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THERMAL DEGRADATION AND ESTIMATION OF DIETARY INTAKES OF VITAMIN C FROM FRUITS AND VEGETABLES

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ABSTRACT

Thermal degradation of vitamin C in eight different vegetables were determined. These comprised Onion, Tomato, Red Pepper, Spinach, Okra, Green Beans, Cauliflower, and Cabbage. Maximum degradation was observed in Tomato with 83% loss while minimum loss of 37% was in Red Pepper. An estimate of adult dietary intake of Vitamin C was carried out with an increased number of samples, the mean dietary intake of 147mg/day was found. Application of t-test indicates significant difference existed between the two classes of peoples studied (t_{cal} = 6.443, and P=0.05)and standard deviation was found to be ±101.

Key words: Thermal degradation, dietary intake and Vitamin C

INTRODUCTION

Vitamin C is known for its antioxidant, anticancerouss and other health promoting properties (Remesh,2005).Deprivation of the vitamin in human being causes deterioration of number of physiological functions. Resulting in scurvy and death following syncope (Raymond and Othmer, 1948). VitaminC is unstable to heat in the presence of oxygen and cooking causes hydrolysis of lectone ring of the vitamin destroying its activities (Pyke, 1977; Devlin, 1992).

$$\underset{\textbf{L – Ascorbic acid}}{C_6H_8O_6} \longrightarrow \underset{\textbf{Dehydroascorbic}}{C_6H_6O_6} \longrightarrow \underset{\textbf{2, 3 – Diketo – L – gulonic acid}}{CO_2HCOCOCOH_2COH_2OH}$$

Antonelli et al. (2000), reported that vitamin C is the less stable among the vitamin and is sensitive to light, heat and air. Deficiency of the vitamin C results from poor diet and or increased need (Devlin, 1992). Population subject to vitamin C deficiency are alcoholics, people under chronic stress and infants fed exclusively on cow's milk (Garba, 2004).

The symptoms of scurvy include anaemia, poor wound healing, loss of appetite, stunted growth, swollen and inflame gum and other symptoms, although overt scurvy is no longer a common diagnosis in the United States and other industrialised countries, nevertheless a review of the clinical literature reveals that scurvy may be resurgent (Jeffrey et al, 1999). Although scurvy is a disease of the past found only in specific subgroup (e.g. alcoholics, institutionalised elderly).disturbing diseases in developing countries.when plasma comcentration of vitamin C are marginal (11 to 28µmol/L).the body's pool of vitamin C is depleted and subclical scurvy results which is not easy to diagnose compare to overt scurvy because its symptoms are non specific among adults 25% of the male non smokers have marginal plasma vitamin C (Jeffry et al, 1999). Although, the aim in cooking was to make the cooked vegetables look attractive and taste well with the loss of nutrient a secondary consideration. Despite the fact that many investigators reported in the literature that, open cooking of vegetables is very destructive to vitamin C. Faith et al, (1936) reported a loss of 75% of vitamin C during cooking of peas. Henry and Gramah (2005) reported a loss of 43% of cooked peas and Faith et al, (1936) listed peas in a group of vegetables losing 40 to 80% of their vitamin C during a short cooking period.

Poor nutritional status of both adult and children could thus, be attributed to the effect of conventional cooking method because it causes significant loss of nutrient in terms of vitamin C. although most of the vegetables and fruits studied are rich sources of vitamin C and are consumed in cooked forms in our daily meals. The actual vitamin C contribution of these foods to total vitamin C intakes is important for nutritional education and diet planning (Jeffry et al, 1999) the present work focus on the status of the vitamin C during thermal treatment of some fruits /vegetables consumed in cooked forms and also estimate intake adequacy of vitamin C among adults within Kano metropolitan expected from consumption of cooked fruits, vegetables and juice drinks. The information obtained from this research could be used as guide and to enhance particular interest in quality control.

EXPERIMENTAL

Fresh samples of vegetables and fruits were purchased from markets around Kano metropolitan, washed several times to remove all visible soil particles and subjected to the extraction procedures.

Vitamin C content of the fresh vegetables and fruits were pre-determined using a modified procedure of the ammonium molybdate method whereby the salt is reduced a blue complex with λmax of 760nm (Bajaj and Kaur, 1981; Audu and Garba, 2004).The cooking method was that adapted by Faith (1936) with few adjustments in the weight of the sample and the amount of water used. 100g composite of each sample was used with 100cm^3 of water and a teaspoonful NaCl added into an enamel pan placed on heating mantle and the contents were heated to 100^{o}c.Theboilng continued for 20minutes.

