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Proximate Composition of Some Leafy Vegetables Use as Relish in Kano State, Nigeria

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Abstract: *The nutrient and physicochemical parameters of some leafy vegetables use as relish in kano state namely: Amaranthus hybridus, Adansonia digitata, Ceratotheca sesamoides and Moringa oleifera were determined. Moisture content ranged between 3.693% in Moringa oleifera to 13.483% in Adansonia digitata. Ash content ranged between 11.240% in Moringa oleifera to 19.693% in Amaranthus hybridus. The crude fat content was found to range from 8.160% in Ceratotheca sesamoides to 12.070% in Moringa oleifera. For the crudefibre content, it ranged between 6.330% in Moringa oleifera to 9.913% in Adansonia digitata. The crude protein content ranged between 7.440% in Adansonia digitata to 22.897% in Ceratotheca sesamoides. The carbohydrate content in the samples ranged from 41.663% in Ceratotheca sesamoides to 51.453% in Adansonia digitata. For the iodine values, the result ranges between 19.670mg/100g in Adansonia digitata to 45.260mg/100g in Moringa oleifera, while for saponification values, the result ranged between 143.990mg/g in Moringa oleifera to 257.127mg/g in Adansonia digitata. The results indicate that while the leafy vegetables could be used in fighting malnutrition, the oils obtained from them could also be used for domestic and industrial purposes.*

Keywords: *Proximate Composition, Iodine, Vegetable, Saponification, Kano.*

1. INTRODUCTION

Vegetables are the edible parts of plants that are consumed wholly or in parts, raw or cooked as part of main dish or salad. Vegetables are valued mainly for their high carbohydrate, vitamin, protein, fat and mineral contents which may be edible roots, stems, leaves, fruits or seeds (Asaolu, 2012).

Leafy vegetables are important items of diet in many Nigerian homes and are valuable sources of nutrients especially in rural areas where they contribute substantially to protein, mineral, vitamin, fiber and other nutrients which are usually in short supply in daily diets (Mosha, 1999). Traditionally, leafy vegetables are cooked and eaten as a relish together with a starchy staple food, usually in the form of porridge (Vaino- Mattila, 2000).Although there is low level of protein in vegetables, there is an increasing awareness of the importance of vegetables in maintaining health, particularly in areas where animal protein is scarce (Baker, 1997). According to Oke, (1998), vegetables contain low calories and negligible quantities of utilizable energy, hence are ideal for obese people who can satisfy their appetite without consuming much carbohydrate (Chionyedua, 2009).In villages, green leaves from wild plants are used as regular and important items of the diet and to supply essential nutrients for normal growth. Green leafy vegetables are useful regulators of the digestive tract. The green color is due to the presence of green pigments, chlorophyll. Chlorophyll is affected by pH and it changes to olive green in acidic condition and bright green in alkaline condition. Some of the acids are released in steam during cooking, particularly if cooked without cover (Aniara, 2014).

2. MATERIALS AND METHODS

2.1. Sample Collection

The four leafy vegetable samples (viz: *Amaranthushybridus*, *Adansoniadigitata*, *Ceratothecase-samoides,* and *Moringaoleifera)* were obtained from '*Yan Kaba* Market Nasarawa Local Government Area in Kano metropolis, Kano State.

2.2. Sample Preparation

The leaves were removed from their stems, washed properly with tap water to remove any soil and other dust particles, rinsed with deionized water and dried under shade to avoid direct contact with the sun. After drying for 7 days, the leaves were ground into powder using ceramic pestle and mortar, sieved with 2mm stainless steel sieve and packed and coded into an air-tight plastic container.

Proximate Composition

Moisture Content

1.0g of each of the vegetable samples was accurately weighed in an already weighed cleaned and dried porcelain crucible. The crucible was allowed in an oven at 100-105^{O}C for 6-12 hours until a constant weight was obtained. The crucible was then placed in a desiccator for 30 minutes to cool. After cooling, the crucible was weighed again (AOAC, 2003)

$$\%\text{Moisture content} = \frac{W1-W2}{W3} \times 100$$

Where;

W_1= Initial weight of sample before drying, W_2= final weight of sample after drying, W3=weight of the sample

Ash Content

An empty, cleaned and dried porcelain crucible was placed in a muffle furnace at 600^{O}C for an hour, cooled in a desiccator and weighed. 1.0g of the sample was measured in the crucible. The crucible and its content were placed in a muffle furnace at 550^{O}C for 2-4 hours. The appearance of gray white ash indicated the complete oxidation of all organic matter in the sample. After the formation of the ash, the crucible together with the ash was cooled in a desiccator and weighed (AOAC, 2003).

$$\%\text{Ash} = \frac{W2-W1}{W3} \times 100$$

Where;

