

# Some Physical Characteristics and Protein Content of Soybean for Instant Soymilk

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## ABSTRACT

The increment of soybean consumption demands product diversification. One example of soybean-based product is extracted soybean in the form of soymilk, which has the following weaknesses: short shelf life, unpleasant aroma, and impractical processing. Therefore, it is necessary to investigate the processing of instant soymilk compared with its brewed solutions using hot and cold water. This experiment will use a completely randomized block design with two factors: the soybean variety ( i.e., Kaba, Burangrang, Anjasmoro, and Argomulyo) and the time to oven of 20 and 30 minutes. The soybean's physical characteristics that will be observed include width, length, thickness, volume, and weight per 100 beans, whereas the powder characteristics shall include yield, moisture, protein content, and degree of lightness. In addition, the characteristics of brewed solutions will be measured using an organoleptical test. The results show that the Argomulyo variety has the biggest size among others, and the Anjasmoro variety contains the highest protein content (38.05%), whereas the Kaba variety has the lowest starch content (4.15%). The best instant soybean powder was the Anjasmoro variety with a time to oven of 20 minutes and the highest protein content (7.88%), where the value of lightness  $L = 83.4$ ;  $a = 3.40$ , and  $b = 17.95$ . Moreover, the organoleptical test result for powder color scored 4.16, and the unfavorable aroma was 3.37, whereas the solutions' color was 3.74; favorable aroma was 2.16; taste was 2.11; while the overall preference was 2.26.

Keywords: physical characteristic, protein content, soybean, instant powder, soymilk

## INTRODUCTION

Soybean is one of the protein sources for most Indonesian people. To fulfill the need of the soybean material-based industry, craftsmen tend to choose imported soybean where supply is guaranteed to be of better bean size and quality, clean, and of expanded ability. This condition encourages the development of local "superior variety" with various characteristics. These varieties include Argomulyo, Burangrang, Anjasmoro, Burangrang, Anjasmoro, Bromo, Panderman, and Grobogan, which are yellowish in color and of a similar size not bigger than imported soybean. These superior

varieties were reported to have higher protein content compared to imported soybean (Ginting, Antarlina, & Widowati, 2009).

Soybean consumption in the form of extracted soybean drinks (i.e., soybean milk or soymilk) is very high, as an impact of the increment in awareness of people toward the importance of nutrients. Soybean is posed as functional food because it contains a flavanoid group compound that produces isoflavone, which is a natural antioxidant (Astuti, 2008; Langkong & Laga, 2009). The mechanism of isoflavone in preventing damage caused by free radical is by donating hydrogen ion and acting as a direct free radical (Astuti, 2008).

Soybean milk, in addition to its high nutrient content, when compared with cattle milk, is affordable price and low in fat, and it does not cause allergic reaction, which makes it suitable for those with lactose intolerance. However, when soybean milk is damaged or stale easily, it may cause to not be able to be preserved in longer time and reaching a wider scope of market. Research found that processing soybean cultivar with different methods can significantly affect the soymilk flavor (Yu et al., 2018). Therefore, this study will test an alternative method in processing instant soybean milk from several soybean varieties, in which the soymilk produced can be easily enjoyable, practical in terms of process, and preserved for longer periods.

Instant food is an artificial form of food that is easy to dissolve and consume with hot or cold water, generally served in powder or granule form. Instant food processing in the form of powder can be made by several methods, including (i) crystallization (Anshar, 2012), (ii) spray drying (Ayadi et al., 2008; Pramitasari et al., 2010), (iii) freeze drying (Wang et al., 2010), (iv) co-crystallization (Junaidi et al., 2013) magnesium carbonate (MC, and (v) foam mat drying (Iswari, 2007; Retnaningsih & Tari, 2014). The purpose of this research is understanding the characteristics of several local Indonesian soybean varieties (Argomulyo, Anjasmoro, Kaba, and Burangrang) in terms of their suitability as a material for instant soymilk.

## MATERIAL AND METHODS

### Materials

The soybean varieties used as material were taken from Balitkabi (2016), such as Kaba, Burangrang, Anjasmoro, and Argomulyo, and another material was sugar. The tools that were used in processing instant soybean milk include the following: a roasting oven, a masher, a blender, 60-mesh sieve, filter cloth, pan, basin, and a stove. Other tools that were used for analysis are as follows: oven dryer, color reader Konica Minolta CR-10, caliper, a digital scale, and a measuring cup.

