CONSUMER PREFERENCE, QUALITY AND SHELF LIFE OF THREE POPULAR VARIETIES OF BANANA (Musa spp. AAA) IN GHANA

Department of Horticulture, Faculty of Agriculture.
Kwame Nkrumah University of Science and Technology, Kumasi.

ABSTRACT

Fruits of Cavendish, Mysore (Alata kwadu, local variety), and Gros Michel varieties of banana were assessed to determine their relative differences in quality, shelf life and consumer preference. A general survey was conducted in the Greater Accra, Eastern, Central, Ashanti and Western Regions of Ghana to assess the consumer and seller preference of the three varieties of banana. Moisture content, total soluble solids (TSS), pH, pulp to peel ratio, vitamin content (B1, B2, and C) and shelf life studies were conducted as indicators of fruit quality over seven stages of ripening based on a standard colour chart. Sensory analysis was conducted using randomly selected panelists from the Department of Food Science and Technology, KNUST, Kumasi, to assess the consumer preference of the fruits based on taste, texture, finger and pulp colour and size of fingers. Mysore had the least moisture levels for all colour stages and lasted longer than both Cavendish and Gros Michel varieties. Mysore recorded the highest TSS of 25% which was significantly different from Cavendish (23.6%) and Gros Michel (24.2%) at colour stage 5 when it is usually consumed. All three varieties recorded similar pH values at colour stage 5. Mysore had the highest vitamin C content (31.0 mg/100g) while Cavendish recorded the highest Vitamins B1 and B2 contents. Mysore had the highest scoring for overall acceptability (1.02) significantly different from Cavendish and Gros Michel. There was however, no significant difference in overall acceptability between Cavendish and Gros Michel.

INTRODUCTION

Musa spp., comprising plantain and banana, are among the world’s leading fruit crops with total world production of 103 million metric tonnes in 2004 (FAOSTAT, 2004). According to Dankyi et al. (2007) among the freshly eaten horticultural crops exported in Ghana, banana is second to pineapple as a foreign exchange earner. In 2007, Ghana exported 2,972 tonnes of banana to the European market and this was a 41% increment on what was exported in 2000. Between 1996 and 2004 banana exports provided a total of $22,404,000 to the Ghanaian economy averaging about $2,489,353 a year.

According to Chandler (1995), banana is rich in vitamins, minerals and other nutrients. The ripe fruit contains about 22% carbohydrate, mainly as sugar.

Banana is high in potassium but low in protein and fat (Pamplona-Roger, 2003). It contains vitamins A and C and about 75% water. Bananas may be eaten fresh, baked, fried, mashed and chilled in pies and also in puddings.

There are four main varieties of bananas that are grown in Ghana. These are Mysore (locally called “Alata kwadu”), Gros Michel, apple banana and red banana belonging to the Cavendish group (Blay, 2004).

A review of banana and plantain production in Ghana by Dankyi et al. (2007) indicated a steady rise in export earnings by Ghana from 1996 to 2004 from 523 to 1,941 value metric tonnes. According to them, the banana industry in Ghana depends largely on the import regime of the European Community. The fruits that do not meet the export standards are however sold on the domestic market. The fruits therefore

compete with the popular local variety, creating a market uncertainty to the producers of the local variety. This calls for the need to investigate the nutritional and shelf-life quality of the export variety so as to advise the local producers on which variety to produce to make more income. This study therefore assessed domestic consumer preference for three common banana varieties in Ghana and their quality attributes.

MATERIALS AND METHODS

Experimental Locations

The experiment was conducted at the Departments of Horticulture (Faculty of Agriculture) and Biochemistry (Faculty of Biochemistry and Food Science), KNUST and the Quality Control Laboratory of the Food and Drugs Board, Accra, Ghana between February and May 2009.

Questionnaire administration

A total of 300 questionnaires were administered to banana consumers and sellers across five regions of Ghana to determine their preferences and the reasons for those preferences. A completely randomized design with three replications was used for the physicochemical analyses.

Experimental procedure

Ten bunches of Cavendish banana fruits were obtained from the Volta River Estates Limited (VREL) located at Akuse, near Akosombo while 10 bunches each of Mysore and Gros Michel were obtained from farmers at Bipong in the Eastern Region of Ghana. Fruits were picked from the middle and distal portions of the bunches. Dehanded fruits were washed and air-dried in the laboratory at the Department of Horticulture, KNUST, Kumasi, Ghana. Uniformly sized fruits were selected. Three replications were used for each variety and each replicate was 12 fingers. Commercial peel color scale recommended by Aurore et al. (2009) with slight modification was used. Peel color scoring was as follows: 1 – entirely deep green; 2 – entirely green; 3 – more green than yellow; 4 – more yellow than green; 5 – yellow with green necks; 6 – entirely yellow; 7 – entirely yellow with brown spots. At the green mature stage (color stage 1), fruit length and the external diameter of the fruits were measured using measuring tape and vernier calipers, respectively. Moisture content, total soluble solids (TSS), pH and pulp to peel ratio were measured for all color stages (1-7). Total soluble solids were determined by weighing 30g of the pulp on an analytical balance. This was then added to 90ml of distilled water and blended for 2 minutes in a laboratory blender and then filtered. A hand refractometer (Bellingham and Stanley model Delta refractometer code 20-60) was used to measure the absolute TSS and corrected to the actual TSS by the formula of Dadzie and Orchard (1997). pH was determined using Suntex pH meter (FF 701). Moisture content was determined by using AOAC (1990) procedure. Weights of peels and pulp were measured separately on an analytical balance from which the pulp to peel ratios were determined.

