RIPENING AND QUALITY CHANGES IN MANGO FRUIT AS AFFECTED BY COATING WITH AN EDIBLE FILM

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Accepted for Publication November 25, 1999

ABSTRACT

Mango fruit has a relatively short storage life of about 2 to 3 weeks at 13°C. In order to prolong the storage life of 'Haden' mangoes, fruit were coated with 3 concentrations (8, 16 and 24 g.L⁻¹) of the edible coating film "Semperfresh" and then stored at 13°C and 85% RH. Fruit were then evaluated every 4 days for up to 32 days for total soluble solids (TSS), titratable acidity (TA), pH, firmness, weight loss, color of the skin, and ascorbic acid content. All 3 concentrations applied to the fruit affected fruit ripening. TA, firmness, and green color were higher in coated fruit, and weight loss, SST, and pH were lower compared with the noncoated fruit. "Semperfresh" had no effect on decay development. Ascorbic acid decreased in all stored fruit, but this decrease was slower in coated fruit, and there were no significant differences between the different "Semperfresh" concentrations.

INTRODUCTION

Mango is one of the most important fruits grown in Mexico. About 85% of the production is distributed in the internal market, and the rest is destined for export.

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especially to the USA, and for processing (Ireta 1988). The mango exported to the USA from Mexico is treated with hot water (46.1°C for 75 or 90 min depending on fruit weight) for fruit fly disinfestation. This treatment removes natural skin coatings and accelerates fruit ripening and deterioration (Campos and Yahia 1991). Treated fruit lose more water than untreated fruit (Campos and Yahia 1991). The minimum storage temperature for mango ranges between 10 to 13°C. At these temperatures the fruit can be stored for 2 to 3 weeks. Controlled atmosphere (CA) storage with 5% O₂ and 5% CO₂ has been tested for ‘Keitt’ mango without any significant advantage (Hatton and Reeder 1965). However, mango has been shipped in modified (MA) and controlled atmospheres (CA) (Yahia 1993; Yahia 1998). A relatively inexpensive method to modify the internal atmosphere of the fruit, and to slow down its metabolism, is the use of permeable edible coatings. These permeable coatings reduce fruit gas exchange and water loss (Lowings and Cutts 1982). “Semperfresh” is a mixture of esters of mono- and di-glycerides with sucrose and carboxymethylcellulose. “Pro-Long”, a similar edible coating to “Semperfresh”, has been shown to delay ripening and reduce water loss in ‘Julie’ mangoes (Dhalla and Hanson 1988).

A significant extension of the postharvest life of mango fruit and maintaining a good quality is important to permit transportation, distribution and commercialization in distant markets. Therefore, the objective of this work was to study the effects of the edible coating “Semperfresh” on quality attributes of ‘Haden’ mangoes during storage at 13°C and 85% RH for up to 32 days.

MATERIALS AND METHODS

‘Haden’ mangoes (Mangifera indica L.) were harvested in Aguaruto, Sinaloa, Mexico at their physiological maturity. They were washed and selected on the basis of uniformity of color, size (300-500 g), and absence of defects.

Aqueous solution (50 g·L⁻¹) of “Semperfresh” was used as stock. After a 2 h hydration period, solutions of 8, 16 and 24 g·L⁻¹ were prepared from the stock. The mangoes were soaked during 1 min in one of the 3 concentrations of “Semperfresh”. The coating over the fruit was permitted to dry for 5 min in air at room temperature. Fruit were then stored at 13°C for up to 32 days, and evaluated every 4 days for total soluble solids (TSS), pH, titratable acidity (TA), firmness, skin color, and weight loss. TSS was measured using a refractometer (Abbe American Optical). The pH was measured using a pH-meter (Beckman Model 40). TA was measured according to AOAC (1990). Firmness was measured on 2 paired points using a firmness-tester (Chatillon DFI-50) with a 6-mm point. Skin color changes were evaluated using a Minolta Chroma-Meter CR 210 (Minolta Corp., Osaka, Japan) by determining the a* and b* values and calculating the ‘Hue’ angle \( \tan^{-1} \frac{b^*}{a^*} \). Calibration was done with a standard white tile. Color measurements
were taken on 2 points of the skin of each fruit. Ascorbic acid (AsA) was measured according to the method of AOAC (1990).

Analysis of variance and comparison of means was done with the Dunnet test at a significance level of 0.05. Results were presented as mean ± SE, except for ascorbic acid data where least significant differences (LSD at 5%) were calculated. Color and firmness data were the average of 8 independent observations, and all other data were the average of 4 independent observations.

RESULTS AND DISCUSSION

"Semperfresh" at the different concentrations used was effective in reducing weight loss of 'Haden' mangoes as compared with the noncoated control (Fig. 1). A statistically significant reduction of weight loss was observed after 12 days of storage. The 8 g.L⁻¹ level was more effective than the 16 and 24 g.L⁻¹. This is probably due to the hygroscopic effect of the higher concentrations. It has been reported that the higher concentration of "Semperfresh" caused the lowest weight loss in 'Amasya' apples (Sumnu and Bayindirli 1995) and in 'Julie' mangoes (Dhalla and Hanson 1988).

All "Semperfresh" coatings were effective in the retention of mango skin color as was shown by changes in the a* value (Fig. 1). Values of a* (indicating changes of green to red colors) increased and were higher in the control than in coated fruit. The increase in the level of "Semperfresh" further suppressed the a* value. "Semperfresh" was also effective in reducing the loss in the 'Hue' angle value of the skin (Fig. 1). This might be due to the inhibition of chlorophyll degradation and/or to reduced synthesis of anthocyanins and/or carotenoids. Inhibition of chlorophyll degradation by "Prolong" was observed in limes (Motlagh and Quantick 1988), and the highest concentration (in a range of 15-25 g.L⁻¹) caused the highest chlorophyll retention. A decrease in carotenoids was observed in 'Julie' mangoes treated with "Pro-long" edible coating (Dhalla and Hanson 1988). In our work we have observed that yellow color on skin did not develop uniformly in fruits treated with 24 g.L⁻¹ of "Semperfresh".