W_1= Weight of empty crucible, W_2= Weight of crucible + ash, W3= Weight of the sample

Crude Fat Content

A 500cm^3 quick fit round bottom flask was washed and dried in an oven at 105^{O}C for 25minutes. It was then allowed to cool to room temperature. 3.0g of the sample was weighed in a free weighed thimble. The thimble containing the sample was inserted into the extraction column of a soxhlet extractor with a condenser connected to it. 250cm^3 of the extracting solvent (petroleum ether) was poured into the round bottom flask that was fitted into the extracting unit. The flask was heated using an electro thermal heater at 60^{O}C for hours until a clear distillate of the extracting solvent was obtained. After the extraction, the thimble containing the fat free sample was removed from the extracting column and allowed to dry at 60^{O}C in an oven until a constant weight was obtained. The weight was recorded and the fat content was expressed as a percentage of the initial weight of the sample (AOAC, 2003).

$$\%\text{Crude fat} = \frac{W2-W3}{W1} \times 100$$

Where;

W_1= Weight of the sample, W_2= Weight of thimble + sample before extraction, W_3= Weight of thimble + sample after extraction.

Crude Fibre Content

2.0g of the defatted sample was weighed in a washed, cleaned and dried 500cm^3 Erlenmeyer flask. 200cm^3 of boiling 1.25% sulfuric acid was added into the flask and the flask was set on a hot plate and a condenser was connected to it. The sample was digested for 30minutes. After that, the flask was removed from the hot plate and its content was filtered through a linen cloth in a funnel. The residue was washed subsequently with boiling water until the washing was no longer acidic. The residue was completely washed back into the flask with 200cm^3 1.25 % boiling NaOH solution. The condenser was connected to the flask and the content was boiled for 30minutes. The content was filtered through a linen cloth and washed thoroughly with boiling water until the washing was no longer basic. The residue was completely transferred to a cleaned dried crucible using a spatula. The content of the crucible was dried in an oven over night and cooled in a desiccator. The crucible and its content were weighed. The content of the crucible was ignited in a muffle furnace at 600^{O}C for 30minutes, cooled and reweighed. The loss in weight gives crude fiber contents of the samples (AOAC, 2003).

$$\%\text{Crude fiber} = \frac{W1-W2}{Wo} \times 100$$

Where;

W_o= Weight of sample taken, W_1= Weight of crucible + residue before ignition, W_2= Weight of crucible + residue after ignition.

Crude Protein Content

0.5g of the dried powdered sample was accurately weighed and completely transferred to a cleaned and dried 500cm^3 macro-kjeldahl flask. 0.5g of selenium catalyst and 3.0g of potassium sulphate (K_2SO_4) was added. 30cm^3 of concentrated sulfuric acid (H_2SO_4) was added through an automatic pipette. The flask was shaken to mix the contents. The flask was then placed on the digestion burner and the digestion was started until the mixture became bluish-green in colour. The heating during this boiling was regulated so that the sulfuric acid (H_2SO_4) condensed about middle of the way up the neck of the flask. The flask was allowed to cool and the digested sample completely transferred to a cleaned 100cm³ volumetric flasks. The digest was diluted to the mark with distilled water. 25cm^3 of boric acid was pipette into a 250cm^3 Erlenmeyer flask and 2 drops of modified methyl red indicator was added. The 500cm^3 macro-kjeldahl flask was attached to the distillation apparatus and 15cm^3 of 40% boric acid was poured into the decomposition chamber of the distillation apparatus. 10cm^3 of the digested sample was introduced into the kjeldahl flask. The end of condenser was placed at about 3cm above the surface of the boric acid (H_3BO_3) solution. The condenser was left cool (below 30^{O}C) by allowing sufficient cold water to flow through and regulate heat in order to minimize frothing and prevent suck back. The ammonia produced as ammonium hydroxide (NH_4OH) was distilled into the boric acid until the boric acid solution changed completely to bluish-green. The distillate was titrated with 0.025N hydrochloric acid (HCl) solution until the bluish-green color change completely to pink. The titre value was recorded and the percentage crude protein content of the sample was calculated. (Eno *et al.,* 2011)

$$\%\text{Crude protein} = 6.25 \times \%\text{N}$$

$$\text{and } \%\text{N} = \frac{TV \times 0.014 \times VD}{VA \times WS} \times 100$$

Where;

TV= Titre value of the sample, VD= Volume of the digest after dilution, N= Normality of HCl

VA= Volume of aliquot taken, WS= Weight of the sample used, 0.014= mili-equivalent weight of nitrogen.

Carbohydrate Content

Total percentage carbohydrate was obtained by different methods as reported by (Onyeike *et al*., (1995). This method involves adding the total values of crude protein, crude fiber, crude fat, moisture and ash contents of the sample and subtracting it from 100 (AOAC, 2003).

