Purslane (Portulaca Oleracea L.) Leaves Extract Addition in Jelly Candy Making

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Keywords: Candy, Jelly, Purslane, Linolenic Acid, Maceration.

Abstract: Purslane or krokot (Portulaca oleracea L.) can grow in warm climates (tropics and subtropics). Purslane plant is known to contain 41.4-66.4% of the omega-3 fatty acids, linolenic fatty acids (C18:3, n-3). Purslane extract contains unsaturated fatty acids, and more than 10% consisted of alpha linolenic acid. This study is done to utilize purslane extract in candy jelly production that can be accepted by panelists. Maceration is used to extract purslane leave with three types of solvents (ethanol, ethyl acetate and hexane). The best extract was obtained by calculating the total yield and GC-MS analysis of purslane leaf extract components. The addition of purslane leaf extract to jelly candy uses concentrations of 0.5%, 1.0%, 1.5% and 2.0% (w/w). The observed parameters include physicochemical analysis (Total Dissolved Solids and pH), color, texture and sensory analysis. Selected jelly candies have a concentration of 0.5% purslane leaf extract. Selected jelly candy has characteristics including ° Hue of 91.54°, Total Dissolved Solids of 34.68° Brix, moisture content of 46.49%, fat content of 1.59%, protein content of 0.43%, ash content of 0.87% and carbohydrate levels of 50.72%. Then based on the results of GC-MS analysis the selected jelly candy contains linolenic acid.

1 INTRODUCTION

Purslane (Portulaca oleracea L.), in Indonesia is known by the name of krokot. Krokot is a type of ornamental plant that can grow on warm climates. In some countries (e.g. China), krokot is commonly used in traditional medicine to treat diabetes and hypotension; and it is also known for its antifungal, antibiotic, antiinflammation, antiestrogenic, and anticancer properties (Agil, et al., 2015; Uddin, et al., 2014; Sultana dan Rahman, 2013; dan Zhou, et al., 2015; Hanan et al., 2014). The leaves contain 41.4-66.4% (1.0-1.6 mg/g) omega-3 fatty acids, which are higher compared to its root and stem. Omega-3 fatty acid has many beneficial effects to human body, namely its anticoagulative and anti-inflammatory properties. It is also known to be good for the brain. Moreover, omega-3 fatty acids are able to prevent chronic diseases, such as cardiovascular related diseases, hypertension, inheritance of diabetes on fetus during pregnancy, inflammation, hyperlipidemia, and cancer (Diana, 2012; Zhou, et al., 2015; Yessoufou, et al., 2015; Calviello and Serini, 2010).

Jelly candy is a type of confectionary with soft, chewy, and elastic texture. Gelatin used in the making of jelly candies comes from connective tissues of pig, cow, or skin from poultries (Subaryono and Utomo, 2006; Riaz dan Chaudry, 2004). Due to its non-halal origin, other hydrocolloids such as carrageenan is used as a substitute for gelatin (Atmaka, Nurhartadi and Karim, 2013).

This research is done to determine the addition of krokot leaf extract in the production of jelly candies, based on its sensory analysis and physic analysis.

2 MATERIALS AND METHODS

The materials used are fresh krokot leaves obtained from BALITRO, Bogor, food grade solvents (ethanol, ethyl acetate, and hexane), granulated sugar, citric acid, kappa-carrageenan, konjac, high fructose syrup (HFS), and orange flavoring. Materials used for analysis consist of distilled water, pro-analysis grade hexane, K2SO4, selenium, H2SO4 97%, H2O2, and saturated boric acid. The equipment used are “Ohaus U-1800 AR 2140” analytical...

2.1 Extraction of Krokok Leaf

The extraction of krokot leaf is done using maceration method. The leaves are dried using cabinet dryer at 50°C for 24 hours (Abdolshahi, et al. (2015); Kaveh, et al. (2017), with modification). The dried leaves are reduced in size and sieved using 35-mesh Tyler sieve to obtain krokot leaf powder. The powder is macerated using three types of solvent (ethanol, ethyl-acetate, and hexane) with the ratio of 1:4 (w:v) powder to solvent for 72 hours. The liquid is then filtered using Whatman No.1 filter paper and the solvent is evaporated by using rotary evaporator at 45°C with adjusted vacuum pressure based on each solvent to obtain krokot leaf extract.

2.2 Production of Jelly Candy

The production of jelly candy is done by combining the hydrocolloid (carrageenan and konjac) with water at 80-90°C in a separate container for each hydrocolloid. Then, in another container, mix high fructose syrup with granulated sugar. When the sugar has dissolved, mix the sugar and syrup mixture with carrageenan and konjac solution, followed by heating. When the mixture temperature reaches 80°C, add the citric acid and flavoring.

