Breadfruit (*Astrocarpus altilis*) Noodle as a Local Food for Improving Food Diversification in Indonesia

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Abstract

Indonesia ranks number one in the world for the level of rice consumption reaching 124 kg per capita per year. In fact, the amount of rice in Indonesia is decreasing because of environmental factors. Meanwhile, the population growth rate in Indonesia is increasing with an average growth rate of 1.43% per year which leads to the increasing demands of rice. Food diversification could be a solution to tackle this problem. It can be done by processing breadfruit into flour and make it as noodle. Breadfruit flour contains high nutrient that makes it potential to be an alternative for the substituent of staple food. It contains 302 calories of energy and 78.9 g of carbohydrate. The main processes are immersion, drying, milling and straining. As a result, breadfruit noodle could be an alternative staple food in Indonesia so that Indonesia will not only depend on rice as its staple food.

Keywords: food security, food diversification, level of consumption, breadfruit, breadfruit noodle

1. Introduction

Based on WHO (World Health Organization) in 2018, 821 million people are starving in this world. The number of hunger in Asia in 2017 has reached 515 million people (WHO, 2018). Indonesia as a country that has abundant food resources also experience similar problems. Rice, which is Indonesia’s staple food, has become an important resources for the community’s daily life. However, the level of rice production continues to decline in addition to the level of public consumption which continues to increase along with the increase in population. Based on BAPPENAS or National Development Planning Agency, the number of population in Indonesia is predicted to be increased from 238.5 million people in 2010 to 305.6 million people in 2035 (BAPPENAS, 2013). This affects the rate of consumption of rice in society. Currently, the demand for rice in Indonesia is estimated to reach about 30 million tons per year, using the rate of consumption of 124 kilograms per capita (Arifin, Aechsani, Martianto, Sari, & Firdaus, 2018).

This condition is inversely proportional to the area of agricultural land, especially rice, which continues to decline. East Java as the largest agricultural area in Indonesia has experienced decreasing of its agricultural area each year, from 1,107,276 ha in 2010 to 1,091,752 ha in 2015. DKI Jakarta as the capital city has experienced a very significant decline in agricultural area, which is 1,312 ha in 2010 became 650 ha in 2015 (BPS, 2016). Decreasing area of agricultural land can affect the quality and quantity of food products, especially rice.

Decreasing level of rice production is also influenced by environmental and climate factors. Rice plants need 600-1200 mm of water for 90-120 days from planting to harvest. Lack of water in the rice production process can have an impact on plant growth. The availability of water for the rice production process is supported by high and low rainfall and irrigation network facilities. Climate factors such as increased temperature and CO₂ can cause a decrease in plant productivity. The extreme climate events in Indonesia, such as the floods and prolonged drought, have an impact on crop damage, so that crop yields can decrease (Estiningtyas, Woro & Muhamad Syakir, 2017).

To overcome the problems above, food diversification can be a solution to tackle this problem. Access to a stable and sustainable food supply is a prerequisite for the establishment of food security at the household level. Food diversification provides alternative food products that have more production quantities with sufficient amounts of essential micronutrients and are easily accessible (FAO, n.d).

Breadfruit is a type of plant that has economic value and has a high nutrient content. This plant has the potential to be developed as a local food-producing commodity for the community. Breadfruit can be processed into a number of food menus, so that it can support the food diversification and food security program. Distribution of breadfruit plants in Indonesia includes Sumatra (Aceh, North Sumatra, West
Indonesia ranked second in the world with the highest level of noodle consumption (WINA, 2019). Based on this fact, breadfruit which is processed into noodles can be a solution to support food diversification and food security in Indonesia.

2. Material and Methods

Preparation of The Breadfruit Noodle Product

Material and method used in this study are based on some literatures. The main raw material used in this study was breadfruit flour. The compositions of breadfruit flour in noodle were substituted with 20% and 30%. (Akanbi, Nazamid, Adebowale, & Farooq, 2011) The additional ingredient was tapioca starch, salt, eggs, cooking oil, and water. The breadfruit made into flour which goes through fermentation process for acid removal and color bleaching (Abidin, Devi, & Adeline, 2013).

The method process of making breadfruit noodle from literature consists of mixing, resting, sheeting, and cutting. The mixing process takes around 15-20 minutes is needed to homogenize all ingredient. The resting process takes around 30-60 minute purposed for water dispersion and gluten forming in the dough. Resting the dough for a long time will result in softer noodle dough then can be stretched. Sheetig process is done with mechanical tool. In this process, soft and extensible gluten fiber is being formed. The suitable temperature in this process is 25°C or higher to avoid the dough becoming rough (Abidin, Devi, & Adeline, 2013).

