Antioxidant Activity and Quality of Ketepeng Cina
(Cassia alata L.) Herbal Tea

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Abstract: The purpose of this research was to study the effect of drying time on antioxidant activity and quality of ketepeng cina (Cassia alata L.) herbal tea. This research used a completely randomized design with five treatments and three replications. The treatments were drying time such as 110, 130, 150, 170, and 190 minutes at 50°C drying temperature of herbal tea. Data were statistically analyzed using analysis of variance and Duncan’s New Multiple Range Test at 5% level. The results showed that the drying time significantly affected antioxidant activity, yield, moisture content, crude fiber content, and sensory assessment (descriptive and hedonic tests), but didn’t significantly affected ash content of herbal tea. The best treatment was herbal tea which dried for 130 minutes. The ketepeng cina herbal tea had antioxidant activity (IC50) 6.18 ppm, yield 49.70%, water content 7.17%, ash content 1.24%, and crude fiber content 15.48%. The descriptive and hedonic tests on the herbal tea showed that color of the steeping tea was yellow, aroma of the steeping tea was scented ketepeng cina leaves, and taste of the steeping tea was bitter. Overall assessment of the herbal tea was rather like by the panelists.

Keywords: Herbal tea; ketepeng cina; antioxidant activity; quality; drying time.

1. Introduction

Today’s modern lifestyle that is instantaneous causing people do not have enough time to pay attention on health of the body. This can give an adverse impact to the health if it’s not counterbalanced by consuming a functional drinks that can keep the body at practical durability in its use. Therefore, the instantaneous life style needs to be balanced by consuming a drink to keep the functional durability of the body. Currently, there are a lot of functional drinks that is not only made from tea leaves, but also other natural materials known as herbal tea.

Herbal tea is one of the functional beverage products from plants and herbs that can help illness treatment and as refresher of the body [1]. Herbal tea can be made from flowers, seeds, leaves, and roots of the tree. One of the plants which can be used as a raw material for functional drink is ketepeng cina (Cassia alata L.). Ketepeng cina leaves contain secondary metabolites compounds that have antioxidant function [2,3].

Ketepeng cina plant comes from tropical America and usually grow in lowlands areas to mountain with an altitude of 1,400 meters above sea level [4]. Some research on ketepeng cina herbs showed that isolation and identification of flavonoid compounds from n-heksane ketepeng cina leaves extract had flavonoids [2] and according to Lumbessy et al. [3], ketepeng cina contained flavonoids as much as 26.86 mg/mL. Ketepeng cina leaf is only used for traditional purposes and has no economic value and its storage also is not durable. One of the ways that can be done to improve the value and extend the life time of ketepeng cina leaf is processing of ketepeng cina leaves into herbal tea products.
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One of the important process in processing of herbal tea is drying process. Drying process is a method for removing or eliminating water from materials through the application of heat energy. Drying can reduce the moisture content of materials and thus inhibit the growth of bacteria and fungi, as well as a decrease of enzyme activity that could damage materials, so it can extend the life time of product and it’s storage. Removing water from the materials can affect the physical and chemical condition of the materials and cause discoloration, texture, and released aroma compound from the food.

Drying process in processing of herbal tea is affected by several factors such as temperature and time. Drying process in high temperature and long time may decreased antioxidant activity of functional drinks. Results of previous research [5] suggested that drying process of soursop leaf at 50 °C for 150 minutes can produce the best quality of soursop herbal tea which had the highest antioxidant activity i.e. 76.06% and the lowest EC50 values i.e. 82.16 µg/ml. Another research results [6] suggested that drying of avocado leaves at 50 °C for 120 minutes can produced the best quality of avocado leaf herbal tea with antioxidant activity of 85.11%. Based on the previous research, the treatment of drying time in making ketepeng cina herbal tea will conducted 110, 130, 150, 170, and 190 minutes with a temperature of approximately 50 °C. The results of this research hopefully can get the best treatment of drying time for ketepeng cina herbal tea in order to obtain antioxidant activity and good quality of ketepeng cina herbal tea.

