The effects of turmeric extract addition on physical and sensory characteristic of arenga-arrowroot starch noodle

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Abstract. Arenga-arrowroot starch noodle is an alternative carbohydrate source made from 75% arenga starch and 25% arrowroot flour. This starch noodle has a bright brown-opaque color character which needs the addition of coloring agents to improve its physical appearance. The aim of this study was to determine the effects of turmeric extract addition on physical and sensory characteristics of the arenga-arrowroot starch noodle. Five variations of concentrations were given to turmeric extract, there are 3%; 6%; 9%; 12%; and 15% w/w. Physical properties which have been analyzed were starch noodle’s color, compression strength, tensile strength, and elongation. Sensory properties which have been analyzed were hedonic scoring for color, odor, taste, overall acceptance and descriptive test for taste parameter. The results showed that addition of turmeric extract gives an impact on physical and sensory characteristic of arenga-starch – arrowroot flour noodle. Addition of turmeric extract caused the decrease of noodle color brightness. The addition of turmeric extract decreased the compression test, elongation and tensile strength of arenga starch-arrowroot flour noodle. Turmeric extract addition increased the yellow color. In sensory analysis, addition of turmeric extract in small quantities (3%, 6%) has no significant different compared to noodle control based on overall acceptance.

1. Introduction
Many local tubers in Indonesia, including arrowroot tuber have potential to developed as a rice substituent and processed into prestigious food [1]. The high carbohydrate content in tuber arrowroot, which is 85.2% and 355 ccal energy [2] makes this tuber potential to developed as an alternative food source to replace rice. Arrowroot can be processed into noodle products mixed with arenga starch with ratio of 75:25 for the best textural properties [3]. Unfortunately, the noodle product has low score to the color acceptance which is not clear and unsatisfied [3]. The phenol content which is quite high in the arrowroot tubers [4], may caused the brown color in the arenga-arrowroot starch. The phenol oxidation reaction becomes quinone by the enzyme polyphenol oxidase (PPO) in the presence of oxygen which affects the enzymatic browning process [5]. Addition turmeric extract into noodle may improve the color acceptance of the product. The aim of this research was to study the effects of turmeric extract addition on physical and sensory characteristic of arenga-arrowroot starch noodle.
2. Materials and methods
The material used were arrowroot tuber from Gunungkidul, arenga starch from Klaten, turmeric from local market, 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 Food Extruder PD-45N (La Pramigiana), cabinet dryer, tray, gas stove along with boiler, plastic sealer, electric stove, and scales. Tools used for analysis were Universal Testing Machine (Zwick 0.5-Lloyd’s Universal Testing Instrument), analytes scales (Sartorius PB160B), chromameter (Konica Minolta), Whatman No.11 filter paper, and glassware needed for analysis purposes.

Research methodologies consisted of (i) extraction of turmeric [6] with some modifications; (ii) noodle making; and (iii) characterization of physical and sensory properties of noodle. Turmeric rhizome was peeled in water, then cut and weighed according to variations in the table 1. Then, put in a blender and add water. Further blending for ± 5 minutes . then filtered using a filter. Turmeric was extracted into 5 variances with water as described in table 1.

| Code | Ratio of fresh turmeric and arenga-arrowroot mix flour (w/w) |
|------|-------------------------------------------------------------|
| GK3  | 3%                                                          |
| GK6  | 6%                                                          |
| GK9  | 9%                                                          |
| GK12 | 12%                                                         |
| GK15 | 15%                                                         |

For making of noodle, the methods which used in this research was based on the common practice in a large scale [7] with some modification to be performed in a laboratory scale. First, weigh and blend arenga starch and arrowroot flour with ratio 75:25. Then, turmeric extract is added 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. Then steamed for ± 3 min until the surface became shiny. The obtained raw noodle was then hung on a cart and steamed for ± 20 min until the color of noodle became transparent. The next step was incubated at room temperature, then separated and dried using cabinet dryer at temperature of 55°C for 6 h until the moisture content was about 10 %. Dry noodle then package using plastic PP 10.

