Characteristic of Arenga Starch-Taro (Colocasia esculenta L.) Flour Noodle with Addition of Beetroot Extract

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Abstract. Taro (Colocasia esculenta L.) flour can be mixed with arenga starch in noodle making with 25% taro flour and 75% arenga starch as the best proportion. Addition of beetroot extract as red natural color may improve consumer preference and change the noodle characteristic. This research purpose is to know the effect of addition of beetroot extract on the noodle characteristic. Coloring extraction was done using 5 variances of beetroot (0.4; 0.6; 0.8; 1; and 1.2 g (fresh weight/ml water). Then, noodle was made and characteristic including physical and sensory properties were evaluated. The result showed that coloring extracts addition decreased the break compression, elongation, and tensile strength of arenga starch-taro flour sohun. Beetroot extract addition increased the red color and didn’t change sensory properties significantly.

1. Introduction
Indonesia has many biodiversity of tuber which contain high amount of carbohydrate. One of local tuber that potential and commonly used is taro tuber. Taro tuber contain carbohydrate for 82.15% [1]. Taro flour can be used for noodle making with addition of arenga starch as amylose source. Arenga starch has been commonly known as a potential raw material to be mixed with tuber in noodle product [2,3]. Arenga starch-taro noodle is an alternative carbohydrate source that can reduce dependency of wheat-based noodle consumption in Indonesia. Thus, arenga starch-taro noodle can increase the economy value of Indonesian local tuber. From the previous research [1], the best composition of arenga starch-taro flour noodle was made with composition: 75% arenga starch and 25% taro flour. However, arenga starch-taro noodle has a different color with commercial product. The noodle color looks unfamiliar thus making consumers are less interested in trying. The addition of natural color which is safe may change the consumer preference. Addition natural color from plant-based also usually incorporated into noodles to serve as nutrition enhancers or to provide specific physiological functions [4]. One of natural color that usually used in food product is beetroot [5, 6]. The major coloring pigment in beetroot is betalains, whose main pigment is betanin-5-O-β-glucosidase, or betanin, which is the most common betacyanin [7]. Beetroot is commonly used as natural color in food product because it contain polyphenol and antioxidant activity [6,8,9]. The aim of this research is to study the characteristic of arenga starch-taro (Colocasia esculenta L.) flour noodle with addition of beetroot extract.
2. Materials and Methods

2.1. Materials
The materials used in the research were *Colocasia esculenta* L. (local tubers) from Gunungkidul, arenga starch from Klaten, beetroot from Yogyakarta, and commercial noodle products (corn noodle and rice noodle of superior brand that was produced by PT. Tiga Pilar Sejahtera, Solo) for product comparison. The tools used for noodle making were noodle making machine (Food Extruder PD-45N, La Pramigiana), cabinet dryer, tray, gas stove along with boiler, plastic sealer, electric stove, and scales.

2.2. Methods
Research methodologies consisted of (i) extraction of natural color from beetroot [10] with some modifications; (ii) noodle production; and (iii) characterization of physical and sensory properties of noodle. Beetroot was extracted into 5 variances with water as shown in table 1.

| Code | Ratio of fresh beetroot weight : water |
|------|--------------------------------------|
| B1   | 0.40 g beetroot/ml water             |
| B2   | 0.60 g beetroot/ml water             |
| B3   | 0.80 g beetroot/ml water             |
| B4   | 1.00 g beetroot/ml water             |
| B5   | 1.20 g beetroot/ml water             |

Making of noodle in this research was based on the common practice in a large scale [11] with some modification to be performed in a laboratory scale. The first step was weighing a mixture of arenga starch and taro flour with ratio 75:25. Then, beetroot extract is added to flour mixture with ratio between flour and extract 1:0.5. The mixture was then molded into pellets with a length of 3-5 cm using the extruder with a diameter of 15 mm. Making pellets aims to expand the surface of the dough so as to facilitate the process of gelatinization when steamed. Pellets then steamed for ± 3 min until the surface became shiny. Steaming should not be too long because it is desired to gelatinization partially on the surface of the pellet. While pellets were still hot, they were entered immediately into the extruder to be molded into noodle threads. The mold used in this process had a diameter of 0.7 mm. The obtained raw noodle was then hung on a cart and steamed for ± 20 min until the color of noodle became transparent. The cooked transparent noodle was allowed to stand until it reached room temperature, then separated and dried in a dryer cabinet at temperature of 55 °C for 6 h until the moisture content was about 10%.

Characterization of the noodle product include of physical and sensory analysis. Physical properties analysis of noodle consisted of color measurement [12], tensile strength [13], elongation [13], and compression test [14]. Sensory properties using hedonic test were determined with attributes: color, taste, odor, and overall liking. The design of the experiment used was a completely randomized design (CRD). Statistical data were analyzed using the software of SPSS version 16 with One Way Anova method with a significant level of 5% in comparison of means using Duncan method.

3. Results and Discussion

3.1 Physical Properties
Physical analysis of noodle i.e color, tensile strength, elongation, and compression test were done. Color is one of important parameters in noodle which influence consumer preferences. Color measurement of noodle product can be seen in table 2.