### Methods

The process flow of soybean characterization is presented in Figure 1.

Instant soybean in powder form was made by cooking the raw soybeans using a toaster oven, followed by a rough mash to separate and peel the skin, and then grinding and sieving with 60-mesh screen. The produced powder was extracted by adding hot water, with a soybean to water ratio of 1:5, which was then filtered using filter cloth. Sugar was added to the filtrate, followed by heating to evaporate the water, which allowed the remains to turn solid by process of crystallization. To obtain fine instant powder, the solid residue was blended and sieved once more using the 60-mesh screen. This method was modified from studies by Ismayasari and Wahyuningsih (2014), IP2TP Yogyakarta (2000), and Langkong and Laga (2009) in which raw soybean shorting was conducted, followed by roasting for 20–30 minutes at a temperature of 150 °C and finally pounding using a grinder before peeling and sieving, similar to that in the current experiment. Raw soybean cooking through roasting was modified by using a roasting oven to make sure that it is evenly well cooked without easily scorching.

In this experiment, a completely randomized design was used with two factors: (1) soybean variety and (2) time to oven. The soybean varieties were Burangrang, Kaba, Anjasmoro, and Argomulyo. Raw soybeans were roasted in the oven for 20 and 30 minutes. First, raw soybeans (as raw material) were observed for the following: physical and chemical characteristics (width, length, thickness, volume, and weight per 100 beans); moisture content using the oven method; protein content using the kjeldahl method; and starch content using acid hydrolysis. Second, soybeans that had been in the oven and grinded were observed for the following: rendement; moisture content using the oven method; protein content using the kjeldahl method; and degree of lightness and organoleptic test. The degree of lightness was presented as  $L$ ,  $a$ ,  $b$ , where  $L$  represents the level of lightness, between 0 to 100;  $a$  represents

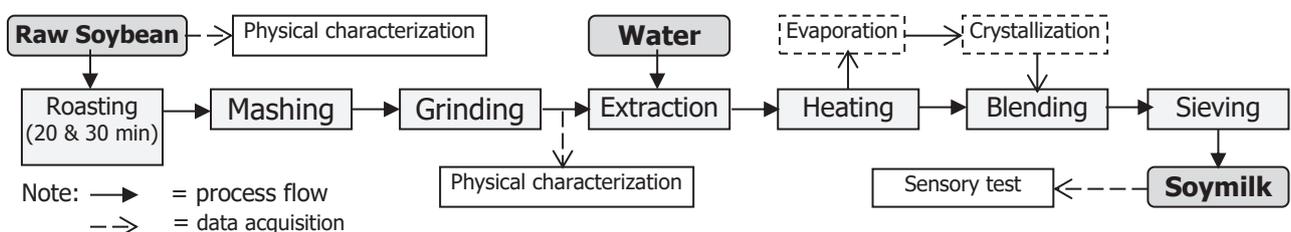


Figure 1. Process flow of soybean characterization for soymilk

the intensity of red color (+) and green (-); and *b* represents the intensity of yellow color (+) and blue (-). Finally, the beverage solutions that resulted from the extracted instant soybean powder were observed for sensory parameters of organoleptic characteristics. Observations were conducted by 25 semi-trained panelists. The organoleptic characteristic scoring was descriptive and hedonic for the sensory parameters. The descriptive organoleptic test of instant soybean powder includes the observation of color and unfavorable aroma using a 5-point scale, with 1 indicating very dark or very strong unfavorable aroma and 5 indicating bright color, strong favorable aroma, and strong soybean taste. The preference test for the instant soybean drinks used a score from 1 to 5 to represent strong dislike and high preference. Data were analyzed by the analysis of variance followed by the Duncan multiple range test at 5% level.

## RESULTS AND DISCUSSION

### Raw Soybean Characteristic

The physical characteristics of soybean were represented by length, width, thickness, weight, volume, and ratio of length to width, and ratio of width to thickness. Table 1 shows that the raw soybeans of Argomulyo and Anjasmoro variety in Figure 2 were relatively bigger than those of Kaba and Burangrang variety. According to Krisnawati and Adie (2015), soybean seed size in Indonesia is divided into three categories: small, medium, and large. The raw soybean size is characterized as small when the weight is less

