Effects of Preactreatment Process with Organic Acids (Averrhoa bilimbi L.) and Japansche Citroen (Citrus limonia Osbeck) Juice on Quality of Chili Powder (Capsicum frutescens)

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ABSTRACT

Preservation process like drying is needed to extend the shelf life of hot chili. However, the drying process lead much quality degradation, such as loss the nutritions. The chili need treatment with blanching and soaking with organic acid such as Japansche citroen and Averrhoa bilimbi L juice. The aim of this research is to know the effects of (Japansche citroen) and (Averrhoa bilimbi L.) juice in soaking process on quality of dried chili (Capsicum frutescens). Factorial Randomized Block Design was used in this research with 2 factor. The first factor was type of fruit juice of Japansche citroen and Averrhoa bilimbi L. The second factor was level of fruit juice concentration (5%, 10%, 15%). The best result of this study is acquired from soaking with Japansce citroen with 15% of concentration. It obtains a* value 51,77±0,16, total color 174,88 ±7,78 ASTA, total phenolic content 8,51±1,11 mg GAE/g, total flavonoid content 22,86±1,24 mg QE/g, capsaicin content 1156322,498 ±95263,46 SHU, ascorbic acid content 0,6427±0,00 mg/g and antioxidant activity IC50 126,80±3,68 ppm.

Keywords: Dried Chili, Soaking with Acid, Japansche citroen, Averrhoa bilimbi, Quality.

ABSTRAK

Pengeringan dan pembubukan ditujukan untuk memperpanjang umur simpan cabai rawit dan sering menghasilkan kerusakan pada nutrisinya, sehingga diperlukan proses treatment dengan blansing dan perendaman menggunakan larutan asam dari asam organik berupa larutan buah jeruk JC dan belimbing wuluh. Tujuan penelitian ini adalah untuk mengetahui pengaruh perendaman dengan larutan jeruk JC dan belimbing wuluh terhadap kualitas cabai rawit kering. Metode yang digunakan adalah Rancangan Acak Kelompok Faktorial (RAKF) yang terdiri dari 2 faktor. Faktor I jenis larutan (jeruk JC dan belimbing wuluh) dan faktor II konsentrasi larutan (5%, 10%, 15%). Hasil perlakuan terbaik pada perendaman jeruk JC dengan konsentrasi 15%. Hasil sampel perlakuan terbaik yaitu nilai warna a* 51,77±0,16, total warna 174,88±7,78 ASTA, total fenol 8,51±1,11 mg GAE/g, total flavonoid 22,86±1,24 mg QE/g, Capsaicin 1156322,498 ±95263,46 SHU, vitamin c 0,6427±0,00 mg/g dan aktivitas antioksidan IC50 126,80±3,68 ppm.

Kata Kunci: Belimbing Wuluh, Cabai Rawit Kering, Jeruk JC, Kualitas, Perendaman
INTRODUCTION

Cayenne pepper is one of the most widely consumed commodity crops by the people of Indonesia compared to other vegetable commodities. The water content in cayenne pepper reaches 88.02% [1]. High levels of cayenne water can cause damage if no proper treatment and preservation process is carried out. In the preservation of cayenne pepper, the most commonly used is drying. Drying that is often done in the food industry has many shortcomings such as can damage the nutritional content, which leads to a decrease in the quality of cayenne pepper [2]. One way to reduce the effects of damage from drying is to provide pretreatment or pre-treatment of the product. The initial treatment that is often used in the food industry is blanching and the use of weak acids [3]. In its development, the blanching method was combined with treatment using weak acids. Acids are known to improve product quality by enzyme inactivation and texture modification. Soaking with acid can also retain color, because acid acts as a chelator [3].

Weak acids can be obtained from natural sources namely fruits. Naturally, Japansche Citroen oranges contain 0.59% acid which is rarely used because of the sour fruit taste. Another fruit that contains acid is starfruit wuluh (Averrhoa bilimbi L.). Starfruit has a variety of acid content, has many benefits and is very easy to obtain. With these considerations, research is needed to obtain scientific evidence on Japansche Citroen oranges and starfruit wuluh (Averrhoa bilimbi L.) as an immersion material after blanching on cayenne pepper to be dried with variations in concentration and testing on its acid compounds.

