Effect of Variation in Drying Time on Chemical Characteristics of Green Bean Juice Flour

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Abstract. The variety and amount of food are closely related to the potential for food waste. Food waste and its accumulation is a critical problem throughout the world. Reducing the burden of food waste in the food production process is an effort to achieve food sustainability by maximizing the remaining food production. One of the efforts that can be made by the nutrition installation at RSUP Dr. Kariadi is using green bean juice dregs from the green bean juice liquid menu so that it does not become food waste. Utilizing green bean dregs into green bean flour is one step that supports food sustainability because mung bean dregs still have nutritional value, and the flour form has a longer shelf life as a result of the water content in the flour is lower than the dregs form. This research was conducted to determine the proximate content of green bean dregs flour. The formulation consists of six different drying times and three repetitions of measurements (triplo). The method used in proximate testing is obtained from the results of calculating protein content using the Kjedahl method, fat content using the Soxhlet method, carbohydrate content using the by-difference method, crude fiber content, water content, and ash content using the AOAC method at the Muhammadiyah University Semarang Laboratory. The result was a protein level of 12.81% ± 0.82 at P3 and a maximum of 15.41% ± 3.87 at P4; Fat content of 0.53% ± 0.058 at P2 and a maximum of 0.76% ± 0.15 at P5; Fiber content was 25.33 ± 2.57 at P2 and maximum 29.19 ± 1.48 at P5; Water content 8.61% ± 0.09 at P5 and maximum 35.41% ± 0.29 at P2; Ash content was 1.09±0.2 at P2 and maximum 1.35±0.3 at P6. The conclusion is that variations in drying time do not have a significant effect on protein, fat, and ash content but do have a significant effect on fiber and water content.

Keywords: Drying Time, Food Waste, Green Bean Flour, Proximate Analysis.

K. Nugraheni et al. (eds.), *Proceedings of the 2nd Lawang Sewu International Symposium on Health Sciences: Nutrition (LSISHSN 2023)*, Advances in Health Sciences Research 80,
https://doi.org/10.2991/978-94-6463-550-8_5

1. Background

Food preparation involves human power, equipment, materials, funds, and other resources to obtain good quality and taste of food that satisfies consumers. However, it can reduce food preparation costs to a reasonable level without reducing quality [1]. A balanced, varied menu, following nutritional adequacy or needs, is one thing that can satisfy consumers when organizing mass meals in institutions, especially hospitals. Menus for mass meals are generally made based on menu rotation within ten days to avoid consumer boredom [2]. The higher the consumer's boredom, the higher the food waste. This was stated by Rochmah et al., who researched factors that influence food waste [1], so food variation is needed.

The variety and amount of food are closely related to the potential for food waste. Food waste and its accumulation have become a critical problem worldwide due to the ever-increasing growth of the world's population. The rapid growth of food waste poses severe threats to society, such as environmental pollution, health risks, and scarcity of disposal land. This raises the urgent need to take appropriate action to reduce the burden of food waste by implementing standard management practices [3].

Reducing the burden of food waste in the food production process is an effort to achieve food sustainability by maximizing the remaining food production [4]. One of the efforts that can be made by the nutrition installation at RSUP Dr. Kariadi is using green bean juice dregs from the green bean juice liquid menu so that it does not become food waste. Green beans are a source of vegetable protein, which plays a role in improving nutrition. The nutritional content in 100 g of green beans includes 323 kcal energy, 22.9 g protein, 1.5 g fat, and 56.8 g carbohydrates, while green bean flour contains 19.09% protein, 0.09% fat, and 2.76% crude fiber. % and carbohydrates 72.86% [5]. Utilizing green bean pulp into green bean flour is one step that supports food sustainability because green bean pulp still has nutritional value, and the flour form has a longer shelf life as a result of the water content in the flour being lower than the pulp form [5].