HPLC procedure recommended by Aslam et al. (2008) was used for vitamin determination. Vitamins C, B₆ and B₁₂ were determined at colour stage 5 when banana is normally consumed. In the determination of the vitamins, 10g of the blended pulp was diluted with distilled water: in a 25ml volumetric flask. This was sonicated for 15 minutes and centrifuged for 5 minutes. The mixture was then decanted and filtered. Drops of the filtrate were injected into the high performance liquid chromatography (HPLC) and the results noted. Standards of the vitamins with known concentrations were weighed and diluted into 25ml volumetric flasks. These were also sonicated and then injected into the HPLC. The quantities of vitamins in the samples were determined using the formula;

\[
\text{Amount of vitamin} = \frac{\text{Peak area of sample} \times \text{vitamin in standard}}{\text{Peak area of standard}}
\]

The shelf life was determined from entirely deep green stage (colour stage 1) to when the fruits were...
Consumer preference

Idun, I., Adzraku, H., Appiah, F., Kumah, P., Adjei, P. Y. and Daaku, B. Y.A

extremely soft, blackish and watery at room conditions (25.8°C, 71%RH).

Consumer sensory evaluation

A panel of 34 untrained people (18 men and 16 women) was used for the sensory evaluation of the banana varieties. Parameters assessed included colour, texture, taste, and overall acceptability. A hedonic scale of 1-5 (Ihekonoroye and Ngoddy, 1985; Chinma and Gernah, 2007) was used in scoring: 1 – Like very much; 2 – Like slightly; 3 – Neither like nor dislike; 4 – Dislike slightly and 5 – Dislike very much.

Data analysis

Survey and physicochemical data were analysed using Statistical Package for Social Scientists (SPSS) version 16 and GenStat Statistical Package Release 11.1, respectively.

RESULTS AND DISCUSSION

Survey

Most of the consumers (66.0%) preferred the Mysore while Cavendish was the least preferred (30.0%) (Table 1). Mysore was preferred due to its taste (55.0%) (Table 2). Most retailers (80.0%) indicated they sold the local variety as against 77.1% for Gros Michel and 8.6% for Cavendish. Mysore and Gros Michel were the popular varieties sold and consumed on the domestic market. The least preference for Cavendish could be attributed to consumers not being familiar with it since it is usually unavailable and therefore consumers are not familiar with it.

Table 1. Consumers preference for different of varieties of banana

<table>
<thead>
<tr>
<th>Variety</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cavendish</td>
<td>9</td>
<td>3.0</td>
</tr>
<tr>
<td>Mysore</td>
<td>198</td>
<td>66.0</td>
</tr>
<tr>
<td>Gros Michel</td>
<td>93</td>
<td>31.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>300</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 2. Reason for consumer preference for Mysore banana

<table>
<thead>
<tr>
<th>Reason</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taste</td>
<td>165</td>
<td>55.0</td>
</tr>
<tr>
<td>Ready availability</td>
<td>45</td>
<td>15.0</td>
</tr>
<tr>
<td>Affordable price</td>
<td>84</td>
<td>28.0</td>
</tr>
<tr>
<td>Texture</td>
<td>6</td>
<td>2.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>300</td>
<td>100.0</td>
</tr>
</tbody>
</table>

It was observed that the local variety (Mysore) was not as readily available as Cavendish. This could be due to Mysore not being grown on large scale in Ghana. Consumers used taste as a determinant of quality and this informed their choice of Mysore. Most respondents (72.0%) indicated Mysore was expensive. This probably could be due to its relative unavailability, higher demand and smaller finger size.

Assessment of quality attributes

Moisture content and shelf life

The moisture content in Cavendish increased from 73.0% in stage 1 to 79.5% in stage 7 (Figure 1). Similarly Gros Michel had increased moisture content from 71.6% in stage 1 to 76.6% in stage 7. The same trend was observed for Mysore with an increase in moisture content from 67.6% to 71.1%. Comparatively, Cavendish had the highest water content while Mysore had the least, the difference being significant (p=0.05).

The moisture content of banana fruits has several implications on its shelf-life and nutritional qualities such that fruits that have high moisture content are known to have reduced shelf-life than those with lesser amount of moisture (Izonfuo and Umuru, 1988). The higher moisture contents of both Cavendish and Gros Michel could partly explain their shorter shelf life (8 days) as compared to Mysore (9 days) due to the favourable environment created for microorganisms (Ihekonoroye and Ngoddy, 1985). The increase in moisture observed in all the three banana varieties can be attributed to the breakdown of most of the carbohydrates and fibres in the fruits thereby
Consumer preference for decreasing the total solids in the bulk of the fruits (Hallam, 1999).