After cooling down to 60°C, krokot leaf extract is added to the mixture (Sugiharto, et al., 2015). The jelly candy mixture is then poured to the mold, that has been applied with molding starch. The jelly candy is left to cool down in room temperature (23-30°C) for an hour before transferring to the refrigerator (4-5°C) and left for 24 hours. During refrigeration, the gel sets. Compared to konjac, the gel from carrageenan sets faster. Carrageenan gel sets at around 40-70°C. However, its setting temperature is highly affected by the sugar content of the jelly candy, thus it is hard to determine the specific set temperature for carrageenan (Williams dan Phillips, 2004; Williams and Phillips1, 2009).

2.3 Characterization of Krokok Leaf Powder

Characterization of krokot leaf powder was done to determine the chemical composition through proximate analysis (AOAC,2015)

2.4 Characterization of Krokok Leaf Extract

The extracts from three different solvent was calculated for its yield using the formula:

$$\text{Yield (\%) } = \frac{\text{weight of krokot leaf extract (g)}}{\text{weight of krokot leaf (g)}} \times 100\%$$

Furthermore, the identification of omega-3 fatty acid is determined using GC-MS.

2.5 Analysis of Krokok Leaf Extract Added Jelly Candy

The produced jelly candy will be analysed for its pH (AOAC, 2005), Total Soluble Solid (Hasyim 2015), Color (Nielsen, 2010), Texture (Azizah 2012), Sensory Evaluation (Lawless and Heymann, 2010; Kemp, et al. 2009), and proximate analysis (AOAC 2015).

3 RESULTS AND DISCUSSION

3.1 Characteristics of Krokok Leaf Powder

The chemical composition of krokot leaf powder is shown in Table 1. Based on the analysis done, the moisture content of the krokot leaf powder is 8.44±0.13%, which accordi ng to Puspitasari and Proyogo (2017), the moisture content of dry plant sample must not exceed 10%. Thus, krokot leaf powder obtained can be used for the next step, maceration.

<table>
<thead>
<tr>
<th>Chemical composition</th>
<th>Result (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content</td>
<td>8.44 ± 0.13</td>
</tr>
<tr>
<td>Fat</td>
<td>3.96 ± 0.07</td>
</tr>
<tr>
<td>Protein</td>
<td>31.75 ± 0.06</td>
</tr>
<tr>
<td>Ash</td>
<td>18.24 ± 0.03</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>37.60 ± 0.03</td>
</tr>
</tbody>
</table>

3.2 Characterization of Krokok Leaf Extract

Based on the extract yield on Table 2., food grade ethanol gives the highest yield among the solvents used, with the value of 8.30±0.02%. Similar result is obtained from a research by Adiyasa, Warsita and Wartini (2015), where ethanol gives the highest extract yield.
Based on the component identification result with GC-MS, all solvent used shows similar result qualitatively, where every extract contains omega-3 fatty acid. Table 3 shows the identification result with GC-MS.

<table>
<thead>
<tr>
<th>Solvent Type</th>
<th>Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl-acetate</td>
<td>4.78±0.14</td>
</tr>
<tr>
<td>Ethanol</td>
<td>8.30±0.02</td>
</tr>
<tr>
<td>Hexane</td>
<td>2.99±0.01</td>
</tr>
</tbody>
</table>

In a research done by Schmid, et al., (2016), ethanol gives higher PUFA (Polyunsaturated Fatty Acid) yield in the extraction of seaweed. Furthermore, ethanol solvent is able to extract higher amount of total fatty acid (TFA). Hence, it is possible that the krokot leaf extract obtained by using ethanol as solvent contain high level of PUFA and TFA. Thus, ethanol is chosen as the best solvent for the extraction of krokot leaf.

Table 3: Total component identification of krokot leaf extract with GC-MS.

<table>
<thead>
<tr>
<th>Solvent Type</th>
<th>Retention Time</th>
<th>Qual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl-acetate</td>
<td>10.314 minutes</td>
<td>98%</td>
</tr>
<tr>
<td>Ethanol</td>
<td>10.968 minutes</td>
<td>99%</td>
</tr>
<tr>
<td>Hexane</td>
<td>10.540 minutes</td>
<td>94%</td>
</tr>
</tbody>
</table>

3.3 Effect of Krokot Leaf Extract Concentration on Total Soluble Solid of Produced Jelly Candy

Based on Figure 1, there is a significant difference in total soluble solids between jelly candy with different level of extract concentration. It can be seen that there is an increasing trend of total soluble solid when higher level of extract is added. Similar trend is seen on a research by Charoen, et al. (2015), where the total soluble solid of the jelly candy produced increases as the level of guava leaf extract is increased. Another possibility is that increase in total soluble solid is caused by the bonding of free water and other particle through stabilizer, thus increasing the total soluble solid and reducing formation of precipitate (Farikha, et al., 2013).