*L*-value indicates the lightness or brightness of the noodle. As shown in table 2, the addition of beetroot extract will reduce the brightness of the noodle. Beetroot extract contain red colour, so it decreased *L*-value of noodle product [5, 15]. The higher score of a value indicates the high intensity of red color in the noodle. The highest a value was B3. Addition beetroot extract increased a value
because it contain betanins as red pigment and have strong antioxidant activity [6,8,9]. The score of A value were decreased in B4 and B5 because addition of high amount of beetroot will make blackish-red to the noodle product.

Table 2. Noodle color with addition of beetroot extract

| Sample | L     | a     | B     |
|--------|-------|-------|-------|
| B0 (control) | 51.79<sup>c</sup> | 2.97<sup>b</sup> | 5.69<sup>bc</sup> |
| B1     | 45.80<sup>b</sup> | 7.41<sup>a</sup> | 4.38<sup>a</sup> |
| B2     | 46.50<sup>b</sup> | 8.65<sup>c</sup> | 6.13<sup>c</sup> |
| B3     | 41.56<sup>a</sup> | 10.50<sup>e</sup> | 6.27<sup>c</sup> |
| B4     | 39.92<sup>a</sup> | 9.47<sup>d</sup> | 5.34<sup>b</sup> |
| B5     | 40.31<sup>a</sup> | 7.77<sup>b</sup> | 5.19<sup>b</sup> |

Note: The same superscript symbol in the same column indicates that samples are not significantly different at a significance level of 95%.

The other important noodle physical parameters were compression test, elongation, and tensile strength. Compression test was analyse in dried noodle as described in figure 1, while tensile strength and elongation were tested in boiled noodle as shown in table 3. The same superscript symbol in the parameter value indicate that sample are not significantly different at a significance level of 95%.

Figure 1. Compression test of dried noodle

Compression test illustrate the noodle power against mechanical (shock) during distribution / storage. The noodle is expected to have a high compression test value so that not easily broken. As shown in figure 1, compression test was decrease with addition of beetroot extract. Compression test was decreased significantly in B1, B2, B3, B4, B5 compared with B0 (control). The more addition of beetroot extract will decreased compression test because addition the particles from beetroot can interfere amylose bond in the noodle. Addition of some plant-based or animal-based tissues and extracts into noodles may negatively affect the sensory, eating, and cooking properties of the final products [16].
Table 3. Elongation and tensile strength of the noodle with addition of beetroot extract

| Sample | Elongation (%) | Tensile strength (N) |
|--------|----------------|----------------------|
| B0 (control) | 16.08 | 0.13 |
| B1     | n/a            | n/a                  |
| B2     | n/a            | n/a                  |
| B3     | n/a            | n/a                  |
| B4     | n/a            | n/a                  |
| B5     | n/a            | n/a                  |

As described in table 3, addition of beetroot extract decreased elongation and tensile strength of boiled noodle therefore it cannot be measure in B1, B2, B3, B4, and B5. Addition of beetroot extract will disrupt the bond between amylose in cellophane so that decrease the elongation and tensile strength of the boiled noodle. Starch amylose content was important parameter which affect textural properties of noodle [17]. Addition of ingredient / extract will make soft product compare to the control and textural properties were decreased [18, 19, 20, 21].

3.2. Sensory Properties

Sensory analysis of noodle with attributes i.e. color, taste, odor, and overall were done as shown in figure 2-5. Sensory analysis using hedonic scale 1-7, which 1 = very dislike; 4 = neutral; 7 = very like. The same superscript symbol in the noodle score indicate that sample are not significantly different at a significance level of 95%

![Figure 2. Color attributes value of noodle](image)

For color attributes, the most preferred noodle with addition of beetroot extract was B5, but there not significantly difference between the color of noodle with beetroot extract addition. However, the noodle color with beetroot addition were significantly lower than comparison noodle (corn noodle / rice noodle).
Addition of beetroot extract will increase taste attributes score compared with noodle control. Beetroot extract have sweet taste so can increase the taste of noodle. The most preferred noodle for taste attributes was B5 which highest addition of beetroot extract, and not significantly different with comparison noodle.

For odor attributes, the most preferred noodle was B4, but there was no significantly difference with the others. This shows that the addition of beetroot extract did not influence the odor of the noodle significantly although beetroot has earthy odor [22].
As shown in figure 5, for overall sensory value, the most preferred sample was B4 and B5 but it not significantly different with noodle control and noodle with beetroot extract. This indicates that the addition of beetroot extract did not influence the overall sensory value of the noodle significantly. In wet sago noodles making, addition of beetroot extract also did not influence the overall sensory value [15].

4. Conclusion
Addition of beetroot extract gave an impact on physical properties of arenga starch-taro flour noodle, which increased the color and decreased compression test, elongation, and tensile strength. For sensory analysis, addition of beetroot extract increase the taste attributes scores of the noodle, but it not significantly different in overall attributes of the noodle product.

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