INTRODUCTION

Vitamin C is known for its antioxidant, anticancerous and other health promoting properties (Remesh, 2005). Deprivation of vitamin C in human being causes deterioration of number of physiological functions. Resulting in scurvy and death following its deficiency. 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 contribution of these foods to total vitamin C intakes of some fruits/vegetables 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). Although scurvy is a disease of the past found in specific subgroup (e.g. alcoholics, institutionalised elderly), disturbing diseases in developing countries, when plasma concentration of vitamin C are marginal (11 to 28 μmol/L), the body’s pool of vitamin C is depleted and subclinical 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.

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 100cm³ of water and a teaspoonful NaCl added into an enamel pan placed on the heating mantle and the contents were heated to 100°C. The boiling continued for 20 minutes.

       syncope (Raymond and Othmer, 1948). Vitamin C is unstable to heat in the presence of oxygen and cooking causes hydrolysis of lactone ring of the vitamin the vitamin destroying its activities (Pyke, 1977; Devlin, 1992).

\[
\begin{align*}
\text{C₆H₈O₆} & \rightarrow \text{C₆H₆O₆} \\
\text{L – Ascorbic acid} & \rightarrow \text{Dehydroascorbic} \\
\text{CO₂HOCOCOH₂COH₂OH} & \rightarrow \text{2, 3 – 2, 3 – Diketo – L – gulonic acid}
\end{align*}
\]
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 = Abf - Abc / Abf
And Amount lost in mg/100g = mg/100g x % loss/100
Where Abf is the absorbance of the fresh sample and Abc 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 the average composition of their diets using method adapted by Onianwa et al, (2000). The survey was conducted over a period of 30 days. 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:

\[ Id = \frac{N \times R \times S \times AV}{7 \times F} \]

Where:  
- \( Id \) = the weekly intake for individual daily intake,  
- \( N \) = frequency of consumption per week,  
- \( R \) = size of the sample,  
- \( S \) = amount of vitamin C in fresh sample,  
- \( AV \) = fraction of vitamin C retained after cooking,  
- \( F \) = sum of the individual daily intake,  
- \( n \) = number of people examined  

The percentage loss 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 C retained. 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 Table 1. Similar results of ascorbic acid loss in cooking were reported for Cabbage and Cauliflower (Pyke, 1977). An approximate loss of 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).

**RESULTS AND DISCUSSION**

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 C retained. 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%.

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

REFERENCES