

## Effect of processing methods on chemical and consumer acceptability of kenaf and corchorus vegetables

Ashaye Olukayode.Adebayo

(\* author for correspondence)

Institute of Agricultural Research and Training P.M.B 5029

Moor-Plantation Ibadan

[kayodeashaye@yahoo.com](mailto:kayodeashaye@yahoo.com)

**Abstract:** Kenaf leaves are rich in nutrients with satisfactory protein digestibility. *Corchorus olitorius* (*Ewedu*) popularly consumed in West Africa is also known to be rich in nutrients. There is however little information about the cooking properties and utilization of kenaf leaves in human diet. The effect of processing methods on chemical and consumer acceptability of Kenaf and *Corchorus* vegetables were investigated. Freshly harvested kenaf leaves (Ife-ken 400, Cuba 108 and Ife-ken 100) and *Corchorus Olitorious* (*C. Olitorius*) were blanched and cooked, cooked and dry and cooked were subjected to chemical analysis such as (Protein, fat ,crude fibre, ash, moisture and vitamin C). Sensory evaluation was by a ten member panel randomly selected from male and female adults. Cooked *C.Olitorius* was significantly higher in crude fibre (1.67%), ash (3.36%) and vitamin C (27.13 ). Cooked Ife ken 400 was higher in crude protein (1.70%), Crude fat (0.48%), crude fibre (1.54%), ash (3.36%) and vitamin C(21.32) when it was compared with other treated kenaf leaf samples. Cooked vegetables were higher in compositional attributes than blanched and cooked vegetables and dry and cooked vegetables. Dry and cooked *C.Olitorius* was significantly higher in colour (7.7), taste (7.4) and mouth feel (7.1). There was no significant difference in flavour of processed vegetable samples. Cooked *C.Olitorius* was higher in overall acceptability (7.1). In general processing methods did not adversely alter the quality of the processed leafy vegetables and processed kenaf leaves compared favourably well with *C.Olitorius* in compositional and sensory attributes. [Journal of American Science 2010;6(2):165-170]. (ISSN:1545-1003).

**Keywords:** kenaf, cooked, processing , *Corchorus olitorius*, sensory

### Introduction

Leafy vegetables play crucial roles in alleviating hunger and food security and that is why they are very important in the diet of many people. Apart from the variety which they add to the menu. They are valuable sources of nutrients where they contribute substantially to protein, mineral, vitamins, fiber and other nutrients which are usually in short supply in daily diets ( Solanke and Awonorin, 2002). In addition to their high concentration of micronutrients, vegetables provide little dietary energy, making them valuable in energy limited diets. The fibre content has been reported to have beneficial effects on blood cholesterol and aids in the prevention of large bowel diseases, while in diabetic subjects, they improve glucose tolerance. They also add flavour, variety, taste, colour and aesthetic appeal to what would otherwise be a monotonous diet. They are in abundance shortly after the rainy season but become scarce during the dry season during which cultivated types are used.

Kenaf ( *Hibiscus cannabinus L* ) is a warm season annual herbaceous plant closely related to cotton (*Gossypium hirsutum*) and okra (*Abelmoschus esculentus*).Its leaves are low in calories and rich in protein and essential oils such as (E)-phytol (28.16%), (Z)-phytol (8.02%), n-nonanal (5.70%), benzene acetaldehyde (4.39%), (E)-2-hexenal (3.10%), and 5-methylfurfural (3.00%) when compared to other leafy vegetables. The leaves are also rich in calcium and phosphorus and have appreciable amounts of Vitamin C. The seeds are rich in essential fatty acids and calories. (Kobaisy *et al.*, 2001)

*Corchorus Olitorius* is a very popular vegetable in West Africa. The young shoot tips can be eaten raw or cooked and it contains high levels of protein and vitamin C

Leafy vegetables are sometimes processed by blanching which is an important pre-processing heat –treatment of vegetable destined for freezing, canning or dehydration. They are also cooked or dried depending on the mode of utilization.(Shittu and Ogunmoyela 2001).

There is however little information about the cooking properties and utilization of kenaf leaves in human diet. Therefore, the need for detail study on the contribution and suitability of kenaf leaf to human diet.

This work is therefore aimed at evaluating the effect of processing methods on chemical composition and consumer acceptability of new and exotic varieties of kenaf and *corchorus* leaves.

