The Effect of Citric Acid on Teak Leaves Anthocyanin Extraction Process 
(Tectona grandis L.) and The Teak Leaves Extract Proportion to The 
Physical and Chemical Syrup Characteristics

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ABSTRACT

Teak (Tectona grandis L.) is one of tropical native herbs from Indonesia, which tubers development has been focused and the leaves become wastes. Nowadays, the teak leaves compound has been investigated alike its phenolic compound for coloring agent, mosquito larvicidal, and organic fertilizer composite. This research aimed to analyze the effect of citric acid addition to the teak leaves extraction process and the impact of teak leaves extract proportion to the physical, chemical, and organoleptic syrup characteristics. This research consisted of 2 main steps. The first was citric acid addition (2%, 3%, 4%, 5% and 6%) on extraction process and the second was teak leaves extract addition on syrup production. The Completely Randomized Design (CRD) with 4 levels of factors (30%, 40%, 50%, and 60%) and 3 replications were applied to analyze the parameter. The citric acid addition gave very significant effect (p>0.01) on pH, antioxidant, and color (L), while it gave not significant effect on color (a and b) and anthocyanin of teak leaves extract. The result showed that the effect of teak leaves extract addition was very significant (p>0.01) on the pH, color (L and a), viscosity, and sugar content of syrup. While it was also significant (p>0.05) on anthocyanin content and insignificant on color (b) of syrup. The best treatment was proved by 50% addition of teak leaves with the value of pH (3.86), viscosity (1.57), sugar content (23), color (L= 31.3; a=2.66; b=-0.4), anthocyanin (0.05), and antioxidant (0.728).

Keywords : teak leaves; anthocyanin; antioxidant; syrup

I. INTRODUCTION

The awareness of natural healthy is growing, and it was proved by the spices and herbs usage as natural medicine [1]. Teak leaf extract (Tectona grandis L.) contains natural pigment called anthocyanin, which produces maroon [2]. Teak leaf also consists antimicrobial such as flavonoids, alkaloids, tannins, anthraquinone and naphthoquinone that obstruct bacteria growth [3]. Altogether teak leaf is promoting for food coloring and food preservation [4].

Anthocyanin is well known as flavonoids [5]. Anthocyanin is polyphenols with known antioxidant activity and is generally accepted as the largest and most important group of water-soluble pigments [6]; [7]. Major sources of anthocyanin are blueberries, cherries, raspberries, strawberries, black currants, purple grapes and red wine [5].

The diversity of anthocyanin depends on the number and position of hydroxyl and methoxy groups on the basic skeleton; the identity, number and positions at which sugars are attached; and the extent of sugar acylation and the acylating agent identity [6]; [8]; [9]. Anthocyanin colour intensity is affected by hydroxyl and methoxyl groups numbers. If hydroxyl groups predominate the color goes more bluish, but if more methoxyl then redness is increased [10]; [11].

II. METHODS

First up to third teak leaves from top position at University of Muhammadiyah Malang field were collected for this study. This research was consisted on two main procedure, there were teak leaves extraction and followed by teak leaves extract addition on the syrup. Then teak leaves were extracted used citric acid
(2%, 3%, 4%, 5%, and 6%) and analyzed the anthocyanin (spectrophotometer absorbance = 511 nm and 700 nm), antioxidant (spectrophotometer), pH (pH-meter) and color (color-reader) of leaves extract [12].

Therefore the leaves extract were added to the syrup production (30%, 40%, 50%, and 60%). The anthocyanin, pH, color, sugar content (hand-refractrometer), and viscosity (viscometer) of syrup were well documented [12]. 30 panelists recorded the organoleptic test of syrup at the end of experiment. The completely randomized design and 3 replications were adopted. Then the data were subjected to analysis of variance (ANOVA), LSD and De Garmo test.

III. RESULTS AND DISCUSSIONS

Citric acid is very soluble weak organic acid that used as an additive in several drinks. Commonly it used to improve the flavor, taste, antioxidant, and to maintain stability (preservative enhancement) [13]. The effect of citric acid addition on the decreasing teak extract pH was very significant (p< 0.01) (Figure 1.). This result in agreement with citric acid addition was able to reduce pH and as stabilizer of sweet potato [14]; [15].

![Figure 1. The effect of citric acid addition to the pH value of teak extract](image1)

The effect of citric acid addition was very significant difference to the color (L). While, it was not significant to the color (a) and (b) of teak extract (Figure 3.). The trend was similar with the experiment of sweet potato [15]. The experiment of frozen strawberry also showed the same trend [20]. It because the citric acid is antibrowning agent which prevent polyphenoloxidase by suppressing pH to form an inactive complex [21]. Commonly, several factors can affect the color alike pH, temperature, light, pigment presence, enzymes, sugar and enzymes [22]; [23].

The addition of citric acid on the anthocyanin of teak extract was not significant (Figure 4.). The stability of anthocyanin was influenced by polyphenoloxidase. Citric acid was used for the inhibitory activity on polyphenoloxidase and the antibrowning activity in minimally processed fruits and vegetables [20].

![Figure 2. The effect of citric acid addition to the antioxidant of teak extract](image2)

Antioxidants able to prevent the initiation of browning by reacting with oxygen. Their effectiveness depends on pH, temperature, light, water activity and composition of atmosphere [16]. The addition of citric acid was very significant on antioxidant activity (Figure 2.) (p<0.01). This result was in agreement with the antioxidant activity of mushroom [17] and chestnut [18]. Many studies have revealed that the antioxidant activities of phenolic compound are probably due to their redox properties, which allow them to act as reducing agents, hydrogen donor and singlet oxygen quenchers [19].
Figure 3. The effect of citric acid addition to Color (L, a, and b) of teak extract

Figure 4. The effect of citric acid addition to the anthocyanin of teak extract

The result of second step was displayed on Table 1, Table 2, and Table 3. The second step analyzed the effect of leaves extract addition on syrup physical and chemical characteristics.