The samples were separately dropped into the boiling water. The heating stops at the ''doneness'' stage for each sample which was pre-determined arbitrarily by traditional way of household food testing. The vegetables samples were removed at done stage from the heating and were allowed to cool for 15 minutes. On exposure to air at ordinary temperature before subjected to the extraction procedure (Faith, 1936).The percentage loss of vitamin C was computed using the following formular (Garba, 2004).

%loss = Ab_f - Ab_c / Ab_f

And Amount lost in mg/100g = mg/100g x % loss/100

Where Ab_f is the absorbance of the fresh sample and Ab_c is the absorbance of cooked sample.

Estimate of Dietary Intake

Consumption pattern of 60 volunteers selected at random, 10 from each of the six metropolitan local governments in Kano City made up of 30 average income class and 30 low income earners of the adult population was estimated from thje average composition of their diets using method adapted by Onianwa et al, (2000). The survey was conducted over a period of 30days. Dietary intakes data of the participating households were collected in specially designed questionnaire, detailed data regarding the household dietary intakes were obtained taking into consideration the mode of consumption, size of the vegetables, frequency or the number of times consumed per day, the information covered the daily meals comprising dinner, lunch, breakfast and in between- meal juice drink. From the amount of vitamin C determined in this study, the results of the loss of vitamin C in cooking and the information on the consumption pattern survey. Vitamin C intake for individual daily meals and the mean of each class were calculated using the formula:

$$Id = \frac{\text{N x R x S x AV}}{\text{7 x F}}$$

Id is the weekly intake for individual daily intake, N frequency of consumption per week, S size of the sample, AV amount of vitamin C in fresh sample, F fraction of vitamin C retained after cooking and ∑x/n where ∑x sum of the individual daily intake, n number of people examined (Onianwa et al,2001). The dietary intake was calculated as the sum of the average values for the dinner, lunch and breakfast intakes. The result obtained was in conformity with the adopted method of food total diet studies (Lavine1999;Remero,1993) for the estimation of dietary intakes of food nutrient and the same approach was used by Onianwa et al (2001) for the estimation of adult dietary intake of copper and zinc content of Nigeria.

RESULTS AND DISCUSION

The amount of vitamin C in both fresh and cooked samples is presented in Table 1 and the data of the two forms of vegetables are also shown in Fig.1. The thermal destruction of vitamin C in the different vegetables during cooking as percentage loss is presented in Fig.2.the result reveals high loss (83%) in cooked tomato, only 17% of the vitamin retained in the sample after cooking, thus it implied that tomato classified as a rich source of vitamin C USDA (1998), has turned out to become poor source after cooking with only 3.84mg vitamin C left. The least value of 37% loss was obtained in cooked pepper still remaining a rich source of vitamin after cooking with 30.96mg vitamin loss, retaining 69.75mg of vitamin C. Statistical analysis of all the sample indicate a significant difference in the percentage loss in the various samples with the average loss of 44.25%. How much vitamin C can be expected lost in cooking and the variation of loss in the different samples studied is shown in Table1. Similar results of ascorbic acid loss in cooking were reported for Cabbage and Cauliflower (Pyke, 1977). An approximate loss 0f 75% of vitamin C during Cooking of Peas was reported (Faith, 1936). Kinetic of vitamin C thermal degradation in Orange juice was carried out (Manson et al., 2001; Remesh, 2005).

Table 1: Percentage of Ascorbic acid loss/ retained in the cooked samples of vegetables

Vegetables	Ascorbic acid in the raw samples in (mg)	Ascorbic acid in the cooked samples in (mg)	% vitamin C retained	% vitamin C loss
Onion	26.19	10.48	40.00	60.00
Tomato	22.58	3.84	17.00	83.00
Spinach	53.15	16.48	31.00	69.00
Okra	4.54	2.77	61.00	39.00
Pepper	110.71	69.75	63.00	37.00
Green Beans	23.95	8.14	34.00	66.00
Cauliflower	68.20	23.88	35.00	65.00
Cabbage	33.33	17.67	53.00	47.00