## Materials and Methods

### Raw materials

Freshly harvested kenaf leaves (Ife ken 400, cuba 108 and Ife ken 100 ) and corchorus leaves were obtained from the experimental farm of the Institute of Agricultural Research and Training (I. A. R. & T.), Moor Plantation, Ibadan Nigeria. The fresh samples were blanched and cooked, dry and cooked and cooked.

### Blanching and cooking process

The freshly harvested vegetable leaves (100gm) were thoroughly cleaned in water to removed extraneous matter before soaking in 200mls of hot water for 30 seconds after which they chopped and cooked for 10minutes. A pinch of salt was added to taste

### Drying and cooking process

The freshly harvested vegetable leaves (100gm) were thoroughly cleaned in water to removed extraneous matter. They were then chopped and dried for 24hours at 55°C before cooking in water for 10mins. A pinch of salt was added to taste

### Cooking process

The freshly harvested vegetable leaves(100gm) were thoroughly cleaned in water to removed extraneous matter. They were then chopped before cooking in water for 10mins. A pinch of salt was added to taste

## Chemical analysis

### Determination of Crude Protein

The micro-Kjeldahl method for protein determination is employed for protein determination. This is based on three principles:

Digestion:  $\text{RNH}_2 + 2\text{H}_2\text{SO}_4 \longrightarrow (\text{NH}_4)_2 + \text{SO}_4 + \text{CO}_2 + \text{H}_2\text{O}$

Distillation:  $(\text{NH}_4)_2 \text{SO}_4 + 2\text{NaOH} \longrightarrow (\text{NH}_3 + \text{H}_2\text{O} + \text{Na}_2\text{SO}_4$

Absorption:  $3\text{NH}_3 + \text{H}_3\text{BO}_3 \longrightarrow (\text{NH}_4)_3 \text{BO}_3$

Titration:  $(\text{NH}_4)_3 \text{BO}_3 + \text{HCl} \longrightarrow \text{H}_3\text{BO}_3 + 3\text{NH}_4\text{Cl}$

## Procedure

The sample (0.5g) was weighed into the micro-Kjeldahl flask. To this were added 1 Kjeldahl catalyst tablet and 10ml of conc.  $\text{H}_2\text{SO}_4$ . These were set in the appropriate hole of the digestion block heaters in a fume cupboard. The digestion was left on for 4 hours after which a clear colourless solution was left in the tube. The digest was carefully transferred into 100ml volumetric flask, thoroughly rinsing the digestion tube with distilled water and the volume of the flask made up to the mark with distilled water. 5ml portion of the digest was then pipetted to Kjeldahl apparatus and 5ml of 40% ( $\text{w/v}$ ) NaOH added.

The mixture was then steam distilled and the liberated ammonia collected into a 50ml conical flask containing 10ml of 2% boric acid plus mixed indicator solution. The green colour solution was then titrated against 0.01 NHCl solution. At the end point, the green colour turns to wine colour, which indicates that, all the nitrogen trapped as ammonium borate have been removed as ammonium chloride. The percentage nitrogen was calculated by using the formula:

$\% \text{ N} = \text{Titre value} \times \text{atomic mass of nitrogen} \times \text{normality of HCl used} \times 4$

The crude protein is determined by multiplying percentage nitrogen by a constant factor of 6.25 (AOAC, 1990).

### Crude Fat Determination

The sample (1g) was weighed into fat free extraction thimble and plug lightly with cotton wool. The thimble was placed in the extractor and fitted up with reflux condenser and a 250ml soxhlet flask which has been previously dried in the oven, cooled in the dessicator and weighed. The soxhlet flask is then filled to  $\frac{3}{4}$  of it volume with petroleum ether (b.pt. 40 – 60°C) and the soxhlet flask extractor plus condenser set was placed on the heater. The heater was put on for six hours with constant running water from the tap for condensation of ether vapour. The set is constantly watched for ether leaks and the heat sources is adjusted appropriately for the ether to bril gently. The ether is left to siphon over several times at least 10 – 12 times until it is short of siphoning. It is after this is noticed that any ether content of the extractor is carefully drained into the ether stock bottle. The thimble-containing sample is then removed and dried on a clock glass on the bench top. The extractor flask with condenser is replaced and the distillation continues until the flask is practically dried. The flask which now contains the fat or oil is detached, its exterior cleaned and dried to a constant weight in the oven (AOAC,

1990). If the initial weight of dry soxhlet flask is  $W_0$  and the final weight of oven dried flask + oil/fat is  $W_1$ , percentage fat/oil is obtained by the formula:

$$\frac{W_1 - W_0}{\text{Weight of sample taken}} \times \frac{100}{1}$$

### Crude Fibre Determination

The sample (2g) was accurately weighed into the fibre flask and 100ml of 0.25NH<sub>2</sub>SO<sub>4</sub> added. The mixture was heated under reflux for 1 hour with the heating mantle. The hot mixture was filtered through a fibre sieve cloth. The filtrate obtained was thrown off and the residue was returned to the fibre flask to which 100ml of (0.31NNaOH) was added and heated under reflex for another 1 hour.