MATERIALS AND METHODS

Material
The materials used in this study include Fresh Hot Pepper, JC Oranges, Carambola Wuluh, Ethanol Pro-Analysis (99%) Merck, DPPH Powder, Ascorbic Acid, KI Powder, Iodine, Amylum, Capsaicin, Galic Acid, Folin Reagents, Sodium Carbonate 7.5%, Quercentin, Aquades, NaNO2 5% and AlCl3 10%

Tools
The tools used in this study include Cabinet drying (local), Cooker (rinai), Knife, Pan, Refrigerator (Electrolux), UV-Vis Spectrophotometer (Jenway), Modified Microwave Assisted Extraction (Anton Paar), Microplate reader (BMG Labtech), Microplate 96-well (Costar 96), Microplate shaker, Micropipette (Finnapipette), Mikrotube, Mikrotip, Vortex, Oven (Binder), Analytical scales (Denver), Desiccators, Blenders (Miyako), 40 mesh sieves, Measuring cups (Pyrex), Iron Spatula, Glass Stirrer, Watch Glass, Thermometer, Dropper Pipette, Measuring Pipet (Pyrex), Suction Ball, Glassware (Pyrex), Pumpkin (Pyrex), Funnel Glass, Dark Glass Bottle, Erlenmeyer (Pyrex), Suction Cup reaction (Pyrex), Test tube rack, Fine filter paper, Coarse filter paper.

Research design
The design used was a Factorial Randomized Block Design (RCBD) using 2 factors. The first factor is the type of soaking solution (JC orange solution and starfruit solution). The second factor is acid concentration (5%, 10%, and 15%). So that obtained 6 combinations with 4 replications and obtained 24 unit experiments. Data from the results of the study were analyzed using analysis of variance statistics or Analysis of Variance (ANOVA) using Minitab software. The data obtained were analyzed using
analysis of variance (ANOVA) with a 95% confidence interval. If the test results show an interaction between the two factors, further tests with DMRT (Duncan Multiple Range Test) are conducted. If one factor is significantly different, further testing of LSD (Least Significant Difference). The selection of the best treatment uses the Zeleny Multiple Attribute method.

**Research Stages**

The research was divided into several stages, namely the selection of raw materials, preliminary research, making samples of dried cayenne pepper by soaking treatment using different types of fruit and concentrations, extraction with MAE, chemical analysis and physical analysis. The preliminary research was divided into two stages, namely the analysis of raw materials and the determination of fruit concentrations based on the observation of the pH and color of the final sample produced (chili powder). Analysis of raw materials includes color analysis (Color reader), moisture content, Capcaisin, total color extracted, total phenol, flavonoids, vitamin C, antioxidant activity. The next step is making samples, chili that has been weighed and then given a preliminary treatment that is blanching and soaking. In this immersion process, the chili is soaked in a solution of Japansche citroen and Starfruit Citrus fruits with concentrations of 5%, 10%, 15% in 200 ml water (v / v), respectively. The controls used in this study were soaking chili with sodium metabsulfite 0.3% and citric acid 1% (v / v). The next analysis phase includes analysis of pH, yield, color, water content, Capcaisin, total extracted color, vitamin C, antioxidant activity, total phenol, flavonoids. After that the best treatment is sought using the multiple attribute method (Zeleny, 1982). The results of the best treatment were compared with controls.

**Analysis Procedure**

The analysis carried out on the immersion solution is the pH of the solution. In the fresh ingredients of chili and dried cayenne, water content, capsaicin levels, total phenol antioxidant activity, total flavonoids, vitamin C content, color and dry yield were analyzed.

**RESULTS AND DISCUSSION**

1. **Analysis of Raw Materials**

The raw material used in this study is cayenne pepper (Capsicum frutescens) from the same variety. All raw materials are analyzed fresh. The parameters of the analysis of fresh cayenne include water content, capsaicin, color, antioxidant activity, total phenols, total flavonoids, vitamin C and total color. The results of the analysis of fresh cayenne are presented in Table 1.

<table>
<thead>
<tr>
<th>Parameters (unit)</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water content (%)</td>
<td>84,54±2,62</td>
</tr>
<tr>
<td>Chilli levels (SHU)</td>
<td>536373.47±28983.74</td>
</tr>
<tr>
<td>Total colour value (ASTA)</td>
<td>199.98±4.95</td>
</tr>
<tr>
<td>Total Fenol (mg GAE/g)</td>
<td>11.57±0.67</td>
</tr>
<tr>
<td>Total Flavonoid (mg QE/g)</td>
<td>36.21±1.14</td>
</tr>
<tr>
<td>Antioxidant activity IC_{50} (ppm)</td>
<td>508.63±16.13</td>
</tr>
</tbody>
</table>
1.2 Analysis of the Degree of Acidity of the Soak Solution

The results of the analysis of the pH of the marinade solution ranged between 2.5-3.2. Variance analysis (ANOVA) results showed the type and concentration of acid significantly affected the pH of the immersion solution. The graph can be seen in Figure 1.

**Figure 1.** Effect of Solution Type and Concentration on Soaking Solution pH

Based on **Figure 1**, the higher the acid concentration, the lower the pH value. JC orange solution has a lower pH compared to wuluh star fruit solution. The more acidic the condition of the solution, the lower the pH value produced because the acid donates protons or H⁺ ions so that the concentration of hydrogen ions in the solution is high, causing the pH value to fall [4].

