Comparative Evaluation of Proximate Composition and Sensory Properties of Fruits and Vegetables from Open Market and Shopping Mall in Port Harcourt City

Patience C. Obinna-Echem, Nkechi J. T. Emelike and Happiness I. Wachukwu- Chikaodi

ABSTRACT

The study evaluated the proximate composition and sensory properties of fruits (banana and tomatoes) and vegetables (Lettuce and cabbage) from an open market and a shopping mall to ascertain the effect of the two environments on the sample quality. Standard analytic procedures were used in sample analysis. Open market samples had moisture, protein, fat, ash, crude fibre and carbohydrate content of 76.56-92.96, 0.25-1.24, 0.03–0.91, 0.56–1.17, 2.20–3.34 and 1.17 – 14.13 % respectively, while values for shopping mall were 80.62-94.10, 0.16–0.29, 0.06–0.21, 0.40–0.86, 1.54–3.87 and 0.91–14.28 % respectively. The degree of likeness for the appearance, flavour (aroma/taste), texture (firmness/crunchiness) and overall acceptability of the samples from the open market ranged from 6.60 - 7.00, 4.90 - 6.35, 5.25 -5.95 and 5.80 - 6.10 respectively, and those of the shopping mall were 6.55–7.25, 4.70–6.65, 5.45–5.95 and 5.85–6.30 respectively. The environment had significant (P≤0.05) influence on the proximate composition and sensory properties of the fruits and the vegetables. Fruits and vegetables from the open market had significantly (P≤0.05) higher nutrient content. The environment of the shopping mall provided the low temperature which improved upon the moisture and sensory attributes of the samples as evidenced in higher degree of likeness of samples from the shopping mall. This revealed the importance of storage and sales of fruits and vegetables under chilled storage.

Keywords: Fruits, vegetables, proximate composition, sensory properties.

I. INTRODUCTION

Fruits and vegetables comprise of the essential part of human diet as they are major source of dietary nutrient of great importance. They include diverse groups of plant foods that vary greatly nutrient and energy content. They supply dietary fibre, vitamins, minerals phytochemicals that serve as antioxidants, phytoestrogens and anti-inflammatory agents [1]. Fruits and vegetables are universally recommended for their health promoting properties and diets rich in fruits and vegetables have been associated with several health benefits which include reduced risk of chronic disease such as blood pressure, cardiovascular diseases, hypercholesterolemia, respiratory illness and body weight management, etc. [2], [3].

In the tropical and subtropical countries of the world, banana (Musa sapientum) is among the most widely consumed fruit [4]. The ripe banana is mostly consumed fresh and sometimes used as an important ingredient in fruit salads or desert foods. Nutritionally, it is a rich sources of minerals, vitamins, carbohydrate, flavonoids and phenolic compounds [5]. Tomato (Lycopersicon esculentum Mill), is a worldwide vegetable fruit. It is an edible berry of the plant Solanum lycopersicum. The fleshy fruit is characterized by a soft pulp, thin skin and many seeds [6]. It can be consumed fresh and also used as a constituent of many prepared foods. Cabbage (Brassica oleraceae var. capitata L) is an important leafy vegetable with both nutritional and therapeutic values. Cabbage contains a range of essential vitamins and minerals as well as small amount of protein and good calorlic value [7]. It is a major ingredient in many salads and a component of many meals. Lettuce (Lactuca sativa L.) are cultivated in many parts of the world is mostly used in salads, either alone or with other vegetables, meet and cheeses. They can also be found in soups, sandwiches and wraps or shawama. Lettuce contain appreciable amount of moisture and other nutrients. It is a good source of fibre, iron, vitamin C and other bioactive compounds such as antioxidants and phytochemicals [8].

There is much concern now on the health benefits derived from food. The quality and nutritional value of fresh fruits and vegetables like banana, tomatoes, lettuce and cabbage are affected by postharvest handling and storage conditions. The sensory properties of fresh produce can be maintained under chilled condition for a few days as extended storage time can lead to chilling injury [9]. There are no available reports in literature on the proximate and sensory properties of fresh produce stored and sold under different environmental conditions, hence this study was aimed at the determination of the proximate and sensory properties of banana, tomatoes, lettuce and cabbage sold in the open market and under chilled condition in a shopping mall.
II. MATERIALS AND METHODS

A. Sample Collection

Unpackaged samples of bananas (Musa sapientum), tomatoes (Lycopersicon esculentum Mill), lettuce (Lactuca sativa L) and cabbage (Brassica oleracea var. capitata L) were purchased from an open market and a major shopping mall in Port Harcourt City. The samples were properly labelled and transported in chilled coolers to the laboratory and preserved in the refrigerator before analysis.