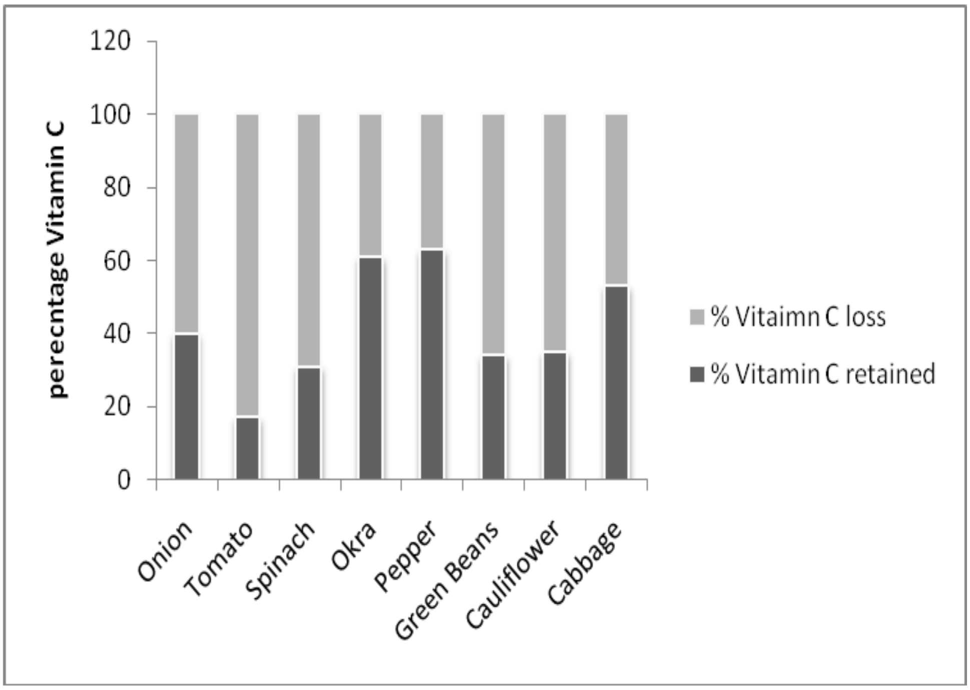

Figure 1: percentage Vitamin C Retained/ Loss after heat treatment of the vegetables