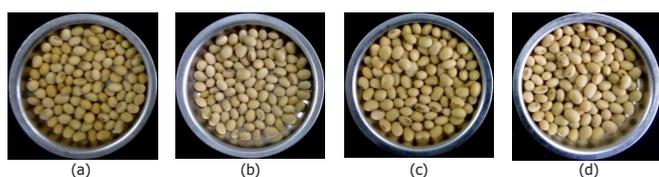


Figure 2. The physical appearance of (a) Kaba, (b) Burangrang, (c) Argomulyo, and (d) Anjasmoro

Table 1. Size properties of soybean varieties

Soybean variety	A	B	C	D	E	F	G
Kaba	10.5	10.55	51.6	69.6	40.6	0.67	1.18
Burangrang	10.0	11.35	60.6	68.8	46.6	0.71	1.13
Argomulyo	12.0	13.72	61.0	73.6	49.8	0.80	1.20
Anjasmoro	12.0	13.00	59.4	75.4	44.6	0.78	1.24

Remarks: A = volume/100 beans (ml); B = weight/100 beans (g); C = width (mm); D = length (mm); E = thickness (mm); F = thickness/width; G = length/width

than 10 g per 100 seeds, medium when the weight ranges 10–14 g per 100 seeds, and large when the weight is greater than 14 g per 100 seeds.

The bean shape can be described by the length/width ratio, where a value above 1 shows that the bean has an oval shape. When the length/width and thickness/width ratios are both equal to 1, the soybean has a sphere shape. A smaller thickness/width ratio (<1) suggests that the bean shape is flatter. Table 1 shows length/width ratios greater than 1 and thickness/width ratios less than 1, meaning that the soybean of all varieties under testing were found to be oval, flat, or near-sphere. According to Yuwono *et al.* (1996), by using the length/width ratio, soybean can be characterized as near-sphere or oval. The characteristic of raw soybean affects the preference of soybean utilization in the food industry. The tofu industry demands soybeans that have a medium to big size, yellowish color, and a thin skin, whereas the soybean milk industry demands soybeans that are small to big in size, which are expected to be freshly harvested.

In this research, the other physical and chemical characteristics of raw soybean include moisture, protein, and starch content. Table 2 shows that the moisture content of all soybean varieties was not significantly different ( $p > 0.05$ ), ranging from 9.72% to 10.05%. The value of moisture content complied with the SNI 01-3922-1995 standard for raw soybean (seed) quality condition, where moisture content below 13% would indicate first class (Ginting & Tastra, 2010). The protein content of raw soybean for the Argomulyo variety was the highest and was significantly different from that of Burangrang, Kaba, and Anjasmoro variety. Meanwhile, the protein content values of raw soybean for the Burangrang, Kaba, and Anjasmoro variety were not significantly different.

In addition, the starch content of Anjasmoro and Argomulyo variety was higher compared with that of Kaba and Burangrang variety (Table 2). The main fraction of starch was amylose and amylopectin. Heating the starch caused swollen granules and increased viscosity. The swollen starch granules indicate a volume increase, which meant it can absorb more water. Furthermore, the instant tofu industry prefers to use soybean material with high starch (e.g., Anjasmoro and Argomulyo variety), because of the texture and appearance aspect (Krisdiana, 2007). In instant soybean milk processing, soybean starch is the part of the bean that is able to infiltrate the cloth during filtration, which caused sedimentation. The sedimentation that was formed showed the stability of instant powder solutions as a result. Stable steep refers to less sedimentation (Langkong and Laga, 2009).

Table 2. Moisture, protein, and starch content of the observed raw soybean

Soybean variety	Moisture (%)	Protein (%)	Starch (%)
Kaba	9.72 <sup>a</sup>	29.47 <sup>a</sup>	4.15 <sup>a</sup>
Burangrang	10.18 <sup>ab</sup>	28.50 <sup>a</sup>	5.59 <sup>b</sup>
Argomulyo	10.89 <sup>b</sup>	32.35 <sup>a</sup>	10.70 <sup>c</sup>
Anjasmoro	10.05 <sup>ab</sup>	38.05 <sup>b</sup>	9.47 <sup>cd</sup>

Remarks: Mean values within a column followed by the same letters are not significantly different ( $p < 0.05$ ).

### Extracted Soybean Powder Characteristic

Figure 3 shows the physical appearance of soybean powder with different time to oven of 20 and 30 minutes. Table 3 shows that the soybean variety factor and time to oven did not significantly affect the moisture content of extracted soybean powder, but significantly affected the protein content. The extracted powder from the Argomulyo variety had the highest protein content (7.88%) in 20 minutes of time to oven. It also had higher protein content compared with the time to oven of 30 minutes.