2. Materials and Methodology

2.1. Materials

Materials used in the study were leaves of ketepeng cina which obtained from garden in Tanjung village, Koto Kampar Hulu Subdistrict, Kampar District, Riau Province. Chemical for analysis used were 10% H2SO4, 10% K2SO4, 10% Mg powder, concentrated HCl, FeCl3, 5% amyl alcohol, 40 ppm solution Diphenylpicryl-hydrazyl (DPPH), and 96% ethanol.

2.2. Research Methodology

The research was conducted as experimentation method using a complete randomized design, which consists of 5 treatments and each tearment was repeated 3 times. The treatments were time on drying process of herbal tea at temperature of 50 °C, such as P1 (110 minutes), P2 (130 minutes), P3 (150 minutes), P4 (170 minutes), and P5 (190 minutes).

2.3. Processing of Ketepeng Cina Herbal Tea

Preparation of materials was done by directly picking ketepeng cina leaves from tree and then sorted by visual on same colour of dark green leaves. After that, ketepeng cina leaves were put into jar to keep fresh until the leaves were carried out to remove the dirt. After the leaves cleaned, withering process was done by dispersing the leaves on rattan basket. The time for withering should be long enough, so that chemical reactions can take place freely between 16-18 hours under normal condition. During the process, the leaves were inverted reverse as much as 2 to 3 times between the upper surface and undersurface of the leaves.

Milling process of the leaves was done using blender to minimize the size of the leaves and reached the size corresponding to commercial powder tea grade [7]. Materials milling was done to accelerated the drying process as well as to facilitate removing an aromatic compounds including the flavonoided and their derivatives [8].

Drying is the last stage in processing of ketepeng cina tea leaves. The drying process refers to Adri and Hersoelistyorini [5], the drying temperature used was 50 °C with drying time 110, 130, 150, 170 and 190 minutes. After that, parameters observation in the research were antioxidant activity, yield, moisture content, ash content, crude fiber content, and sensory assessment.
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2.4. Analysis Data

Data obtained were analyzed statistically using Analysis of Variance (ANOVA). If the obtained data showed that $F_{\text{count}} \geq F_{\text{table}}$, the data were proceed with Duncan's New Multiple Range Test (DNMRT) at the 5% level.

3. Results and Discussion

3.1. Antioxidant Activity

The result of antioxidant activity of ketepeng cina herbal tea with of 2,2-diphenyl-1-picrylhydrazyl hydrate (DPPH) method can be seen on Table 1. Antioxidant activity of ketepeng cina fresh leaves as raw material of herbal tea were medium with Inhibitory Concentration$_{50}$ (IC$_{50}$) values of 128.29 µg/ml, while the antioxidant activity of the herbal tea was strong with IC$_{50}$ value of 43.79-101.45 µg/ml. The drying process at temperature of approximately 50°C can increase antioxidant activity in materials from medium became very powerful antioxidant activity, but if the drying process take time too long, antioxidant activity will decreased because the antioxidant compounds have been damaged by the heating process.

Table 1. Antioxidants activity of ketepeng cina herbal tea

<table>
<thead>
<tr>
<th>Treatments</th>
<th>IC$_{50}$ (µg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_1$ (110 minutes)</td>
<td>43.79</td>
</tr>
<tr>
<td>$P_2$ (130 minutes)</td>
<td>60.18</td>
</tr>
<tr>
<td>$P_3$ (150 minutes)</td>
<td>69.08</td>
</tr>
<tr>
<td>$P_4$ (170 minutes)</td>
<td>84.45</td>
</tr>
<tr>
<td>$P_5$ (190 minutes)</td>
<td>101.45</td>
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</tbody>
</table>

Description: IC$_{50}$ of less than 50 µg/ml (very strong), IC$_{50}$ value 50 µg/ml to 100 µg/ml (strong), IC$_{50}$ value 100 µg/ml to 150 µg/ml (medium), IC$_{50}$ 151 µg/ml up to 200 µg/ml (low)

A very strong antioxidant activity was found in treatment $P_1$ (110 minutes) with IC$_{50}$ values of 43.79 µg/ml. A decrease in absorbance occurs because of the addition of electron pair from antioxidant compounds on nitrogen group in the structure of DPPH compounds. Solution of DPPH was purple, intensity of purple color will decrease as the DPPH radical electrons bind to hydrogen electrons, the stronger antioxidant activity of the sample will be seen on greater decrease in the intensity of the purple color [9].

