Effect of Additional Suji Leaves and Turmeric Extract on Physicochemical Characteristic and Antioxidant Activity of Arenga-Canna Noodle

Miftakhussolikhah1, D Ariani1, ERN Herawati1, A Nastiti2, M Angwar1, Y Pranoto2
1Research Unit for Natural Product Technology, Indonesian Institute of Sciences, Gading, Playen, Gunung Kidul, Yogyakarta, Indonesia
2Faculty of Agricultural Technology, Gadjah Mada University, Yogyakarta, Indonesia

E-mail: miftalipi@gmail.com

Abstract. Canna can be used as raw material for noodle but need a substitute material such as arenga starch. Arenga-canna noodle has dark appearance. Addition coloring agents from suji leaves and turmeric extract was done to improve product appearance and its functional characteristics. In this study, noodle was made with five variations of suji leaves and turmeric extract. Physical and chemical properties of noodle were analyzed. The results showed addition suji leaves extract and turmeric extract 0.4 g suji leaf/ml water and 0.06 g turmeric/ml water respectively, produce the best arenga-canna noodle quality. The addition of natural coloring agents increased antioxidant activity.

1. Introduction

Starch noodle (vermicelli) is a noodle that consumed by Indonesian people. Starch noodle is a flour-based product preferred by most Indonesians. Demand and consumption of noodle was significantly increase. However, it was not followed by raw materials availability, especially mung bean that remains to be imported for fulfillment. On the other hand, canna (Canna discolor) root is one of potential carbohydrate source but the utilization was still limited. So far canna utilization was still limited in starch form and the flour was not used optimally. Canna flour can be used as raw material in food processing such as starch noodle. We try to utilize flour rather than starch to explore canna utilization for noodle raw material.

Some research that investigate local material which can substitute noodle raw material has been conducted. According Li and Vasanthan [1] ideal starch for noodle raw material should have high amylose content, limited degree of swelling granules, low breakdown, and type C brabender curve. Canna root has relatively low amylose content so need a substitution material to improve canna noodle characteristics. Based on Alam [2], arenga starch has suitable characteristics for starch noodle, so arenga starch could be used for canna noodle substitute material.

Study about arenga-canna noodle characteristics has been conducted by Yosieto [3]. From the result, the best noodle produced from 75% arenga starch and 25% canna flour. The product has the closest physical properties to commercial products and the most preferred by the panelists. However, the appearance of noodle was less attractive and the panelist did not like with the color. Starch noodle from canna flour and arenga starch has dark color and ugly appearance. Therefore it is necessary to add dye to improve physical appearance of arenga-canna noodle. Addition of natural coloring agents from suji leaves extract and turmeric extract was done to improve product appearance and its functional characteristics.

In this study, starch noodle was made with 75% arenga starch and 25% canna flour. Dye was added with five variations suji leaves extract at 0.4 g suji leaves/ml water; 0.6 g suji leaves/ml water 0.8 g suji leaves/ml water 1.0 g suji leaves/ml water and 1.2 g suji leaves/ml water and for turmeric extract at 0.06 g turmeric/ml water; 0.12 g turmeric/ml water; 0.18 g turmeric/ml water; 0.24 g turmeric/ml water and 0.30 g turmeric/ml water. Starch noodle without addition of natural coloring agents was used as control. Physical properties of noodle was analyzed. Chemical composition of selected starch noodle was then analyzed. The subjective of this study are to determine the concentration of suji leaves and turmeric extract which produce best arenga-canna starch noodle quality and to improve its antioxidant activity.

2. Materials and Method

2.1. Materials

The main material used in this study was canna flour and arenga starch. Canna flour made from eight months old fresh canna bulbs. Arenga starch was bought from local industry. Suji leaves and turmeric was bought from local market. Maize starch noodle and rice noodle (Superior, PT Tiga Pilar Sejahtera) used as comparator commercial products.
2.2. Noodle with addition suji leaves and turmeric dye extract

Noodle was made from 75% arenga starch and 25% canna flour with dye extract addition.

Table 1. Variation of suji leaves and turmeric extract

| Code  | Addition of dye extract          |
|-------|----------------------------------|
| GS 1  | 0.4 gram suji leaves / ml water  |
| GS 2  | 0.6 gram suji leaves / ml water  |
| GS 3  | 0.8 gram suji leaves / ml water  |
| GS 4  | 1.0 gram suji leaves / ml water  |
| GS 5  | 1.2 gram suji leaves / ml water  |
| GK 1  | 0.06 gram kunyit / ml water      |
| GK 2  | 0.12 gram kunyit / ml water      |
| GK 3  | 0.18 gram kunyit / ml water      |
| GK 4  | 0.24 gram kunyit / ml water      |
| GK 5  | 0.30 gram kunyit / ml water      |

2.3. Determination of noodle physical properties before and after cooking.

Noodle strength was analysed based on Suryani [4], tensile strength and elongation of noodle was determined according to Chen et al [5].