In food production, moisture content affects the preservation ability. Low moisture content increases preservation time, which causes less amount of free water that can be used by microorganisms (Langkong & Laga, 2009). In accordance with the national standard (SNI) of cattle milk powder as a similar product for comparison, the maximum moisture content was set to 5%, so that the average moisture content of instant soybean powder produced in this research is in compliance with the SNI standard (Table 5). The instant soybean powder that was produced from Anjasmoro variety had the highest protein content (7.134%), which was matched by the protein content (38.035%) of raw material from the same variety (Table 2). The

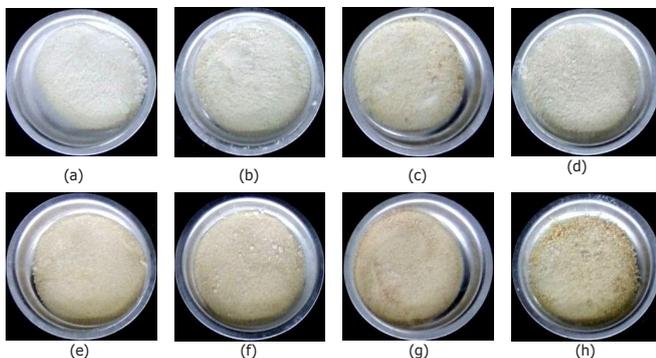


Figure 3. The physical appearances of soybean powder of (a) Kaba at 20 minutes, (b) Burangrang at 20 minutes, (c) Argomulyo at 20 minutes, (d) Anjasmoro at 20 minutes, (e) Kaba at 30 minutes, (f) Burangrang at 30 minutes, (g) Argomulyo at 30 minutes, and (h) Anjasmoro at 30 minutes.

research results from Sukasih *et al.* (2009) showed that the protein content tends to reduce by increasing the heating temperature. According to Langkong and Laga (2009) the addition of instant soybean powder may increase the protein content in processing chocolate powder.

The protein content in the instant soybean powder was low because of the heating process and sugar addition. The high temperature of 150°C and the longer time to oven (30 minutes) caused damage to the amino acid that produces protein. Palupi *et al.* (2007) asserted that heating is mostly used in the process of sterilization, cooking, and drying. Furthermore, previous research suggests that excess heating in longer periods result to a decrease in protein content, which is characterized by the brown color of the product. Roasting the raw soybean for a longer time may cause the protein content to decrease (IP2TP Yogyakarta, 2000).

Table 3. Average moisture and protein content of instant soybean powder for each soybean variety within different time to oven

	Moisture content (%)	Protein content (%)
Variety:		
Kaba	3.22 <sup>a</sup>	5.76 <sup>b</sup>
Burangrang	4.23 <sup>a</sup>	5.37 <sup>b</sup>
Argomulyo	3.31 <sup>a</sup>	5.63 <sup>b</sup>
Anjasmoro	5.01 <sup>a</sup>	7.13 <sup>a</sup>
Time to oven:		
20 minutes	4.44 <sup>a</sup>	6.76 <sup>a</sup>
30 minutes	3.45 <sup>a</sup>	5.18 <sup>b</sup>
Variety*Time to oven		
Burangrang*20 minutes	4.86 <sup>a</sup>	6.18 <sup>b</sup>
Burangrang*30 minutes	3.62 <sup>a</sup>	4.55 <sup>d</sup>
Kaba*20 minutes	3.45 <sup>a</sup>	6.29 <sup>b</sup>
Kaba*30 minutes	3.00 <sup>a</sup>	5.22 <sup>c</sup>
Anjasmoro*20 minutes	5.94 <sup>a</sup>	7.88 <sup>a</sup>
Anjasmoro*30 minutes	4.10 <sup>a</sup>	6.39 <sup>b</sup>
Argomulyo*20 minutes	3.52 <sup>a</sup>	6.70 <sup>b</sup>
Argomulyo*30 minutes	3.10 <sup>a</sup>	4.55 <sup>d</sup>

Remarks: Mean values within a column followed by the same letters are not significantly different ( $p < 0.05$ ).

### Color Characteristic

An object reflects or transmits visible lights in various wavelengths, which can be perceived or measured in descriptive color (Dawson & Acton, 2018). The lightness intensity of the instant soybean milk powder may improve consumer preference, and color lightness is one of the parameters to generate

an acceptable food product (Moskowitz, Beckley, & Resurrection, 2012). Color has been shown to influence consumer perception of food quality.