Table 1. Leaves Extract Addition Impacts on Syrup pH, Viscosity, and Sugar Content

<table>
<thead>
<tr>
<th>Treatment</th>
<th>pH</th>
<th>Viscosity</th>
<th>Sugar Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>3.95a</td>
<td>1.60a</td>
<td>25.33a</td>
</tr>
<tr>
<td>40%</td>
<td>3.85a</td>
<td>1.90b</td>
<td>25a</td>
</tr>
<tr>
<td>50%</td>
<td>3.86a</td>
<td>1.57a</td>
<td>23a</td>
</tr>
<tr>
<td>60%</td>
<td>4.002b</td>
<td>1.87a</td>
<td>23.67a</td>
</tr>
</tbody>
</table>

F-test | ** | **
CV (%) | 0.05 | 0.07 | 0.27

Remark: ** = Significant difference at P<0.01.

Table 1 showed the leaves extract addition impacts on syrup pH, viscosity and sugar contents were very significant difference (p<0.01). The highest pH was shown by 60% leaves addition. Therefore, the highest viscosity was shown by 40% leaves addition and the highest sugar content was shown by 30% leaves addition.

Table 2 displayed the effect of leaves extract addition on the syrup color. The result showed that the effect of leaves extract addition on the color (L) and (a) were very significant (p<0.01), while on the color (b) was insignificant. The larger value of color (L, a, b) means lighter, redder, and more yellow [24]. This results were lower with teak wood, the lightness (L) index ranged 42.86-68.31, the redness (a) 6-16.94 and yellowness (b) 16.84-33.32 [25].

Table 2. The Effect of Leaves Extract Addition on Syrup Color (L, a and b)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>L</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>29.5a</td>
<td>3b</td>
<td>-1.3</td>
</tr>
<tr>
<td>40%</td>
<td>29.3a</td>
<td>2.63a</td>
<td>-0.8</td>
</tr>
<tr>
<td>50%</td>
<td>31.3b</td>
<td>2.66a</td>
<td>-0.4</td>
</tr>
<tr>
<td>60%</td>
<td>30.1a</td>
<td>2.67a</td>
<td>0.3</td>
</tr>
</tbody>
</table>

F-test | ** | ** | NS
CV (%) | 0.28 | 0.31

Remark: ** = Significant difference at P<0.01; NS = Not significant

The letters (a-b) in each column shows significant difference at P<0.01

Table 2 described the effect of leaves extract addition on syrup anthocyanin was significant (p<0.05) and insignificant on antioxidant. This result was in agreement with Tectona grandis contains natural pigment called anthocyanin that produces maroon color [2]. The Table 3 also shown the highest score of anthocyanin and antioxidant was in treatment 50%.

Table 3. Leaves Extract Addition Effect on Syrup Anthocyanin and Antioxidant

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Anthocyanin</th>
<th>Antioxidant</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>-0.009a</td>
<td>0.38</td>
</tr>
<tr>
<td>40%</td>
<td>-0.09a</td>
<td>0.393</td>
</tr>
<tr>
<td>50%</td>
<td>0.05c</td>
<td>0.728</td>
</tr>
<tr>
<td>60%</td>
<td>-0.02b</td>
<td>0.406</td>
</tr>
</tbody>
</table>

F-test | * | NS
CV (%) | -3.18

Remark: * = Significant difference at P<0.05; NS = Not significant

The letters (a-b) in each column shows significant difference at P<0.01

The organoleptic test result was shown on Table 4. The highest score for appearance was 3.35 (50%) , aroma was 3.12 (50%) , taste 3.64 (50%), and texture 3.35 (40%). The data described that the panelist mostly liked the treatment of 50% teak leaves addition on
syrup. Based on De Garmo test, the best treatment was shown by treatment 50% leaves extract addition.

Table 4. Leaves Extract Addition Effect on Syrup Organoleptic

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Appearance</th>
<th>Aroma</th>
<th>Taste</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>2.94</td>
<td>2.41</td>
<td>2.82</td>
<td>2.76</td>
</tr>
<tr>
<td>40%</td>
<td>3.29</td>
<td>3.06</td>
<td>3.35</td>
<td>3.35</td>
</tr>
<tr>
<td>50%</td>
<td>3.35</td>
<td>3.12</td>
<td>3.64</td>
<td>3.11</td>
</tr>
<tr>
<td>60%</td>
<td>3.71</td>
<td>2.94</td>
<td>3.53</td>
<td>3.17</td>
</tr>
</tbody>
</table>

IV. CONCLUSION

The citric acid addition gave very significant effect (p<0.01) on pH, antioxidant, and color (L), while it gave not significant effect on color (a and b) and anthocyanin of teak leaves extract. While, the effect of teak leaves extract addition was very significant (p<0.01) on the pH, color (L and a), viscosity, and sugar content of syrup. While it was significant (p<0.05) on anthocyanin and was insignificant on color (b) of syrup. The best treatment was shown by 50% addition of teak leaves.

Acknowledgment

This research was financial supported by PKM program Ministry of Research Technology and Higher Education of The Republic of Indonesia (RISTEKDIKTI). Our great appreciation also to the Dean of Agriculture and Husbandry Faculty, advisory committee and lab mate on Technology for Agricultural Products Department, University of Muhammadiyah Malang who have assisted authors in preparing, observing, and writing this paper.

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