Effect of Blanching on Quality of Sour Cherry (Prunus cerasus L. CV. CAB) Juice

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Abstract: In this experiment, the effect of blanching time and temperature on the enzyme activity of polyphenol oxidase (PPO), peroxidase (POD) in sour cherry pulp and the quality of juicing was probed and the thermal stability of PPO in sour cherry, sweet cherry, apple and peach pulps were compared. The results showed that, with 3~4 min of blanching using water bath (at 85°C) and with the core temperature of pulp higher than 50°C, over 95% of PPO and POD in sour cherry pulp were inactivated; through juicing after 3 min of blanching, the content of soluble solids, anthocyanin, total phenols and ascorbic acid (Vc) in the prepared juice was increased, with obvious color preservation effect; compared with sweet cherry, apple and peach, the PPO in sour cherry had poor thermal stability and the lowest enzyme activity, which was conducive to the inhibition of enzymatic browning during the processing.

Key words: Sour cherry • Blanching • Polyphenol oxidase (PPO) • Peroxidase (POD) • Quality

INTRODUCTION

Sour cherry (Prunus cerasus Ledeb) with bright colors, special taste and rich nutrition, it contains significant levels of polyphenolids (anthocyanins and other flavonoids), as well as the alkaloid, melatonin [1]. Sour cherry has many effects such as regulating sleep, scavenging free radicals, antioxidation, anticancer and so on [2,3]. It mainly used for juice, wine, jam and other processed products [4,5]. In actual production, blanching is often used for inhibition of enzymatic browning and color preservation in fruit juice processing. However, excessive blanching damages the nutrients in the juice severely [6] and different blanching temperature and time are needed for the inactivation of polyphenol oxidase (PPO) and peroxidase (POD) in different fruits. It is particularly important to design appropriate time and temperature for blanching. Therefore, the enzyme inactivation effect of blanching for sour cherry pulp, the change of juice quality after blanching and the thermal stability of PPO in different fruits were studied in this experiment in order to provide reference for the processing technology of sour cherry.

MATERIALS AND METHODS

Plant Materials and Reagents: Mature sour cherry fruits (Prunus cerasus Ledeb. cv. CAB) and sweet cherry fruits (Prunus avium Ledeb. cv. Hongdeng) were picked in the cherry germplasm resource orchard of Beijing Academy of Agriculture and Forestry Science, China. After selection, cleaning and disinfection, sour cherry and sweet cherry were stored at -30°C for refrigeration. The apples (cv. Fuji) and peaches (cv. Wanmi) were bought from the market in Beijing. All of the chemical reagents for experiment were domestic and analytically pure.

Blanching Treatment: Stoppered test tube at six each weighed 10.0 g sour cherry pulp, 85°C water bath blanching and pulp core temperature measurement. One tube was taken out every 1 min and was cooled quickly in ice bath for the determination of PPO, POD and quality indicators of the prepared juice after blanching treatment. Stoppered test tube at ten each weighed 10.0 g sour cherry pulp, 10~100°C water bath blanching respectively, for each treatment temperature increases 10°C. The temperature was kept unchanged for 3 min after the core
temperature of pulp reached the set temperature and then cooled in ice bath immediately after removal. The changes of enzyme activity of PPO in sour cherry pulp after Blanching at different temperatures were measured. Weigh 10.0 g sour cherry, sweet cherry, apple and peach pulp in four stoppered test tube, respectively. With 60°C water bath blanching, each fruit pulps core temperature reaches 60°C for 3 min and then cooled in ice bath immediately after removal. The fruit pulp PPO activity was measured. Each treatment was repeated 3 times and the average value was taken as the result.

Enzyme Activity Measurement of PPO and POD: Five grams of fruit pulp was homogenized with 5-mL 0.1 mol/L sodium phosphate buffer (pH 7.5) containing 1% polyvinylpolypyrrolidone and then centrifuged at 12,000 r/min for 20 min at 4°C. The supernatant was collected for the enzyme assay. PPO activity was determined by the method of Liu et al. [7]. The standard reaction mixture contained 1.0 ml of 0.1-mol/l catechol, 1.0 ml, 0.1 mol/l phosphate buffer (pH 7.5) and 1ml of crude enzyme and was incubated for 5 min at 20°C or as indicated in the Results and Discussion section. By measuring the increase in absorbance at 420 nm with a UV-spectrophotometer (TU-1810, Beijing Puxi General Instrument Co., Beijing, China), the PPO activity was expressed as one unit = 0.001 ΔA420/min/g fresh weight.

The enzyme activity determination of peroxidase (POD): 2 ml of reaction solution was taken (10 ml pH 7.5 0.1 mol/l phosphate buffer, 100 μl 30% H₂O₂, and 50 μl 22 Guaiacol) in 10 ml centrifuge tube, which was laid in 20°C water bath for 5 min and then added with 1 ml of crude enzyme and shook up well. Immediately, measuring the increase in absorbance at 470 nm with UV-spectrophotometer, the POD activity was expressed as one unit = 0.001 ΔA470/min/g fresh weight.

