Pumpkin flour effects on antioxidant activity, texture, and sensory attributes of flat tubers noodle

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Abstract. Canna and arrowroot are local tubers which have high amount of amylose content and suitable for noodle. Flat noodles are one type of noodles that are characterized with a thin flat shape and is generally made from starch. Pumpkin flour is one of the processed products of pumpkin fruit, which can be used in manufacturing of formulated foods as functional ingredient. The aim of this research was to study the effect of pumpkin flour on texture, antioxidant activity, and sensory attributes of flat tubers noodle. In this study, flat noodle was made from canna or arrowroot starch, which is added with pumpkin flour. We added the pumpkin flour (0%, 5%, 10%, and 15% w/w, canna or arrowroot starch basis) in the flat noodle formulation. Result showed that the addition of pumpkin flour increased antioxidant activity of flat tubers noodle. The stickiness of flat tubers noodle increased with the increasing of pumpkin flour level. Flat noodle made form arrowroot starch was stickier than flat canna noodle. Sensory analysis was carried out on flat canna noodle with hedonic scoring method to identify which product is the most preferred by the panelist. Generally the aroma and taste of flat canna noodle did not vary with increasing of pumpkin flours level. Flat noodle made from canna starch with 10% of pumpkin flour obtained the highest score for color, texture (stickiness), and overall acceptability assessed. Antioxidant activity and stickiness measurement of flat canna noodle with 10% of pumpkin flour were 39.80% and 3350 gf respectively.

1. Introduction
Noodles are one the most popular Indonesian foods owing to its taste and ease of preparation [1]. According to data of World Instant Noodles Association (WINA), instant noodle consumption in Indonesia reached 12.52 million servings in 2019 [2]. In wheat noodle making the presence of gluten protein produce an elastic and compact structure of noodle so it can avoid noodle stickiness and cooking losses. The absence of gluten in non-wheat noodle compositions affects noodle quality. Therefore, in non-wheat noodles, the gluten protein network has to be replaced by using a gelling agent the gelling properties of starch [3]. Flat noodles are one type of noodles that are characterized with a thin flat shape and is generally made from starch [4].

Canna (Canna edulis Kerr) and arrowroot (Maranta arundinacea) are local tubers which can be used as sources of carbohydrate content and have nutritional value similar to that of wheat. Canna and arrowroot starch contained amounts of amylose (35% and 21.9%, respectively) [5]. According to Chansri et al. [6], high amylose starch is an ideal starch as raw material for noodles. Flour and starch from tubers can be used to substitute wheat flour in noodle preparation. As stated by previous researchers, canna flour and arrowroot flour can be used as raw materials in the making of noodles [7,8].
The characteristics of noodle, such as texture and sensory attributes, are important factors affecting product quality [9]. The high stickiness of noodles is an undesirable texture parameter for noodle quality. Sensory evaluation has been carried out to evaluate sensory attributes and consumer acceptance of the product [9]. Color is one of the critical parameter that indicated visual appearance and overall acceptability of noodles and can influences purchasing decisions [10]. The color of noodle can be improved by adding some natural ingredients to the noodle. Pumpkin (Cucurbita moschata) is one of the most desirable vegetables and abundantly available in Indonesia [11]. Dabash et al. [12] stated that pumpkin can be processed into flour which has a longer shelf-life and can be used in the manufacture of formulated foods. Pumpkin flour is popular due to its highly-desirable flavour, sweetness and deep yellow-orange color. The yellow-orange characteristic color of pumpkin is due to the presence of carotenoids that can act as antioxidants in the human body [13]. A previous study has shown that the replacement of corn flour with pumpkin flour affected texture and sensory parameters in gluten-free pasta [14]. The purpose of this study was to study the effect of pumpkin flour on texture, antioxidant activity, and sensory attributes of flat tubers noodle.

2. Materials and methods

2.1. Materials
The materials used in this study were canna starch, arrowroot starch and yellow pumpkin flour (purchased from local producer ‘Kusuka Ubi’ in Yogyakarta), salt and water. While the instruments used in this research were digital scales, a mixer, an aluminum tray, a steamer, an infrared dryer, scissors, a texture analyzer, a spectrophotometer, and glassware.

2.2. Flat Noodle Preparation
The flat tubers noodle were prepared by mixing 100 g canna starch/arrowroot starch with pumpkin flour (PF). As a control was used flat noodle made from 100% tubers starch without the addition of pumpkin flour. The treatments which were carried out in this research were the pumpkin flour concentrations (5%; 10%; and 15% pumpkin flour/100 g tubers starch). The additional ingredients were salt (1%) and water (1:1) based on tubers starch. All ingredients mixed and stirred using a mixer to form a slurry. The slurry (80 g) poured into an aluminum tray (25cm x 28cm x 2cm), steamed at 100 ℃ for 3 minutes using a steamer, and then cooled at a room temperature. The flat tubers noodle sheet dried in an infrared dryer at 45-50 ℃ to half-dry. Half-dry flat noodle sheets cut off into small sheets and dried again at 45-50 ℃ for ± 1 hour. Flat noodle packed and stored for analysis.