"Semperfresh" coatings decreased the loss in fruit firmness (Fig. 2). Fruit firmness decreased in coated and in noncoated fruit, but the decrease was slower in coated fruit. Noncoated fruit were always less firm than coated fruit. This is probably due to the development of an adequate internal atmosphere in coated fruit. A loss in mango pulp rupture force was more gradual in fruit treated with 7.5-10 g/L⁻¹ "Pro-Long" edible coating (Dhalla and Hanson 1988). "Semperfresh" sucrose polyester at different levels (5,10,15 and 20 g.L⁻¹) was effective in maintaining the firmness of apple fruit for 25 days (Sumnu and Bayindirli 1995). In tomatoes, an edible coating based upon corn-zein film was reported to delay the loss of firmness (Park et al. 1994).
FIG. 1. CHANGES IN WEIGHT LOSS (%), a* AND HUE ANGLE VALUES IN 'HADEN' MANGOES COATED WITH DIFFERENT CONCENTRATIONS OF "SEMperfresh" AND STORED AT 13 C FOR UP TO 32 DAYS

Vertical bars indicate standard error of the mean.
FIG. 2. CHANGES IN FIRMNESS (N), TOTAL SOLUBLE SOLIDS, pH AND TITRATABLE ACIDITY IN 'HADEN' MANGOES COATED WITH DIFFERENT CONCENTRATIONS OF "SEMPERFRESH" AND STORED FOR UP TO 32 DAYS

Vertical bars indicate standard error of the mean.
TSS increased during ripening, reached a peak after 16 to 24 days and then decreased (Fig. 2). TSS was lower in fruit treated with "Semperfresh". Significant differences between coated and noncoated fruit were observed after 8 days at 13C. The highest TSS levels of noncoated fruit (16.5%) were never reached by the sucrose-polyester coated mangos. At the end of the storage period TSS was similar in treated and nontreated fruit, showing levels between 13 and 15%. A similar effect has been reported in 'Julie' mangoes (Dhalla and Hanson 1988), in 'Amasya' apples (Sumnu and Bayindirli 1995) and in mandarins (Bayindirli et al. 1995).

"Semperfresh" coating was effective in maintaining a lower pH than that observed in noncoated mangoes (Fig. 2). The difference was significant after 8 days of storage. The highest pH observed in coated fruit was 4.75 at the end of the storage period. The highest pH exhibited by the noncoated mangoes was 5.66. There were no significant differences between the effects of the different concentrations of "Semperfresh".

A continuous decline in TA, from 0.83 to 0.1%, was observed during the first 12 to 16 days of storage (Fig. 2). Coating with the sucrose polyester at the different concentrations was found to be effective in the retention of the loss in TA compared to the noncoated fruit. The increase in the concentration of "Semperfresh" significantly decreased the loss in TA. TA in coated fruit did not reach the lowest level observed in untreated fruit. A TA retention was reported in 'Amasya' apple for concentration of "Semperfresh" higher than 5 g.L⁻¹ (Sumnu and Bayindirli 1995), in 'Julie' mangoes (Dhalla and Hanson 1988) and in mandarins (Bayindirli et al. 1995) treated with 15 g.L⁻¹ of "Semperfresh". It is possible that higher CO₂ concentration accumulated internally in the treated fruit tissue resulting in an increase in acidity.

As A decreased in coated and noncoated mango fruit (Table 1). This reduction was slower in coated fruit compared to the control in the first 2 weeks of storage, but changes were similar in the coated and control fruit in the last 2 weeks.

Anthracnose started to develop on coated and noncoated fruit after 24 days, which determined the end of the storage period, and was not affected by the application of "semperfresh" (data not shown).

CONCLUSIONS

Coating with 8, 16 and 24 g.L⁻¹ of "Semperfresh" retarded ripening and affected the quality attributes of 'Haden' mangoes. "Semperfresh" reduced water loss and color change, but had no significant effect on ascorbic acid. Further studies using lower concentrations of "Semperfresh" in combination with decay control treatments are recommended.
TABLE 1.
ASCORBIC ACID CONTENT (MG/100G FWB) IN 'HADEN' MANGOS COATED WITH DIFFERENT CONCENTRATIONS OF "SEMPERFRESH" AND STORED FOR UP TO 32 DAYS AT 13C AND 85% RH

<table>
<thead>
<tr>
<th>Storage Period (Days)</th>
<th>&quot;Semperfresh&quot; Concentration (g. L(^{-1}))</th>
<th>LSD 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.8</td>
<td>1.6</td>
</tr>
<tr>
<td>0</td>
<td>17.3</td>
<td>17.3</td>
</tr>
<tr>
<td>4</td>
<td>17.1</td>
<td>15.1</td>
</tr>
<tr>
<td>8</td>
<td>15.5</td>
<td>13.9</td>
</tr>
<tr>
<td>12</td>
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<tr>
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<td>10.8</td>
<td>14.0</td>
</tr>
<tr>
<td>20</td>
<td>11.8</td>
<td>11.4</td>
</tr>
<tr>
<td>24</td>
<td>10.5</td>
<td>9.3</td>
</tr>
<tr>
<td>28</td>
<td>9.1</td>
<td>9.4</td>
</tr>
<tr>
<td>32</td>
<td>---</td>
<td>9.7</td>
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</tbody>
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\(^1\)fruit were not analyzed due to decay.

REFERENCES