The mixture was filtered through a fibre sieve cloth and 10ml of acetone added to dissolve any organic constituent. The residue was washed with about 50ml hot water twice on the sieve cloth before it was finally transferred into the crucible. The crucible and the residue was oven-dried at 105°C overnight to drive off moisture. The oven-dried crucible containing the residue was cooled in a dessicator and later weighed to obtain the weight  $W_1$ . The crucible with weight  $W_1$  was transferred to the muffle furnace for ashing at 550°C for 4 hours. The crucible containing white or grey ash (free of carbonaceous material) was cooled in the dessicator and weighed to obtain  $W_2$ . The difference  $W_1 - W_2$  gives the weight of fibre (AOAC, 1990). The percentage fibre was obtained by the formula:

$$\% \text{ Fibre} = \frac{W_1 - W_2}{\text{Weight of sample}} \times 100$$

### Determination of Ash

The sample (2g) was weighed into a porcelain crucible. This was transferred into the muffle furnace set at 550°C and left for about 4 hours. About this time it had turned to white ash. The crucible and its content were cooled to about 100°C in air, then room temperature in a desiccator and weighed (AOAC, 1990).

The percentage ash was calculated from the formula below:

$$\% \text{ Ash content} = \frac{\text{Weight of ash}}{\text{Original weight of sample}} \times \frac{100}{1}$$

### Moisture content Determination

The sample (2g) was weighed into a previously weighed crucible. The crucible plus sample taken was then transferred into the oven set

at 100C to dry to a constant weight for 24 hours overnight. At the end of the 24 hours, the crucible plus sample was removed from the oven and transferred to desiccator, cooled for ten minutes and weighed (AOAC, 1990).

If the weight of empty crucible is  $W_0$

Weight of crucible plus sample is  $W_1$

Weight of crucible plus oven dried sample  $W_3$

$$(\% \text{ Moisture}) = \frac{W_1 - W_3}{W_1 - W_0} \times \frac{100}{1}$$

### Determination of Vitamin C:

Ascorbic acid was determined using the procedure described by Kirk and Sawyer (1991). Standard indophenol's solution was prepared by dissolving 0.05g 2,6-dichloro Indophenol in water diluted to 100ml and filtered. To standardize, 0.053g of ascorbic acid was dissolved in 90ml of 20% metaphosphoric acid and diluted with water to 100ml. 10ml of this solution was pipette into a small conical flask and titrated with indophenol's solution until a faint pink colour persists for 15seconds. 2ml of the extracted juice from the calyces was pipette into a conical flask and 5ml of 20% metaphosphoric acid (as stabilizing agent) was added and made up to 10ml mark with water. It was titrated with the indophenols solution a faint pink colour persists for 15seconds. The vitamin content in the calyces was calculated

$$\text{Vitamin C in mg/100g} = \frac{\text{Titre value} \times 0.212 \times 100}{\text{Wt of sample}}$$

### Sensory evaluation

Sensory evaluation of vegetable samples were on the basis of colour, taste, flavour mouth feel and overall acceptability using ten membered untrained male and female adults that are familiar with the product in question. They were independently evaluated using the difference technique described by Larmond (1977). The nine-point hedonic scale was used to determine the preference of panelist. Ratings were from (1-9). One corresponding with extreme dislike and nine with extreme likeness.