Table 4. Average values of *L*, *a*, and *b* of instant soybean powder, for each variety with different time to oven

Parameters	<i>L</i>	<i>a</i> <sup>+</sup>	<i>b</i> <sup>+</sup>
Variety:			
Kaba	79.35 <sup>a</sup>	5.02 <sup>a</sup>	17.55 <sup>a</sup>
Burangrang	80.82 <sup>a</sup>	3.87 <sup>a</sup>	18.77 <sup>a</sup>
Anjasmoro	82.45 <sup>a</sup>	4.05 <sup>a</sup>	17.55 <sup>a</sup>
Argomulyo	82.45 <sup>a</sup>	4.32 <sup>a</sup>	17.12 <sup>a</sup>
Time to oven:			
20 minutes	83.04 <sup>a</sup>	3.20 <sup>a</sup>	17.42 <sup>a</sup>
30 minutes	79.37 <sup>b</sup>	5.44 <sup>b</sup>	18.07 <sup>a</sup>
Variety*Time to oven			
Burangrang*20 minutes	83.30 <sup>a</sup>	2.70 <sup>a</sup>	18.90 <sup>a</sup>
Burangrang*30 minutes	78.35 <sup>a</sup>	5.05 <sup>a</sup>	18.65 <sup>a</sup>
Kaba*20 minutes	81.20 <sup>a</sup>	3.40 <sup>a</sup>	16.40 <sup>a</sup>
Kaba*30 minutes	77.50 <sup>a</sup>	6.65 <sup>a</sup>	18.70 <sup>a</sup>
Anjasmoro*20 minutes	83.40 <sup>a</sup>	3.40 <sup>a</sup>	17.95 <sup>a</sup>
Anjasmoro*30 minutes	81.00 <sup>a</sup>	4.70 <sup>a</sup>	17.15 <sup>a</sup>
Argomulyo*20 minutes	84.25 <sup>a</sup>	3.30 <sup>a</sup>	16.45 <sup>a</sup>
Argomulyo *30 minutes	80.65 <sup>a</sup>	5.35 <sup>a</sup>	17.80 <sup>a</sup>

Remarks: - Mean values within a column followed by the same letters are not significantly different ( $p < 0.05$ ).

- *L* = level of lightness from 0 to 100; *a* = greenish or reddish color; (*a*<sup>+</sup> is reddish and *a*<sup>-</sup> is greenish); *b* = yellowish or bluish color (*b*<sup>+</sup> is yellowish and *b*<sup>-</sup> is bluish).

In Table 4, color measurement parameters *L*, *a*, and *b* were included. A higher *L* value in the sample means more lightness in color (0 value for black and 100 for whitish colored). The *L* values of the instant soybean powder for all tested varieties were not significantly different (Table 4). These results show that the starch and protein content of the different tested varieties did not affect the *L* value of the instant powder that was produced. However, the high starch and protein content in the Anjasmoro and Argomulyo variety (Table 1) could trigger a Maillard reaction, such that the product becomes brownish. This can be caused by the relatively lower heating temperature of 150 °C. The time to oven has significantly affected the *L* value of the product. The longer time to oven (30 minutes) resulted in less lightness of the instant soybean powder, such that the product is more brownish in color. Hence, longer heating can cause a Maillard reaction that results to a brownish color.

The results of the analysis using the Duncan test show that the *a* value of the instant soybean powder

was not affected by the different tested varieties tested, but it was affected by the time to oven (Table 4). The longer time to oven (30 minutes) caused higher *a* values, which resulted in a more reddish color. On the other hand, the *b* value was not affected by different tested varieties and time to oven. The values of *a* and *b* were used to determine the degree of hue (°hue), which is one of the product appearance parameters. It is a color characteristic based on the amount of light reflected by an object, with values from 0 to 359°.

## Organoleptical Test

### Soybean Powder

In the organoleptic test of color parameters for instant soybean powder, the panelists preferred the color of the Burangrang variety with 20 minutes of time to oven, giving it a score of 4.75; whereas the Anjasmoro variety that spent 20 minutes in the oven was given a score of 4.16. This shows that the color of instant soybean powder that was put in the oven for 20 minutes was more preferred, which may have been affected by the higher level of lightness ( $L = 83.04$ ) of soybean powder when processed for 20 minutes (Table 4).

