Efficacy of Plant Hormone on the Extension of Shelf Life, Postharvest Behaviour and Quality of Kishanbhog Mango (*Mangifera indica* L.)

M. Ibrahim 1, F. Yeasmin 2, M.H. Morshed 3, M.O.H. Helali 4, A.K.M.S. Alam 5, D. Talukder 6

1-4 Fruits and Food Processing and Preservation Research Division. Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratories, Rajshahi, Bangladesh

2-3 Department of chemistry, Khulna University of Engineering and Technology, Khulna, Bangladesh

5 Applied Botany Research Division, BCSIR Laboratories, Rajshahi, Bangladesh

6 Applied Zoology Research Division, BCSIR Laboratories, Rajshahi, Bangladesh

Abstract: Freshly harvested and uniformly ripe mango cultivar of kishanbhog was collected from the experimental mango research garden of BCSIR Laboratories, Rajshahi, Bangladesh during June – July, 2011 and 2012. The application of plant hormone (IAA, NAA and 2,4-D) at various concentration (10, 20 and 30 ppm) for the extension of storage life (i.e. shelf life), reduction of postharvest weight loss and quality characteristics of mango cultivar of kishanbhog was studied. The storage life of treated mangoes was prolonged 26.67 % as compared to that from control one and the hormone treatments with 10 and 30 ppm IAA, 10 ppm NAA and 30 ppm 2,4-D concentrations were found to be more effective in prolonging 4 days of storage life of this cultivar. But at the last edible stage the weight loss of hormone treated mangoes with NAA 30 ppm concentration was the lowest (16.01 %) as compared to that of control one (22.65). The nutritional value of mango was also affected remarkably after treatment with plant hormone. The quality of hormone treated mangoes might be superior in terms of vitamin C, total soluble solids, total sugar, reducing sugar, non reducing sugar content of its pulp which were higher than those of control one. At the last edible stage chemical analysis of hormone treated mango pulp showed the increased amount of total sugar (25.49 %), reducing sugar (25.31 %), non-reducing sugar (22.49 %), total soluble solids (24.22 %) and vitamin C (23.12 %) while the amount of titrable acidity (18.76 %) was decreased as compared to that from control mango.

Keywords: Plant Hormone, Mango, Shelf life, Quality and Kishanbhog.

1. Introduction

Mango is now recognized as one of the best fruits of all indigenous fruits due to its excellent flavour, attractive fragrance, beautiful shades of colour, delicious taste and high nutritive value and also economic potentiality in fruit base crop (Ibrahim et al., 2011 and Prasad & Nalini, 1988). Besides being consumed as fresh fruits, both ripe and green fruits are used to make varieties of products such as juice, jam, jelly, pickle, chutney, nectar, squash, powder etc (Gofur et al., 1997; Shalunkhe and Kadam, 1995.)

For this reason mango is acknowledges as the King of fruits in Bangladesh as well as in other South- East Asian countries (Ibrahim, 2001; Molla and Miyan, 1974). Nutritionally mango is very important because it contains appreciable quantity of vitamin C, sugar and minerals, which readily available and easily assimilable in human body and therefore is capable to prevent many deficiency diseases (Kalam, 2001 and Litz, 1997). Mango has got a unique position among fruits grown in Bangladesh in respect of nutritional value, taste and consumers acceptability (Salunkhe and Kadam, 1995).

In recent years the total production of mango in Bangladesh is 8,89,176 MT (BBS, 2012) Approximately 2,66,752 - 3,11,211 MT fruits go waste during postharvest handling, storage and ripening (Lashley, 1984 and Meah, 1992). Among the fruits mango manifested the highest postharvest losses because of its high perishability and climacteric pattern and is closely linked with the development of suitable technology which reduces the losses at different stages of harvesting, packaging and storage. Quality mangoes are produced in the north–western part of Bangladesh, of which about 35-38 % post harvest losses are caused due to inefficient handling, improper transportation, storage and marketing (Rubbi et al., 1985). Hence the development of technologies for reducing postharvest losses is a necessary prerequisite for the promotion of the fruit industry. It is very important not only to produce more but also to save whatever is grown at production cost.