Nutritional Analysis of The Breadfruit Noodle

Breadfruit noodle nutritional analysis is done descriptively by collecting breadfruit noodle nutritional data from various literature and comparing the nutritional data with the standard quality of noodle based on SNI 01-29974-1996. The nutrient content includes ash content, and moisture content, protein, fat, carbohydrate and resistant starch. Moreover analysis of nutrient of raw material is needed to analyze the quality of breadfruit noodle by comparing nutritional data between breadfruit flour and several local foods.

Evaluation of Acceptability The Breadfruit Noodle

Determination of breadfruit noodle’s community acceptance level is done through sensory tests including color, aroma, taste, and texture, as well as overall preferences. Sensory test was based on data obtained from the appropriate research literature. Sensory test data was compared between noodle which substituted by 20% and 30% breadfruit flour.

3. Results and Discussion

Results

The determination of breadfruit noodle’s quality is done by quality analysis of raw material which is breadfruit flour by comparing its nutrient content per 100gr with several local food in Indonesia. The comparison is shown in Table 1.

<table>
<thead>
<tr>
<th>Foods</th>
<th>Energy (cal)</th>
<th>Carbohydrate (gr)</th>
<th>Protein (gr)</th>
<th>Fat (gr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breadfruit flour</td>
<td>302</td>
<td>78,9</td>
<td>3,6</td>
<td>0,8</td>
</tr>
<tr>
<td>Breadfruit</td>
<td>108</td>
<td>28,2</td>
<td>1,3</td>
<td>0,3</td>
</tr>
</tbody>
</table>
Analysis nutrient content of breadfruit noodle is done with two type of dough. The first dough consists of 20% breadfruit flour and 80% of wheat flour. Meanwhile, the second dough consist of 30% breadfruit flour and 70% of wheat flour. The analysis includes moisture content, ash content, protein, fat, carbohydrate and resistant starch. Nutrient content is shown in Table 2.

Table 2. Nutrient content of breadfruit noodle

<table>
<thead>
<tr>
<th>Formula</th>
<th>Moisture Content (%)</th>
<th>Ash Content (%)</th>
<th>Protein (%)</th>
<th>Fat (%)</th>
<th>Carbohydrate (%)</th>
<th>Resistant Starch (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% : 80%</td>
<td>10,538</td>
<td>2,862</td>
<td>11,658</td>
<td>0,201</td>
<td>74,56</td>
<td>1,877</td>
</tr>
<tr>
<td>70% : 30%</td>
<td>11,229</td>
<td>3,155</td>
<td>10,433</td>
<td>0,177</td>
<td>75,005</td>
<td>2,318</td>
</tr>
</tbody>
</table>

Source : (Nurcahyo, E et.al, 2014)
Information :
20% : 80% = 20% Breadfruit Flour and 80% Wheat Flour
30% : 70% = 30% Breadfruit Flour and 70% Wheat Flour

Standard quality of dry noodle in Indonesia that is used is based on SNI 01-2974-1996. This standard is used for comparing the nutrient content of breadfruit noodle to determine the quality of breadfruit noodle. SNI 01-2974-1996 is shown in Table 3.

Table 3. Standard quality of dry noodle in Indonesia based on SNI

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Unit</th>
<th>Standard Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organoleptic :</td>
<td>-</td>
<td>Normal</td>
</tr>
<tr>
<td>- Aroma</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>- Colour</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>- Taste</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Moisture content</td>
<td>% w/w</td>
<td>8 – 10</td>
</tr>
<tr>
<td>Ash content</td>
<td>% w/w</td>
<td>Max 3</td>
</tr>
<tr>
<td>Protein</td>
<td>% w/w</td>
<td>Min 8</td>
</tr>
<tr>
<td>Food additives :</td>
<td></td>
<td>Must not be contained</td>
</tr>
<tr>
<td>- Borax and Boric acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Food colouring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Formalin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Metal contamination:
- Lead: Max 1.0
- Copper: Max 1.0
- Zinc: Max 40.0
- Mercury: Max 0.05

Arsenic contamination: Max 0.5

Microbe contamination:
- Total Plate Count (TPC): Colony/gr, Max $10 \times 10^4$
- E. coli: MPN/gr, Max 10
- Mold: Colony/gr, Max $10 \times 10^6$

Source: SNI 01-2974-1996

Acceptability sensory test is obtained from literature through testing from Indonesian community. It is done with two type of dough. The first dough consists of 20% breadfruit flour and 80% of wheat flour. Meanwhile, the second dough consist of 30% breadfruit flour and 70% of wheat flour. The result of sensory tests is shown in Table 4 and 5.