Physical characteristic of the noodle consisted of color [8], tensile strength, elongation [9], and compression test [10]. Sensory analysis of the noodle was carried out using a hedonic test [11] with 7 scales, namely 1 for dislike, and 7 for extremely very like. Sensory parameters include color, aroma, taste, and overall acceptance. In addition, a descriptive test of the sweetness attribute on the product also done, with 5 scales, namely 1 for not sweet / bitter, and 5 for extremely very sweet/bitter. There were 26 untrained panelists that used in this research. The design of the experiment used was a completely randomized design (CRD) with three replicates. Statistical data were analyzed using the software of SPSS version 22 with One Way Anova method with a significant level of 5% in comparison of means using Duncan method and Independent T Test.

3. Results and discussions

3.1. Physical characteristic of arenga-arrowroot noodle
Color is one of the important visual attributes that consumers consider when buying a noodle [7]. The color of the arenga-arrowroot noodle can be seen in table 2.
Table 2. Color of arenga-arrowroot noodle

| Sample  | Color |
|---------|-------|
|         | L     | a     | b     |
| G       | 48.73<sup>d</sup> | 1.87<sup>a</sup> | 8.57<sup>b</sup> |
| GK3     | 40.94<sup>c</sup> | 2.94<sup>b</sup> | 21.3<sup>d</sup> |
| GK6     | 40.35<sup>c</sup> | 4.19<sup>c</sup> | 20.72<sup>d</sup> |
| GK9     | 32.36<sup>b</sup> | 4.96<sup>d</sup> | 14.43<sup>c</sup> |
| GK12    | 27.36<sup>c</sup> | 5.32<sup>c</sup> | 6.96<sup>a</sup> |
| GK15    | 27.55<sup>d</sup> | 6.16<sup>f</sup> | 7.81<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%

Addition of turmeric extract cause the value of L decreases, the value of a increases, and the value of b decreases compared with sample G (without addition of turmeric extract). Curcumin which will tend to give a brownish red color in an alkaline condition so that the noodle has a brownish color [12]. The other important noodle physical characteristic were compression test, tensile strength, and elongation as described in table 3.

Table 3. Compression test, tensile strength, and elongation of arenga-arrowroot noodle

| Sample  | Compression test (N) | Tensile Strength (N) | Elongation (%) |
|---------|----------------------|----------------------|----------------|
| G       | 3.67<sup>c</sup>    | 0.28<sup>c</sup>    | 19.55<sup>c</sup> |
| GK3     | 3.26<sup>b</sup>    | 0.14<sup>b</sup>    | 18.90<sup>f</sup> |
| GK6     | 2.63<sup>bc</sup>    | 0.13<sup>b</sup>    | 15.63<sup>bc</sup> |
| GK9     | 2.47<sup>abc</sup>   | 0.13<sup>b</sup>    | 15.05<sup>bc</sup> |
| GK12    | 2.29<sup>ab</sup>    | 0.06<sup>a</sup>    | 9.50<sup>ab</sup> |
| GK15    | 1.94<sup>a</sup>    | 0.04<sup>a</sup>    | 6.48<sup>a</sup> |

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

Addition of turmeric extract cause decrease in compression test, tensile strength, and elongation of arenga-arrowroot noodle compared with sample G (without turmeric extract addition). The decrease in the physical characteristic may occurs because the turmeric rhizome component was non-starch components, so it will result in broken amylose chain bonds, thus the noodle structure will become more fragile so that the value of the physical characteristic were decreases. Addition of ingredient / extract will make soft product compare to the control and textural properties were decreased, include noodle product [13, 14, 15, 16, 17].