The shelf life of any fruit consists of ripening and senescence. After harvest, fruits undergo many physiological and biochemical changes during storage. The shelf life of fruits could be prolonged significantly through slowing down the process leading to ripening and controlling the microbial decay (Bose et al., 1999; Gofur et al., 1997). Information regarding the extension of storage life of mango through the treatment of plant hormones in Bangladesh is very scanty. The present study has been undertaken to extend the storage life (shelf life) and to reduce the spoilage of mango as caused by various factors without changing the original fruit quality.

2. Materials and Methods

Freshly harvested and uniformly ripe mango cultivar of kishanbhog were collected from the experimental mango research garden of BCSIR Laboratories, Rajshahi,
Bangladesh during June–July, 2011 and 2012. During the period of study the ambient temperature and relative humidity in the laboratory ranged between 30-35°C and 75-80% respectively. The physical and chemical composition of fresh mango were analyzed and the data were recorded in Table 1. Only sound and firm ripe 150 mangoes of averagely uniform size, shape and colour were undertaken in this experiment. The mangoes were divided in 10 lots, containing 15 mangoes in each lot and the treatments were made with three different plant hormones IAA, NAA and 2,4-D at three different concentrations (i.e. 10, 20 and 30 ppm). So there were altogether 10 treatments including the control. The lots of mangoes under experiments were marked and designed. The lots of mangoes were dipped for 5 minutes in plant hormone solutions of 10, 20 and 30 ppm Indole acetic acid (IAA), Naphthalene acetic acid (NAA) and 2,4-dichlorophenoxy acetic acid (2,4-D). One lot was dipped only in one solution. The control mango was dipped in water for the same duration and kept at ambient temperature (30-35°C) in identical condition. For determining the postharvest weight losses, the initial weight was recorded just after the treatment. Subsequently, their weights were recorded at two days interval and the loss in weight was expressed as the percentage over the initial weight. The biochemical changes were also determined by the standard methods. The sugar content was determined by spectrophotometric method (Miller, 1959), the reducing sugar was estimated by the same method (Jayaraman, 1981) and vitamin C was estimated by tritrimetric method (Mohadevan and Sridhar, 1982) using 2.6-dichlorophenol indophenol. TSS was determined by refractometric method (Gofur et al., 1997) and pH was determined by a standard pH meter (Gofur et al., 1998). Acidity was estimated by acid–base titrimetric method (Rangana, 1986) using standard sodium hydroxide solution. The preserved mango was analyzed periodically and the results were recorded in tables (Table 2 & 3). Organoleptic test (Begum et al., 2007) of the control and hormone treated mangoes at the last edible stage was performed by a panel of ten Judges and the mangoes were classified as follows on the basis of their scoring, excellent- 80 % or above, good 70-80 % and below 70 % fair depending on general appearance, colour, flavour, taste and texture (Table 4). Microbiological (Morshed et al., 2008) and Toxicological (Yesmin et al., 2014) studies of plant hormones (IAA, NAA and 2,4-D) were carried out in Microbiology Laboratory, Department of Pharmacy, Rajshahi University, Rajshahi, Bangladesh and Department of Pharmacology and Therapeutics, Rajshahi Medical College, Rajshahi, Bangladesh. The recorded data were statistically analyzed and means of different parameters were compared by least significant difference (LSD) test (Karim, 1976).

