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Materials and Methods

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Shelf life and quality of mango as influenced by low temperature storage

M.A. Uddin¹, M.F. Mondal and M. S. Islam
Department of Horticulture, Bangladesh Agricultural University, Mymensingh

Abstract
The experiment was carried out to study the shelf life and postharvest quality of mango as influenced by low temperature storage at the Laboratories of the Department of Horticulture and Biochemistry and the Central Laboratory of the Bangladesh Agricultural University, Mymensingh. Four varieties of mango such as Langra, Fazli, Laksmi and Kalibhog were used in the experiment. Low temperatures used in this experiment were, 9, 11, 13 and 15 °C including a control (room temperature). There were significant variations among the varieties and also among the storage temperature treatments in respect of shelf life, pulp to peel ratio, total weight loss and total sugar content. Although longer shelf life was recorded in fruits stored at lower temperatures (9 and 11 °C), the fruits did not ripen properly at these temperatures even after keeping at room temperature and also the edible qualities of those fruits were not satisfactory. In case of cv. Fazli, the longest shelf life was obtained in fruits stored at 13 °C which was statistically identical with those stored at 15 °C.

Key words : Shelf life, quality, mango, low temperature, storage

Introduction
Mango (Mangifera indica L.) is commercially grown in a number of countries of the world. The mango fruits deteriorate in quality due to its climacteric nature and high perishability. In Bangladesh, there exists a large number of good varieties of mango which are of superior taste and quality but many fruits are spoiled due to lack of storage facilities. Shelf life of fruits can be extended and quality can be maintained through different postharvest techniques including atmospheric modification (Lashley, 1984). Seymour et al. (1990) reported that the shelf life of mango could be extended significantly by storing the fruits at low temperature (13-15 °C). But information on specific cultivated varieties in respect of low temperature storage is not available in Bangladesh. The present study was, therefore, undertaken to determine the shelf life of mango cv. Langra, Kalibhog, Laksmi and Fazli using low temperature treatments without sacrificing the quality of fruits and also to observe the physico-chemical changes associated with ripening during storage.

Materials and Methods
The experiment was conducted at the Postgraduate Laboratory of the Department of Horticulture and Central Laboratory of the Bangladesh Agricultural University (BAU), Mymensingh. Chemical analysis was done at the Laboratory of the Department of Biochemistry, BAU, Mymensingh during the period from June to September 2005. Four mango varieties cv. Langra, Kalibhog, Laksmi and Fazli were used in this experiment. Uniform hard mature mango fruits of each variety were collected from the farmers' orchard of Nowabganj. The experiment consisted of above mentioned four varieties and five temperature treatments (9, 11, 13, 15 °C and room temperature as control). Each treatment comprised five randomly selected fruits of each variety with three replications. Shelf life, pulp to peel ratio, total weight loss and total sugar content were determined. Physico-chemical parameters were estimated following Ranganna (1979). Pulp to peel ratio was estimated by removing the pulp from the peel and weighing by an electric balance. Total weight loss was calculated by subtracting final weight from initial weight and dividing with initial weight. Total sugar contents of mango pulp were determined colorimetrically by the Anthrone method (Jayaraman, 1981) and dinitrocinnamic acid method (Miller, 1976). Data were statistically analyzed with computer program MSTAT and the mean separation was done by DMRT and the LSD values were used in the graphs.

Results and Discussion
Shelf life of mango
The shelf life of mango was significantly influenced by variety. The variety Fazli had the longest shelf life, (22.13 days) and the shortest shelf life (16.47 days) was recorded in Kalibhog (Fig. 1). Low temperature treatment prolonged the shelf life of mango. The longest shelf life (25.17 days) was observed at 9 °C and the shortest (8.50 days) was recorded in control (Fig. 2).

There was no significant interaction between variety and storage temperature treatment on the shelf life of mango. But there were significant variations among the treatment combinations. The longest shelf life (28.00

¹ Graduate student
Table 1. Combined effects of variety and low temperature treatment on shelf life, pulp to peel ratio, total weight loss, total sugar content of mango

<table>
<thead>
<tr>
<th>Combinations</th>
<th>Shelf life (days)</th>
<th>Pulp to peel ratio at Pre-ripe</th>
<th>Pre-ripe</th>
<th>Ripe</th>
<th>End of shelf life</th>
<th>Pre-ripe</th>
<th>Pre-ripe</th>
<th>Ripe</th>
<th>End of shelf life</th>
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<td>6.53</td>
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<td>6.11k</td>
<td>6.49k</td>
<td>6.29k</td>
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<td>5.71k</td>
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<td>6.48k</td>
<td>6.28k</td>
<td>5.51k</td>
<td>8.55l</td>
<td>12.33l</td>
<td>5.32h</td>
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<td>6.33l</td>
<td>6.48l</td>
<td>6.68l</td>
<td>3.01h</td>
<td>9.06g</td>
<td>13.32k</td>
<td>5.75d</td>
<td>8.72c-g</td>
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<td>6.63i</td>
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<td>11.23d</td>
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<td>5.34m</td>
<td>6.46k</td>
<td>5.00a</td>
<td>13.44a</td>
<td>20.77a</td>
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<td>9.42c</td>
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<td>4.11p</td>
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<td>7.54e</td>
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<td>9.02e-c</td>
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</tbody>
</table>