2.4. Determination of noodle chemical characteristics

Water content, ash content, protein content and fat content determined based on AOAC method [6]. Antioxidant capacity was conducted according to Rohman and Riyanto [7].

3. Results

3.1. Physical properties arenga-canna noodle before and after cooking

Physical properties arenga-canna noodle with natural dye addition before and after cooking, including strength of raw noodle, tensile strength and elongation of cooking noodle were shown in Table 2.

Table 2. Physical properties arenga-canna noodle with natural dye addition

| Code  | Strength (N) | Tensile Strength (N) | Elongation (%) |
|-------|--------------|----------------------|----------------|
| GK 1  | 3.21b        | 0.23c                | 21.16a         |
| GK 2  | 2.80b        | 0.14c                | 13.17a         |
| GK 3  | 2.65b        | 0.08ab               | 12.40b         |
| GK 4  | 1.71a        | 0.05ab               | 11.21a         |
| GK 5  | 1.16c        | 0.03c                | 10.84b         |
| Control | 4.93d       | 0.28d                | 22.46a         |
| Commercial A | >400d | 0.10bc             | 92.47b         |
| Commercial B | >400d        | 0.05c               | 20.84a         |
| GS 1  | 3.24d        | 0.13c                | 28.96b         |
| GS 2  | 2.57c        | 0.12c                | 19.05ab        |
| GS 3  | 2.32c        | 0.10abc              | 15.37ab        |
| GS 4  | 1.18b        | 0.05ab               | 12.37ab        |
| GS 5  | 0.63a        | 0.02a                | 7.54a          |
| Control | 4.93a        | 0.28d                | 22.46b         |
| Commercial A | >400d       | 0.10bc             | 92.47b         |
| Commercial B | >400d          | 0.05ab             | 20.84a         |

The mean values within the same column followed by different superscript letters differ significantly (p < 0.05).

3.2. Chemical properties of arenga-canna noodle

Chemical properties arenga-canna noodle with natural dye addition was shown in Table 3.
Table 3. Chemical properties arenga-canna noodle

| Chemical properties        | Sample          |
|---------------------------|-----------------|
|                           | GS 1 (%)       | GK 1 (%)       | Control (%)  |
| Water content             | 11.60b         | 11.95c         | 11.77bc      |
| Ash content               | 1.03b          | 0.88a          | 0.98b        |
| Fat content               | 0.02a          | 0.05a          | 0.11a        |
| Protein content           | 0.74c          | 0.53ab         | 0.44a        |
| Carbohydrate content      | 86,60a         | 86,59a         | 86,76a       |

(by difference)

The mean values within the same column followed by different superscript letters differ significantly (p < 0.05).

3.3. Antioxidant capacity of arenga-canna noodle

Antioxidant capacity of GS 1, GK 1, and controls noodle are presented in Table 4. Noodle with the addition of turmeric extract showed the highest antioxidant content.

Table 4. Antioxidant capacity of arenga-canna noodle

| Sample       | Antioxidant (%) |
|--------------|-----------------|
| Control      | 0.03ab          |
| GS 1         | 0.10ab          |
| GK 1         | 0.58a           |
| Arenga starch| 0.00a           |

The mean values within the same column followed by different superscript letters differ significantly (p < 0.05).

4. Discussion

Statistical analysis (Table 2) showed that all canna-arenga noodle formula with addition suji leaves and turmeric resulting lower strength value than control and commercial product. More suji leaves and turmeric extract added to canna-arenga noodle, will produce weaker canna-arenga noodle, so resulting lower quality of noodle. The quality of noodle increase as the strength value (N) of noodle increase, because the noodle was more difficult to break. Strength of noodle influenced by bonds between molecules in the starch granules. The higher substitution of high amylose starch, more amylose molecules bond in the starch granules that causes the bonds between the starch molecules is getting stronger and not easily broken [4]. Thus, the addition of extract suji leaves and turmeric which does not contain starch in higher concentrations will interfere formation of bonds between amylose in starch granules, so arenga-canna noodle will be more easily broken.

Canna-arenga noodle with addition suji leaves and turmeric extract resulting different tensile strength compare to control products. Higher concentration of suji leaves and turmeric extract resulting lower tensile strength. Suji leaves and turmeric extract would add non-starch substances and will disrupt the bond between amylose molecules in crystalline form, so that the compactness of granular structure decreased, therefore lower force required to break the noodle.

However, higher concentration of turmeric and suji leaves extract resulting lower elongation. Elongation of arenga-canna noodle was proportional to the tensile strength. This is due to increased cohesiveness causing noodle elongation increased, so that the noodle will be more difficult to break [8]. Addition higher concentration of suji leaves and turmeric would add higher non-starch substances. Then it will disrupt the bond between amylose molecules in crystalline form, so that the compactness of granular structure will be decreased, therefore lower force required to break the noodle. As a result, the noodle quality decreases due the noodle would be easily broken when cooking.