3. Results and Discussions

The table 1 shows that the pulp percentage (74.20%) of kishanbhog variety is higher than those of well known variety of mango in Bangladesh on the other hand the percentage of skin and stone is lower than those variety (Shafique et al., 2006). It is clear from table 1 that the total soluble solids content in the fresh mango pulp is 16.50 % where as in the case of control, it is 14.7% and in the case of hormone treated mangoes are 18.3-19.5 % in all cases, the acidity (% as citric acid) varied from 0.14-0.16 % and the total sugar content ranged from 11.25-12.70 %. As regards taste, flavor and colour of the pulp under study (Table 4) were found to be overall similar except vitamin C (ascorbic acid) content.

It is reveled form the fig. 1 that the storage life of mango was significantly influenced by different treatments of plant hormones. The storage life was longer (15 days ) in 30 ppm IAA and 30 ppm NAA treated fruits followed by 10 ppm NAA 20 ppm IAA and 30 ppm 2,4-D (13 days) treated fruits compared to that of control (11 days). The foregoing results clearly indicate the efficacy of plant hormone to prolong the storage life of mango 2 to 4 days with IAA, NAA, and 2,4-D treatments. The findings of Chattopadhaya et al.,1992 and Singh et al.,1987 in this respect support the results obtained in this study. A significant variation was found among the treatments in respect of postharvest loss in weight during the storage period up to last edible stage. But the effect was more pronounced in 30 ppm NAA and 30 ppm IAA treated fruits (Table 2). The loss in weight was increased with the increase of storage period. There was a lowest weight loss in 30 ppm NAA treated fruits (16.01 %) and lower weight loss in 30 ppm IAA (17.33 %) and 20 ppm IAA (17.39 %) compared to control (22.65 %). Literature in relevant to plant hormones as preservative to control weight loss in stored mango is scanty. However, it is reported that the weight loss (%) in fruits increase with increasing of storage period regardless of method of ripening (Wasker and Masalkar 1997). From the results (Table 3) it is evident that the treatments of different plant hormones significantly differ from one another in respect of TSS content of mangoes. However, the control mango showed lower TSS value (14.3 %) compared to treated mangoes (18.3% - 19.5%). Increased TSS in treated fruits might be attributed to the conversion of starch into sugars occurred during ripening (Bauna, 1976). Increased TSS value with IAA, NAA and 2,4-D was also reported by Tang et al., (1997 ). The total sugar content of the fruits in different treatments varied from 11.25 % - 12.70 %. The treatments of different growth regulators significantly differ in this aspect compared to control and also reducing sugar and non–reducing sugar (Tang et al.,1997). pH, acidity and vitamin C (Ascorbic acid ) content of mangoes subjected to treatment of different plant hormones showed significant variation. Similar results were also reported by Chattopadhay et al., (1992). Studies of biochemical, hematological and histopathological parameters of hormone (IAA, NAA and 2,4-D) treated mice indicated that IAA, NAA and 2,4-D are safe for application on fruits (Morshed, 2005 and 2006). It is evident from Table 4 the physical characters of control and hormone treated

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Quantity</th>
<th>Nutrients</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>79.65</td>
<td>Carotene (μg/100g)</td>
<td>4823</td>
</tr>
<tr>
<td>Total solid (%)</td>
<td>20.35</td>
<td>pH</td>
<td>03.85</td>
</tr>
<tr>
<td>Total soluble solids (%)</td>
<td>16.50</td>
<td>Ash (%)</td>
<td>00.27</td>
</tr>
<tr>
<td>Total sugar (%)</td>
<td>10.35</td>
<td>Fibre (%)</td>
<td>00.46</td>
</tr>
<tr>
<td>Reducing sugar (%)</td>
<td>03.76</td>
<td>Pulp content (%)</td>
<td>74.20</td>
</tr>
<tr>
<td>Non reducing sugar (%)</td>
<td>06.59</td>
<td>Skin (Peel) content(%)</td>
<td>13.70</td>
</tr>
<tr>
<td>Acidity as citric acid (%)</td>
<td>00.17</td>
<td>Stone content (%)</td>
<td>12.10</td>
</tr>
<tr>
<td>Vitamin C (mg/100g)</td>
<td>13.65</td>
<td></td>
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</tr>
</tbody>
</table>

Table 1: Proximate composition of fresh mango pulp determined by standard methods
mangoes were compared by the judges on the basis of appearance, colour, flavour, taste and texture. It can be showed from their suggestions that the treated mangoes are quite superior to that from control mango (Ibrahim, 2001).

