The Effect of Yellow Natural Color from Turmeric on Physical and Sensory Properties of Arenga Starch-Taro (Colocasia esculenta L.) Flour Noodle

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INTRODUCTION

Indonesia is a country rich in biodiversity, i.e. taro tuber. Generally, the carbohydrate content of taro tuber has been found to be 82.15% [1]. High carbohydrate content makes taro as a potential for the development of staple food. Moreover, taro flour can be utilized as various kinds of processed products such as noodle, but it needs other ingredients, like arenga starch.

Arenga starch in the noodle products has been potentially mixed with tubers [2,3]. For example, in Indonesia, an alternative carbohydrate source was reported using arenga starch in taro noodles. As a result, the dependency on the consumption of wheat-based noodles can be reduced. Susanti in 2013 had reported that the best composition for preparation of arenga starch-taro flour noodles was 75% using arenga starch and 25% using taro flour [1]. In that report, different colors of commercial products compared to the arenga starch-taro noodles were found to provide less interest of consumers for the consumption of the food. Hence, a natural color such as turmeric, generally known as safe ingredients in food products, can be additionally added to change in the consumer preference [4]. Since turmeric is also often used for medicinal products as it has provided a positive effect on human health due to phenolic content and high antioxidant activity [5,6], we report the effect of natural color extracts from turmeric on the physical and sensory properties of the noodles.

EXPERIMENTAL

General

This research used local tubers Colocasia esculenta L. from Gunungkidul, Yogyakarta, Indonesia. Arenga starch was used from Klaten, Central Java, Indonesia. For product comparison, noodle products in the form of corn and rice were commercially provided by PT. Tiga Pilar Sejahtera, Solo. Food extruder with a model of PD-45N from La Parmigiana was used for the preparation of noodle. Other tools for the preparation consisted of several items such as plastic sealer, scales, electric dan gas stove attaching to the boiler, tray, and cabinet dryer.

Method

This research was prepared using three main procedures. The first two procedures were performed for the extraction of natural color from turmeric rhizome and for the usage of isolated natural color for the production of noodles. In the last procedure, the produced noodles were characterized for the evaluation of physical and sensory properties.

Keywords: arenga starch, natural color, noodle, taro flour, turmeric rhizome extract

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Firstly, turmeric was extracted using 5 different treatments from the ratio of fresh turmeric weight to water as described in Table 1.

### Table 1. The variance of turmeric extracts

<table>
<thead>
<tr>
<th>Sample</th>
<th>The ratio of fresh turmeric weight/water</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1</td>
<td>0.06 g turmeric/mL water</td>
</tr>
<tr>
<td>K2</td>
<td>0.12 g turmeric/mL water</td>
</tr>
<tr>
<td>K3</td>
<td>0.18 g turmeric/mL water</td>
</tr>
<tr>
<td>K4</td>
<td>0.24 g turmeric/mL water</td>
</tr>
<tr>
<td>K5</td>
<td>0.30 g turmeric/mL water</td>
</tr>
</tbody>
</table>

Secondly, the production of noodles was prepared on a laboratory scale using some modification in the large scale of common practice [8]. In the first step, arenga starch was mixed with tao flour with a ratio of 75:25. To this mixture, turmeric extract was added where the ratio was 1:0.5. By using extruder with a diameter of 15 mm, the mixture was molded into pellets with the size of 3-5 cm in length. These pellets can be used to expand the surface of the dough. Moreover, the process of gelatinization can be facilitated when it was steamed. For the steaming of the pellets, it was performed for ±3 mins where it can be completed until the surface became shiny. Since gelatinization on the surface of the object is desired to partially form, the steaming time should not be too long. For the preparation of noodle threads, pellets in the hot condition were extruded with molding diameter of 0.7 mm. As the results, the raw noodles were hung on a cart and was then steamed for 20 mins. This process can be stopped until the appearance of the noodles became transparent. The obtained noodles were treated to stand until it reached room temperature. The resulting transparent noodles were separated and then dried at 55°C for 6 hrs using a dryer cabinet at 55°C for 6 hrs. This step was completely finished when the moisture content was achieved about 10%.