Green bean dregs flour can be used for enteral formulas and a mixture of snack products such as biscuits, steamed sponge cakes, and pudding [5]. Making flour from raw materials requires high temperatures, which can damage the nutritional value of an ingredient [6]. One of the nutritional values that need to be considered is the chemical characteristics related to proximate levels, consisting of protein content, fat content, carbohydrate content, water content, ash content, and fiber content. Based on this background, this research was conducted to determine the proximate content of green bean dregs flour.

2. Method

This experiment has six formulations of different drying times and three repetitions of measurements (triple). The difference in drying time is based on research conducted by Sumardiono and Susetyowati [7][8], namely drying at a temperature of 50°C with a time of 4, 5, 6 hours and 14, 15, 16 hours. Mung bean juice dregs were obtained from Dr. Kariadi General Hospital, Semarang, and flour was made at the Food Technology Laboratory, Muhammadiyah University, Semarang, and proximate content testing was carried out at the Nutritional Value Analysis Laboratory, Muhammadiyah University, Semarang. The research was conducted from October to November 2023.

Ingredients for making green bean dregs flour: mung bean dregs. Proximate test materials: 0.325N H_2SO_4 solution, distilled water, 1.25N NaOH solution, 95% ethanol, 10% K_2SO_4, Na_2CO_3, citric acid, distilled water, luff solution, KI, sodium thiosulfate, CH_3COOH, 70% and 90% alcohol, K_2SO_4 10%, granulated sugar (sucrose), Acetobacter selenium bacteria, Na_2SO_4: HgO, $Na_2S_2O_3$, 0.02 N HCl solution, 4% boric acid, BCG+MR, Aquades. Product-making tools: mori cloth, basin, baking dish 30 cm x 30 cm x 2 cm, tray dryer, dry blender, 60 mesh sieve. Proximate test equipment: 50 ml Kjeldahl flask, Kjeldahl distillation apparatus, 100 ml Erlemeyer, 10 ml measuring cup, dropper pipette, 50 ml biuret, electric stove, analytical balance, fume cupboard, soxhletation apparatus, analytical balance, oven.

2.1. Process of Making Mung Bean Juice Flour

The dregs of green bean juice obtained from the leftovers from making Green Bean Juice are squeezed using a mori cloth. The pulp that has been squeezed is arranged 0.5 cm high on a baking sheet measuring 30 cm x 30 cm x 2 cm, then dried in a tray dryer at a temperature of 50°C with varying times according to the treatment. After reaching the appropriate treatment time, the ingredients are blended using a dry blender and filtered using a 60-mesh sieve.

2.2. Proximate Analysis

Protein Content Test (Kjedahl Method). 5 grams of sample is put into a Kjeldhal tube. The mixture ($CuSO_4$; K_2SO_4 = 1:8) and 10 ml of concentrated H_2SO_4 were added into the tube and then heated to 300°C for 12 hours. A total of 25 ml of distilled water was put into the tube by flowing it through the walls, which was then shaken to remove the remaining heat. Samples at room temperature are put into a 50 ml tube, and the rest is rinsed until it reaches a volume of 50 ml. A total of 5 ml of solution was added with 10 ml of 10 N NaOH and then put into the distillation machine. The resulting steam is then collected in a tube containing 5 ml of 2% boric acid mixed with two drops of Tarchirho indicator. Boric acid is then titrated against N/70 H_2SO_4 until it turns pink. Total Nitrogen can be calculated with the equation.

$$\text{Total Nitrogen (\%)} = \frac{(V \times 14 \times 100 \times 50)}{(100 \times 70 \times 5 \times W)}$$

% protein contain = %N x conversion factor
V = volume of N/70 H_2SO_4
W = sample weight
Conversion factor = 6,25

Fat Content Test (Soxhlet Method. Weigh a sample of 2 grams into a Soxhlet tube. Heating is adjusted until the solvent in the form of petroleum ether can flow 5-6 times per hour at a temperature of 60°C-80°C. Extraction is carried out for 16-20 hours. The solvent was then transferred into a glass beaker, evaporated in a boiling water bath, and then cooled to room temperature using a desiccator. Fat content can be measured with the following equation.