The drying process resulted in a reduction of active substances contained in a food, a decrease in antioxidant activity was affected by the process of oxidation that caused enzymatis polyphenols and decline the substances. Inhibitory Concentration$_{50}$ (IC$_{50}$) value is inversely proportional to the antioxidant concentration that is an ability of the compound. The lower IC$_{50}$ value means the stronger power of antioxidant activity [10]. According to [11], as a longer of drying time, the antioxidant activity of torbangun leaves tea also decline, this was caused by antioxidant properties in torbangun leaves that was not resistant to the warming process. Sari [6] also said that the longer of drying time caused antioxidant activity of avocado leaves tea decreased. According to [12], drying time gave significantly effect on antioxidant activity, the longer drying time caused antioxidant activity progressively decreased.

3.2. Phenolic and Flavonoids Compounds

Table 2 showed that all of ketepeng cina herbal tea contains phenolic and flavonoids compounds. These compounds were decreased as longer of drying tim, this was due to the characteristics of these compound which were not resistant to heat. This result was in line with [2,3] which study about isolation and identification of flavonoid compounds from n-heksane ketepeng cina leaves extract. Table 2 showed that treatment $P_1$ (110 minutes) had the highest content of phenolic and flavonoids compounds. The longer drying time caused phenolic and flavonoids compounds reduced, which was marked by waning of the blackish-blue and orange color in the sample.
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<table>
<thead>
<tr>
<th>Table 2. Phenolic and flavonoid compounds in ketepeng cina herbal tea</th>
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<tbody>
<tr>
<td><strong>Treatment</strong></td>
</tr>
<tr>
<td>P₁ (110 minutes)</td>
</tr>
<tr>
<td>P₂ (130 minutes)</td>
</tr>
<tr>
<td>P₃ (150 minutes)</td>
</tr>
<tr>
<td>P₄ (170 minutes)</td>
</tr>
<tr>
<td>P₅ (190 minutes)</td>
</tr>
</tbody>
</table>

Description: the + sign stated that samples positively contains phenolic or flavonoids compounds

### 3.3. Quality of herbal tea

The quality of herbal tea (yield, water content, ash content, and fiber content) after further tested by DNMRT on levels 5% can be seen in Table 3. The table showed that drying time on any different treatment gave significantly effect on yield of herbal tea, each treatment was different on each other treatment. The highest yield was obtained from treatment of P₁ (110 minutes) by 54.4%, while the lowest yield was obtained from treatment of P₅ (190 minutes) by 47.08%, this was due to the longer drying time will lowered the amount of herbal tea yield. This result was in line with the statement of Sudarmadji et al., [13], as longer of drying time can increase contact duration of food to heat and yield obtained will be decreased. The result from previous research [14] about the differences in temperature and drying time on antioxidant activity of powdered soursop leaves showed that the same results with the highest yield in powdered soursop leaves 44.86-31.97%, as a longer of drying time then yield of herbal tea tend to decreased. The difference in yield of herbal tea was strongly influenced by the water content.

<table>
<thead>
<tr>
<th>Table 3. Quality of ketepeng cina herbal tea</th>
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<tr>
<td><strong>Quality parameters</strong></td>
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<tr>
<td></td>
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<tr>
<td>Yield (%)</td>
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<tr>
<td>Moisture content (%)</td>
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<tr>
<td>Ash content (%)</td>
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<tr>
<td>Crude fiber content (%)</td>
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</tbody>
</table>

Description: the number followed a different lowercase indicates significantly different according to DNMRT test at 5% level.

Moisture content of ketepeng cina fresh leaves were 67.50%. Table 3 showed that drying time on any different treatment gave significantly effect on moisture content of ketepeng cina herbal tea. The highest moisture content was obtained from P₁ treatment (110 minutes) of 12.00%, while the lowest moisture content was obtained from P₃ treatment (190 minutes) of 3.58%. Declining moisture content in herbal tea was affected by evaporation of water resulting from drying process. The longer of drying process caused the moisture content in the leaves was getting lower. It is supported by previos statements [12], the rate of evaporation influenced by humidity levels and also by the temperature around the material dried. Moisture content in the ketepeng cina herbal tea powder around 12.00-3.58%, whereas moisture content of herbal tea from P₂, P₃, P₄, and P₅ treatments have met the quality standards SNI 01-3836-2013 of dried tea [17].