Arenga-canna noodle with addition suji leaves and turmeric extract which selected based on physical characteristics then determined their chemical characteristics, such as water content, ash content, protein content, fat content, carbohydrate content, amylose content, resistant starch (RS), and dietary fiber (Table 3). Chemical properties are properties that are important in determining the quality of arenga-canna noodle and to provide additional functional value.

Water content affect shelf life of food product. Higher moisture content of a food product affected greater degree of product deterioration during storage. The result showed that water content of noodle with addition natural dye extract from suji leaves and turmeric significantly different from controls. Water content of noodle
affected by the type of material, the components contained, drying temperature, drying time, tools, material thickness and material size. Water content quality requirements for starch noodle based on SNI 01-3723-1995 was 14.5% (w/w). The water content of arenga canna noodle is still lower than SNI requirement, so all arenga canna noodle meets the requirements. The ash content indicates food inorganic substances levels in mineral elements form [9]. The presence of inorganic substances in noodle will affect the darker color of noodle caused by oxidation [10]. The ash content of arenga canna noodle GS1, GK1, and control were 1.03%; 0.88%; and 0.98% respectively. Maximum ash content according to SNI 01-3723-1995 for starch noodle is 0.5% (w/w). High levels of ash can be due to calcium, sodium, phosphorus and other minerals contained in the raw material of arenga-canna noodle. Fat content is not the quality parameters of noodle according to SNI 01-3723-1995. Low fat content of can prevent rancidity caused by oxidation of fatty acids [11].

Protein content is one of important parameter because it is directly related to the nutritional value. The amount of protein content will determine consumers acceptance, because protein is a nutritional compound which is also required by the human body. However, the protein content is not the quality parameters of noodle according to SNI 01-3723-1995. The protein values of noodle with natural pigments were significantly different and tend to be lower when compared with with noodle control. This indicates that protein component in the tubers are a minor components. The protein content increased due to the addition of suji leaves and turmeric extract. Charles et al. [12] stated that the presence of proteins in various kinds of noodle will contribute to the texture properties of noodle.

Amylose content have very strong influence on the product characteristics. High amylose content on a product will simplify product encounter retrogradation. Starch with high amylose content was suitable for making noodle [13]. Extract natural dyes from plants that are used do not contain starch (non-starch). More non-starch ingredients were added, will made lower amylose content in starch noodle. Frei [14] classified amylose content as high amylose content (> 25%), moderate (20.1-25%), low (12.1-20%), very low (5.1 -12%) and glutinous (0-5%). Thus it can be said that the entire noodle products classified as high amylose.

The existence of resistant starch (RS) can be affected by various factors including processing, type of starch (amylose amyllopectin ratio), physical characteristic of material (degree of hydration, particle size) and the presence of other components such as lipid, protein, etc [15]. Results of statistical analysis at significance level of 95% showed significantly different results between arenga canna noodle and control noodle. Arenga starch noodle containing 49.08% RS, while noodle control resulting lower RS content. Noodle control only contains 75% arenga starch so have lower amylose content. Higher RS content affected by high amylose content and due to processing. It is also of the manufacturing processes in the manufacture of vermicelli done steaming, cooling. According Marsono [15], the process of heating or boiling, followed by other processes can improve RS content.

Dietary fiber is defined as a part of the plant that is not digested by human digestive tract enzymes including constituent of plant cell walls (cellulose, hemicellulose, pectin and lignin) and gum [16]. Dietary fiber content in arenga canna noodle at significance level of 95% have significantly different to noodle control. The fiber content is influenced by raw material used in noodle. Noodle from 100% arenga starch had lower dietary fiber because only contain arenga starch, while control noodle had higher dietary fiber because there was canna flour as substitute material. Processing could give an impact dietary fiber content in noodle. According Indriyani [17] longer heat treatment process will lead to more dietary fiber components damage. Thus the longer drying process, the more dietary fiber will be hydrolyzed.

Based on Table 4, noodle with the addition of turmeric extract showed the highest antioxidant content. It is caused by the content of antioxidants in turmeric is curcinum which resistant to heat treatment. Antioxidants contained in suji leaf is chlorophyll, which sensitive to heat. In drying process, noodle quality changes may occur such as degradation of antioxidant activity. Low antioxidant content of noodle with addition of suji leaf due to changes in chlorophyll into derivatives, such as feofitin and other chlorophyll derivatives that have antioxidant activity which is lower than the native chlorophyll [18]. The higher temperature, the higher rate of reaction, so antioxidant decreased faster. Antioxidants are compounds that can delay or prevent oxidation reactions of free radicals. Antioxidants react with free radicals that can inhibit free radicals to cause damage. In food stuffs, antioxidant found in many vegetables and tubers.

5. Conclusion
Addition suji leaves extract and turmeric extract 0.4 g suji leaf/ml water and 0.06 g turmeric/ml water respectively, produce the best arenga-canna noodle quality. Addition natural coloring agents increased antioxidant activity

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