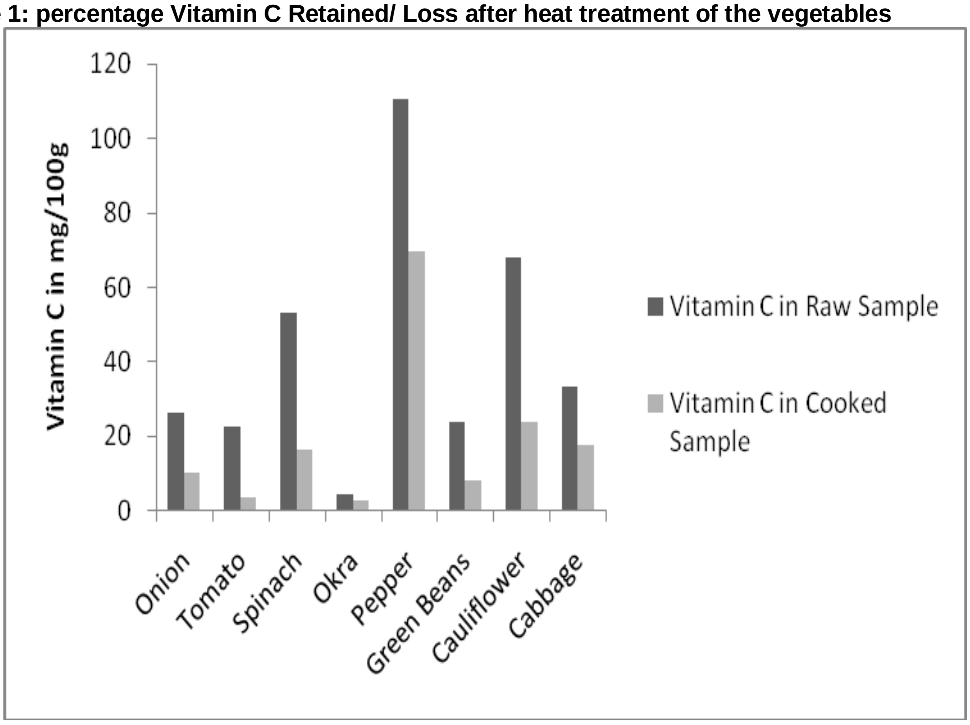

Figure 2: Comparison in Vitamin C Contents between the Raw and Cooked Vegetables

The vitamin C dietary intake for the individual daily meals of the two different classes of peoples studied in Figure 3, the mean of each class was also found. The average of the two means was found to be 147mg and was taken as the daily intake (Onianwa et al., 2001). The intake ranged from 49.80mg to a high daily intake of 355.76mg (Fig.3). Statistical analysis of the data for the mean vitamin C intake between the two classes studied indicate significant difference among the two groups (t_{cal} = 6.4432, t_{tab} = 1.960 and P = 0.05) and the standard deviation was ±1.01. The recommended dietary allowance (RDA) is 60mg for adults(Lavine et al., 1999).

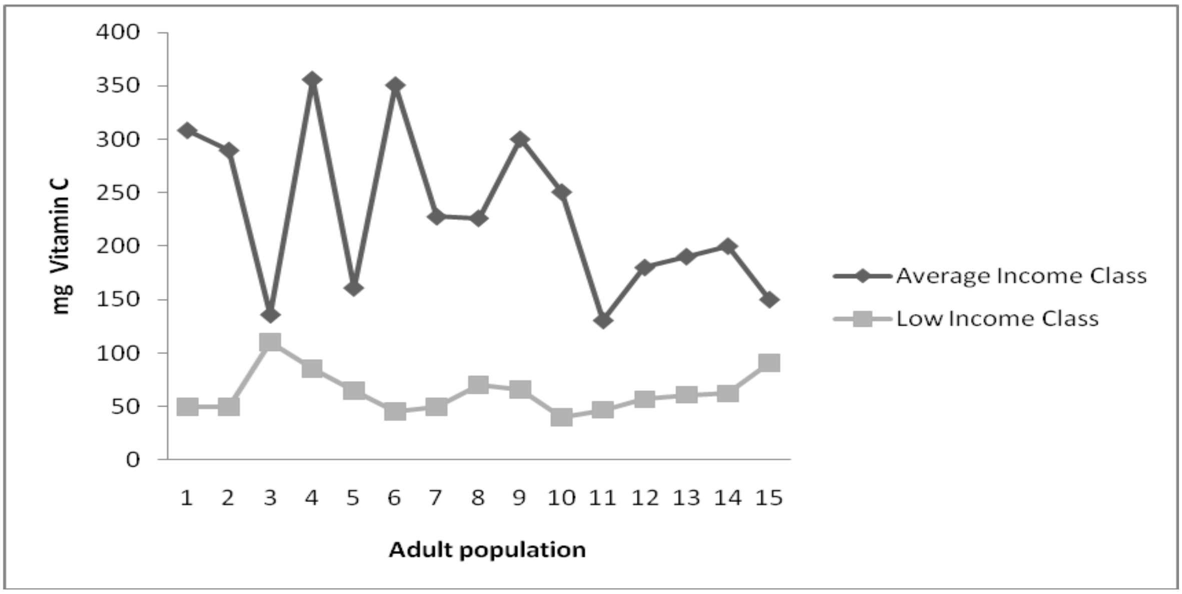

Figure 3: Class Comparison for Vitamin C Intakes

Thus, comparison between the two classes indicate that, less income group consumed lower amount of Vitamin C then the recommended dietary allowance per day Fig.3. On the contrary the average income class consumed greater than the recommended dietary allowance, although other factors apart from heat such as presence of trace metals, storage method and processing may lower the level of the Vitamin C. Vitamin C deficiency is more likely in lower class. The high Vitamin C intake in the average income class can be attributed to the high Vitamin C contents of the available fruits/vegetables in the area.

CONCLUSION / RECOMMENDATIONS

Based on the findings in this study, the following conclusion can be drawn: cooking brings about destruction of Vitamin C contents of vegetables, in some cases the loss is enough to course deficiency of the Vitamin. The recommended dietary intakes should be increased by taking row Vitamin C sources as more than 50% loss was recorded in some samples due to the effect of only two factors viz cooking and exposure to air, virtually very little will be left when other factors come into effects. The loss in ascorbic acid during cooking can be reduced by cooking quickly in a small amount of water, or steaming food with container tightly covered.

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