2. Quality Characteristics of Hot Pepper Powder

The cayenne pepper used in this study came from the same variety with 6 variations of treatment. All ingredients are analyzed in powder condition. The parameters of the analysis of the quality of cayenne pepper include chemical and physical properties such as: water content, yield, pH of the solution, total spiciness (capsaicin), color, total color, antioxidant activity, total phenol, total flavonoids, and vitamin C.

2.1 Chemical Characteristics of Hot Pepper Powder

2.1.1 Moisture Content of Chili Powder

The results of the analysis of the water content of cayenne pepper powder ranged between 7.82-7.94%. The results of analysis of variance (ANOVA) showed the type and concentration of acid did not significantly affect the moisture content of cayenne Powder. The graph can be seen in **Figure 2**.

**Figure 2.** Effect of Type and Concentration of Solution on the Moisture Content of Powdered Chillies

<table>
<thead>
<tr>
<th>Konsentrasi Larutan (%)</th>
<th>5%</th>
<th>10%</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kadar Air (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jeruk JC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belimbing Wuluh</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

| Vitamin C (mg/g) | 1.12±0.10 |
| Colour L*       | 59.83±2.94 |
| Colour a*       | 26.80±1.69 |
| Colour b*       | 34.15±2.61 |
Based on data from the USDA the water content in chili powder is 7.15% [5]. High water content will easily cause damage to food. The higher the water content contained in food, it will cause microorganisms to easily develop, freshness and storability decreases resulting in changes in food ingredients [6].

2.1.2 Levels of Capsaicin Hot Pepper Powder

The results of the analysis of capsaicin levels ranged between 1080446-1156322 SHU. The results of analysis of variance (ANOVA) showed the type and concentration of acid did not significantly affect the levels of capsaicin. The graph can be seen in Figure 3.

2.1.3 Antioxidant Activity of Chili Powder

IC50 analysis results ranged from 126-165 ppm. The results of analysis of variance (ANOVA) showed the type and concentration of the solution significantly affected antioxidant activity. The graph can be seen in Figure 4.

Based on the IC50 value obtained, the antioxidant activity of cayenne powder increases with increasing concentration of the soaking solution. This is caused by the addition of JC orange and starfruit juice containing citric acid. Citric acid can reduce pH, and a low pH value affects the antioxidant value due to regeneration of primary antioxidant compounds [8]. When pH is low, more free H+ can regenerate antioxidants by binding to phenoxy radicals to re-form antioxidant compounds [9].

2.1.4 Total Phenol Chili Chili Powder

The result of total phenol analysis ranged from 7.05 to 8.51 mg GAE / g. The results of the analysis of variance (ANOVA) showed the concentration of the solution significantly affected the total phenol. The graph can be seen in Figure 5.
Figure 5. Effect of Solution Type and Concentration on Total Phenols

This shows that the higher the concentration of the solution, the higher the total phenol value produced. The higher the concentration of the solution, the pH decreases or the more acidic the solution results from citric acid in the fruit. The lower the pH value the more free H+ and antioxidant regeneration can occur by binding to phenoxy radicals to form antioxidant compounds again [9]. Antioxidant activity increases with increasing concentration, so does total phenol increase. Phenols play a role in antioxidant activity, the greater the content of phenols, the greater the antioxidant activity [10].

2.1.5 Total Flavonoid Chili Powder

The results of total flavonoid analysis ranged between 18-22 mg QE / g. The results of analysis of variance (ANOVA) showed the concentration of the solution significantly affected the total flavonoids. The graph can be seen in Figure 6.

Figure 6. Effect of Solution Type and Concentration on Total Flavonoids

The difference in the concentration of the soaking solution gives a real effect, this is because the higher the acid content, the more phenolic content of an ingredient increases. The higher the concentration of the acid solution, the increased antioxidant activity is thought to be caused by increased functional properties of the residue (ascorbic acid, total carotene, and total phenolic) in the ingredients [11]. Different genetic factors in each cayenne pepper cause the content of the resulting flavonoid compounds also varies [12]. The total bioactive compounds produced by each food can vary depending on genotype, environmental factors such as climate or harvest conditions and processing [7].

2.1.6 Levels of Vitamin C Hot Pepper Powder

The results of the analysis of vitamin C levels ranged from 0.61 to 0.64 mg / g. The results of analysis of variance (ANOVA) showed the concentration of the solution had a significant effect on vitamin C. The graph can be seen in Figure 7.
Based on these results, the higher the concentration of the solution, the higher the levels of vitamin C obtained. Increased vitamin C in cayenne pepper powder is caused by increased levels of citric acid in solution. Acid can increase the stability of vitamin C thus protecting it from oxidation of catalyst metals [9]. Citric acid has a synergistic relationship with pH, so the pH is low and Vitamin C can survive in acidic conditions [13].

