Extraction of Oleoresin from Big Red and Curly Red Chili Using Solvent Extraction Method

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Abstract
Red chili (Capsicum annuum L.) is one of the Indonesian horticulture commodity which having economic value due to its high demand for food and pharmacy industries. Capsicum oleoresin can be produced from this chili by solvent extraction to increase its added-value. The study aimed to characterize oleoresin produced from big red chili and curly red chili. The method used in this study was experimental laboratory with descriptive analysis. The parameters measured were yield, color, specific gravity and solvent residue of the oleoresin. The research results showed that the highest yield of oleoresin was obtained from seedless curly chili with an average yield of 15.37%. The oleoresin color was dark red, with average specific gravity 1.01 to 1.06 g/ml and solvent residue content of 3.58% to 12.07%, respectively.

INTRODUCTION
Chili is one of the horticulture products that has high economic value and widely cultivated in Indonesia due to its appropriate climate and high level of consumption. There are three types of chili found in Indonesia that are big chili, small chili and ornamental chili. Among these types of chili, big chili (Capsicum annuum L.) is the kind of chili that has highest production in Indonesia, which is consist of red big chili and red curly chili.

Since it is a living thing as the agricultural produce, the metabolism reaction was conducted even after harvested and lead to have short shelf life. The two metabolism processes that occurred after harvested are respiration and transpiration (Kader, 1992). During respiration it takes oxygen from the air, breakdowns the reverse carbohydrate and produces water, carbon dioxide and energy to maintain its life until senescence (Wills et al., 1981). In the ambient temperature of storage, the self life of chili after harvested was around 4–7 days.

However, instead of its perishable characteristic, the price of this commodity tend to fluctuate along the season time. In the low season, the price is very high that caused by its low supply. On the other hand, in the high season, the price is very low due to high supply of chili. In the high season, chili price around Rp 5,000,-/kg while in low season the price may reach Rp 120,000,-/kg. This low price selling at the high season may lower than the operational production cost, therefore it is not feasible economically.

In order to overcome problems of its short shelf life and low price at the high season and to increase its added value, it is needed to transform the fresh chili into products that can extent its shelf life and has higher added value. Oleoresin is one of the products that can be extracted from chili. The chili oleoresin has high potential utilization for food and pharmacy industries due to its active content. Some usefulness of chili oleoresin are reported such as used as chili spray (DuBay, 1995), food flavor and colorant (Attokaran, 2011), as well as natural antioxidant (Yanishlieva, 2006).
Although many studies have been published on the extraction of oleoresin from chili (Archuleta, 1995; Barry et al, 2008), little research on this oleoresin from chili that planted in Indonesia has been reported. In compared with others chili variety, red big chili and curly chili are mostly cultivated in Indonesia. Curly chili that usually called as “cabe keriting” was consumed for making hot taste food, while red big chili (“cabe merah besar”) usually was utilized because of its color.

Chili oleoresin was made through the process of chili drying, size reduction, extraction using solvent and evaporation of the solvent. Fresh chili used in this process can be whole chili or chili without seed. Usually in order to simplify the preparation of chili, whole chili was used, however Komara (1991) found that there was different number of oleoresin in the pulp and seed of chili so it is required to study the oleoresin of whole chili and chili without seed.

Regarding this lack of information about characterization of oleoresin from these Indonesian red big chili and curly chili, the study on the characteristic of the oleoresin in order to find out its potential utilization is hence needed. Therefore, the principal aim was to study the characterization of oleoresin from red big chili and curly chili, using whole chili and without seed chili.

MATERIAL AND METHOD
The fresh red chili (Capsicum annum L.) of big and curly red varieties were obtained from PT Bimandiri, Lembang, Bandung, West Java. Oleoresins from the chili were extracted using ethanol 96%. The method used in this research was experimental laboratory with descriptive analysis. Experiment factors were variety of red chili (big and curly red chili) and with and without seeds with 3 replications. The parameters measured on the oleoresin were yield, color changes, specific gravity, and solvent residue.

Oleoresin Extraction
Fresh chili was sliced and dried using convection oven drier at 60°C to produce dried chili with water content of 10%. Dried chili then milled and shifted using rotap tyler (40 mesh). Dried chili powder was extracted in glass extraction apparatus to obtain its oleoresin using ethanol 96% at temperature of 40°C. The crude oleoresin was filtered using vacuum filter and then evaporated at temperature of 50°C, 160 cmHg using rotary vacuum evaporator.

Specific gravity (SNI 06-2385-2006)
The pycnometer was cleaned by filling it with ethanol, emptied and dried carefully with dry air, permitted to stand for 30 minutes and weighed accuracy (a). Then the pycnometer was filled with distilled water, placed it in a water bath at 25°C for 30 minutes. It was dried and weighed (b). The pycnometer was cleaned by filling it with ethanol and diethyl ether again, emptied and dried carefully with dry air, permitted to stand for 30 minutes and weighed accuracy (c). Then the pycnometer was filled with the sample, placed it in a water bath at 25°C for 30 minutes, dried and weighed (d). Specific gravity was (d-c)/(b-a).