B. Proximate Analysis

Proximate composition: moisture, ash, crude protein, crude fibre and fat contents of the vegetables were analysed according the standard method of AOAC [10]. Briefly, moisture was determined by drying the samples to a constant weight in a hot air oven (DHG 9140A) at 105 °C. Determination of protein was by Kjeldahl method. The efficiency of the nitrogen values was corrected with acetonilide values and multiplied by the factor of 6.25 to obtain the protein value. E Lipid was obtained from the exhaustive extraction of known weight of samples with petroleum ether using rapid Soxhlet extraction apparatus (Gerhardt Soxtherm SE-416, Germany). Ash was determined gravimetrically after incineration in a muffle furnace (Carbolite AAF-11/18, UK) at 550 °C for 24 h. Crude fibre was obtained using the standard enzymatic-gravimetric method. Carbohydrate content was determined by the difference: 100 - (Moisture + protein + Fat + Ash + Crude fibre).

C. Sensory Analysis

Upon purchases, the fruits and vegetables were physically assessed for the following attributes: Aroma, Appearance, firmness and visible signs of microbial growth. Further sensory evaluation on the samples was carried out using the method described by Iwe [11]. A panel of 20 assessors consisting of staff and students chosen from the university community evaluated appearance, flavour (aroma/taste), texture (firmness/crunchiness) and overall acceptability of the samples based on a 9-point hedonic scale. The degree of likeness of the sensory attribute expressed as: 1 – dislike extremely, 2 – dislike very much, 3 – dislike moderately, 4 – dislike slightly, 5 – neither like nor dislike, 6 – like slightly, 7 – like moderately, 8 – like very much and 9 – like extremely.

D. Statistical Analysis

Data obtained were subjected to analysis using Minitab (Release 18.0) Statistical Software (Minitab Ltd., Coventry, UK). Statistic differences were obtained using analysis of variance (ANOVA) under the general linear model and Fisher pairwise comparison at 95% confidence level.

III. RESULT AND DISCUSSION

A. Proximate Composition of Fruits and Vegetables from Open Market and Shopping Mall in Port Harcourt City

The proximate composition of the fruits and vegetables from the open market and the shopping mall are shown in Table 1.

<table>
<thead>
<tr>
<th>Samples</th>
<th>Location</th>
<th>Moisture</th>
<th>Protein</th>
<th>Lipid</th>
<th>Ash</th>
<th>Crude fibre</th>
<th>Carbohydrate</th>
<th>Total Solid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana</td>
<td>Open Market</td>
<td>76.56±0.03</td>
<td>2.5±0.01</td>
<td>0.91±0.33</td>
<td>1.17±0.60</td>
<td>2.98±1.16</td>
<td>14.13±1.81</td>
<td>23.44±1.05</td>
</tr>
<tr>
<td></td>
<td>Shopping Mall</td>
<td>80.62±1.73</td>
<td>0.16±0.01</td>
<td>2.1±0.02</td>
<td>0.65±0.56</td>
<td>3.87±0.73</td>
<td>14.28±1.17</td>
<td>19.38±1.73</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>Open Market</td>
<td>92.69±0.13</td>
<td>0.35±0.06</td>
<td>0.03±0.40</td>
<td>0.77±0.55</td>
<td>2.98±1.16</td>
<td>3.18±1.16</td>
<td>7.31±0.13</td>
</tr>
<tr>
<td></td>
<td>Shopping Mall</td>
<td>93.86±2.49</td>
<td>0.21±0.10</td>
<td>0.09±0.01</td>
<td>0.55±0.40</td>
<td>1.73±0.72</td>
<td>3.55±1.38</td>
<td>6.14±2.49</td>
</tr>
<tr>
<td>Lettuce</td>
<td>Open Market</td>
<td>92.96±0.43</td>
<td>1.24±0.22</td>
<td>0.34±0.02</td>
<td>0.95±1.17</td>
<td>3.34±0.00</td>
<td>1.17±0.13</td>
<td>7.04±0.43</td>
</tr>
<tr>
<td></td>
<td>Shopping Mall</td>
<td>96.44±0.17</td>
<td>0.60±0.04</td>
<td>0.12±0.01</td>
<td>0.40±0.95</td>
<td>1.54±0.00</td>
<td>0.91±0.10</td>
<td>3.56±0.17</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Open Market</td>
<td>91.54±0.17</td>
<td>0.27±0.01</td>
<td>0.10±0.05</td>
<td>0.56±0.86</td>
<td>2.20±0.50</td>
<td>5.33±0.69</td>
<td>8.46±0.12</td>
</tr>
<tr>
<td></td>
<td>Shopping Mall</td>
<td>94.10±0.76</td>
<td>0.29±0.04</td>
<td>0.06±0.01</td>
<td>0.60±0.77</td>
<td>1.56±0.23</td>
<td>3.40±0.44</td>
<td>5.90±0.76</td>
</tr>
</tbody>
</table>

Means with the same superscript for each parameter and each of the fruit and vegetable are not significantly different. N=3±SD.