Thirdly, the physical properties of noodles were analyzed using several techniques such as color measurement [9] with chromameter “Konica Minolta CR-400”, and mechanical measurements such as tensile strength [10], elongation [10], and compression test [11] properties using Universal Testing Machine “Zwick Z0.5”. Moreover, sensory properties were determined using a hedonic test with 26 untrained panelists.

The experiment design was prepared as a Completely Randomized Design (CRD). For statistical analysis, the statistical software such as SPSS program was used based on One Way Anova method and the comparison was used Duncan method with a significant level of 5%.

### RESULTS AND DISCUSSION

#### Physical Properties

Physical properties of noodles were determined by the characterization of color, tensile strength, elongation, and compression test. In particular, color is generally found as one of the important parameters in noodles. The presence of color can influence consumer preferences. Table 2 shows the addition of natural color from turmeric extract toward the color changes of noodle products. When turmeric weight was increased, the brightness of the noodle was reduced. By the addition of color ingredients, L-value of noodle products was found to be decreased [12,13].

Table 2. Changes in noodle colors with the addition of natural color from turmeric

<table>
<thead>
<tr>
<th>Sample</th>
<th>L (lightness)</th>
<th>a</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>K0 (control)</td>
<td>51.790</td>
<td>2.97b</td>
<td>5.69a</td>
</tr>
<tr>
<td>K1</td>
<td>50.64c</td>
<td>1.53a</td>
<td>30.50b</td>
</tr>
<tr>
<td>K2</td>
<td>49.41b</td>
<td>2.43a</td>
<td>32.02a</td>
</tr>
<tr>
<td>K3</td>
<td>48.95*</td>
<td>3.15b</td>
<td>34.20b</td>
</tr>
<tr>
<td>K4</td>
<td>40.32*</td>
<td>6.68a</td>
<td>28.96b</td>
</tr>
<tr>
<td>K5</td>
<td>40.72d</td>
<td>8.06a</td>
<td>28.62b</td>
</tr>
</tbody>
</table>

Note: The same superscript from the smallest to the highest (a to e) was used to indicate that samples are not significantly different at a significance level of 95%, and L, a and b values indicate the lightness or brightness, green-red and blue-yellow components of noodles, respectively.

The addition of the turmeric extract on the noodles was aimed to improve the yellow color, and it was illustrated in b-value. The b-value was increased up to K3 noodles, then was decreased from K4 to K5 noodles, but the b-values of K4 and K5 noodles were not significantly different at the p > 0.05. Yellow color in the noodle was increased with the addition of turmeric extract because turmeric contains curcumin as a yellow pigment color. The yellow color in turmeric is mainly due to the presence of 3 major pigments: curcumin 1,7-bis-(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione, dimethoxy-curcumin and bis-dimethoxy-curcumin [6]. Decreasing b-values in K4 and K5 noodles can be probably assigned from the excessive yellow dye amount in the noodles which gave an orange color. This color was indicated by the low intensity. This result was supported by L-value analysis that it was different from K3 and K4, where L-value of K3 samples had higher brightness than that of K4.

Other physical parameters of the noodles have been usually evaluated by compression test, elongation, and tensile strength. Figure 1 shows the compression test of dried noodles, while tensile strength and elongation of boiled noodles were described in Figures 2 and 3. It was found that the same superscript symbol in the parameter values. These results indicate that at the significance level of 95%, the samples are not significantly different from such variation.

![Figure 1. Changes in compression test values of the dried noodles. The same superscript from the smallest to the highest (a to e) was used to indicate that samples are not significantly different at a significance level of 95%.

In the compression test, it can be used to illustrate the noodle power against mechanical (shock). Such mechanical test happened during distribution or storage. Generally, a high compression test value of the noodles is expected so that it is not easily broken. The value from the compression test was decreased and lower with increasing of the turmeric extract as
shown in Figure 1. Generally, the addition of color coloring extracts decreased compression test to 69.97%.

Elongation and tensile strengths of noodles were significantly decreased to 39.05% and 84.62% with the addition of turmeric extract, as described in Figures 2 and 3. Tensile strength represents the consumption quality of noodles, and it also corresponds to elasticity and tenacity for the strain of noodles [14]. Hence, the disruption of the bonding between amylose in cellophane tends to occur in the addition of turmeric extract. In this mixture, like a noodle, it will decrease the elongation. Moreover, the textural properties of the noodles were also determined by the content of starch amylose [15]. Indeed, such addition of ingredients or extracts can make a soft product and decreasing in textural properties when it was compared to the control [12,16-18].