Data generated were subjected to statistical analysis using Duncan Multiple range test (Duncan, 1955)

### Results and discussion

Table 1 depicts the effect of different processing methods on chemical composition of kenaf and corchorus leaves. In blanched and cooked vegetables, Corchorus vegetables was significantly higher than other blanched and cooked kenaf vegetables in protein, fat, crude fibre, ash and vitamin C although blanched and cooked Ife-ken 400 was significantly higher than other blanched and cooked kenaf based vegetables in proximate compositional attributes. The differences observed may be due to varietal influence (Richard *et al.*, 2007, Oboh 2005, Ado 1993)

In cooked vegetables, it was also seen that cooked corchorus leaves was higher in proximate parameters with cooked Ife-ken 400 being significantly higher than other cooked kenaf vegetables in protein, fat, crude fibre, ash, and vitamin C. There was no significant difference in the moisture content of cooked vegetable samples

at  $p < 0.05$ . Cooking is popularly known to decrease the nutrient attributes of foods ( Oladumoye *et al.*, 2005, Oteng-Gyang and Machi 1987)

In dry and cooked vegetables, dry and cooked Corchorus leaves was higher in protein, fat, crude fibre and vitamin C. There was no significant difference in the ash contents of dry and cooked corchorus and cuba (108) kenaf leaves. The moisture content of all dry and cooked vegetables were not significantly different from each other. This finding agreed with the report of Oshodi (1992) about variability in the compositional attributes of some dried vegetables.

In general kenaf cooked leafy vegetables were higher in compositional attributes than blanched and cooked vegetables and dry and cooked vegetables. Processed kenaf vegetables compared favourably well with processed corchorus vegetables.

**Table 1. Effect of processing methods on chemical composition of Kenaf and corchorus leaves.**

	Protein (%)	Fat (%)	Fibre (%)	Ash (%)	Moisture (%)	Vitamin C Mg/100g
Blanched/Cooked						
C.Olitorius	1.82 <sup>a</sup>	0.47 <sup>c</sup>	1.55 <sup>b</sup>	3.27 <sup>c</sup>	85.78 <sup>a</sup>	26.31 <sup>b</sup>
Ife-ken (400)	1.63 <sup>d</sup>	0.43 <sup>d</sup>	1.46 <sup>c</sup>	2.96 <sup>f</sup>	87.35 <sup>a</sup>	18.23 <sup>d</sup>
Cuba (108)	1.22 <sup>h</sup>	0.21 <sup>h</sup>	1.22 <sup>g</sup>	2.33 <sup>k</sup>	89.58 <sup>a</sup>	13.19 <sup>f</sup>
Ife-ken (100)	1.14 <sup>i</sup>	0.24 <sup>g</sup>	1.25 <sup>f</sup>	2.47 <sup>j</sup>	89.25 <sup>a</sup>	9.83 <sup>i</sup>
Cooked						
C.Olitorius	1.93 <sup>a</sup>	0.62 <sup>a</sup>	1.67 <sup>a</sup>	3.51 <sup>a</sup>	88.35 <sup>a</sup>	27.13 <sup>a</sup>
Ife-ken (400)	1.70 <sup>c</sup>	0.48 <sup>c</sup>	1.54 <sup>b</sup>	3.36 <sup>b</sup>	88.70 <sup>a</sup>	21.32 <sup>c</sup>
Cuba (108)	1.53 <sup>e</sup>	0.43 <sup>d</sup>	1.35 <sup>e</sup>	3.22 <sup>d</sup>	88.74 <sup>a</sup>	18.23 <sup>d</sup>
Ife-ken (100)	1.29 <sup>g</sup>	0.29 <sup>f</sup>	1.24 <sup>f</sup>	3.16 <sup>e</sup>	89.04 <sup>a</sup>	14.65 <sup>e</sup>
Dry and cooked						
C.Olitorius	1.72 <sup>b</sup>	0.52 <sup>b</sup>	1.47 <sup>c</sup>	2.83 <sup>g</sup>	87.57 <sup>a</sup>	12.75 <sup>g</sup>
Ife-ken (400)	1.47 <sup>e</sup>	0.37 <sup>e</sup>	1.24 <sup>f</sup>	2.64 <sup>h</sup>	87.74 <sup>a</sup>	9.33 <sup>j</sup>
Cuba (108)	1.51 <sup>f</sup>	0.45 <sup>d</sup>	1.40 <sup>d</sup>	2.80 <sup>g</sup>	86.99 <sup>a</sup>	11.53 <sup>h</sup>
Ife-ken (100)	1.30 <sup>g</sup>	0.28 <sup>f</sup>	1.16 <sup>h</sup>	2.54 <sup>i</sup>	88.55 <sup>a</sup>	8.46 <sup>k</sup>

Means in the same column followed by the same letter are not significantly different from each other at  $P < 0.05$

Table 2 describes the effect of different processing methods on sensory properties of kenaf and corchorus leaves.

