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DETERMINATION OF CARBOHYDRATE AND β-CAROTENE CONTENT OF SOME VEGETABLES CONSUMED IN KANO METROPOLIS, NIGERIA

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ABSTRACT
A study was carried out to determine the soluble carbohydrate and β-carotene content of some selected vegetables which include sorrel (Hibiscus subdariffa), carrot (Daucus carota) and Moringa (Moringa oleifera).Soluble carbohydrate was determined by Anthrone method Spectrophotometry at wavelength of 620nm. It was found that Moringa leaves had the highest percentage of carbohydrate (10.1%) followed by carrot with (8.7%), while sorrel had the least (7.1%). The β-carotene content was determined by spectrophotometry and the values obtained were used to estimate retinol equivalent (vitamin A content) of the vegetables. Moringa leaves were found to have the highest concentration of β-carotene (2.33 x 10^2 µg/l) followed by sorrel with 1.264 x 10^2µg/l, while carrot had the least value of 3.03 x 101µg/l. The findings of the investigation have revealed varying levels of carbohydrate and β-carotene content in the vegetables analysed which have direct bearing on their nutritional status.

Key words: Carbohydrates, β-carotene, Vitamin A, Vegetables, Kano

INTRODUCTION

Carbohydrates are compounds made up of carbon hydrogen and oxygen, thus they are regarded as hydrates of carbon represented as C (H_2O). They are of special importance as they constitute more than 50% of the dry weight of most plants (Lehninger, 1993). Carbohydrates are the most abundant bio molecules on earth; each year photosynthesis converts more than 100 billion metric tonnes of carbondioxide (CO_2) and water (H_2O) into cellulose and other plant products (Herman, 1968). Carbohydrates perform a number of functions ranging from stores of potential energy in animals to source of energy and as supporting tissues in plants (Dyke, 1960). Carotenoids on the other hand comprise a large group of natural pigments widely distributed in the plant and animal kingdoms. They are yellow-orange in colour, insoluble in water but soluble in organic solvents. They are present as pigments in many vegetables and fruits and are associated with chlorophyll in higher plants, playing important role during photosynthesis by passing on the light energy they absorb to chlorophyll, they also protect the chlorophyll from excess light and oxidation. Carotenoids are of two types: carotenes and xanthophylls. The most widespread and important carotene is β-carotene which is found abundantly in some plants. The essential role of β-carotene as a dietary source of vitamin A has been known for many years (Britton, 1995). Among the provitamin A Carotenoids in food namely beta-carotene, alpha-carotene, gamma-carotene and beta-cryptoxanthin, beta-carotene is the one that is most efficiently converted to retinol (Olson *et al*., 2000). Vitamin A is essential for a variety of biological processes, many of which are related to growth cellular differentiation and interactions of cells with each other or with extracellular matrix. Its deficiency, even in its relatively early stage, results in impairments in linear growth, cartilage and bone development and epithelial cell differentiation and function (Roberts and Sporn, 1984; Deluca, 1991).

This study was aimed at evaluating the soluble carbohydrate and β-carotene content of some selected vegetables consumed locally viz: sorrel (inflorescence), carrot and *Moringa* leaves, with a view to determining whether they meet the dietary requirement of their consumers. It is envisaged that the findings of the investigation would provide additional information on the nutritional status of the vegetables.

MATERIALS AND METHODS

Sample collection and handling

The vegetables used for this investigation were obtained from Rimi market in Kano metropolis. They were purchased at regular intervals (weekly) to ensure a supply of fresh samples throughout the period of the study. The parts of the vegetables used were as follows: Sorrel-inflorescence; Carrot-modified tap root; *Moringa*-leaves. A sample of each vegetable was washed and ground to a fine pulp using pestle and mortar. The operation was done under dim light to reduce the rate of carotene oxidation contained in them. One gramme (1g) and 10g of macerated sample were weighed using Metler PT balance for carbohydrate and β-carotene analysis respectively.

Carbohydrate analysis

One gramme(1g) of macerated sample was placed in 25ml bottle, 10ml of distilled water was then added and shaken vigorously followed by addition of 15cm^3 of 52% perchloric acid.

This was stirred continuously for 30minutes and the mixture was later filtered using Whatman no1 filter paper. One millilitre (1ml) of the filtrate was mixed with 4cm^3 of Anthrone reagent in a test tube and the absorbance of the mixture was measured using spectrophotometer at a wavelength of 620nm. The total soluble carbohydrate was then estimated using the standard curve of Glucose (Pearson *et al.*, 1976).