In each column, the figures having common letter(s) do not differ significantly at 1% level by DMRT

Varieties Storage temperature treatments
V₁ : Fazli T₀ : Control (storage at room temperature)
V₂ : Kalibhog T₁ : Storage at 9 °C
V₃ : Lakshmibhog T₂ : Storage at 11 °C
V₄ : Fazli T₃ : Storage at 13 °C
T₄ : Storage at 15 °C

days) was found in Fazli at 9 °C and the shortest (6.67 days) was in Kalibhog under control treatment (Table 1). The shelf life decreased with the increase in storage temperature for all the varieties. This might be due to some physiological changes which were in agreement with those of Seymour et al. (1990).

Pulp to peel ratio
Variation among the varieties in respect of pulp to peel ratio was significant during storage of mango. The highest pulp to peel ratio (10.78) was found in Fazli and the lowest (4.97) was recorded in Kalibhog (Fig. 3). Pulp to peel ratio was also significantly influenced by low temperature treatments. At ripe stage, the highest pulp to peel ratio (7.64) was recorded in control and the lowest value (6.93) was obtained in those fruits, which were stored at 9 °C (Fig. 4). The maximum pulp of peel ratio (10.87) was noticed in Fazli at control, and the minimum (4.41) was obtained in Kalibhog when stored at 9 °C. It was also noticed that pulp to peel ratio
increased with the increase in temperature during storage in all the varieties (Table 1). Higher rate of moisture loss from the peel than pulp was probably the cause of increasing pulp to peel ratio. The findings were in agreement with those of Ahmed *et al.* (1988).

Total weight loss
There were significant variations among the varieties in total weight loss during storage (Fig. 5). The highest total weight loss (10.74%) was observed in Kalibhog and the lowest was recorded in Fazli (7.61%). Low temperature treatments had also significant effect on total weight loss during storage. Maximum total weight loss (11.57%) was observed in control fruits, while the minimum (6.88%) was recorded in fruits stored at 9 °C (Fig. 6).

Maximum weight loss (13.44%) was recorded in Kalibhog at control and the minimum (9.76%) was noticed in Fazli at 9 °C (Table 1). A sharp increase in total weight loss was observed during storage period with the increase in storage temperature for all the varieties used. It might be due to increase in transpiration, respiration, dehydration and evaporation rates at higher temperatures. The results were in agreement with the findings of Zora *et al.* (2001), who stated that physiological weight loss reduced in mango when stored at 13 °C.

Sugar content of pulp
Significant variations were found in respect of total sugar contents during storage among the varieties of mango. At ripe stage, the highest total sugar (8.80%) was found in Langra and the lowest was observed (7.19%) in Laksmnbhog (Fig. 7). Low temperature treatment had also significant effect on sugar content during storage of mango. At ripe stage, the highest total sugar was 9.84% in control and the lowest was 5.32% at 9 °C (Fig. 8). At ripe stage, the maximum total sugar content (11.10%) was recorded in Langra at control, and the minimum (5.00%) was noticed in Laksmnbhog at 9 °C (Table 1). It was also observed that there was a gradual increase in
total sugar content with the increase in storage period and temperature (Upadhyay and Tripathi, 1985, Mondal et al., 1998 and Tsuda et al., 1999). They reported that total sugar and reducing sugar contents of mango increased during storage. It might be due to the conversion of starch to reducing and non-reducing sugars.

Fig. 7. Main effect of variety on total sugar (%) of mango (Vertical bars represent LSD at 5% level of significance)

Fig. 8. Main effect of low temperature treatments on total sugar of mango (Vertical bars represent LSD at 5% level of significance)

From the above discussion, it may be concluded that Fazli was the best among the varieties of mango for prolonging shelf life. Though 9 °C caused the longest shelf life, the mangoes did not ripen properly at this temperature and it was not acceptable as the sugar content was low. So, for mango storage, without sacrificing the quality, 13 °C was the most acceptable temperature. But in case of cv. Fazli, the longest shelf life was obtained in fruits stored at 13 °C which was statistically identical with those stored at 13 °C which was statistically identical with those stored at 15 °C. Therefore, 13 - 15 °C may be recommended for storage of mango. Further study may be undertaken with more varieties and temperatures beyond 15 °C to reach the conclusion for different varieties of mango.

References