**Conclusion:** Hormone treated mangoes are significantly improved in all respect i.e. lower postharvest weight loss, better quality, more storage life and more acceptable in physical characters than those of control one.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>pH</th>
<th>TSS (%)</th>
<th>Total sugar (%)</th>
<th>Reducing sugar (%)</th>
<th>Non reducing sugar (%)</th>
<th>Acidity (% as citric acid)</th>
<th>Vitamin C (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 ppm IAA</td>
<td>4.76</td>
<td>19.3</td>
<td>11.30</td>
<td>3.65</td>
<td>7.65</td>
<td>0.15</td>
<td>9.21</td>
</tr>
<tr>
<td>20 ppm IAA</td>
<td>4.75</td>
<td>19.2</td>
<td>12.70</td>
<td>3.92</td>
<td>8.15</td>
<td>0.15</td>
<td>9.30</td>
</tr>
<tr>
<td>30 ppm IAA</td>
<td>4.63</td>
<td>18.3</td>
<td>11.50</td>
<td>3.95</td>
<td>7.55</td>
<td>0.16</td>
<td>9.50</td>
</tr>
<tr>
<td>10 ppmNAA</td>
<td>4.75</td>
<td>18.5</td>
<td>11.55</td>
<td>3.60</td>
<td>7.95</td>
<td>0.14</td>
<td>9.35</td>
</tr>
<tr>
<td>20 ppmNAA</td>
<td>4.74</td>
<td>18.7</td>
<td>11.25</td>
<td>3.45</td>
<td>7.80</td>
<td>0.14</td>
<td>9.29</td>
</tr>
<tr>
<td>30 ppmNAA</td>
<td>4.65</td>
<td>19.5</td>
<td>12.52</td>
<td>4.36</td>
<td>8.24</td>
<td>0.16</td>
<td>9.56</td>
</tr>
<tr>
<td>10 ppm2,4-D</td>
<td>4.74</td>
<td>19.3</td>
<td>12.30</td>
<td>3.85</td>
<td>8.45</td>
<td>0.15</td>
<td>9.20</td>
</tr>
<tr>
<td>20 ppm2,4-D</td>
<td>4.73</td>
<td>19.5</td>
<td>12.25</td>
<td>3.50</td>
<td>8.25</td>
<td>0.15</td>
<td>9.25</td>
</tr>
<tr>
<td>30 ppm2,4-D</td>
<td>4.73</td>
<td>18.7</td>
<td>11.40</td>
<td>3.38</td>
<td>8.20</td>
<td>0.14</td>
<td>9.30</td>
</tr>
<tr>
<td>Control</td>
<td>4.90</td>
<td>14.7</td>
<td>9.50</td>
<td>2.95</td>
<td>6.55</td>
<td>0.12</td>
<td>7.35</td>
</tr>
<tr>
<td>LSD(0.01)</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

IAA: Indole acetic acid; NAA: Naphthalene acetic acid; 2,4-D: 2,4-Dichlorophenoxy acetic acid; TSS: Total soluble solids

**Table 2:** Postharvest weight loss of hormone treated and control mango (%) at two days interval during the storage period

**Table 3:** The nutritional value of mango pulp from control and hormone treated mango at the last edible stage during the storage period

**Table 4:** The grading of control and hormone treated mango as judged by the panel of judges based on general qualities of mango

*Control : Dipped in water only, *Treated: Dipped in solution of hormone treatment
Figure 1: Storage life of mango cultivar of kishanbhog treated with 10 ppm, 20 ppm & 30 ppm of IAA, NAA & 2,4-D and control during the storage period

References