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**Sensory Properties**

Figures 4-7 show the sensory properties of the noodles. In this study, color, taste, odor, and overall score were used to evaluate the sensory properties using a hedonic scale from 1 to 7 (1 = very dislike; 4 = neutral; 7 = very like). It was found that the noodle score gave the same superscript symbol, indicating no significant difference at the significance level of 95% for all samples.

In Figure 4, color attributes for K2 noodle showed the most preferred noodles with the addition of turmeric extract. It was also found that the color of K1 and K2 noodles, as well as comparative noodles (corn and rice noodles), have displayed no significant difference in their scores. The addition of turmeric extract increased the color preference, but it decreased when more turmeric extract was added to the noodles. Color preference was decreased in K3-K5 noodles because the high addition of turmeric extract would make a darker color in the noodles. The preferred instant noodle is the noodle which has color and high brightness color [19].

In Figure 5, taste attributes showed that K2 noodle is the most preferred noodle. The taste of noodles can be increased by the addition of turmeric extract. Among the noodles, K5 was the least preferred ones. This might be due to the addition of turmeric in a high amount that might provide a slightly bitter taste. Turmeric contains a compound which produces taste bitter and pungent aroma [20].

In Figure 6, odor attributes also showed that K2 noodle is the most preferred noodle. Other noodles showed no significant difference compared to the most preferred ones. This result shows that the odor of the noodles did not significantly influence by the addition of turmeric extract.

Figure 7 shows the overall sensory value of noodles. Based on the above evaluation of the sensory values, K2 noodle among other samples was the most preferred one. The addition of turmeric extract in high amount to the sample could make dark color and bitter taste in the noodles. Therefore, the panelist preference showed decreasing in the sensory values. Indeed, the addition of other ingredients extracts will influence the sensory analysis of noodle products [14,16].
CONCLUSION

The addition of turmeric as coloring extract affects the physical and sensory characteristics of noodles as synthesized from arenga starch – taro flour. By adding turmeric extract, the physical properties showed decreasing in the break compression, elongation, and tensile strength of the noodle products. Moreover, this addition provided increasing in the yellow color of the noodles. From the sensory analysis, K2 prepared from addition of 0.12 g turmeric/mL of water was found to be the most preferred noodles.

ACKNOWLEDGMENT

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REFERENCES


Figure 6. Odor attributes score value of noodles. The same superscript from the smallest to the highest (a to e) was used to indicate that samples are not significantly different at a significance level of 95%.

Figure 7. The overall value of noodles. The same superscript from the smallest to the highest (a to e) was used to indicate that samples are not significantly different at a significance level of 95%.

Figure 8. The yellow color of noodles. The same superscript from the smallest to the highest (a to e) was used to indicate that samples are not significantly different at a significance level of 95%.

Abstrak

Mie umbi talas-pat peri aren (Colocasia esculenta L.) adalah salah satu alternatif sumber karbohidrat yang dibuat dari 75% umbi talas dan 25% pati aren. Penelitian ini bertujuan untuk mempelajari pengaruh ekstrak kunyit sebagai pewarna alami terhadap sifat-sifat fisika dan sensoris mie. Penambahan ekstraksi pewarna dilakukan dengan 5 variasi ekstrak kunyit (0,06; 0,12; 0,18; 0,24; dan 0,30 g (berat segar/mL air). Mie dibuat dan diikuti dengan evaluasi sifat-sifat fisika dan sensoris. Hasil penelitian menunjukkan bahwa penambahan ekstrak kunyit menurunkan kuat patah ke 69,97%, pemanjangan ke 39.05%, dan kekuatan tekanan ke 86.62%. Penambahan ekstrak kunyit meningkatkan warna kuning pada produk mie. Mie yang paling disukai dari analisis sensoris adalah mie dengan penambahan 0,12 g ekstrak kunyit.

Kata kunci: ekstrak, mie, pati aren, pewarna alami, umbi talas kunyit

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