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by Anatje Lihiang

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ANALYSIS OF PHYSICAL AND CHEMICAL PROPERTIES ON THE COMPARISON OF THE USE OF GOROHO BANANA FLOUR (*Musa acuminate*) AND CORNMEAL (*Zea mays*) IN THE MANUFACTURE OF DRIED NOODLES

ANATJE LIHIANG

Manado State University
Faculty of Mathematics and Natural Sciences
Department of Biology Education
Email : anatjelihiang@unima.ac.id

ABSTRACT

Goroho banana flour (*Musa acuminate*) and corn flour (*Zea mays*) are non-wheat flours that have a fairly high starch content, so they have the potential to be used as noodles. The quality of goroho banana flour is influenced by one of them by its starch content. The higher the substitution rate of goroho banana flour added, the higher the starch content, because goroho banana flour has a higher starch content than wheat flour. The purpose of this study was to determine the physical and chemical properties in the comparison of the use of goroho banana flour and corn flour in the manufacture of dry noodles. The noodle making process consists of mixing ingredients, steaming, compaction of dough, forming sheets and strands, steaming noodles, drying and packaging. The treatment used is flour from goroho banana and corn flour, namely 50 percent: 50 percent, 60 percent goroho banana flour: 40 percent corn flour and 70 percent goroho banana flour: 30 percent corn flour. The results showed that the best noodles were produced by 60 percent goroho banana flour and 40 percent corn flour. With the physical properties of the noodles produced, namely elongation of 238.76 percent; hardness of 635.88 gf; suppleness of 0.783 gf; and a yield of 77.23 percent. The chemical properties of the noodles produced are water content of 9.83 percent, fat 0.91 percent, protein 7.07 percent, ash 1.29 percent, crude fiber 1.73 percent, and starch 73.84 percent.

Keywords: Goroho banana flour, cornstarch and dried noodles

INTRODUCTION

Noodle is one of the most popular dishes in Asia, one of which is in Indonesia. It is a pity that the raw material for noodles, namely wheat flour, is still 100 percent obtained from imports. To reduce the dependence on wheat flour, local raw materials have begun to be used to replace wheat flour that can be processed into commercial food products. Local food products that have the potential to substitute wheat flour include goroho bananas (*Musa acuminate*) and corn (*Zea mays*). The goroho banana is a specific banana of North Sulawesi. The processing of goroho bananas into flour is a form of diversification of local food that makes goroho bananas have added value, which can be used in raw materials for making noodle products. The processing process of goroho banana flour can use a relatively simple technology compared to the tapioca flour processing process so that it can be made easily and quickly and does not require a lot of water and a large processing area. Tepung derived from Goroho banana has a fairly high starch content, therefore it is suitable for overcoming calorie needs in food. In addition to the aspect of large availability of raw materials, the high starch content in goroho banana flour is also the basis for the development of noodle products. The quality of goroho banana flour is influenced by one of them by its starch content. According to Sondakh (1990), k adar banana starch goroho 80.89%, karbohydrate 75.18%, protein 5.16%, fat 0.9%, moisture content 11.99%, total sugar 1.83% and crude fiber 2%. From this data, it is proven that the potential for the development of goroho bananas as an alternative food sourced from carbohydrates is very likely because the starch content is quite high, namely 80.89%, and sugar 1.83% so that it is safe for consumption by people suffering from sugar disease (*Diabetes militus*). Therefore, goroho banana flour can be used for a variety of processed products, such as base cakes and pastries such as cakes, biscuits, bronis and dried noodles.

The higher the substitution rate of goroho banana flour, the starch content will increase, because goroho banana flour has a higher starch content than wheat flour. Suismono and Darmadjati (1992) stated that the higher the starch content in noodles, the higher the water absorption because the gelatination is higher. With the high ability to absorb water, noodles can be obtained with a chewy texture and do not break easily (Rosmeri and Monica, 2013). For the use of goroho banana flour as an ingredient in making non-wheat noodles, it is necessary to add corn flour which has a relatively high protein content. Mudjisihono, et al., (1993) reported that corn protein content ranged from 6.9 to 10.04 percent with an average of 8.95 percent. In addition, corn flour contains natural dyes derived from β-carotene compounds, lutein and zeaxanthin (Juniawati, 2003). So that in making corn noodles there is no need to use additional dyes. Furthermore, accordingto Nurali, et al (2012) Goroho banana flour has a fairly high nutritional content, namely carbohydrates 75.18%, protein 5.16%, fat 0.97% and the proportion of starch 70.78% consisting of amylose 39.59% and amylopectin 31.19%. While the starch content in corn flour is 60.07 percent with an amylose content of 22.88 percent and ami lopectin of 37.19 percent (Ekafitri, 2011) Jarnsuwan and Thongngam (2012) stated that the amylose content in flour that optimum for noodle making is 28 – 39 percent.