Residual Rate of Enzyme Activity (%): It is expressed by the ratio of the enzyme activity before and after blanching treatment.

Measurement of Relevant Indicators
The Preparation of Crude Juice of Sour Cherry: The blanched sour cherry pulp was centrifugated at 8000 r/min for 15 min, then the supernatant liquid was collected and a small amount of impurities was removed with filter paper, thus the crude juice of sour cherry was obtained.

The Juice Yield Rate (%): It is expressed by the percentage of the mass of the crude sour cherry juice after blanching and the mass of the fruit pulp before blanching. Soluble solids (SS%): The SS% in the crude juice of sour cherry was measured with the refractometer (PAL-1, ATAGO, Japan), in contrast with the ultrapure water.

Chromatic Aberration: The chromatic aberration of the crude juice of sour cherry was measured with colorimeter (CR-400, Konica Minolta Sensing, Japan) for five times, with the average value as the result. Therein, L’ value is degree of brightness, a ’ value is degree of redness; b ’ value is degree of yellowness.

Anthocyanin (mg/100g): It was measured with pH differential method [8], 3 times with the average value as the result.

The Total Phenols (mg/100g): It was measured by the Folin-Ciocalteu colorimetry [9], 3 times with the average value as the result.

Ve (mg/100g): It was measured with 2,4-dinitrophenylhydrazine colorimetry, 3 times with the average value as the result.

RESULTS AND DISCUSSION
Influence of Blanching Time on the Enzyme Activity of PPO, POD in Sour Cherry Pulp: In the experiment, blanching treatment using water bath (85°C) was conducted on sour cherry pulp and the variation of PPO, POD activity and core temperature with time during blanching process were measured. It can be seen from Fig. 1 that, with the blanching time increasing, the residual rates of PPO, POD activity of sour cherry pulp went down significantly and POD activity decreased more than that of PPO; the core temperature of pulp raised with blanching time increasing, especially during the first 3 min. When blanching time was up to 2 min, the residual rates of PPO, POD activity of sour cherry pulp were 51.50 and 6.47% respectively and the core temperature of pulp reached 69°C; When blanching time was up to 3 min, the residual rates of PPO, POD activity of sour cherry pulp were 25.43 and 4.19%, respectively and the core temperature of pulp reached 76°C. When blanching time was up to 5 min, the residual rates of PPO, POD activity of sour cherry pulp were 4.08% and 3.47%, respectively and the core temperature of pulp reached 80°C.
Influence of Blanching Time on PPO Enzyme Activity of Sour Cherry: Sour cherry pulp was blanched for 3 min at different temperatures respectively and changes in PPO activity were determined. It can be seen from Fig. 2 that, with the blanching temperature rising, the residual rate of PPO activity of sour cherry pulp went down significantly; if the pulp was blanched for another 3 min immediately after the core temperature of pulp reached 30°C, the residual rate of PPO activity was 46.43%; if the pulp was blanched for another 3 min immediately after the core temperature of pulp reached 50°C, the residual rate of PPO activity was 4.15%. Therefore, if the pulp was blanched for 3 min immediately after the core temperature of pulp reached 50°C, 95.85% of the PPO could be inactivated. The experimental results in 2.1 showed that the heat resistance of POD of sour cherry pulp is poorer than that of PPO, thus, core temperature of pulp higher than 50°C and blanching time more than 3 min can be the inactivation conditions of PPO and POD in sour cherry pulp. The experimental results approximated the research results of inactivating PPO in blackberry using blanching treatment by Tian et al. [10]. That is to say, when the blackberry pulp was blanched for 2~3 min with the core temperature of blackberry being 53.3°C or more, its PPO could be inactivated.

Test of PPO Activity of Different Fruit Pulp: Fruit pulp of sour cherry, sweet cherry, peach and apple was blanched respectively. When the core temperature of pulp reached 60°C and was kept unchanged for 3 min, the changes of PPO activity before and after blanching treatment were measured. It can be seen from Fig. 3 that PPO enzyme activity was different for different fruit test samples; of which, the PPO activity of peach was the highest, reaching 327.13 U/min•g; the PPO activity of apple was the second, up to 103.18 U/min•g; the PPO activity of sweet cherry was 115.7 U/min•g; the PPO activity of sour cherry was the lowest, 73.3 U/min•g. When the core temperature of pulp reached 60°C and was blanched for another 3 min, the PPO activity went down significantly for all fruits; of which, the PPO activity of sour cherry was reduced by 97.03%; the PPO enzyme activity of sweet cherry was reduced by 97.86%.
Table 1: Effect of blanching time on quality of sour cherry juice