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Sensory Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Color</td>
</tr>
<tr>
<td>20% : 80%</td>
<td>3.64</td>
</tr>
<tr>
<td>30% : 70%</td>
<td>2.92</td>
</tr>
</tbody>
</table>

Source: (Nurcahyo, E et.al, 2014)
Information: 20% : 80% = 20% Breadfruit Flour and 80% Wheat Flour
30% : 70% = 30% Breadfruit Flour and 70% Wheat Flour

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<tr>
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<td>Color</td>
</tr>
<tr>
<td>20% : 80%</td>
<td>3.63</td>
</tr>
<tr>
<td>30% : 70%</td>
<td>3.47</td>
</tr>
</tbody>
</table>

Source: (Biyumna, U.L et.al, 2017)
Information: 20% : 80% = 20% Breadfruit Flour and 80% Wheat Flour
30% : 70% = 30% Breadfruit Flour and 70% Wheat Flour
4. Discussion

Breadfruit (Astocarpus astilis) originates from the Pacific, Polynesia, and Southeast Asia, including Indonesia (Supriati, 2010). Breadfruit plants have many advantages compared to other food crops. In famine season, breadfruit plants can continue to grow where this condition can greatly help people when they lack food resources. Breadfruit plants are not seasonal plants so they can be harvested repeatedly. In addition, in the process of growth, breadfruit is not affected by rainfall. Breadfruit plants can also be up to decades and can grow continuously if treated properly. Breadfruit plants can grow well in all kinds of soil can also be grown in the lowlands, medium to reach ± 600 m /asl. Breadfruit can begin to bear fruit at the age of 5 years to 50 years. It can produce 400 pieces per tree. In terms of availability, breadfruit production in Indonesia continues to increase from year to year, in 2000 production was 35,435 tons, increased to 62,432 tons in 2003 and increased again to 66,994 tons in 2004, in 2005 to 73,637 tons and increased to 92,014 tons in 2007 with a harvest area of 13,359 ha. Even breadfruit cultivation techniques are quite easy and simple. These conditions are very beneficial for breadfruit farmers so it is very possible for farmers to produce large amounts of breadfruits a staple food source (Kusuma, Budiman and Hidayat, 2017).

Breadfruit can be a solution for food diversification in Indonesia because of two reasons. First, because the large amount of breadfruit in Indonesia. The potential number of breadfruit flour production.

\[
\text{Amount of Breadfruit Flour} = \text{Np} \times \text{Na} \times P
\]

Information:
- Np : Number of Breadfruit Production per tree per year (piece)
- Na : The average weight of fruit (gram)
- P : The literature value of percentage of fruit to flour (%)

Data on the number of breadfruit production in Indonesia, the average weight of the breadfruit, and the percentage of flour from each fruit were obtained from previous studies. According to Supriati (2010) the average weight of one breadfruit is 600 gram and percentage of fruit yield to flour is 30% of the fruit weight. Meanwhile, according to Kusuma, Budiman and Hidayat (2017) the number of breadfruit production in Indonesia per tree is 400 piece per year.

\[
\text{Amount of Breadfruit Flour} = 400 \text{pieces} \times 600 \text{grams} \times 30\% \\
= 72,000 \text{gram} \text{or} 72 \text{Kg} \text{flour per tree per year}
\]

Based on that, as much as 72 kg of breadfruit flour can be produced per breadfruit tree per year.

Second, because the carbohydrate content of 100 grams of breadfruit is equal to 1/3 of rice carbohydrate (Table 2). If the breadfruit is processed into breadfruit flour then the carbohydrate content is equivalent to rice, only the amount of calories is slightly lower compared to other local food such as corn, cassava, and potatoes. The position of breadfruit as a source of carbohydrates is still above the third commodity (Supriati, 2010).

Based on these two reasons, breadfruit flour can be an alternative solution in food diversification in Indonesia. However, there needs processing to increase the added and economic value of breadfruit flour. Processing breadfruit flour into noodles can be a value added food and an alternative food diversification due to high consumption of noodles in Indonesia, accordance with the taste of public consumption where Indonesia is ranked second in the world with the highest level of noodle consumption (WINA, 2019). This can increase the alternative of local food other than rice which is easily available in Indonesia which also affects the increase in food diversification in Indonesia.