Table 3 showed that the drying time did not give significant effect on ash content of ketepeng cina herbal tea, ash content of ketepeng cine fresh leaves were 1.98%. Ash content in powdered ketepeng cina herbal tea 1.22-1.38% and have met the quality standards of dried tea (SNI 01-3836-2013). Ash content in food is depending on the type of material, heating process, time, and temperature used during drying process [15].

The average crude fibre content on ketepeng cine herbal tea produced after further tested by DNMRT on levels 5% can be seen in Table 3. Table 3 showed that the drying time on any different treatment have significant effect on crude fiber content of ketepeng cine herbal tea. The highest levels of crude fiber was obtained from treatment P₁ (110 minutes) of 17.24%, while the lowest crude fiber content was obtained from treatment P₅ (190 minutes) of 13.00%. The lower crude fiber content of herbal tea, the tea will be in a good quality. This was in line with the results of previous research [16].
which produced black tea with crude fiber content ranged 15.84%-13.56%, the longer of drying time the crude fiber content tend to decreased. Based on Indonesia National Standardization [17], criteria of crude fiber contained in powder tea is maximum of 16.50%, thus P2, P3, P4, and P5 treatments already met the standard.

3.4. Sensory assessment of herbal tea

The average sensory assessment (color, aroma, taste, and overall assessment) of ketepeng cina herbal tea after further tested with DNMRT at 5% can be seen Table 4. Table 4 showed that the color of steeping ketepeng cina herbal tea in P1 treatment was significantly different by P2, P4, and P5 treatments, but was not significantly different with P3 treatment. Based on SNI 3836-2013 [17], the colour of steeping tea in a good quality is a typical products. The results of average sensory assessment on color of ketepeng cina herbal tea was found that the highest value was treatment P2 (drying time 130 minutes) by 3.40 (yellow), the lowest value was treatment P4 (drying time 170 minutes) of 2.04 (yellow brownish).

Table 4. Sensory assessment on ketepeng cina herbal tea

<table>
<thead>
<tr>
<th>Sensory assessment</th>
<th>SNI</th>
<th>Treatment s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1</td>
<td>P2</td>
</tr>
<tr>
<td>Color of steeping tea</td>
<td>Typical tea products</td>
<td>2.84b</td>
</tr>
<tr>
<td>Aroma of steeping tea</td>
<td>Typical tea products</td>
<td>4.00b</td>
</tr>
<tr>
<td>Taste of steeping tea</td>
<td>Typical tea products</td>
<td>4.16b</td>
</tr>
<tr>
<td>Overall assessment</td>
<td>Typical tea products</td>
<td>2.52ab</td>
</tr>
</tbody>
</table>

Description: the number followed a different lowercase indicates significantly different according to DNMRT test at 5% level. Number in color 1=brown; 2=yellow brownish; 3=yellow; 4=green; 5=green yellowish. Number in aroma 1=not flavorful ketepeng cina leaves; 2=a little scented ketepeng cina leaves; 3=slightly scented ketepeng cina leaves; 4=scented ketepeng cina leaves; 5=very scented ketepeng cina leaves. Number in taste 1=not bitter; 2=somewhat bitter; 3=a little bitter; 4=bitter; 5=very bitter. Number in overall assessment 1=do not like; 2=rather like; 3=a little like; 4=like; 5=really like.

The longer of drying time in tea processing, the color of ketepeng cina steeping tea was increasingly faded. The color of ketepeng cina steeping tea were range from green yellowish to brown. The drying process had plays a role in the formation of color in ketepeng cina steeping tea. Ketepeng cina herbal tea color waning due to the onset of degradation of pigments-pigments in leaves of ketepeng cina, especially chlorophyll pigments which were degraded into feoefitin and caused a brown color nd flavonoidas pigment which produced yellow color.

According to Lubis [15], too long drying time can caused pigments in materials undergoing oxidation and become faded and changed color of the material as well as the decline of quality material [18]. Based on previous research [5], as longer of drying time in soursop leaves tea, the color of the steeping tea produced increasingly faded. According to Fitrayana [19], a decrease in natural color of herbal tea during drying process was caused by substances damaged like chlorophyll in leaves of pare.