$$\text{Fat Content} = \frac{(W2 - W1) \times 100}{W}$$

W = sample weight in grams
W1 = Weight of the glass beaker
W2 = Weight of the glass beaker + fat. Weight is measured in grams

Fiber Content Test (AOAC Method). Crude fiber analysis determines precipitates after samples are reacted with solid acids and bases. The crude fiber test uses the gravimetric method with 1 gram of sample placed in an Erlenmeyer flask and 50 ml of 0.3 N H_2SO_4 added, then heated for 30 minutes using a reverse cooler on top. After that, 25 ml of 1.5 N NaOH was added and heated again for 30 minutes using medium heat. The heated liquid is then filtered using filter paper that has been previously weighed and then washed with 50 ml of hot water, 50 ml of 10% K_2SO_4, and 25 ml of acetone. The filter paper is then placed in a porcelain cup and dried in the oven at 85°C for approximately 30 minutes. Then, it was placed in a desiccator for 1 hour and weighed until constant. Crude fiber content is calculated based on the following formula:

$$\text{Fiber Content (\%)} = ((a-b))/c \times 100\%$$

a = weight of fiber residue and dry filter paper (g)
b = Weight of dry filter paper (g)
c = material Weight (g)

Water Content Test (AOAC). Evaporation of other components with stable heating is the principle of determining the moisture content of the oven method. A sample of 2 grams is put into a dry container, and the Weight is known. Samples and rates were dried in an oven at 105°C for 4 hours. The exchange rate is cooled in a desiccator, weighed, then dried again every half hour until it obtains a constant weight.

$$\text{Water Level \%} = (a - b)/c \times 100\%$$

a = Final weight after being in the oven (g)
b = kurs (g)
c = sample weight (g)

Ash Content Test (AOAC). The ashed material is placed in a particular container, namely a crucible made of porcelain. Ashing temperature 105° for 4 hours. The weighing of the materials is carried out in cold temperatures. The crucible containing the ash is heated in an oven at 105°C to reduce its temperature and then placed in a desiccator.

$$\text{Ashed Content\%} = \frac{\text{Ash Weight (gram)} \times 100\%}{\text{Sample weight (gram)}}$$

3. Result and Discussion

3.1. Characteristics of Mung Bean Extract Flour Yield

Yield is a comparison of the amount of extract produced from raw materials. The resulting yield is in Table 1 from green bean dregs made into flour.

Table 1. Average Values of Mung Bean Juice Flour Yield.

	Rendemen (%)±SD
P1	64,03±0,22
P2	70,67±0,24
P3	67,97±0,07
P4	90,63±0,5
P5	88,60±0,3
P6	91,77±0,18

The lowest yield was in P1 (drying for 4 hours), namely 64.03 ± 0.22. The low yield is due to the higher water content, so the texture of the green bean pulp is not too dry, and the grinding process results are not as smooth and as large as in other treatments with less water content. Drying for a longer time results in the texture of the green bean dregs being more brittle and easily crushed when ground. This is in line with Pasaribu et al.'s research on the effect of drying time on the yield of mung bean sprout flour, which shows an increase in yield with increasing drying time [9].

3.2. Characteristics of Mung Bean Extract Flour Nutrition Value

The results of the extraction of green bean dregs were subjected to proximate testing to determine chemical characteristics. The proximate test results consist of carbohydrate content, protein content, fat content, fiber content, water content, and ash content, shown in Table 2.

Table 2. Test Results for Proximate Content of Mung Bean Juice Flour.

Method	Rata-rata ±SD					
	Carbohydrate level (%)	Protein level (%)	Fat Level (%)	Fiber Level (%)	Water Level (%)	Ash level (%)
P1	53,67±0,77[a]	15,33±0,63	0,66±0,056	26,56±1,1[a]	29,12±0,18[a]	1,2±0,23
P2	50,15±0,87[a]	12,81±0,82	0,53±0,058	25,33±2,57[a]	35,41±0,29[b]	1,09±0,2
P3	50,94±1,24[a]	14,13±0,99	0,62±0,057	28,71±0,31[b]	33,03±0,33[c]	1,26±0,05
P4	73,02±3,81[b]	15,41±3,87	0,69±0,10	25,39±0,74[a]	9,67±0,13[d]	1,19±0,28
P5	75,16±2,08[b]	14,22±1,79	0,76±0,15	29,19±1,48[b]	8,61±0,09[e]	1,22±0,2
P6	73,87±1,40[b]	12,93±0,96	0,63±0,15	27,31±1,95[a]	11,20±0,13[f]	1,35±0,3
Nilai p	0,03	0,4	0,22	0,02	0,00	0,8