Moisture content of the fruits and vegetables ranged from 76.56–92.96 and 80.62–94.10% respectively for samples from the open market and the shopping mall. Total solid content for the open market and the shopping mall ranged from 7.04–23.44 and 3.56–19.38% respectively. The moisture content of the banana, lettuce and cabbage from the open market was significantly (P≤0.05) lower than those obtained from the shopping mall. The total solid content followed the similar trend as the moisture content. The moisture content of the bananas, cabbage and the tomatoes were similar to the report by Kookal et al [12], Tayyeb et al [13] and Garuba et al [14] respectively, while the moisture content of the lettuce was higher than the report by Nwachukwu and Aba [15]. Fruits and vegetables generally have high moisture content and are classified as highly perishable. The moisture contents are in line with the compositional features for fruits (61.0–89.1%) and vegetables (84.3–94.7%) [1]. The decrease in the moisture content of the samples from the open market indicated that the storage and sales environment has influence on the fruits respiratory abilities. Samples stored and sold under chilled condition, as was the case in the shopping mall, retained more moisture. The loss in moisture of the samples from the open market may have contributed to the increase in Total solid content and therefore the concentration of nutrients.

The fruits and vegetables had protein content of 0.25–1.24 and 0.16–0.29% respectively for samples from the open market and the shopping mall. The protein content of samples from the open market was significantly (P≤0.05) different from those obtained from the shopping mall except for the cabbages did not differ significantly (P>0.05). The protein content of the bananas, lettuce and cabbages were lower than the reports in literature [12], [16], [17], [13]. Proteins are building blocks of life. Though protein is mostly looked for in animal sources, some fruits are also good in protein but not as much as the animal sources. The protein content of the vegetables is within the compositional features (0.2–1.1 %) while that of the fruits were lower than the compositional feature (0.5–3.9%) [1]. A high protein diet can help build muscles, increase metabolism and enhance immunity and

TABLE 1: PROXIMATE COMPOSITION OF FRUITS AND VEGETABLES FROM OPEN MARKET AND SHOPPING MALL IN PORT HARCOURT CITY

DOI: dx.doi.org/10.24018/ejfood.2021.3.1.234

Vol 3 | Issue 1 | January 2021
fruits are some of the recommended sources of source protein. There are concerns about the impact of protein on acid production, of which more intake of fruits and vegetables is recommended rather than reduced protein intake due to the alkalinization effect of fruits and vegetables [18].

Lipid content of the fruits and vegetables varied from 0.03–0.91 and 0.06–0.21% for the open market and the shopping mall respectively. The lipid content of the samples differed significantly (P≤0.05), with means for the samples from the open market significantly (P≤0.05) higher than those from the shopping mall, except for tomatoes where the fat content was higher in samples from the shopping mall. The lipid content of the, cabbage, lettuce and tomatoes are lower than reports in literature [13]-[15], but that of the bananas was higher than the report by Oyeyinka and Afolayan, [16]. Lipids are very important source of energy containing twice the energy value of carbohydrates and perform basic roles in the structure and function of biological membranes and are precursors of a variety of hormones [19].

Fruits and vegetables from the open market had ash of 0.56–1.17% while the ash content of samples from the shopping mall were 0.40–0.86 % respectively. The ash content of samples from the shopping mall was significantly (P≤0.05) lower than those from the open market. The ash content of the bananas, lettuce and cabbage was similar to the report in literature [16], [15], [13]. The ash content of the tomatoes was lower than the report by Garuba et al [14]. Ash is the inorganic residue that remains after incineration or complete oxidation of organic component of food and a representation of the total mineral content in food. While dietary fibre is an important in [20]. The high ash content of the samples is an indication of good source of minerals. Several studies have confirmed that fruits and vegetables are good sources of minerals.

Crude fibre content of the fruits and vegetables from the open market and the shopping mall ranged from 2.20–3.34 and 1.54–3.87% respectively. The crude fibre content followed the same trend as the ash content except for the banana samples where the fibre content of the sample from the shopping mall was significantly (P≤0.05) higher. The crude fibre content of the tomatoes was comparable with the report by Onifade et al [21] and lower than the report by Garuba et al [14]. The fibre content of the lettuce was for the shopping mall was comparable with the report by Nwachukwu and Aba, [15] while those from the open market were higher. The crude fibre content may indicate the dietary fibre composition of the fruits and vegetables as only the edible portions were analysed as it was with the banana. Fruits and vegetables are known as suppliers of fibre and fibre intake is associated with lower cardiovascular diseases and obesity [1]. Dietary fibre is an indigestible component of food that provide bulk to gastrointestinal content, stimulates peristalsis and thus maintains normal bowel function among other health benefits [19], [21].