Unfavorable aroma, referred to as bad scent (or *langu*), in soybean was confirmed to be disliked for all soybean products. The bad scent might be caused by the existence of lipoxygenase enzyme. The lipoxygenase enzyme is an enzyme that is sensitive to temperature, whose peak activity occurs at 30–40 °C. Unfavorable aroma can be minimized by using the soaking and heating method (reference, year). Table 5 shows that the unfavorable aroma of instant soybean powder from the Burangrang, Kaba, Anjasmoro, Argomulyo variety with 20 and 30 minutes of time to oven was not too disturbing, which ranged from 3.21 to 3.47 (neutral-weak of favorable aroma), and it was not significantly different in every treatment. In addition, Pramitasari (2010) found that adding ginger is proven to be able to cover the unfavorable aroma from extracted soybean. In addition, it can provide a good effect on health.

### Instant Solutions

The instant solution was made by adding the instant powder with water. Panelists scored the color of the instant soybean solutions, which ranged from 1.89 to 4.26. This shows that the variety and time-to-oven factors significantly affected the instant soybean solutions ( $p = 0.001$ ). The preferred color came from the Burangrang, Argomulyo, and Anjasmoro variety with 20 minutes of time to oven, whereas the less preferred color came from the Kaba variety with 30 minutes of

Table 5. Average values of the organoleptic test of extracted instant soybean powder for different varieties and time to oven

Variety	Time to oven (minutes)	Instant soybean powder		Instant soybean powder solutions			
		Color	Unfavorable aroma	Color	Favorable aroma	Taste	Preference
Burangrang	20	4.74 <sup>a</sup>	3.47 <sup>a</sup>	4.26 <sup>a</sup>	2.68 <sup>bcd</sup>	2.89 <sup>a</sup>	2.84 <sup>abc</sup>
	30	2.84 <sup>de</sup>	3.21 <sup>a</sup>	3.26 <sup>bc</sup>	3.37 <sup>a</sup>	3.42 <sup>a</sup>	3.11 <sup>ab</sup>
Kaba	20	3.53 <sup>bc</sup>	3.37 <sup>a</sup>	2.37 <sup>d</sup>	3.16 <sup>ab</sup>	3.05 <sup>a</sup>	3.37 <sup>a</sup>
	30	2.84 <sup>de</sup>	3.21 <sup>a</sup>	1.89 <sup>d</sup>	2.95 <sup>abc</sup>	2.84 <sup>a</sup>	2.89 <sup>ab</sup>
Anjasmoro	20	4.16 <sup>ab</sup>	3.37 <sup>a</sup>	3.74 <sup>ab</sup>	2.16 <sup>d</sup>	2.11 <sup>b</sup>	2.26 <sup>cd</sup>
	30	2.95 <sup>cd</sup>	3.21 <sup>a</sup>	3.00 <sup>c</sup>	2.53 <sup>bcd</sup>	2.95 <sup>a</sup>	2.53 <sup>bc</sup>
Argomulyo	20	4.16 <sup>ab</sup>	3.47 <sup>a</sup>	4.16 <sup>a</sup>	2.37 <sup>cd</sup>	1.63 <sup>b</sup>	1.95 <sup>d</sup>
	30	2.26 <sup>e</sup>	3.47 <sup>a</sup>	2.11 <sup>d</sup>	3.16 <sup>ab</sup>	3.16 <sup>a</sup>	2.84 <sup>abc</sup>

- Remarks: - Mean values within a column followed by the same letters are not significantly different ( $p < 0.05$ ).
- Score for color: 1–5 (very dark color to very bright color).
  - Unfavorable aroma: 1–5 (strong unfavorable aroma to very weak unfavorable aroma).
  - Favorable aroma: 1–5 (very dark color to very bright color).
  - Taste: 1–5 (weak soybean taste to very strong soybean taste).
  - Preference: 1–5 (not preferred to highly preferred).

time to oven (Table 5). According to IP2TP Yogyakarta (2000), roasting the soybeans for 20 minutes produces soybean powder that is more preferred on the basis of taste, aroma, color, or preference (Likert) as a whole. A bright color was more preferred by the panelists. The longer time to oven caused a more brownish color, which resulted to lower scores from the panelists. The color of the instant soybean solutions was affected by the Maillard reaction in the oven, as well as the caramelization process. The brown color was a result of the Maillard reaction (Troise, 2017), where reducing glucose is heated, and the caramelization process, where the glucose is heated above its melting point, resulting to a brown color followed by a change in flavor.