Note: Different letter notations in one column indicate meaningful differences in levels

3.3. Carbohydrate Level

Carbohydrates have a prominent role as a provider of glucose for body cells, which will then be converted into energy. The characteristics of carbohydrates regarding temperature are characterized by the caramelization process, which affects the product's color [9]. Changes in the results of carbohydrate levels in this study can be seen in Figure 1.

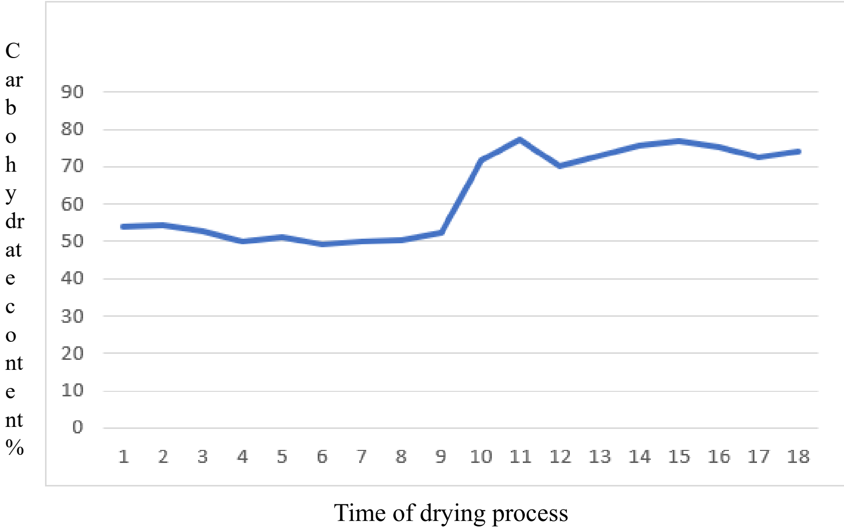


Fig. 1. Tren of carbohydrate content.

In green bean dregs flour, the minimum value of carbohydrate content was 50.15% ± 0.87 at P2, and the maximum was 73.87% ± 1.40 at P6. The ANOVA test results showed that drying time significantly affected carbohydrate content with a value of $p=0.03$ ($p<0.05$). Further, DMRT tests showed significant differences between treatment groups P1, P2, P3, P4, P5, and P6. The high carbohydrate content in P6 is due to the lower water content due to the long drying time. This is in line with research conducted by Priya et al. regarding the effect of temperature and time on green beans. The higher the temperature and the longer the heat exposure, the lower the water content and the higher the concentration of other nutrients, including carbohydrate levels [10]. The carbohydrate content in green beans is 62 grams per 100 grams, so the highest carbohydrate content in green bean dregs flour is higher than in green beans.

3.4. Protein Level

Protein levels in food are influenced by the processing method. Food processing at high temperatures impacts protein levels [11]. The green bean dregs flour protein test results were obtained using the Kjedahl method. The trend of changes in the protein content of green bean dregs flour can be seen in Figure 2.