Percentage carbohydrate=100-(%moisture + %ash + %crude protein + % crude fat+ %crude fibre).

Saponification Value

1.0g of the sample's oil extracted was weighed and transferred to a 500cm^3 Erlenmeyer flask. 25cm^3 of 0.5M alcoholic potassium hydroxide (KOH) was added to the sample using pipette. A blank determination was prepared simultaneously with the sample. A condenser was connected to the flask and the mixture was allowed to boil gently and steadily for 30 minutes. The mixture was allowed to cool but not sufficiently to form a gel. 1.0cm^3 of phenolphthalein indicator was added to the contents of the flask. The solution was titrated with 0.5N hydrochloric acid (HCl) until the pink colour disappeared completely. The titre value was recorded and the saponification value was calculated (AOAC, 1993).

$$\text{Saponification value} = \frac{(B-S)\times 56.1 \times N}{W}$$

Where;

B= Blank titre value, S= Sample titer value, N= Normality of HCl

56.1= Concentration coefficient of KOH, W=Weight of the sample.

Iodine Value

1.0g of the sample's oil extracted was weighed and placed into a 500cm^3 volumetric flask. 15cm^3 of carbon tetrachloride was added to the sample in the volumetric flask and swirled to ensure the complete mixing of the sample. 25cm^3 of wij's solution (iodine monochloride) was added to the flask using pipette. A stopper was put to the flask and swirled to ensure complete mixing. The sample in the flask was placed in a dark for 30minutes at room temperature. The flask was removed from storage and 20cm^3 of 10% potassium iodide (KI) solution was added followed by 150cm^3 of distilled water. The mixture was titrated with 0.1N Sodium thiosulphate ($Na_2S_2O_3$) solution by adding with constant and vigorous shaking until the brown colour disappeared. 1.5cm^3 of starch indicator was added to the mixture and the titration was carried on until the blue-black colour disappeared. A blank determination was conducted simultaneously and the sample's and blank's titres were recorded (AOAC, 1993).

$$\text{Iodine value} = \frac{(B-S)\times N\times 12.69}{W}$$

Where;

B= Blank titre, S= Sample titre, N= Normality of $Na_2S_2O_3$, W= Weight of the sample

3. Results and Discussion

Results

Table: *Proximate analysis results*

Vegetables / **Parameters**	***A.hybridus***	***A.digitata***	***C.sesamoides***	***M.oleifera***		
M.C(%)	5.640±0.231^a	13.483±0.386^a	6.827±0.015^a	3.693±0.250^a		
A.C(%)	19.693±0.078^b	8.913±0.076^a	12.613±0.064^b	11.240±0.010^a		
C.F.C(%)	8.860±0.098^c	8.797±0.110a	8.160±0.085^c	12.070±0.087^a		
F.C(%)	9.720±0.157^d	9.913±0.090^a	8.143±0.105^d	6.330±0.118^a		
P.C(%)	11.930±0.619^e	7.440±0.762^a	22.897±0.672^e	18.397±1.542^a		
C.C(%)	44.127±1.038^f	51.453±0.515^a	41.663±0.251^f	48.270±1.893^a		
S.V(mg/g)	199.157±2.805^a	257.127±1.617^b	185.133±2.805a	143.990±3.239^b		
I.V(mg/100g)	31.517±0.370^a	19.670±0.630^a	29.613±0.367a	45.260±0.364^a		

Mean ± standard deviation with different letters in the same row are significantly different at P<0.05. M.C=Moisture content, A.C=Ash content, C.F.C=Crude fat content, F.C=Fiber content, P.C=Protein content, C.C=Carbohydrate content, S.V=Saponification value, I.V=Iodine value

Discussion

The moisture content of the vegetable samples analysed ranged from 3.693 to 13.483% with *M.oleifera* having the lowest value and *A.digitata* with the highest value (Table). Abiona *et al.*, (2015) reported the moisture content level of *A.digitata* to be (78.20%) which is significantly higher than that of the A.digitata (13.483%) obtained in this work. Mgbemena and Obodo, (2016) reported the

moisture content of *M.oleifera* leaves as 4.84% which is slightly higher. The scores are low and could be attributed to the period of sampling which was about onset of dry season/ the harmattan period, a season characterized by intensive sunlight and dryness. Moisture content makes important contribution to the texture of the leaves and help in maintaining the protoplasmic content of the cells.

For ash content, the result ranged between 8.913% in *A.digitata* to 19.693% in *A.hybridus* (Table). Akinbosun and Areola (2015) have reported a very low ash content value in *A.hybridus* as 5.10% which is lower when compared to that of the sample analyzed in this work. Abiona *et al*., (2015) and Ayodeji, (2018) have reported a low value of 4.08% and 7.34% respectively when compared to that of the *A.digitata*and *H.sabdariffa* analyzed. The analyzed leafy vegetables were found to be rich in ash. Lienel (2002) observed that ash content is an important tool in evaluating nutritional quality of food since it indicates the general mineral contents of foods. These values indicate that these leafy vegetables species may be considered as good sources of minerals when compared to values (2-10%) obtained for cereals and tubers.