The colour of dry and cooked corchorus olitorius was significantly higher than other processed vegetables. Dry and cooked Ife-ken (400) and cuba (108) kenaf vegetables were not significantly different from cooked Ife-ken (400) and cooked cuba (108). This indicates that drying process did not mar their colour. It was also observed that blanched and cooked cuba (108) and

blanched and cooked Ife-ken (100) were not significantly different from cooked cuba (108) and cooked Ife-ken (100). Blanching did not adversely affect the colour of the vegetables. This finding agreed with the report of (Nantawan and Weibiao 2009, Onayemi and Badifu 1989 ). The taste of dry and cooked corchorus olitorius was significantly higher than other treated vegetables at  $p < 0.05$ . However, the taste of dry and cooked Ife-ken 400, dry and cooked cuba (108), cooked Ife-ken (400), blanched and cooked cuba (108) and blanched and

cooked Ife-ken (1000 were not significantly different from each other. This is an indication of the fact that the different processing methods did not adversely affect their taste. Hudson and Janice (2004) reported the similar trend with dehydrated cowpea leaves.

The flavour of all processed vegetables were not significantly different from each other at  $p < 0.05$ . Processing methods did not adversely affect the flavour of the vegetables (Hudson and Janice 2004).

Dry and cooked *corchorus olitorius* was also significantly higher in mouthfeel at  $p < 0.05$ . Dry and cooked Ife-ken (400), dry and cooked cuba (108) and cooked Ife-ken (400) were not significantly different from each other at  $p < 0.05$ .

Blanched and cooked cuba (108), blanched and cooked Ife-ken (100), cooked cuba (108) and dry and cooked Ife-ken (100) are all significantly lower than other treated vegetables in mouth feel but are not significantly different from each other.

General acceptability scores showed that cooked *corchorus olitorius* was higher and all blanched and cooked vegetables with dry and cooked vegetables were not significantly different from each other at  $p < 0.05$ . Cooked kenaf vegetable (108) was significantly lower than others.

It is therefore of noteworthy that acceptable sensory scores were given to processed kenaf leaves and none was rejected.

Table 2. Effect of processing methods on sensory properties of Kenaf and *corchorus* leaves.

	Colour	Taste	Flavour	Mouth feel	General acceptability
Blanched/Cooked					
C.Olitorius	7.00 <sup>abc</sup>	6.50 <sup>abc</sup>	6.60 <sup>a</sup>	6.20 <sup>abc</sup>	6.10 <sup>ab</sup>
Ife-ken (400)	6.20 <sup>bcd</sup>	5.30 <sup>c</sup>	5.90 <sup>a</sup>	5.70 <sup>abc</sup>	5.70 <sup>ab</sup>
Cuba (108)	5.80 <sup>cd</sup>	5.50 <sup>bc</sup>	5.40 <sup>a</sup>	5.00 <sup>c</sup>	5.80 <sup>ab</sup>
Ife-ken (100)	5.80 <sup>cd</sup>	5.50 <sup>bc</sup>	5.30 <sup>a</sup>	5.10 <sup>c</sup>	5.60 <sup>ab</sup>
Cooked					
C.Olitorius	7.50 <sup>ab</sup>	7.00 <sup>ab</sup>	6.70 <sup>a</sup>	6.90 <sup>ab</sup>	7.10 <sup>a</sup>
Ife-ken (400)	5.90 <sup>cd</sup>	5.60 <sup>bc</sup>	5.90 <sup>a</sup>	5.6 <sup>bc</sup>	5.50 <sup>ab</sup>
Cuba (108)	5.90 <sup>cd</sup>	5.20 <sup>c</sup>	5.90 <sup>a</sup>	5.30 <sup>c</sup>	5.20 <sup>b</sup>
Ife-ken (100)	6.10 <sup>cd</sup>	6.10 <sup>abc</sup>	6.40 <sup>a</sup>	6.30 <sup>abc</sup>	6.20 <sup>ab</sup>
Dry and cooked					
C.Olitorius	7.7 <sup>a</sup>	7.4 <sup>a</sup>	6.60 <sup>a</sup>	7.10 <sup>a</sup>	6.70 <sup>ab</sup>
Ife-ken (400)	5.60 <sup>cd</sup>	5.60 <sup>bc</sup>	6.00 <sup>a</sup>	5.40 <sup>bc</sup>	5.80 <sup>ab</sup>
Cuba (108)	5.80 <sup>cd</sup>	5.70 <sup>bc</sup>	6.00 <sup>a</sup>	5.50 <sup>bc</sup>	5.70 <sup>ab</sup>
Ife-ken (100)	5.40 <sup>d</sup>	5.30 <sup>c</sup>	5.40 <sup>a</sup>	5.00 <sup>c</sup>	5.50 <sup>ab</sup>

Means in the same column followed by the same letter are not significantly different from each other at  $P < 0.05$ .