<table>
<thead>
<tr>
<th>Blanching time (min)</th>
<th>Juice yield (%)</th>
<th>SS (%)</th>
<th>Vc (mg/100g)</th>
<th>L*</th>
<th>a*</th>
<th>b*</th>
<th>Anthocyanin (mg/100g)</th>
<th>Total phenols (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>70.3</td>
<td>8.95</td>
<td>13.26±0.05</td>
<td>19.34±0.01</td>
<td>5.65±0.08</td>
<td>3.01±0.04</td>
<td>4.25±0.15</td>
<td>170.54±0.47</td>
</tr>
<tr>
<td>1</td>
<td>69.0</td>
<td>8.95</td>
<td>16.02±0.09</td>
<td>18.77±0.04</td>
<td>6.19±0.16</td>
<td>3.60±0.06</td>
<td>7.30±0.12</td>
<td>195.60±5.11</td>
</tr>
<tr>
<td>2</td>
<td>68.8</td>
<td>8.95</td>
<td>10.70±0.18</td>
<td>18.72±0.07</td>
<td>5.80±0.05</td>
<td>3.24±0.04</td>
<td>8.77±0.31</td>
<td>210.92±2.25</td>
</tr>
<tr>
<td>3</td>
<td>67.4</td>
<td>9.25</td>
<td>10.46±0.06</td>
<td>19.27±0.02</td>
<td>5.80±0.05</td>
<td>3.24±0.04</td>
<td>9.20±0.08</td>
<td>215.84±1.76</td>
</tr>
<tr>
<td>4</td>
<td>65.6</td>
<td>9.25</td>
<td>9.33±0.01</td>
<td>19.91±0.02</td>
<td>6.23±0.07</td>
<td>2.22±0.02</td>
<td>9.54±0.14</td>
<td>217.45±1.34</td>
</tr>
<tr>
<td>5</td>
<td>62.7</td>
<td>9.50</td>
<td>9.37±0.02</td>
<td>19.11±0.03</td>
<td>6.55±0.08</td>
<td>2.72±0.03</td>
<td>8.83±0.10</td>
<td>213.31±0.19</td>
</tr>
<tr>
<td>6</td>
<td>62.7</td>
<td>9.75</td>
<td>8.75±0.12</td>
<td>18.38±0.05</td>
<td>6.93±0.11</td>
<td>3.26±0.05</td>
<td>7.69±0.32</td>
<td>190.21±4.33</td>
</tr>
</tbody>
</table>

Cherry was reduced by 55.27%; the PPO enzyme activity of apple was reduced by 73.66%; and the PPO enzyme activity of peach was reduced by 54.95%. Colak et al. [11] showed that different cherry cultivars have different thermal stability of PPO. Therefore, different species or varieties of the same species are different in enzyme activity and thermal stability of PPO [11]. According to actual experience, the level of PPO activity is related to its storability. The peach with shorter storage period has relatively higher PPO enzyme activity level, while sour cherry has relatively lower PPO activity level and is less prone to enzymatic browning. Therefore, it is easier to prevent enzymatic browning using blanching treatment for the sour cherry, which has relatively poor thermal stability of PPO and relatively low enzyme activity.

**Effect of Blanching Time on Quality of Sour Cherry Crude Juice:** In this experiment, blanching treatment using 85°C water bath was conducted on sour cherry pulp and the impact of blanching on the amount of sour cherry juice yield was determined. Data presented in Table 1 showed that increasing blanching time, the juice yield rate of sour cherry pulp went down; soluble solids content increased slowly; content of Vc, anthocyanin and total phenol increased at first and then decreased, respectively; the values of L*, a*, b* do not had regular changes. The fact that juice yield rate of sour cherry pulp went down may be due to inevitable loss of some pulp during blanching process of sour cherry pulp after thaw and the increase of pulp viscosity resulted from the dissolving out of a large amount of pectin substances, which made juicing more difficult [10,12]. Vc content was the highest with 1 min of blanching; anthocyanin content was the highest with 4 min of blanching; and the total phenol content was the highest with 3 min of blanching. Therefore, proper blanching is good for increasing soluble solids, improving the effect of dissolving out pigment and phenolic substances; while excessive heat treatment will lead to decomposition of Vc, pigments and other nutrients [6]. Compared with the color indicators before blanching, the value of redness degree a* increased significantly, indicating that the blanching had a clear effect on color preservation. In addition, Mao et al. [12] researches reported that, blanching has a significant effect on delaying the increasing of sugar, titratable acid, viscosity and microbes. Considering the comprehensive effects of blanching on inhibition of PPO, POD enzyme activity, the best experimental result could be attained if sour cherry pulp was blanched in 85°C water bath for 3–4 minutes.

**CONCLUSIONS**

With 3–4 min of blanching treatment using water bath (at 85°C) and with the core temperature of pulp higher than 50°C, the enzyme activity of more than 95% of PPO and POD in sour cherry pulp could be deprived, thus inhibiting the enzyme activity effect of PPO and POD in sour cherry pulp effectively, increasing the amount of soluble solids, anthocyanin and total phenols after juicing and improving the juice quality. Compared with sweet cherry, apple and peach, the PPO in sour cherry has poor thermal stability and weak enzyme activity, which is more conductive to preventing enzymatic browning during the processing using blanching treatment.

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**REFERENCES**