3.4 Effect of Krokot Leaf Extract Concentration on pH of Produced Jelly Candy

Based on Figure 2, there is a significant difference in pH value between jelly candies with different levels of krokot leaf extract. In Figure 2, an inverse relationship can be seen on the pH of jelly candy and the addition of krokot leaf extract. This is due to the addition of citric acid in the making of jelly candy. The decrease in pH can also be explained due to the addition of carrageenan (Septiani, et al. (2013). The presence of anhydrogalactose group on carrageenan decreases the dispersion of carrageenan, thus reducing the (H⁺) ion that is bound in the jelly candy, effectively reducing the pH of the product. The jelly candies from every treatment is categorized as acidic to less than 7 pH value. According to Sperbe and Doyle (2009), pH value in candies have range between 2.0 until 8.0.

3.5 Effect of Krokot Leaf Extract Concentration on Color of Produced Jelly Candy

The °Hue value of the candy can be seen on Figure 3, where there is no significant difference on °Hue value between jelly candy with different concentration of krokot leaf extract. The °Hue value of the product ranges between 86.91 to 92.52°, where according to Munsell color system, the jelly candy color is categorized as yellow. Increasing the...
concentration of krokot leaf extract will increase the °Hue value of the jelly candy. However, the result obtained is different from visual observation, where the candy shows dark green color. This is due to the presence of antioxidant in the extract used. According to a research by Liu, et al. (2000), krokot contains high level of antioxidant in form of beta-carotene (22-30 mg/g). MacDougall (2002) said that beta-carotene gives yellow orange to food product. According to USDA (2015), a cup of raw carrot contains 10605 µg or 10.6 mg beta-carotene. Due to high level of beta-carotene in the krokot leaf extract, it affects color perceived as yellow.

3.6 Effect of Krokot Leaf Extract Concentration on Texture of Produced Jelly Candy

Texture is an important parameter when determining the physical characteristic of jelly candy. The type and concentration of gelling agent used will determine the texture of jelly candy produced (Imeson, 2010). The observed parameters used in texture analysis of jelly candy are hardness, springiness, cohesiveness, chewiness, and gumminess.

Based on Figure 6, krokot leaf extract has a significant effect towards the hardness of jelly candy produced. Hardness value tend to decrease as the level of extract is increased. Lower hardness value indicates softer texture, and vice versa (Octaviana, Purwijantiningsih and Pranata, 2013).

Decrease in hardness can also due to jelly candy, which considered hygroscopic, absorbs water when exposed to environment with high humidity and temperature, making the product softer when analyzed (Koswara, 2009; Rahmi, et al., 2012).

Based on Figure 7, no significant difference is shown between different level of extract concentration of krokot leaf extract will increase the °Hue value of the jelly candy. However, the result obtained is different from visual observation, where the candy shows dark green color. This is due to the presence of antioxidant in the extract used. According to a research by Liu, et al. (2000), krokot contains high level of antioxidant in form of beta-carotene (22-30 mg/g). MacDougall (2002) said that beta-carotene gives yellow orange to food product. According to USDA (2015), a cup of raw carrot contains 10605 µg or 10.6 mg beta-carotene. Due to high level of beta-carotene in the krokot leaf extract, it affects color perceived as yellow.

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concentration towards the springiness of jelly candy. Springiness of jelly candy is usually not affected by the addition of different levels of extract concentration. Similar result is shown in a research by Atmaka, Nurhartadi and Karim (2013), where different *Curcuma zanthorrhiza* extract concentration shows no significant effect to the elasticity of jelly candy produced.

Based on Figure 8, there is a significant difference towards the cohesiveness of jelly candy between different levels of extract. Cohesiveness value of jelly candy tends to increase as the amount of extract added is increased. The increase and decrease in cohesiveness value is affected by things like moisture content, sugar, and other minor components, which may affect the molecular bond of the gel structure (Rahmi, *et al*., 2012; Delgado and Bañón, 2014).

As seen on Figure 9., there is a significant difference of jelly candy chewiness between different levels of extract concentration. A research by Purwaningtyas, Suhartatik and Mustofa (2017), however, shows no effect on chewiness from the addition of *suji* and *siril* leaf extract. The increase in chewiness of the jelly candy produced may be attributed by the moisture content, total soluble solids, and gelling agent working synergistically (Delgado and Bañón, 2014).

Despite increasing value, the gumminess of jelly candy produced shows no significant difference between different levels of extract added. Gumminess shows gel strength, where it is affected by moisture content, total soluble solids, and presence of other minor components. (Delgado and Bañón, 2014; Rahmi, *et al*., 2012).