## Conclusion

Cooked leafy vegetable samples were higher in compositional attributes than blanched and cooked vegetables and dry and cooked vegetables. Also Ife-ken (400) was significantly higher than other processed kenaf vegetables in protein, crude fat, crude fibre and vitamin C.

Acceptable sensory scores were given to processed kenaf leaves and none was rejected.

In general processing methods did not adversely alter the quality of the processed leafy vegetables. Processed kenaf leaves from Ife-ken (400), Cuba (108) and Ife-ken (100) compared favourably well with *corchorus olitorius* in compositional and sensory attributes and can be used as an alternative to *corchorus olitorius*.

## Correspondence to:

Ashaye Olukayode Adebayo  
Institute of Agricultural Research and Training  
Obafemi Awolowo University  
P.M.B 5029  
Moor-Plantation Ibadan, Nigeria  
Mobile phone: +2348023253829  
Emails: [kayodeashaye@yahoo.com](mailto:kayodeashaye@yahoo.com);  
[kayodeashaye@softhome.net](mailto:kayodeashaye@softhome.net)

## References

[1] Ado A.A 1983. Ascorbic acid contents of foods commonly consumed in the Northern states of Nigerian. *Nigerian Food Journal*; **1**:129-133.

- [2] AOAC. 1990 “*Official Method of Analysis*”, 15<sup>th</sup> edn., Association of Official Analytical Chemists. Washington D C.,
- [3] Duncan DB (1955). Multiple range and Multiple F tests, *Biometrics*, vol11 No 1 pp1-5
- [4] Hudson N and Janice R 2004. Multivariate analysis of the sensory changes in the dehydrated cowpea leaves *Talanta* 64:1:23-29
- [5] Kobaisy M, Tellez M.R, Webber C.L, Dayan F.E Schrader K.K and Wedge D.E 2001. Phytotoxic and fungitoxic activities of the essential oil of kenaf (*Hibiscus cannabinus* L ) leaves and its composition *J Agric Food Chemistry* 49:8:3768-3771
- [6] Larmond E. 1977 *Laboratory Methods for Sensory Evaluation of Foods*. Publication No.1637, Research branch, Department of Agriculture, Ottawa,Canada
- [7] Nantawan T and Weibiao Z 2009. Characterization of microwave vacuum drying and hot air drying of mint leaves ( *Mentha cordifolia* opiz fresen). *Journal of Food Engineering* 91:3:482-489.
- [8] Oboh G 2005. Effect of some post harvest treatments on the nutritional properties of *cnidoscolus acotifolus* leaf. *Pakistan journal of Nutrition* 4:4:226-230
- [9] Oladunmoye OO, Ojeniyi S and AO Bankole 2005. Mineral Composition of tender and matured cassava leaves after home cooking procedures. *Proceedings: 29<sup>th</sup> Annual Conference of the Nigerian Inst. Of Food Science and Technology*. Eboyi State University, Abakaliki, 151-152.
- [10] Onayemi O and Badifu G.I.O 1987. Effect of blanching and drying methods on the nutritional and sensory quality of leafy vegetables. *Plant Foods for Human Nutrition* 37:291-298.
- [11] Oshodi A.A 1992. Comparison of proteins, minerals and vitamin C content of some dried leafy vegetables. *Pakistan Journal of Science Industrial Research* 35:267-269.
- [12] Oteng - Gyang K and Ji Machu 1987 Changes in the ascorbic acid content of some tropical leafy vegetable during traditional cooking and local processing *Food Chemistry* 23:9-17.
- [13] Richard A.E, Djuikwo U.N, Gouado I and Mbofung C.M 2007. Effect of the method of processing and preservation on the quality parameters of three Non-conventional leafy vegetables. *Pakistan Journal of Nutrition* 6:2:128-133.
- [14] Shittu TA and OA Ogunmoyela 2001 Water blanching treatment and nutrient retention in some Nigerian green leafy vegetables. *Proceedings: 25 the Annual Conference of the Nigerian Institute of Food Science and Technology, Lagos*, 64-65.
- [15] Solanke Of and SO. Awonorin 2002 Kinetics of vitamin C degradation in some tropical green leafy vegetables during blanching. *Nigerian Food Journal* 24-32.

9/25/2009