3.2. Sensory characteristic of arenga-arrowroot noodle

Sensory analysis of noodle with attributes i.e. color, odor, taste, overall acceptance, sweetness/bitterness were done as shown in table 4. As shown in table 4, GK3 has the highest favorite color compared to the others. However, this value was not significantly different when compared to sample G/control (without turmeric extract addition). There was a tendency that more addition of turmeric rhizome extract will decrease the noodle color parameter. This was positively correlated with the results of color testing using chromameter which states that with the higher concentration of turmeric, the color of the arenga-arrowroot noodle will be increasingly brownish yellow and darker. In addition, the preference value for color in all arenga-arrowroot noodle were significantly different with commercial products A and B. This was due to the higher brightness of commercial products with a range of L values > 51.00 [3].
Table 4. Sensory characteristic of arenga-arrowroot noodle

| Sample  | Color  | Odor   | Taste  | Overall acceptance | Sweetness/Bitterness |
|---------|--------|--------|--------|--------------------|----------------------|
| G       | 3.96<sup>b</sup> | 4.27<sup>b</sup> | 3.77<sup>b</sup> | 4.08<sup>b</sup> | 1.23<sup>ab</sup>    |
| GK3     | 4.12<sup>b</sup> | 3.88<sup>ab</sup> | 3.65<sup>ab</sup> | 3.58<sup>ab</sup> | 1.38<sup>abc</sup>   |
| GK6     | 3.92<sup>b</sup> | 4.00<sup>ab</sup> | 3.58<sup>ab</sup> | 3.65<sup>ab</sup> | 1.54<sup>bc</sup>    |
| GK9     | 3.04<sup>a</sup> | 3.69<sup>ab</sup> | 3.54<sup>ab</sup> | 3.50<sup>a</sup>  | 1.54<sup>bc</sup>    |
| GK12    | 3.19<sup>a</sup> | 3.50<sup>a</sup>  | 3.27<sup>ab</sup> | 3.19<sup>a</sup>  | 1.65<sup>c</sup>     |
| GK15    | 3.00<sup>a</sup> | 3.46<sup>a</sup>  | 3.04<sup>a</sup>  | 3.15<sup>a</sup>  | 1.62<sup>c</sup>     |
| Commercial A | 5.62<sup>c</sup> | 4.23<sup>b</sup> | 5.15<sup>c</sup>  | 5.23<sup>c</sup>  | 1.12<sup>a</sup>    |
| Commercial B | 5.65<sup>c</sup> | 4.23<sup>b</sup> | 4.81<sup>c</sup>  | 5.04<sup>c</sup>  | 1.15<sup>c</sup>    |

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

In the odor attribute, the value has a tendency to decrease with increasing concentration of turmeric rhizome addition. This is due to the content of sesquiterpene ketone which contributes 59% to the total turmeric essential oil gives a brightly bitter and distinctive taste and aroma to the product [18]. Addition of turmeric extract also decrease the taste attribute. The lower preferred value is caused by the essential oil content in turmeric which has a soft, spicy character [19]. In the bitterness character, the highest bitterness value was GK12. The value of bitterness was significantly different when compared with noodle G and commercial products. The spicy character contained in turmeric essential oil plays a role in the emergence of bitter characters in the product [19]. In overall acceptance, addition of turmeric extract in small quantities (GK 3, GK 6) has no significant different compared to noodle control (G). Otherwise, addition of turmeric extract in high quantities (GK 9, GK 12, GK 15) has significant different compared to noodle control (G). Many studies reported addition other ingredient/extract will influence the sensory analysis of noodle product [20, 21].

4. Conclusion

Addition of turmeric extract give an impact on physical and sensory characteristic of arenga starch – arrowroot flour noodle. Addition of turmeric extract cause the decrease of noodle color brightness. The addition of turmeric extract decreased the compression test, elongation, and tensile strength of arenga starch-arrowroot flour noodle. Turmeric extract addition increased the yellow color. In sensory analysis, addition of turmeric extract in small quantities (3%, 6%) has no significant different compared to noodle control based on overall acceptance.

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