Color changes
Color changes was measured using chromameter Minolta CR-400. Analytical data were expressed as Hunter L (brightness), a* (greenness/redness) and b* (yellowness/blueness).
Solvent residue

Solvent residue in chili oleoresin was determined by evaporation of solvent contained in oleoresin, with the procedure as follows: 2 gram oleoresin was placed in the flask of rotary vacuum evaporator at temperature of 50°C and pressure of lower than 1 atm pressure within one hour until no more solvent evaporated.

RESULT AND DISCUSSION

Yield of Chili Oleoresin

The yield of oleoresin was represented as the weight ratio of oleoresin to chili powder. The study showed that the yields of oleoresin in the two different variety of big chili were in the range of 12.03-15.37%. Figure 1 showed the yield of oleoresin in two different big chili variety.

The Figure 1 illustrated that the highest yield of oleoresin was obtained from the red curly chili without seed (15.37%). In the variety of curly chili, the yield of curly chili without seed was higher than the yield of curly chili with seed, while in red big variety, the yield was quite equal. The higher yield in chili without seed may due to the higher oleoresin component in the pulp than in its seed, in accordance with research by Komara (1991) who found that the highest oleoresin was in the pulp (12.74%) for cayenne chili rather than in the seed (6.34%) and stalk (9.64%). This data can be used to choose the preparation process of making oleoresin that to produce high yield of oleoresin, the separation of the seeds from the pulp of chili is needed.

Specific gravity of Chili Oleoresin

The specific gravity of oleoresin in two different big chili varieties are reported in Figure 2. It can be seen that specific gravity of oleoresin in the two different variety of big chili were in the range of 1.01-1.06 g/ml. These results are comparable with the early reported results of 1.0073-1.1073 g/ml at 25°C (Archuleta, 1995). The Figure 2 illustrated that the highest specific gravity of oleoresin was obtained from the red big chili without seed (1.06 g/ml). It may differ due to the different of inside constituent of the oleoresin. The longer the chain of the component, the higher number of its specific gravity.

Color of Oleoresin

Color is a quality parameter that commonly used for consumer to decide the value of the oil beside it’s intrinsic content. The consumer tended to choose the dark red compared to light red color. In this study, color of the oleoresin was assessed using chromameter with the result as presented in Table 1 and the visual color assessment as showed in Figure 3. Using the chromameter and visual assessment, there was not identified a significant different between the two varieties of red chili. The color of oleoresin produced in this study were red with reflected by a* value in the range of 0.72-3.81. The color of this oleoresin was somewhat similar to color of oleoresin extracted by Archuleta (1995) which is dark red. The red color of the oleoresin may be due to the component of the oleoresin like capsanthin dan capsorubin that having red colored (Attokaran, 2011; Pérez-Gáluez, 2003; Srisajjalertwaja, 2012).

Solvent Residue

Solvent residue of oleoresin from two different big chili varieties are presented in Figure 4. This figure showed the percentage of solvent that entrained in the oleoresin after
evaporation. Figure 4 illustrated that highest solvent residue was in the oleoresin from the red big chili with seed, while the lowest solvent residue was in the red curly chili without seed. This residue was due to the condition of evaporation process and was not caused by the variety of chili. In this research, evaporation was conducted at 50°C, whereas the boiling point of ethanol as the solvent is 78.4°C. The low temperature of evaporation was used in order to maintain the quality of the active component such as capsaicin and color component that has low boiling point.

According to Apriyanto (2001), the acceptable solvent residue of oleoresin for food industry was 1% without giving drug effect. Apparently, solvent residue of the oleoresin produced from the study did not meet this requirement Therefore, reevaporation of oleoresin is needed in the next process in order to produce oleoresin with the solvent residue less than 1%.

CONCLUSIONS
The results of this study showed some differences of oleoresin characteristics from red big and red curly chili with seed and without seed. The yield of oleoresin were ranged from 12.03-15.37%. The highest yield of oleoresin was obtained from red curly chili without seed (15.37%). All solvent residue of the oleoresin were more than 1% with the lowest solvent residue was obtained from red curly chili without seed (3.58%). The oleoresin color was red with the highest a* value (that reflected the red color in the color assessment) was obtained from red big chili (3.81)

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### Tables

Table 1. Color of Oleoresin

<table>
<thead>
<tr>
<th>Treatment</th>
<th>L*</th>
<th>a*</th>
<th>b*</th>
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<tbody>
<tr>
<td>Red curly chili with seed</td>
<td>22.62 ± 0.39</td>
<td>1.52 ± 1.54</td>
<td>-5.51 ± 0.36</td>
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<tr>
<td>Red curly chili without seed</td>
<td>22.41 ± 0.48</td>
<td>0.86 ± 0.54</td>
<td>-4.55 ± 0.18</td>
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<tr>
<td>Red big chili with seed</td>
<td>22.31 ± 0.34</td>
<td>3.81 ± 1.81</td>
<td>-5.40 ± 0.68</td>
</tr>
<tr>
<td>Red big chili without seed</td>
<td>22.54 ± 0.13</td>
<td>0.72 ± 1.87</td>
<td>-4.03 ± 1.56</td>
</tr>
</tbody>
</table>
Figures

Fig 1. Yield of Red Curly and Red Big Chili Oleoresin.

Fig 2. Specific Gravity of Oleoresin

Figure 3. Oleoresin of red chili

Figure 4. Solvent Residue of Oleoresin