The instant soybean solutions were scored with reference to their favorable aroma. In Table 5, the variance analysis results show that the favorable aroma of the soybean instant solutions was affected by a combination of variety and time to oven ( $p = 0.001$ ). Soybean from the Burangrang variety with 30 minutes of time to oven was given a higher score compared to that with 20 minutes of time to oven, whereas the 30 minutes of time to oven for the Argomulyo was given a higher score compared to 20 minutes of time to oven. For the Anjasmoro and Kaba variety, the time to oven did not affect the aroma (Table 5). This shows that favorable aroma is triggered by heating soybean for 30 minutes. This favorable aroma was formed by the Maillard and caramelization reaction in soybean. According to Krisdiana and Heriyanto (2000) and Krisdiana (2007),

the instant soybean solution from Argomulyo variety tends to produce unfavorable aroma (*langu*), which was also found in the instant soybean solutions produced from Argomulyo variety. This shows that the heating treatment during processing can inactivate the enzyme that triggers the unfavorable aroma.

Moreover, the panelist scores for the taste of instant soybean solutions ranged from 1.63 to 3.42. The analysis of variance showed that soybean variety and time to oven significantly affected the taste of the solutions ( $p = 0.001$ ). The Anjasmoro and Argomulyo varieties with 20 minutes of time to oven resulted in lower taste scores compared to other treatments. Smaller beans that were put in the oven for 20–30 minutes were more preferred, whereas bigger beans with 20 minutes of time to oven were less preferred. This suggests that different dimensions can affect the heat transfer process, as shown in the bigger size of bean that was not well cooked after 20 minutes of time to oven. Therefore, appropriate heating can produce highly preferred soybean taste and aroma for consumers, whereas excessive heating can cause protein damage and changes in flavor as result of overcooking, which is not preferred by consumers.

### Preference

The panelist preference scores for the instant soybean solutions ranged from 1.95 to 3.37 (Table 5). The analysis of variance showed that the soybean variety and time to oven significantly affected the

panelist preference. The highest average score of 3.37 (ordinary to like) was given to the Kaba variety with 20 minutes of time to oven, whereas the lowest score of 1.95 (dislike a lot to dislike) with significant difference was found in the Argomulyo variety with 20 minutes of time to oven.

The whole preference score is an overall panelist judgment on color, aroma, and taste of instant soybean solutions produced. Table 5 shows that instant soybean solutions from the Kaba and Burangrang variety with 20 and 30 minutes of time to oven, as well as the Argomulyo variety with 30 minutes of time to oven, were not significantly different and were preferred over the Anjasmoro variety with 20 and 30 minutes of time to oven and the Argomulyo variety with 20 minutes of time to oven. These results show that processing smaller sizes of soybeans with 20 and 30 minutes of time to oven is optimal in producing highly preferred instant soybean powder solutions. On the other hand, soybeans with bigger sizes (i.e., Argomulyo and Anjasmoro) can be better processed with 30 minutes of time to oven or more.

## CONCLUSIONS

The physical parameters of instant soybean milk raw material from biggest to smallest were as follows: Argomulyo, Anjasmoro, Burangrang and Kaba. The shape of the Kaba variety was flatter than other varieties. The moisture content of the raw soybean material was 9.72–10.89% in compliance with the SNI; Argomulyo had the highest protein content (38.05%); whereas Kaba had the lowest starch content (4.15%). The characteristic of instant soybean powder was affected by variety and time to oven. The highest protein content was found in soybean powder from Anjasmoro variety with 20 minutes of time to oven. The degree of lightness of the powder was affected by time to oven, where the lightest was found in 20 minutes of time to oven. The best nutrient characteristic resulted from the Anjasmoro variety with 20 minutes of time to oven. The moisture content of extracted soybean powder of all varieties with time to oven were in compliance with SNI standards, which ranged from 3.10% to 4.86%, except for the Anjasmoro variety with 20 minutes of time to oven, which reached 5.94%. Moreover, the panelists showed overall preference for all varieties of instant soybean powder with 20 minutes of time to oven. Meanwhile, the preferred instant soybean solutions came from soybeans with smaller size and low starch content, namely, Burangrang and Kaba with 20 and 30 minutes of time to oven.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this research.

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