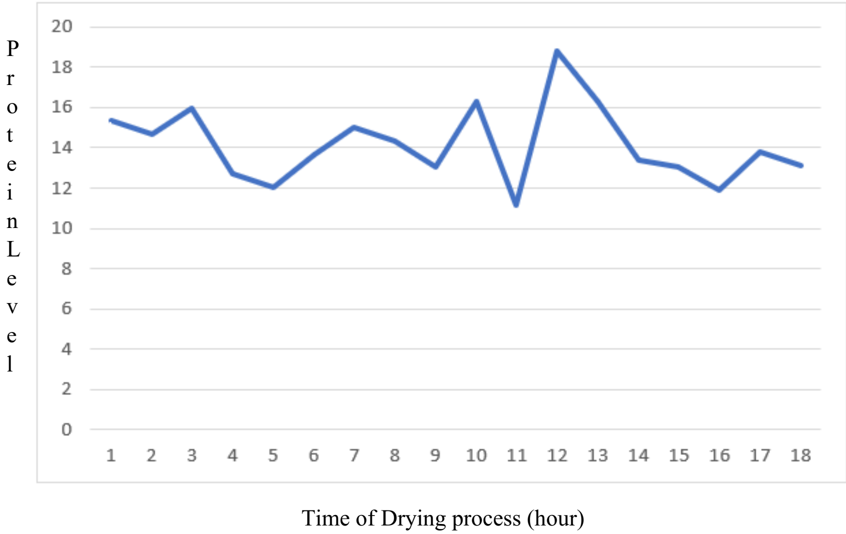
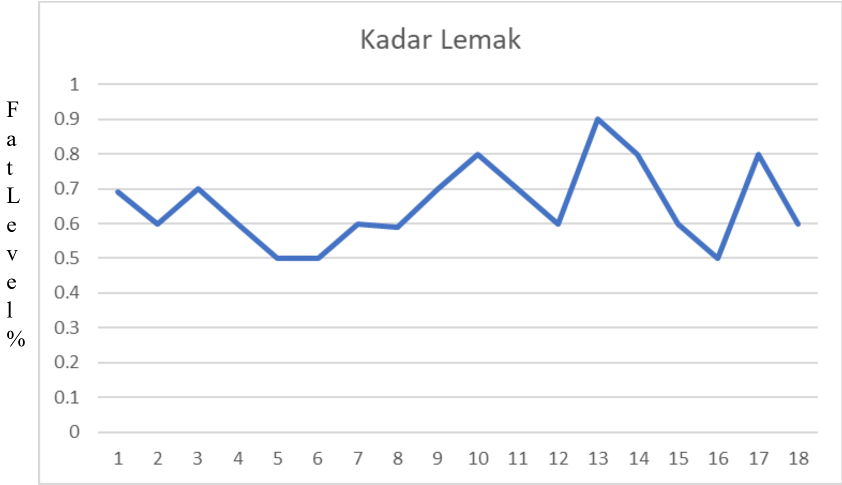


Fig. 2. Trend of Protein Level.

In mung bean dregs flour, the minimum value of protein content was 12.81% ± 0.82 at P3, and the maximum was 15.41% ± 3.87 at P4. The results of the ANOVA test showed that drying time did not significantly affect protein content with a value of p=0.4 (p>0.05), so no further DMRT test was carried out. Protein is one of the macronutrients that is susceptible to high temperatures. The higher the temperature in processing food containing protein, the more the potential for protein damage increases. However, this occurs at temperatures >80°C [12]. The temperature for harvesting green bean dregs is 55°C, so the protein denaturation process is not too high. The use of a tray cabinet allows the temperature to be controlled. The high protein content in mung bean dregs can indicate the potential for utilizing mung bean dregs in high-protein food products such as enteral formula mixtures for patients requiring high bioavailability protein products [13].

3.5. Fat Level

The fat content in green beans is 1.26 grams per 100 grams 14, but the processing process will impact a product's nutritional value. The trend of the fat test results on green bean dregs based on the drying time can be seen in Figure 3.



Time of Drying process (hour)

Fig. 3. The trend in fat level.

In mung bean dregs flour, the minimum value of protein content was 12.81% ± 0.82 at P3, and the maximum was 15.41% ± 3.87 at P4. The results of the ANOVA test showed that drying time did not significantly affect protein content with a value of $p=0.4$ ($p>0.05$), so no further DMRT test was carried out. Protein is one of the macronutrients that is susceptible to high temperatures. The higher the temperature in processing food containing protein, the more the potential for protein damage increases. However, this occurs at temperatures >80°C [12]. The temperature for harvesting green bean dregs is 55°C, so the protein denaturation process is not too high. The use of a tray cabinet allows the temperature to be controlled. The high protein content in mung bean dregs can indicate the potential for using mung bean dregs in high-protein food products such as enteral formula mixtures for patients requiring high bioavailability protein products [13].

