Influence of cold shock treatment on CAT activity of ginkgo seed during storage

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Abstract
The material in this experiment was the seeds of *Ginkgo biloba L.*, the ginkgo seeds treated with ice water (0°C) for different periods of time (1 h, 2 h, 3 h, and 4 h) and stored at room temperature were used to study the influence of cold shock treatment on CAT activities during storage. The experiment showed that cold shock treatment reframed the declining of CAT activities, and the degree of reframent was increasing with the time of cold shock treatment.

Introduction
Cold shock treatment was firstly studied by Ogata and Sakamota in 1979, they found that some fruits treated with ice water (0°C) for several hours after harvest had significantly longer shelf time and better storage quality, which were called 'cold shock effect'. Then, some other reports showed that cold shock treatment was prospective in storage practice. However, there were a lot of debates on the mechanism of cold shock treatment, and it was hard to draw a definitive conclusion. CAT have the function to keep the balance of oxygen metabolism and protect membrane structure, therefore, it could delay the senescence of ginkgo seeds to some extent. It has great significant in practice and theoretical research to study the influence of cold shock treatment on CAT activities during storage. However, there is a few of systematic reports on cold shock treatment to affect CAT activities of ginkgo seed during storage. The objective of this experiment is to study the influence of cold shock treatment on CAT activities and give a base for the treatment to be used in practice to store ginkgo seed.

Material and Methods

Material

Hand harvested mature seeds of *Ginkgo biloba L.* were obtained at Nanxong, and immersed in saturated solution of Ca(OH)₂ for decortication. The rotten and/or scarred seeds were removed. Uniform samples of ginkgo seeds in size (2.4g/each) and ripeness were selected.

Methods

Cold shock treatment: The ginkgo seeds were immersed in water with 1000 ppm Spane after decortication, and then removed from water. The seeds were chosen randomly and divided into 6 groups. Each group was put into a PE bag, and immersed in 40°C water for different periods of time (CK: 0h, 1 #: 0.5h, 2 #: 1h, 3 #: 1.5h, 4 #: 2h, 5 #: 2.5h). During storage, the ginkgo seeds were wrapped in 0.01mm PE and mean temperature was 24.3°C, mean RH was 83.7%.

Methods of measurement: Measurement of CAT activities was previously described by Zhang Baichao (1986). Decay and desiccation percentage was measured by observation of 5 persons in the room of storage. After cold shock treatment, CAT activities, decay and desiccation percentage were measured per 30 days.

Results and Discussion

The effect of cold shock treatments on changes of CAT activities during storage was described as in Table 1. During storage, the differences of CAT activities between CK and each cold shock treatment reached significant level (P < 0.05) or the most significant level (P < 0.01), which showed that cold shock treatment effectively controlled the decrease of CAT activities during storage. From the 61st to 121st day, the CAT activities of all treatments decreased much more rapidly than other 60 days periods of storage, and the variation values from the 61st to 121st day were all above 0.57 mgH₂O₂/g (10min), while the values from the 1st to 61st day were all less than 0.42mg H₂O₂/g·10min).

With the time of cold shock treatment increasing, CAT activities increased. During storage, the mean values of CK (cold shock treatment 0h), 1 #: (1h), 2 #: (2h), 3 #: (3h), and 4 #: (4h), were 1.14, 1.33, 1.39, 1.44 and 1.46 mg H₂O₂/g, 10min, resp. The linear regression of cold shock treatment time and CAT activities mean value was as follow:

\[ Y = 1.2020 - 0.0750X \]

in which, Y stood for the mean value of CAT activities (mgH₂O₂/g·10min; X stood for the time of cold shock
treatment (h); \( r = 0.9212; F > F_{0.01} \).

The above-mentioned analysis showed that positive linear correlation between the mean value of CAT activities and the time of cold shock treatment reached the most significant level, which meant that within 4h of cold shock treatment, longer time of cold shock treatment resulted in better effort to maintain CAT activities. In this experiment, cold shock treating more than 4h was not designed, because it exerted obviously negative influence on the color and surface of ginkgo seeds.

Comparison of mean values of CAT activities, decay percentage and desiccation percentage during storage was shown in Table 2. With mean value of CAT activities decreasing, mean value of decay percentage increased. The linear regression of decay percentage and CAT activities mean value was as follow:

\[ Y = 15.6581 - 8.8506X \]

<table>
<thead>
<tr>
<th>No. of Treatments</th>
<th>Hours of cold shock treatment (h)</th>
<th>Mean value of CAT activities (mg H(_2)O(_2)/g, 10min)</th>
<th>Mean value of decay percentage (%)</th>
<th>Mean value of desiccation percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CK</td>
<td>0</td>
<td>1.14 ± 0.11*</td>
<td>5.24 ± 0.14</td>
<td>14.63 ± 0.52</td>
</tr>
<tr>
<td>1#</td>
<td>1</td>
<td>1.33 ± 0.13**</td>
<td>4.49 ± 0.17**</td>
<td>12.31 ± 0.60**</td>
</tr>
<tr>
<td>2#</td>
<td>2</td>
<td>1.39 ± 0.12**</td>
<td>3.72 ± 0.16**</td>
<td>10.92 ± 0.39**</td>
</tr>
<tr>
<td>3#</td>
<td>3</td>
<td>1.44 ± 0.10**</td>
<td>2.97 ± 0.19**</td>
<td>9.96 ± 0.42**</td>
</tr>
<tr>
<td>4#</td>
<td>4</td>
<td>1.46 ± 0.12**</td>
<td>2.04 ± 0.15**</td>
<td>9.10 ± 0.35**</td>
</tr>
</tbody>
</table>

* Means and Standard errors; ** Significant at \( P = 0.01 \).

Desiccation is one of the most important physiological diseases of ginkgo seed during storage. Desiccation percentage increased with the decrease of CAT activity. The linear regression of desiccation percentage and CAT activities mean value was as follow:

\[ Y = 33.7842 - 16.5682X \]

\( X \) stood for the mean value of CAT activities (mg H\(_2\)O\(_2\)/g, 10min); \( Y \) stood for the mean value of desiccation percentage (%); \( r = -0.9824; F > F_{0.01} \). The above-mentioned analysis showed that negative linear correlation between the mean value of CAT activities and desiccation percentage reached the most significant level. It means that within 4h of cold shock treatment, lower CAT activity resulted in higher decay percentage during storage. Cold shock treatment maintained CAT activity, and therefore decreased desiccation percentage. So far, there has not been a definitive explanation on mechanism of ginkgo seed desiccation, more researches are needed to find out the
internal relation between cold shock treatment, CAT activity and desiccation of ginkgo seed.

**Conclusion**

It was proved in this experiment that positive linear correlation between the mean value of CAT activities and the time of cold shock treatment reached the most significant level. It meant that within 4h of cold shock treatment, longer time of cold shock treatment resulted in better effort to maintain CAT activities.

Within 4h of cold shock treatment of this experiment, negative linear correlation between the mean value of CAT activities and decay percentage, desiccation percentage reached the most significant level. Cold shock treatment maintained CAT activity, and therefore decreased desiccation percentage and decay percentage during storage.

**References**


Lu Denchun, 1993 Influence of temperature on the storage of ginkgo seed. The fruit tree of Shanxi, 2, 38–39

This research was supported by a joint grant from the natural sciences foundation and high education department of Guangdong province.