The hardness analysis of noodles made from modified cassava flour, spirulina (Spirulina platensis) and basil leaves extract (Ocimum sanctum L.)

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Abstract. The alternative solution for high import costs of wheat flour is by substituting wheat flour with mocaf (modified cassava flour). Mocaf is a modification of cassava flour made by fermentation treatment using lactic acid bacteria, acetic acid or enzymes. However, mocaf has a low gluten and protein content so it might produce noodle products with a poor texture. Therefore, it is necessary to add other ingredients in order to increase protein content and change the appearance, one of which is fortification with spirulina. Spirulina has a natural aroma like the smell of fresh seaweed with a slightly fishy aroma that comes from the high protein content. Hence, it is necessary to add basil leaf extract which can give a distinctive smell of basil to overcome the fishy aroma of the noodles. This research was conducted to determine the texture of modified noodles from mocaf with the addition of spirulina and basil leaf extract using a texture analyzer. Based on the research conducted, it was found that the addition of basil and spirulina leaf extracts could affect the texture of mocaf noodles to become more chewy, dense and not easily broken.

1. Introduction
Indonesia is a country that has high level of noodles consumption; ranging from adults to children. Noodles are food that has practical properties, is filling and can be processed quickly so that many people consume noodles as staple food. Noodles in the market can be divided into wet noodles, dry noodles and instant noodles. Wet noodles are type of noodle made from wheat flour, with or without the addition of other food ingredients, wet noodles are long, small and wet. Wet noodles contain of 80 grams (%) of water content, 14 grams of carbohydrates (%), 3.3 grams of fat (%), 0.6 mg of protein (%) and 86 calories in 100 grams of wet noodles [1]. Wet noodles are easily damaged because microbes grow in high water content (more than 30%) and it caused the shelf life is short [2].
The raw material for making wet noodles is wheat flour. Wheat flour cannot be planted in Indonesia, so it is imported from another country. To reduce the high import costs, it is expected that there will be an alternative raw material that can reduce the use of wheat flour. One substitute for wheat flour is mocaf (modified cassava flour). Mocaf is a modification of cassava flour by fermentation treatment using lactic acid bacteria, acetic acid or enzymes that produce flour that has a soft, white texture and does not smell typical of cassava [3]. However, mocaf has weaknesses which are the absence of gluten and low protein content. Meanwhile, in making noodles, flour with high protein content is needed because protein content will have a positive effect on the texture, especially the elasticity of the noodles [4]. The mocaf substituted wet noodles produced will have low protein content and are below the SNI standards so it is necessary to add a protein source in the form of spirulina.

Spirulina is a type of microalgae that contains protein in quite high amounts. The protein content in spirulina is 63% on dry weight [5]. Spirulina as an alternative natural ingredient has high protein content, it was expected to be able to increase the nutritional value of mocaf substituted wet noodles such as protein, vitamins and fiber. Spirulina has a fishy aroma so basil leaf extract is added to reduce the fishy smell. This study aims to determine the effect of the addition of spirulina and basil leaf extract on the texture of the resulting noodles such as the hardness.

2. Material and methods

2.1 Material

The materials used in this study included wheat flour, mocaf (MOCAF Sukses, Solo), cornstarch, egg yolk flour (SKM Eggs, India), Soy Protein Isolate or SPI (Gushen, China), butter, basil extract (Semarang), spirulina, salt, egg yolk, and water. The tools used are a mixer (Kirin, Indonesia), a noodle maker (Ardin, Indonesia), a pan, measuring cup, texture analyzer (Brookfield CT 3, US), refrigerator (Modena, Italy).

2.2 Method

This research consisted of several stages. The steps were making wet noodles with fortification of spirulina and basil leaf extract; and also analyzing the hardness of the wet noodle texture.

2.2.1 Preparation of noodles. Preparation of noodle was adopted from previous research with modification. The treatment given to wheat flour: Mocaf was 35%: 15%. The treatments given to the noodles are as follows:

Ko: noodles without the addition of mocaf, spirulina, and basil leaf extract
Km: Mocaf noodles without addition of spirulina and basil leaf extract
Ks: Mocaf noodles with addition of 2% spirulina and 5% basil leaf extract

2.2.2 Analysis of texture profile (hardness). Texture profile analysis refers to the previous research method by Fan F [6] using the Texture Analyzer. This test was performed by setting the cylinder probe with trigger of 4.5 g, deformation of 3 mm and speed of 1 mm/s. The noodle samples were placed on the plaque of the texture analyzer. And then the probe squeezed the noodles and showed the hardness value on the display. After the hardness value was appeared on the display, then it was noted.

3. Results and discussion

The results of the texture analysis of the noodles made from modified cassava flour are presented in a graph as shown in Figure 2.
Texture is one of the quality requirements that showed the characteristics of wet noodle products, with this parameter it can determine the level of chewiness, hard, soft, tender, sticky and smooth in wet noodles [7]. The texture of the noodles is influenced by several factors such as the raw materials used and the temperature during the production process [8]. Based on Figure 2, it can be seen that wet noodles with the addition of basil leaf extract and spirulina treatment have the lowest hardness value when compared to control noodles and mocaf noodles without the addition of basil and spirulina leaf extracts. This shows that the addition of basil leaf extract and spirulina can have an effect on changes in the texture of wet noodles. The addition of basil leaf extract to wet noodles can have an effect on the texture of wet noodles due to the presence of chemical compounds in the form of ascorbic acid, methyl chavicol (estragole), linalool, citral, methyl cinnamate and eugenol which cause the texture of the noodles to be softer and mushy and can decrease the fishy smell. [9]. The protein content of microalgae spirulina platensis flour is quite high which can affect the quality of food texture and plays...
an important role in the analysis of the physical properties of food during the processing process. The texture of the wet noodles with addition of spirulina is chewier and more compact because the water contained in the noodles is attracted by the spirulina so that the texture of the noodles becomes chewier. However, the addition of too much spirulina causes the texture of the noodles to become harder and brittle [10]. The mechanism of texture formation is through the heating process and the length of time it takes during processing, in which the boiling process occurs during the starch gelatinization process and protein coagulation so that the noodles become chewy [11].

![Figure 2](image-url)  
*Figure 2. The Hardness value of Mocaf noodles in all treatments.*

4. Conclusion

Based on these results it can be concluded that the addition of spirulina and basil leaf extract can affect the texture of the mocaf noodles to become more chewy, solid, and not easily broken. This result is related to the quality of the noodles and consumer acceptance.

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