### 3.7 Effect of Krokot Leaf Extract Concentration on Sensory Evaluation of Produced Jelly Candy

As shown on Table 4., higher extract concentration shows an increase score in color albeit not significant. Higher level of extract will show greener color jelly candy.
Table 4: Effect of Krokot Leaf Extract to scoring of jelly candy.

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Color</th>
<th>Flavor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5%</td>
<td>4.04±1.9a</td>
<td>4.40±1.03c</td>
</tr>
<tr>
<td>1%</td>
<td>5.11±1.22b</td>
<td>3.53±1.10b</td>
</tr>
<tr>
<td>1.5%</td>
<td>5.00±1.15b</td>
<td>3.33±1.40b</td>
</tr>
<tr>
<td>2%</td>
<td>5.36±1.12b</td>
<td>2.89±1.48a</td>
</tr>
</tbody>
</table>

Addition of higher extract concentration exhibit significant effect to the flavor score of jelly candy. According to Table 4., panelist gives lower score on higher extract concentration due to addition of higher amount extract affects the flavor of candy negatively. Based on the result, addition of krokot leaf extract to jelly candy up to 2.0% shows no significant difference to the aroma and chewiness score.

Hedonic sensory evaluation is done by determining the likeability of panelist towards color, flavor, and overall. The result is expressed in Table 5.

Table 5: Effect of Krokot Leaf Extract to hedonic of jelly candy.

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Color</th>
<th>Flavor</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5%</td>
<td>5.08±0.99b</td>
<td>5.47±1.06c</td>
<td>5.29±0.87c</td>
</tr>
<tr>
<td>1%</td>
<td>4.23±1.20a</td>
<td>4.73±1.27b</td>
<td>4.74±1.16b</td>
</tr>
<tr>
<td>1.5%</td>
<td>4.14±1.32a</td>
<td>4.37±1.53b</td>
<td>4.44±1.28b</td>
</tr>
<tr>
<td>2%</td>
<td>3.90±1.44a</td>
<td>4.11±1.67b</td>
<td>4.29±1.54a</td>
</tr>
</tbody>
</table>

3.9 Effect of Krokot Leaf Extract Concentration on Proximate Analysis ofProduced Jelly Candy

The chosen jelly candy is the one with 0.5% krokot leaf extract. The proximate analysis of the chosen jelly candy is shown on Table 6. Based on the identification result of jelly candy with chosen krokot leaf extract using GC-MS, it is shown that the jelly candy contains alpha-linolenic acid, which is an omega-3 fatty acid. The total component analysis of jelly candy is shown on Table 7.

Table 6: Effect of Krokot Leaf Extract to scoring of jelly candy.

<table>
<thead>
<tr>
<th>Composition</th>
<th>Result (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Content</td>
<td>46.49±0.30</td>
</tr>
<tr>
<td>Ash Content</td>
<td>0.87±0.00</td>
</tr>
<tr>
<td>Fat</td>
<td>1.59±0.01</td>
</tr>
<tr>
<td>Protein</td>
<td>0.43±0.00</td>
</tr>
<tr>
<td>Carbohydrate (by difference)</td>
<td>50.72±0.13</td>
</tr>
</tbody>
</table>

Table 7: Effect of Krokot Leaf Extract to scoring of jelly candy.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Retention Time</th>
<th>Qual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jelly candy with 0.5% krokot leaf extract</td>
<td>13,636 minutes</td>
<td>99%</td>
</tr>
</tbody>
</table>

4 CONCLUSIONS

Proximate analysis shows krokot leaf powder has moisture content of 8.44%, which will be extracted using by maceration on the next stage. Highest extract yield is obtained by using food grade ethanol as solvent, with 8.30% yield. From GC-MS analysis, it is shown that extract using food-grade solvents (ethanol, ethyl acetate, hexane) contains alpha-linolenic fatty acid. Addition of krokot leaf extract decreases the lightness of jelly candy produced. While the texture of jelly candy produced is improved, the chewiness is not affected. The °Hue value is not affected by the increase of extract concentration. The jelly candy with 0.5% krokot leaf extract is chosen based on panelist acceptance with overall acceptance score of 5.29. The chosen jelly candy has color of yellowish green with °Hue value of 91.54%. The characteristic of chosen jelly candy produced has total soluble solids of 34.68 °Brix, 46.49% moisture content, 1.59% fat content, 0.43% protein content, 0.87% ash content, and 50.72% carbohydrate content. Based on GC-MS result, the chosen jelly candy contains alpha-linolenic acid with retention time of 13.636 minutes and 99% qual.

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