The average descriptive assessment of ketepeng cina steeping tea aroma after further tested with DNMRT at 5% level can be seen in Table 4. From Table 4 can be seen that aroma of ketepeng tea steeping tea from treatment P1 was not significantly different from treatment P2 but significantly different from treatments P3, P4 and P5. Based on SNI 3836-2013 [17], the aroma of herbal tea in a good quality is a typical of tea product. The results of the sensory assessment of ketepeng cina steeping tea was found that the P3 treatment (drying time 150 minutes) had the highest value of 4.76 (very scented ketepeng cina leaves) while the lowest value was P4 treatment (drying time 190 minutes) of 3.32 (scented ketepeng cina leaves).

A decreased of ketepeng cina steeping tea aroma due to the activation of enzymes during withering process that can caused released a variety of volatile compounds on material and rised to distinctive aroma on ketepeng cina herbal tea, as longer of drying time the scent of ketepeng cina herbal tea declined. This was in line with Sribudiani [20], as longer of drying time caused aroma of rosella herbal tea produced progressively diminished, this was because of the destruction of aromatic
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compounds in the drying process. The previous research [5] stated that the length of drying time may caused a decline in tea aroma of soursop leaves herbal tea.

Table 4 showed that taste of ketepeng cina steeping cina from P1 treatment had the same taste with P2 treatment, but different with P3, P4, and P5 treatments. According to SNI 3836-2013 [17], the taste of steeping tea in a good quality was a typical of tea products. Results of the average of sensory assessment showed that the ketepeng cina steeping tea from P2 (drying 130 minutes) treatment had the highest value by 4.24 (somewhat bitter), but the lowest value was herbal tea from P4 treatment (drying 170 minutes) by 3.04 (a little bitter).

Bitter taste of ketepeng cina steeping tea will progressively decreases caused by long time of drying and declining levels of polyphenols. Table 4 showed that ketepeng cina herbal tea had phenolic compounds and flavonoids, a taste of herbal tea was influenced by the presence of flavonoids and polyphenols in the tea. Flavonoids have not colored, water-soluble, and bringing the bitter taste in steeping tea. This was in line with Sribudiani [20], as longer of drying time the bitter taste of rosella steeping tea getting waned. According to Saragih [11], taste of tobangun herbal leaves getting waned due to reducing of the content of essential oil during drying process.

The average of overall assessment on ketepeng cina steeping tea after further tested with DNMRT at 5% level can be seen in Table 4. Tabel 4 showed that overall assessment of steeping tea from P1 treatment same with t P2, P4 and P5 treatments but different from P3 treatment. The average of overall sensory assessment showed that steeping tea treatment of P3 had the highest value of 2.85 (a little like) while the lowest value found on the P4 treatment by to 2.36 (rather like). Ketepeng cina herbal was disliked by panelists because of it’s bitter taste. According to Doroini [21], the parameters of color, aroma, and flavor were combination of overall assessment.

Ketepeng cina herbal tea is expected to meet the chemical quality and acceptable to consumers which showed in descriptive and hedonic sensory assessment. Based on chemical analysis and standardization of Indonesia (SNI 3836-2013), ketepeng cina herbal tea from treatment of P2 (130 minutes) was chosen as the best quality of herbal tea. Herbal tea from treatment P2 had a moisture content 7.17%, ash content 1.24%, crude fibre content 15.48%, phenolic and flavonoids compounds as powerful antioxidant activity with IC50 values of 60.18 μg/ml. Sensory assessment of ketepeng cina leaves by panelists with a description of yellow color of steeping tea, scented ketepeng cina leaves of steeping tea, bitter taste of steeping tea, and a little like by the panelist.

4. Conclusion

Drying time in processing of ketepeng cina herbal tea gave significant effect on antioxidant activity, yield, moisture content, crue fiber content, and sensory assessment in parameters of color, aroma, taste, and overall assessment. The best quality of ketepeng cina herbal tea based on chemical analysis and sensory assessment in descriptive and hedonic tests was ketepeng cina leaves which were dried for 130 minutes.

References