Pigment extraction for β-carotene analysis

This was carried out according to the method of the Association of Official Analytical Chemists (AOAC, 1980). In to a conical flask containing 50ml of 95% ethanol,10g of the macerated sample was placed and maintained at a temperature of 70-80^{o}C in a water bath for 20minutes with periodic shaking. The supernatant was decanted, allowed to cool and its volume was measured by means of a measuring cylinder and recorded as initial volume. The ethanol concentration of the mixture was brought to 85% by adding 15ml of distilled water and it was further cooled in a container of ice water for about 5minutes. The mixture was transferred in to a separating funnel and 25ml of petroleum ether (pet-ether) was added and the cooled ethanol was poured over it. The funnel was swirled gently to obtain a homogenous mixture and it was later allowed to stand until two separate layers were obtained. The bottom layer was run off into a beaker while the top layer was collected in to a 250ml conical flask. The bottom layer was transferred in to the funnel and re-extracted with 10ml pet-ether for 5-6 times until the extract became fairly yellow. The entire pet-ether was collected in to 250ml conical flask and transferred in to separating funnel for re-extraction with 50ml of 80% ethanol. The final extract was measured and poured in to sample bottles for further analysis.

Measurement of absorbance

The absorbance of the extracts was measured using a spectrophotometer (model 22UV/VIS) at a wavelength of 436nm. A cuvette containing pet-ether (blank) was used to calibrate the spectrophotometer to zero point. Samples of each extract were placed in cuvettes and readings were taken when the figure in the display window became steady. The operation was repeated 5-6 times for each sample and average readings were recorded. The concentration of β-carotene was calculated using Bear-Lamberts Law, which states that the absorbance (A) is proportional to the concentration(C) of the pigment, as represented by the equation:

$A \propto L$ (if concentration(C) is constant).

$A=ECL$; $C=A/EL$

Where:

C= concentration of carotene

A= absorbance

E=extinction coefficient

L= thickness of cuvettes (path length) =1cm

E of β-carotene =$1.25x10^4$µg/l

RESULTS

The average concentration of carbohydrates in the vegetables analysed is presented in Table 1. The values indicate that Moringa leaves had the highest concentration (110mg/ml) followed by carrot (87mg/ml), while sorrel recorded the least (71.1mg/ml). A similar pattern was observed for the β-carotene concentration as well as the retinol equivalent for the vegetables as shown in Table 2.

DISCUSSION AND CONCLUSION

Carbohydrate concentration is higher in *Moringa* followed by carrot, while sorrel had the least. Leaves of *Moringa* were used for the analysis as against modified tap root for carrot and inflorescence in the case of sorrel. Leaves are rich in starch which accounts for the observed high concentration of carbohydrate in *Moringa* leaves compared with the other vegetables .It was also observed that the final extract of the *Moringa* sample had a dark green colour compared with that of sorrel and carrot which were pale green which is indicative of higher chlorophyll content. In a similar investigation, Bassir (1980) had estimated carbohydrate content of some vegetables using the procedure of Pomoraz and Meloan (1971) and found that the content was higher in green samples compared to non-green ones.

Analysis of β-carotene content of the vegetables used in the study revealed that it was highest in *Moringa* leaves and least in carrot. This could be attributed to the close association of β-carotene to chlorophyll. In a similar investigation, Mustapha (2008) reported higher concentration of β-carotene in spinach and lettuce, which are green leafy vegetables, as against carrot. This is an indication that vegetables with higher chlorophyll content are likely to be richer in β-carotene. The findings of the study further suggest that *Moringa* leaves had higher vitamin A content compared to the other vegetables having recorded a higher retinol equivalent. This further suggests the direct association between β carotene and vitamin A.

The study has shown that carbohydrate and β-carotene content varies from one vegetable to another and with plant part. It also revealed a close association between chlorophyll and β-carotene as well as Vitamin A and β-carotene.

Table 1. Carbohydrate concentration of the vegetables analysed

Vegetable	Absorbance (620nm)	Carbohydrate concentration (mg/ml)
Sorrel	0.080	71.10
Carrot	0.097	87 .0
Moringa	0.122	110.0

Table 2. Concentration of β-carotene and retinol equivalent of the vegetables analysed

Vegetable	absorbance (436nm) (µg/l)	β-carotene concentration (µg/l)	Retinol equivalent (µg/l)
Sorrel	1.580	$1.264x10^2$	$0.211x10^2$
Carrot	0.379	$3.03x10^1$	$0.505x10^1$
Moringa	2.914	$2.33x10^2$	$0.388x10^2$

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