2.2 Physical Characteristics of Hot Pepper Powder

2.2.1 Yield of Chili Powder

The yield analysis results ranged between 24.11-24.98%. The results of the analysis of variance (ANOVA) showed the type and concentration of the solution had no significant effect on yield. The graph can be seen in Figure 8.

The treatment of the type of solution and the concentration of the marinade solution did not significantly affect the yield of cayenne pepper powder. The yield is influenced by the processing time and the drying temperature. The decreasing yield occurs because of the processing that results in weight loss [14]. The higher the temperature and the longer the drying time used to dry a material, the more water evaporates from the material [15].

2.2.2 Analysis of Color of Chili Powder

2.2.2.1 Color L

The results of the L color analysis range between 45-49. The results of analysis of variance (ANOVA) showed the type and concentration of the solution significantly affected the color of L. The graph can be seen in Figure 9.
Acid soaking causes the brightness and redness to increase because the enzymes are inactivated, and the acid is a chelating agent that can prevent browning reactions [16]. Citric acid functions significantly as an anti-browning agent during processing and storage so that it can maintain the color intensity of the material and increase the brightness [17].

2.2.2.2 Color a

The results of color analysis a range between 40-51. The results of the analysis of variance (ANOVA) showed the type and concentration of the solution significantly affected the color a. The graph can be seen in Figure 10.

Overall, the type of JC orange solution has a * higher color than starfruit solution. Acid solutions are known to maintain color because they act as chelating agents. Acids that are acidulant include citric acid contained in fruits that can retain carotene so that it retains its reddish color [18].

2.2.2.3 Color b

The results of the color analysis b ranged between 37-49. The results of analysis of variance (ANOVA) showed the type and concentration of the solution significantly affected the color b. The graph can be seen in Figure 11.

The data states that the higher the concentration of the soaking solution, JC orange and starfruit, will increase the yellowish value. Addition of citric acid can inhibit the browning reaction and can be used as a substitute for sulfite. The higher concentration of citric acid will increase the yellowish color [17].

2.2.3 Total Color

The results of the total color analysis ranged between 160-174 ASTA Variance analysis results (ANOVA) showed the type and concentration of the solution did not significantly affect the total color. The graph can be seen in Figure 12.
In the above study, the highest value of ASTA was found in JC orange solution with a concentration of 15%. The color value is related to the carotene content in the material. This increase in ASTA value is related to free carotenoids that can be produced when drying slowly. The higher the ASTA value, the better the brightness and color richness of the material [19].

3. Best treatment

Determination of the best treatment using the Zeleny method. The parameters used are reddish color (a *), total color value, total phenol, total flavonoids, vitamin C levels, and antioxidant activity (IC50). The results of the determination of the treatment obtained a type of soaking solution of lime with a concentration of 15%. After obtaining the best treatment, the results will be compared with the results of the analysis of fresh chili and control that is immersion with sodium metabisulfite solution 0.3% + 1% citric acid, 1% citric acid solution, and water. The results of the comparative analysis can be seen in Table 2.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>Best Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water</td>
<td>Na₂S₂O₅ + C₆H₅O₇</td>
</tr>
<tr>
<td>Color a*</td>
<td>40,85±0,08</td>
<td>42,35±0,55</td>
</tr>
<tr>
<td>Total Color (ASTA)</td>
<td>161,14±14,87</td>
<td>165,34±7,48</td>
</tr>
<tr>
<td>Total Fenol (mg GAE/g)</td>
<td>6,83±0,11</td>
<td>6,92±0,59</td>
</tr>
<tr>
<td>Total Flavonoid (mg QE/g)</td>
<td>16,75±1,06</td>
<td>20,90±1,36</td>
</tr>
<tr>
<td>Capsaicin (SHU)</td>
<td>1053975,31 ± 40234,12</td>
<td>947817,28 ± 38425,35</td>
</tr>
<tr>
<td>Vitamin C (mg/g)</td>
<td>0,4978±0,00</td>
<td>0,5077±0,07</td>
</tr>
<tr>
<td>Antioxidant activity IC50 (ppm)</td>
<td>153,36±4,20</td>
<td>158,34±1,22</td>
</tr>
</tbody>
</table>
Based on Table 2, each parameter of the best treatment has a better value than the control treatment.

**CONCLUSION**

The best treatment results on soaking JC oranges with a concentration of 15%. The best treatment sample results are a *51.77 ± 0.16 color value, 174.88 ± 7.78 ASTA total color, total phenol 8.51 ± 1.11 mg GAE / g, total flavonoids 22.86 ± 1, 24 mg QE / g, spiciness level (capsaicin) 115632,498 ± 95263.46 SHU, vitamin c 0.6427 ± 0.00 mg / g and the antioxidant activity of IC50 126.80 ± 3.68 ppm.

**REFERENCES**


