecule hemoglobin [19]. The human body contains

approximately 4 grams of iron. Iron deficiency is a serious health problem affecting a large proportion of the world population or health, low work capacity, blindness and premature death [20].

### CONCLUSION

From the above study, cabbage has been shown to contain reasonable amount of iron and folic acid which in turn can serve as a source of these two minerals.

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