In the determination of crude fat content, 8.160±0.085 was obtained in *C.sesamoides* as the least value and 12.070±0.087 in *M.oleifera* as the highest value(Table). For the crude fat content in *M.oleifera*, Mgbemena and Obodo, (2016) have recorded almost similar value of 11.50% as that of the *M.oleifera* analyzed. The crude fat content obtained which ranges from 8.160% in *C.sesamoides* to 12.070% in *M.oleifera* confirmed the findings of many authors which showed that leafy vegetables are poor sources of lipids (Ejoh*et al*., 1996). However, it is important to note that diet providing 1-2% of its caloric energy as fat is said to be sufficient to human beings, as excess fat consumption leads to cardiovascular disorders such as atherosclerosis, cancer and aging(Kris-Etherton *et al*., 2002). Therefore, the consumption of these leafy vegetables in large amount may be recommended to individuals suffering from obesity.

The crude fiber contents ranged from 6.330% in *M.oleifera* to 9.913% in *A.digitata* (Table 1). Edogbanya (2016) and Abiona *et al.,* (2015) reported a relatively low values of 5.70% and 2.45% crude fiber content respectively in *A.digitata* sample. This result showed that virtually all these selected leafy vegetables have an appreciable level of crude fiber content with *A.digitata* having recorded the highest composition of 9.913%. This score suggested that it can be recommended for patients with constipation/dyspepsia. Fiber is well known for maintaining bulk, motility and increasing peristalsis by surface extension of the food in the intestinal tract (Meyer 2004; Mc Donald *et al*., 1995; Sizer and Whitney, 2003).

The protein content determined in the samples ranges from 7.440% to 22.897% with *C.sesamoides* having the highest value and *A.digitata* with the lowest value(Table 1). The result obtained in *A.digitata* as 7.440±0.762% is in accord with the result of 5.700% determined by Edogbanya (2016). *For C.sesamoides* (22.897±0.672%) and *M.oleifera* (18.397±1.542%) which have gotten almost similar values, Ijeomah *et al*., (2012) and Offor *et al*., (2014) reported a crude protein values in samples same as the ones mentioned above as 28.83% and 24.2% respectively and the result is in accord with the findings of this research. Considering the corroboration of the results of the analyzed samples with the results of the literature reports of the same samples, it can simply be concluded that these leafy vegetables are generally rich sources of protein irrespective of their areas of cultivation.

The iodine value among the samples analyzed was found to range from 19.670mg/g in *A.digitata* to 45.260mg/g in *M.oleifera,* (Table). Guy *et al.,* (2013) reported the iodine value to range from 79.10mg/100g in sirkarzie oil to 86.93mg/100g in F-mix oil. The least iodine value obtained in this literature is even much higher than the highest value reported in this research and this simply signifies that the two results are not in agreement with each other. Since the iodine values obtained in the leafy vegetable oils analyzed in this study fell below 100mg/100g, they could be classified as non-drying oils and this could qualify them to be used in the paint industry, (Akubugwo and Ugbogu, 2007).

In the Saponification value determination, the result was found to range from 143.990mg/100g in *M.oleifera* to 257.127mg/100g in *A.digitata* (Table). Umarani*et al*., (2008) reported the saponification value of some vegetable oils and the result ranged from 186.20mg/g in Sesame oil to 205.18mg/g in Almond oil. This result is in agreement with the findings of this work. In another literature titled nutrient contents and lipid characterization of seed pastes of four selected peanut (*Arachishypogaea*) varieties from Ghana, Guy *et al*., (2013) reported the Saponification values to range from 144.70mg/g to 208.97mg/g which is also in agreement with the result of the samples analyzed in this research. The saponification value obtained in this research and that of the literatures reported indicates that the oils

contain a large number of fatty acid of low molecular weight and hence useful in the soap industries and in the manufacture of lather shave creams, (Onyeike and Oguike, 2003). The saponification value is only of interest if the oil is going to be used for industrial purposes as it has no nutritional significance, (Asiedu, 1989).

4. CONCLUSION

The nutritive analyses of leafy vegetables that are used as relish in Kano state were found to be rich in carbohydrate content. They contains appreciable amount of crude protein, crude fiber, ash content but low moisture and crude fat contents. They were also found to contain oils with appreciable amount of saponification and iodine values. This recommends them to be classified as non-drying oils and at the same time oils that contains large number of fatty acids of low molecular weight which hence qualifies them to be used in the paint and soap industries respectively.

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