2.3. Antioxidant Activity
Antioxidant activity of flat tubers noodle were determined by using 2.2’-difenil-1- picrylhydrazyl radical (DPPH) method [15]. Amount of 0.2 g of flat tubers noodle was extracted with 5 mL methanol using vortex for 1 minute and filtered to obtain the extract. Two hundred and eighty microliters of 0.1 mM DPPH solution was pipetted into each well plate followed by 20 µL of sample, or solvent for the blank. The mixture was incubated at 30°C for 1h, and the absorbance at 515 nm was measured with a microplate reader. The inhibition percentage of the radical scavenging activity was calculated using the equation:

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\% DPPH = \frac{1 - \text{sample absorbance}}{\text{blank absorbance}} \times 100\%
\]  

Where A0 is absorbance of the blank and As is absorbance of the sample at 515 nm

2.4. Texture
Flat noodle texture, expressed as stickiness, was measured using a texture analyzer (TAXT-Plus, Stable Micro Systems, Surrey, UK) and determined using a Heavy Duty Platform (HDP/90) probe. Flat noodles were boiled in 150 ml of water until completely cooked. The test was performed by placing sample (cooked flat noodles) under the retaining plate in as flat a position as possible (and centrally
aligned if testing stranded products) at mode: pre-test Speed: 1.0 mm/s, test speed: 0.5 mm/s, post-test speed: 10.0 mm/s, compression force: 1000g, compression time: 2 sec, withdrawal distance: 10.0mm, trigger type: Auto - 20g, tare mode: Auto.

2.5. Sensory Attributes
Three flat tubers noodle with the lowest stickiness were evaluated by 30 untrained panelist. The panelist evaluated the flat tubers noodle based on how much they liked the color, aroma, taste, texture (stickiness) and overall acceptability. Sensory evaluation of cooked flat noodle was carried out using 7-point hedonic scale (1 representing dislike extremely and 7 representing like extremely). Panelist was provided with a cup of water to refresh their palate after testing each sample.

2.6. Statistical analysis
All measurement was carried out in triplicate and results were expressed as mean ± standard deviation. Analysis of variance (ANOVA) was used to determine the significant differences between the samples. Means were compared according to Fisher’s least significant difference (LSD) procedure at a significance level of P < 0.05. All statistical analyses were performed using Microsoft Excel 2007.

3. Results and discussions

3.1. Antioxidant Activity
The antioxidant activity of flat tubers noodle was evaluated using DPPH assay.

![Figure 1. Antioxidant activity of flat tubers noodle.](image)

Figure 1 demonstrates that the scavenging activity of flat tubers noodle with pumpkin flour addition ranged from 32.16 to 50.91% on flat canna noodle and 31.34 to 49.40% on flat arrowroot noodle, respectively. The addition of pumpkin flour increased the antioxidant activity of flat tubers noodle compared to control. This result can be due to the fact that pumpkins are rich in β-carotene, which functions as an antioxidant [16]. Malkanthi et al. [17] reported that antioxidant activity was increased in 5% pumpkin seed powder incorporated biscuits compared to control. Nyam et al. [18] found that bread supplemented with 5% pumpkin had a 37.99% increase in DPPH radical scavenging activity in pumpkin seed bread as compared to control bread. Similar results also reported that fortified cupcakes with 10% pumpkin powder had the highest level of antioxidant activity [19].
3.2. Texture

Stickiness is defined as the maximum peak force to separate the probe from the sample’s surface upon probe retraction (the higher the force value, the stickier is the sample). The texture of flat noodle with respect to the stickiness is shown in Figure 2.

Figure 2 showed that the addition of pumpkin flour determined an increase in the stickiness of flat tubers noodle. The stickiness of flat canna noodle with addition of pumpkin flour ranged from 2920 to 3704 g was lower than the stickiness of flat arrowroot noodle (3701 to 5369 g). The stickiness depends on the quantity and quality of starch and its gelatinization condition [20]. Canna starch has a high amylose content resulting noodle with low stickiness and more compact. Amylose have inter molecular bonding force stronger than the amyllopectin thereby inhibiting leaching In addition, starches with high setback viscosity were retrogradated quickly so that noodles texture becomes more cohesive and non-sticky because in the surface of noodles formed a layer of starch which has been retrogradated [21]. Furthermore, the addition of pumpkin flour increased the water absorption of composite flour (tubers starch and pumpkin flour) which resulted in noodle more sticky. Li et al. [22] stated that a higher water absorption of Djulis flour produces very soft and sticky noodles. Our result was similar to the adhesiveness of pasta which stated that the adhesiveness was increased by increasing pumpkin flour content in the pasta formulation [14][23].

3.3. Sensory Attributes

Three flat tubers noodle with the lowest stickiness i.e flat canna noodle with 5% of pumpkin flour, flat canna noodle with 10% of pumpkin flour and flat canna noodle with 15% of pumpkin flour were evaluated by 30 untrained panelist. Results from the sensory attributes of flat canna noodles are shown in Figure 3. Generally the aroma and taste of flat canna noodles did not vary with increasing of pumpkin flours level. Color indicated visual appearance that is a key quality index in noodles which influences purchasing decisions [10]. Panelists rated the color of flat canna noodles with 10% of pumpkin flour highest (mean score of 5.5) than other flat canna noodles. The observed trend for color may be attributed to the fact that flat canna noodles with 10% of pumpkin flour appeared brighter compared to others. Panelist were more liked towards the texture (stickiness) of flat canna noodle with 10% of pumpkin flour, and this obtained a mean score of 4.5 (“rather like”). Flat noodle made from canna starch with 5% and 10% of pumpkin flour obtained the same mean score for overall acceptability assessed.
4. Conclusions
The addition of pumpkin flour increased antioxidant activity of flat tubers noodle. The stickiness of flat tubers noodle increased with the increasing of pumpkin flour level. Generally the aroma and taste of flat canna noodle did not vary with increasing of pumpkin flours level. Flat noodle made from canna starch with 10% of pumpkin flour obtained the highest score for color, texture (stickiness), and overall acceptability assessed. Antioxidant activity and stickiness measurement of flat canna noodle with 10% of pumpkin flour were 39.80% and 3350 gf respectively.

Conflict of interest
The authors have no conflict of interest to state regarding this manuscript.

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