3.6. Fiber Level

The SNI for green bean flour states that the standard crude fiber content is 3%. Trends in fiber content based on drying time can be seen in Figure 4.

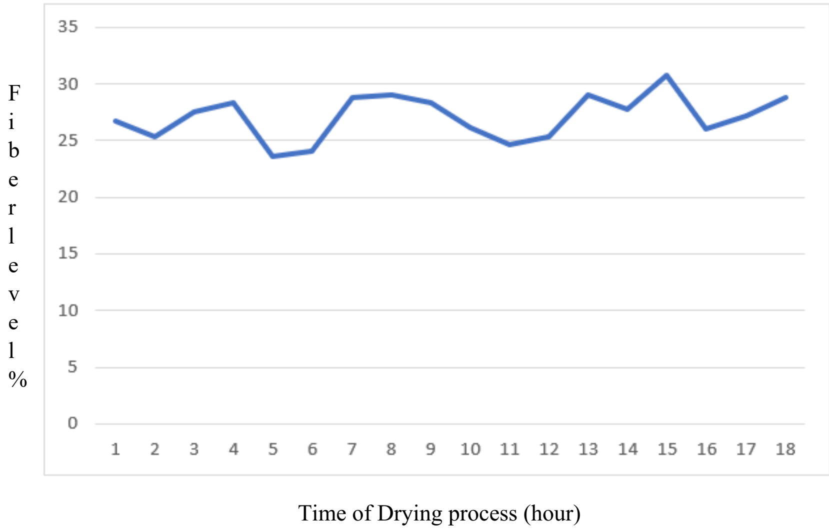


Fig. 4. Fiber Trend.

In green bean dregs flour, the minimum value of fiber content was 25.33 ± 2.57 at P2, and the maximum was 29.19 ± 1.48 at P5. The ANOVA test results showed that drying time significantly affected fiber content with a value of $p=0.02$ ($p<0.05$). Further, DMRT tests showed significant differences between treatment groups P1, P2, P4, and six and groups P3 and P5. The drying process at a temperature of 50°C does not damage the fiber contained in green bean dregs, in line with Hart et al.'s research on temperature and time relating to fiber content in food ingredients. Hart said that drying at less than 200°C can be dried in more than 30 minutes [15]. This causes the fiber content in green bean dregs flour to exceed the SNI requirements for Green Bean Flour. Adding mung bean dregs can be used for high-fiber processed products intended for dyslipidemia patients [16].

3.7. Water Level

The drying time for green bean dregs refers to previous research conducted by Lestari and Triwitono [5][17]. The quite extreme time selection between 4,5,6 and 14,15,16 was carried out to determine the difference in the level of flour dryness as measured by water content. The trend of changes in water content can be seen in Figure 5.

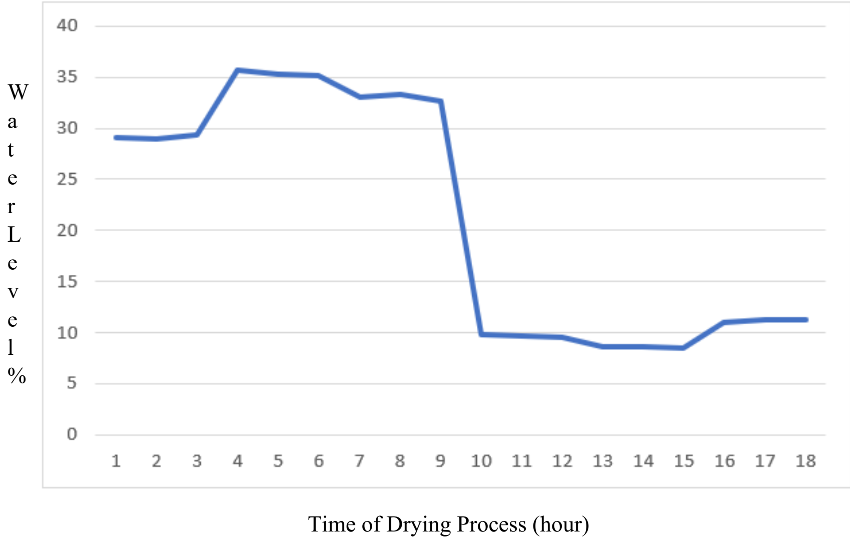


Fig. 5. Trend of water level.

