Effects of Chitosan Coating on Postharvest Quality and Shelf Life of Banana Fruit

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Abstract – This study was conducted to determine the effect of chitosan on postharvest quality and shelf life of “Hom Thong” Banana (Musa AAA Group, Gros Michel) fruit. The banana samples were dipped for 1 min and 2 times into chitosan solution of 0% (control), 0.2%, 0.4%, 0.6%, 0.8%, 1.0% and 1.5% (w/v). The coated samples were stored at room temperature (30±2°C) until decadent. The properties of weight loss, color, total soluble solids, and firmness for all samples were measured every 3 day. A chitosan coating could reduce weight loss and prolong color from greenish to yellowish of the banana. The increasing in total soluble solids and delay changing firmness during samples storage was found as the chitosan coating. Increasing the concentration of chitosan coating pronounced the beneficial effects on the postharvest quality. Coating “Hom Thong” Banana with 1.5% chitosan solution was found the most effectiveness for treatments that could prolong the shelf life until 18 days from 10 days.

Keyword: Chitosan coating; Postharvest quality; Banana
1. Introduction

“Hom Thong” Banana is an important fruit for commercial in world trade. Bananas are usually harvested by cutting the plant carefully to prevent damage to the fruits. It is harvested at full maturity for domestic consumption, but for export it must be shipped unripe so the harvesting stage should be before fully mature. An important problem that affects to the fruit exporting is postharvest management according to a short shelf life. Green bananas are shipped at temperature range from 13-14°C. One method of extending postharvest shelf-life is the use of edible coating. Many techniques of fruit coating for storage after harvest have been developed to extend the shelf life and prolong freshness of fruits such as polyethylene wax emulsion, TAL Prolong, beewax, carnuba, candelilla, chitosan, and paraffin. Application of the chitosan-edible coatings is promising to improve the quality and extend shelf life in manufacturing process. A composite film derived from chitosan has good wet strength, gas barrier, and biodegradable. Chitosan is a safe material that has been reported to form an ideal film-coating on fruits surface to delay the ripening of fruits. It has been successfully used as food wraps [1] and thus maintains the quality and reduced weight loss of fruits and vegetable such as litchi, Chinese water chestnut and longan fruit [2][3].

Consequently, objective of this work was to study the effects of chitosan coating on postharvest shelf life and quality consist weight loss, color, total soluble solids and firmness of “Hom Thong” Banana.

2. Materials and method

2.1 Materials

“Hom Thong” Banana (Musa AAA Group, Gros Michel) fruit samples were obtained from a commercial market. Fresh fruits were selected for uniform size, shape, and color.

2.2 Experimental method

Prepared different concentrations of chitosan solutions (0.1, 0.2, 0.3, 0.4, 0.5 and 1%) by dissolved with 0.5% acetic acid. After washing, the fruit were dipped for 1 min into chitosan (80-85% deacetylated) solution of 0% (control), 0.2%, 0.4%, 0.6%, 0.8%, 1.0% and 1.5% (w/v). Two times dipped coating was performed after the fruit dried to make sure for completely coated. The coated samples were stored at room temperature (30±2°C) until decadent.

2.3 Determining of Weight Loss

Weight loss was measured and calculated progressively on the basis of a comparison for fruit weight as coating with chitosan during the storage period. The percentage of weight loss was calculated as equation (1).

\[
\text{Weight loss} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100 \quad (1)
\]

2.4 Color Measurement

The color value of banana was measured by a Hunter Lab, Color Flex model. The color was expressed as L*-value for lightness, a*-value for redness (+) or greenness (-), and b*-value for yellowness (+) or blueness (-). Additionally, the total color difference (\(\Delta E\)) was defined as equation (2).

\[
\Delta E = \left[ (L_0 - L_f)^2 + (a_0 - a_f)^2 + (b_0 - b_f)^2 \right]^{1/2} \quad (2)
\]

Where \(L_0\) and \(L_f\) are the initial and final lightness value, respectively. The \(a_0\) and \(a_f\) are the initial and final redness value, respectively. The \(b_0\) and \(b_f\) are the initial and final yellowness value, respectively. A standard white plate (\(L^* = 92.82, a^* = -1.24, b^* = 0.50\)) and a black plate were used to standardize the instruments.

2.5 Measurement of Total Soluble Solids (TSS)

Tissue (20 g) from “Hom Thong” Banana was homogenized in a grinder and then centrifuged for 20 min. The supernatant phase was collected and analyzes to determine the amount of total soluble solids, °Brix, using a hand refractometer (ATAGO, N-α model) [4].

2.6 Firmness Analysis

The firmness value was measured during storage until decadent by using texture analyzer (TA.XT.plus, stable micro systems model). The samples were taken from different parts of fruit with the pressure tester equipped with a 5 mm diameter flat plunger, which penetrate to a depth of 10 mm at a test speed of 50 mm/min [5]. The average value of firmness for each fruit was calculated from these values.