The fruits and vegetables had carbohydrate content in the range of 1.17–14.13 and 0.91–14.28 % for the open market and the shopping mall respectively. Banana had significantly (P≤0.05) the highest carbohydrate content while tomatoes had the least. There was no significant (P≥0.05) difference in the carbohydrate content of the bananas from both locations. This implied that location had no influence on the carbohydrate content of the bananas. The mean for lettuce and cabbage from the open market was significantly (P≤0.05) lower than those from the shopping mall. The carbohydrate content of the tomatoes from the shopping mall was significantly (P≤0.05) higher than those of the open market. The carbohydrate content of the tomatoes was similar to the report by Garuba et al [14]. Lettuce and banana had lower carbohydrate content than report in literature [14], [15]. Carbohydrates are the major energy suppliers in food as much as 60% can be provided [19].

The result revealed that the environment had significant (P≤0.05) influence on the proximate composition of the fruits and the vegetables. Though fruits and vegetables from the chilled storage environment of the shopping mall retained more moisture with less total solid content, the nutrient content was significantly lower (P≤0.05) than those of the open market.

B. Sensory Properties of the Selected Fruits and Vegetables from the Open Market and the Shopping Mall in Port Harcourt City

The fruits and vegetables upon purchases had no objectionable smell, they were firm in texture, not wilted for the vegetables, and appeared fresh with no visible manifestations of microbial growth. These are indicators of good quality that meets the consumers stated need of freshness.

With further sensory analysis, the sensory evaluation of the appearance of the fruits and vegetables are shown in Fig. 1. The degree of likeness of the appearance ranged from 6.60–7.00 and 6.55–7.25 respectively for the open market and the shopping mall. There were no significant (P≤0.05) differences in the appearance of the samples irrespective of the locations. The assessors rating of the appearance of the lettuce was significantly higher than others and the rating was that of moderate likeness.

Fig. 2 showed the degree of likeness of the flavour (aroma and taste) of the fruits and vegetables. It varied from 4.90–6.35 and 4.70–6.65 for the open market and the shopping mall respectively. The environment had significant (P≤0.05) effect on the flavour of the samples except for the bananas. The degree of likeness of the bananas by the assessors was significantly (P≤0.05) the highest and the rating was that of slight likeness. The rating for the tomatoes and the cabbage from the open market was that of slight dislikeness and it was significantly (P≤0.05) higher than those from the shopping mall but the reverse was the case for the lettuce. The lettuce from the shopping mall was rated neither like-nor-dislike while those from the open market were disliked slightly. The banana was evaluated based on taste; the sweetness of the bananas may have accounted for the highest degree of likeness by the assessor’s. The aroma of Fruits stored at 5 °C can develop unpleasant aroma due to the loss of some principal volatile compounds [22] and enzymatic changes during ripening can alter the flavour and aroma of fruits Krumbein et al [23].
The degree of likeness of the texture of the fruits and vegetables ranged from 5.25–5.95 and 5.45–5.95 for the open market and the shopping mall respectively as shown in Fig. 3. The fruits were evaluated in terms of firmness and crunchiness for the vegetables. Except for the cabbage where the texture of the samples from the shopping mall were significantly (P≤0.05) higher than the open market, there was no significant (P≤0.05) difference in the texture of the other fruits and vegetable irrespective of the location. The texture of the cabbage from the shopping mall had significantly (P≤0.05) the highest rating of slight likeness while the other samples had a rating of neither like-nor-dislike.

The overall acceptability of the fruits and vegetables as shown in Fig. 4 for the open market and the shopping mall ranged from 5.85–6.10 and 5.60–6.30 respectively and differed significantly (P≤0.05) except for the bananas. The assessors’ overall acceptability of the tomatoes and the lettuce from the open market rated as like slightly, was higher than those of the shopping mall that were rated neither like-nor-dislike. The rating for the cabbage from the shopping mall was that of slight likeness while that of the open market was neither like-nor-dislike. The acceptability of the bananas was higher than the other fruits. This may equally be attributed to the sweetness of the fruits. Sensory attributes are used by consumers at the point of sales to provide an indication of freshness and good quality.

One way of improving on the quality of fresh produce is by the use of low temperature among others [14]. The environment of the shopping mall provided the low temperature which was evidenced in the higher degree of likeness of the sensory attributes of the samples from the shopping mall.

ACKNOWLEDGMENT

The author appreciates the technical assistance of Mr Nicholas of the Analytical Laboratory in the Department of
Food Science and Technology, Rivers State University, Port Harcourt.

REFERENCES