The minimum water content value in green bean dregs flour was 8.61% ± 0.09 at P5, and the maximum was 35.41% ± 0.29 at P2. The ANOVA test showed that drying time significantly affected water content with a value of $p=0.00$ ($p<0.05$). Based on the DMRT follow-up test results, there were significant differences in each group. The longer the drying time, the lower the water content. This is due to the heat produced by the tray dryer, which is set at a temperature of 50°C. A tray dryer ensures that the flour yield does not change. The SNI requirement for green bean flour is a maximum water content of 10%. The minimum value for green bean dregs flour is 8.61 ± 0.09 in the P5 treatment (drying for 15 hours). Even in this case, it shows that more drying from 12 hours can produce flour that meets SNI regarding flour moisture content standards.

3.8. Ash Content

The ash content is tested to be used in determining micronutrients. The ash content in an ingredient shows the amount of minerals in a food. The trend of changes in ash content in green bean dregs flour can be seen in Figure 8.

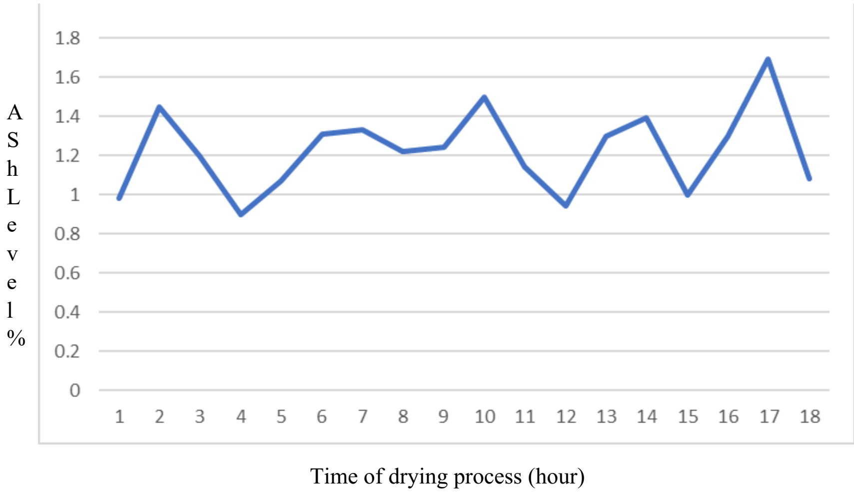


Fig. 6. The trend of ash level.

In green bean dregs flour, the minimum value of ash content was 1.09 ± 0.2 at P2, and the maximum was 1.35 ± 0.3 at P6. The results of the ANOVA test showed that drying time did not significantly affect ash content with a value of $p=0.8$ ($p>0.05$), so no further DMRT test was carried out. There was no difference in ash content in each treatment group, even though the drying time differed. This is not in line with research conducted by Lestari et al., which shows that drying time is related to drying time, so a trend of increasing ash content occurs when the drying duration increases [5]. Factors influencing ash content are drying time, raw materials, and ashing methods. In this study, the AOAC method was used to measure ash content.

4. Conclusion

Variations in drying time did not have a significant effect on protein content, fat content, and ash content but had a significant effect on fiber content and water content. The best time for drying green bean dregs flour at P5 is drying for 15 hours at 50°C.

Acknowledgments. This journal article was written based on the results of research in Kariadi Hospital Semarang and Food Technology of Nutrition Department Universitas Muhammadiyah Semarang. The contents are the full responsibility of the authors.

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