2.7 Statistical Analysis

The data from the repeated experiments were analyzed to determine whether the variances were statistically homogeneous. Statistical comparisons were made by one-way analysis of variance (ANOVA) followed by Duncan’s multiple range test. Least significant differences (LSDs) were calculated to compare significant effects at \(P \leq 0.05\) level.
3. Results and Discussion

3.1 Effect of Chitosan Coating on Weight Loss

Condition (0% chitosan). Among various chitosan concentrations, increasing chitosan concentration has resulted in weight retention of stored bananas. After 18 days of storage, the weight loss of the control samples and 1.5% chitosan-coated were 28.23% (highest) and 19.18% (lowest), respectively.

![Graph showing weight loss over storage time for different chitosan concentrations](image)

Fig.1 Effect of chitosan coating on weight loss of “Hom Thong” Banana during storage at room temperature (30±2°C)

3.2 Effect of Chitosan Coating on Color

The feature of banana ripening that is most obvious to a casual observer is the color change from green to yellow. Finally, quality analysis of chitosan coating showed that change of lightness value (L*), redness value (a*), yellowness value (b*) and the total color difference (ΔE*) decreased with increase concentration of chitosan coating. (Table 1) The effect of chitosan coating on the total color difference value of banana is shown in Fig.2. After 15 days of storage the banana treated with 1.5% chitosan was the lowest of the total color difference value.

![Graph showing total color difference over concentration of chitosan coated](image)

Fig.2 Effect of chitosan coating on the total color difference value of “Hom Thong” Banana during storage at room temperature (30±2°C)

3.3 Concentrations of Total Soluble Solids

The effect of chitosan coating on the total soluble solids content of banana is shown in Fig.3. The total soluble solids content were investigated in the both uncoated and coated banana pulp with chitosan during storage. Sucrose was the major presented sugar; the main increase occurred in early ripening process and increasing to the maximum content in fully ripened fruits. The total soluble solids content of banana increased during shelf life in all treatments and the bananas that were coated with chitosan had lower contents of total soluble solids than the controlled samples. From the results, it was indicated that chitosan coated banana significantly delayed the increasing rate of the total soluble solids content. The 1.5% chitosan coated could be one which was the most effective treatments.

![Graph showing total soluble solids over storage time for different chitosan concentrations](image)

Fig.3 Effect of chitosan coating on total soluble solids of “Hom Thong” Banana during storage at room temperature (30±2°C)

Table 1. Effect of chitosan coating on the color changed of banana after 15 days of storage at room temperature (30±2°C)

<table>
<thead>
<tr>
<th>Chitosan coating (%)</th>
<th>Lightness (L*)</th>
<th>Redness (a*)</th>
<th>Yellowness (b*)</th>
<th>ΔE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>16.50±0.13</td>
<td>9.38±0.02</td>
<td>21.65±0.11</td>
<td>28.84±0.16</td>
</tr>
<tr>
<td>0.2</td>
<td>14.50±0.02</td>
<td>6.89±0.05</td>
<td>21.03±0.27</td>
<td>26.42±0.30</td>
</tr>
<tr>
<td>0.4</td>
<td>14.42±0.10</td>
<td>7.73±0.07</td>
<td>21.03±0.27</td>
<td>26.65±0.28</td>
</tr>
<tr>
<td>0.6</td>
<td>13.44±0.31</td>
<td>6.68±0.09</td>
<td>20.18±0.46</td>
<td>25.15±0.38</td>
</tr>
<tr>
<td>0.8</td>
<td>14.33±0.01</td>
<td>5.39±0.04</td>
<td>20.05±1.16</td>
<td>25.21±0.94</td>
</tr>
<tr>
<td>1.0</td>
<td>13.54±0.01</td>
<td>6.81±0.10</td>
<td>17.46±0.26</td>
<td>23.13±0.22</td>
</tr>
<tr>
<td>1.5</td>
<td>11.49±0.35</td>
<td>4.20±0.48</td>
<td>13.49±0.19</td>
<td>18.32±0.40</td>
</tr>
</tbody>
</table>

Mean within the same column with different letters are significantly different at the 95% confidence level.
3.4 Effect of Chitosan Coating on Firmness

The effect of chitosan coating on the firmness of banana is shown in Fig.4. The firmness decreased sharply on the initial day of storage in all treatments. Bananas that were coated with chitosan had higher firmness value than controlled condition through the end of storage. The decreased in firmness which observed in coated fruits were not statistically significant among various chitosan concentrations. After 15 days of storage, the banana treated with 1.0 and 1.5% chitosan had the highest firmness value.

![Fig.4 Effect of chitosan coating on firmness of “Hom Thong” Banana during storage at room temperature (30±2°C)](image)

4. Conclusions

The application of chitosan coating could be beneficial in extending postharvest life, maintaining quality, and controlling decay of “Hom Thong” banana. In summary, the 1.5% chitosan coating was more effective than another treatment. Ripening of coated bananas was delayed when compared with controlled samples. Chitosan coating could reduce weight loss, delay changing color and firmness during storage, and increasing the total soluble solids. This studying can be considered for commercial application during storage and marketing.

5. Acknowledgements

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References