![Graph showing moisture content of banana pulp during ripening](image1)

**Figure 1** Changes in Moisture content of banana pulp during ripening.

**Total Soluble Solids**

All three varieties showed increases in TSS from stage 1 to stage 2 and thereafter slight increases up to stage 6. Between stages 6 and 7, there were decreases in TSS for all three varieties, but greatest in Cavendish. At stage 7 Mysore fruits recorded 24.5% TSS, which was significantly higher than the least (16.7%) in Cavendish (Figure 2).

At stage 5, the commonly eaten stage of banana, Mysore had the highest TSS content, though not significantly different from Gros Michel and the least, Cavendish. This implied that Mysore tasted better in terms of sweetness than Gros Michel and Cavendish, because during ripening, the stored carbohydrates in the form of starch is converted to simple sugars, thereby increasing the TSS content of the fruits (Forsyth, 1980; Marriott et al., 1981). The significant decrease in TSS and hence in sugars in the Cavendish variety could be partly due to microbial activity (fungal growth) resulting in use of sugars in their metabolism.

**pH**

There was a general decrease in pH between stages land 3 for all the three varieties. By stage 5, the stage at which banana is consumed, all the three varieties had a decrease in pH and practically had similar values (Figure 3). Thus it could be argued that pH was not an important criterion to distinguish between the three varieties in terms of taste since at the most needed stage there were no differences.

Dadzie and Orchard (1997) observed that the pH of most fruits is high at harvest but decreases with ripening. According to Wills et al. (1989) during ripening organic acids decline as they are respired or converted to sugar. This conversion is important in creating the desired sugar-acid balance.

![Graph showing total soluble solids of banana pulp during ripening](image2)

**Figure 2** Changes in total soluble solids of banana pulp during ripening.

![Graph showing pH of banana pulp during ripening](image3)

**Figure 3** Changes in pH of banana pulp during ripening.

**Pulp to peel ratio**

The pulp to peel ratio decreased in all three varieties from stages 1-7 (Figure 4). Mysore had the highest value from stages 1 to 3 and thereafter declined.
steadily till it recorded the lowest at stage 7. Cavendish had the lowest peel to pulp ratio from stages 1 to 6.

According to Dadzie and Orchard (1997), ripening comes with increased sugar levels in the pulp which creates osmotic pressure favouring movement of water from the peels to the pulp. This increases the weight of the pulp relative to the peel and therefore results in a increased pulp to peel ratio. This characterization of banana fruits was exhibited by all three varieties, Cavendish, Mysore and Gros Michel.

**Vitamins**

Mysore recorded the highest vitamin C content of 30.96mg/100g pulp while Gross Michel had the lowest with a value of 24.73mg/100g. Cavendish had the highest levels of Vitamin B₉ and B₁₂ with 2.14 mg/100g pulp and 6.96mg/100g pulp respectively while Mysore had the least with values of 1.65mg/100g pulp for vitamin B₉ sample and 3.44g/100g pulp for vitamin B₁₂ (Figure 5).

Considering the daily recommended intake of 75mg for Vitamin C (National Academy of Science, 2004) the consumption of Mysore is better than the other varieties in contributing to meeting the recommended daily intake. Vitamin C is well noted for promoting cell development, normal tissue growth and repair and fortifying the immune system. As regards Vitamins B₉ and B₁₂, all three varieties contain amounts higher than the daily recommended intake and as such they are all good sources of the vitamins B₉ and B₁₂.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Finger Taste</th>
<th>Texture Overall Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cavendish</td>
<td>1.82</td>
<td>3.23</td>
</tr>
<tr>
<td>Mysore</td>
<td>3.82</td>
<td>1.23</td>
</tr>
<tr>
<td>Gros Michel</td>
<td>2.94</td>
<td>2.29</td>
</tr>
<tr>
<td>LSD (P=0.05)</td>
<td>0.76</td>
<td>0.80</td>
</tr>
</tbody>
</table>

**Sensory evaluation**

Mysore had superior overall acceptability score of 1.02 (Table 3) compared with Cavendish and Gros Michel. This superior performance could be attributed to its superior taste (1.23) and texture (1.43). This performance confirms consumer preference for taste of Mysore (Table 2). Mysore had highest Vitamin C content of 30.96mg/100g pulp at eating stage (stage 5). The high Vitamin C content and lower moisture content could also have contributed to its superior performance.
carried out. It also recorded the longest shelf life relative to the other varieties and was the most preferred by the consumers as reflected in the survey and sensory evaluation. All the three varieties are good sources of Vitamins C, B₆ and B₁₂. Mysore recorded higher vitamin C content while Cavendish had higher levels of vitamins B₆ and B₁₂.

REFERENCES