An analysis of breadfruit noodle needs to be done as an alternative food for food diversification. It is based on quality analysis and analysis of community acceptance of the product. It also must be compared with the quality standards of noodles to ensure the quality. Based on a research by Nurcahyo, E., Amanto, B., & Nurhartadi, E. in 2014, the nutrient content of breadfruit noodle that was tested are ash content, moisture content, protein, fat, carbohydrate and resistant starch. A comparison on ingredients of breadfruit noodle dough within breadfruit flour and wheat flour was made. The first ingredients of breadfruit noodle dough had 20% breadfruit flour and 80% wheat flour. The second ingredients of breadfruit noodle dough had 30% breadfruit flour and 70% wheat flour.

The breadfruit noodle consist of 20% breadfruit flour and 80% wheat flour has 10.538% of moisture content; 2.862% of ash content, 11.658% of protein; 0.201% of fat, 74.56% of carbohydrate and 1.877%
of resistant starch. The breadfruit noodle consist 30% breadfruit flour and 70% wheat flour has 11.229% of moisture content; 3.155% of ash content, 10.433% of protein; 0.177% of fat, 75.005% of carbohydrate and 2.318% of resistant starch. According to SNI 01-2974-1996, the standard quality for moisture content in dry noodle 8-10%, ash content with a maximum 3% and protein with a minimum 8%. Compared to SNI 01-2974-1996 about standard quality of dry noodle, the breadfruit noodle consist of 20% breadfruit flour and 80% wheat flour is the one that is most in accordance with the standards.

Based on research acceptability of Indonesian with breadfruit noodle can be represented by sensory test. The test consists of the attributes of color, aroma, taste, texture, and overall sensory test assessment. Based on a research by Nurcahyo, E., Amanto, B., & Nurhartadi, E. in 2014, represent that the score of sensory test had range 2.92 – 3.64. For ingredients which consist of 20% breadfruit flour and 80% wheat flour, the color test is 3.64; the aroma test is 3.44; the taste test is 3.32; the texture test is 3.6; and overall the score is 3.44. Whereas for ingredients which consist of 30% breadfruit flour and 70% wheat flour, the color test is 2.92; the aroma test is 3.12; the taste test is 2.72; the texture test is 2.88; and overall test score is 2.92. Indonesian preference for the acceptance on breadfruit noodle is the one with the ingredient of 20% breadfruit flour and 80% wheat flour.

A research by Biyumna, UL., Wiwi, S.W., Nurud, D in 2017, represent the score of sensory test had range 3.47 – 4.13. For ingredients which consist 20% breadfruit flour and 80% wheat flour, the color test is 3.63; the aroma test is 4.13; the taste test is 4; the texture test is 3.9; and overall the score is 4.1. Whereas for ingredients which consist 30% breadfruit flour and 70% wheat flour, the color test is 3.47 the aroma test is 3.97; the taste test is 3.57; the texture test is 3.5; and overall test score is 3.6. Indonesian preference for the acceptability on breadfruit noodle is the one with the ingredient 20% breadfruit flour and 80% wheat flour.

For the acceptability test, Indonesian prefer breadfruit noodle with lower breadfruit flour substitution concentration. It is because the increasing of breadfruit flour substitution produced dry noodle with darker color. For aroma test, Indonesian prefer breadfruit noodle with lower breadfruit flour substitution. The increasing of breadfruit flour substitution caused the typical aroma of breadfruit on dry noodle is more pronounced. The taste test shows that Indonesian prefer dry breadfruit noodle with lower breadfruit flour concentration. This is because the breadfruit flour in the noodle has a distinctive taste and flavor that is rarely felt by many panelists. For texture test, Indonesian prefer dry breadfruit noodle with lower concentration of breadfruit flour substitution because they found it more elastic. The texture of the noodles decreases with increasing breadfruit flour composition. This is because breadfruit flour does not have gluten content. Gluten is very influential in the formation of the structure of noodles. With the lower gluten content in the dough, the ability of the dough to have elastic properties and a continuous structure will be lower, so that the resulting noodles break easily and reduce Indonesian’s assessment on the texture of the noodles.

5. Conclusion

In conclusion, the number of population that continues to increase each in Indonesia has affects the increasing number of demands for rice resulting in vulnerability to national food security. Food diversification can be a solution to tackle this problem by processing breadfruit into flour. The reasons are because of the large amount and its nutrient content which is equivalent to rice and has the highest nutrient content among other local foods. Breadfruit noodle favored by consumers is the one with the ratio 80% wheat flour : 20% breadfruit flour which has acceptance rate of 3.44 (likes). It is in accordance with SNI 01-2974-1996.

Acknowledgments

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Reference

SNI 01-2974-1996 : Mie Kering, National Standardization Agency of Indonesia, 1996.