The purpose of this study was to determine the best physical properties and chemical properties of the treatment in the comparison of the use of goroho banana flour and cornstarch in the manufacture of dry noodles

RESEARCH METHODS

1. Time and Location

This research activity was carried out at the Biology laboratory of Manado State University during the research in February – April 2022.

2. Noodle Making Process

The process of making goroho banana noodles begins with the process of weighing ingredients, namely goroho banana flour measuring 60 mesh as much as 350 grams, corn flour measuring 60 mesh as much as 150 g, salt as much as 5 g and water as much as 200 ml. Salt is useful for giving flavor, strengthening the texture of noodles, increasing the flexibility and elasticity of noodles and for binding water. Water serves as a salt binder and helps the gelatinization process when the dough is steamed (Winarno, 2008). The amount of water greatly determines the stickiness of M. so that the water added is too little, the gelatinization process is less than perfect so that the starch is gelatinized which is produced a little and has not been able to bind the dough properly. However, if the addition of water is too much, the dough is too cooked. Overcooked dough causes the resulting noodle strands to become sticky due to the large amount of solids that diffuse out of the starch (Susilawati, 2007).

The first mixing process is mixing 70 percent of the parts of goroho banana flour and cornstarch, which is 350 grams with 5 grams of salt dissolved in 200 ml of water. The goal is that the steamed dough will produce a dough that is not sticky to the roller of the sheeting machine and plastic glue so that it can be thinned. Mixing materials is carried out using a mixer tool.

The dough that has been mixed is then steamed for 15 minutes using a steambox, which is used to thicken some of the starch (about 70 percent) so that it can act as a dough binder. If the steaming is not done, then the dough cannot be shaped and molded into noodles. this is because the endosperm protein of the goroho banana contains a lot of Zein (60 percent) which cannot form an elastic-cohesive dough mass when only added water and kneaded, as well as gliadin and glutelin in wheat (Soraya, 2006).

After steaming, the second mixing is done, namely the dough mixed with 30 percent of the part of the goroho banana flour and corn flour that has not been mixed (as much as 150 grams) mixing is done using a mixer until the dough is evenly mixed.

After the dough is evenly mixed, then the dough compaction process is carried out toincrease the degree of gelatinization. The compaction of the dough causes more amylose to come out of the starch granules and serves as a binder to the components of the dough. Sel ain the compaction of the dough also increases the compression in the dough. Compression causes the dough to be more compact and easily shaped into sheets (Susilawati, 2007). Compaction of the dough using a compactor with a press-thread system and is carried out as much as 2 times compaction.

The process of forming sheets and cuttingmenj a in the noodle strands is carried out using a noodle printer. In the process of forming B Aran glue, the dough is thinned using a roll press repeatedly (8-10 times) with a roll press distance setting until it reaches a thickness of 1.6 – 2 mm, during this pressing process, the mi sheets are pulled in one direction so that the fibers are aligned. According to Astawan (2005) smooth and unidirectional fibers will result in an mi that is smooth, chewy, and quite elastic. Next, the dough sheets are cut into strands of noodles anda noodle printing machine (Slitter).

The steamed mi strands are printed using a steam box at a temperature of 95-100 °C for 20 minutes with the aim of perfecting the starch gelatination process so that the noodles produced are more elastic and chewy. Steamed noodle strands are then dried with sunlight for approximately 4-6 hours depending on weather conditions. The process of making goroho banana noodles can be seen in figure 1.

Trial Design

The treatment used in this study was flour from goroho banana and corn flour in a ratio of 1) 50: 50, 2) 60: 40, 3) 70: 40, each treatment di ulang as many as 3 times.

Analysis

The parameters analyzed in each treatment were the physical properties of dry noodles, namely elongation, hardness, stickiness, chewiness and yield while the chemical properties were: Water, Fat, Starch, Protein, Crude Fiber and Ash. The treatment selected from each parameter is the one that meets the condition category as shown in table 1

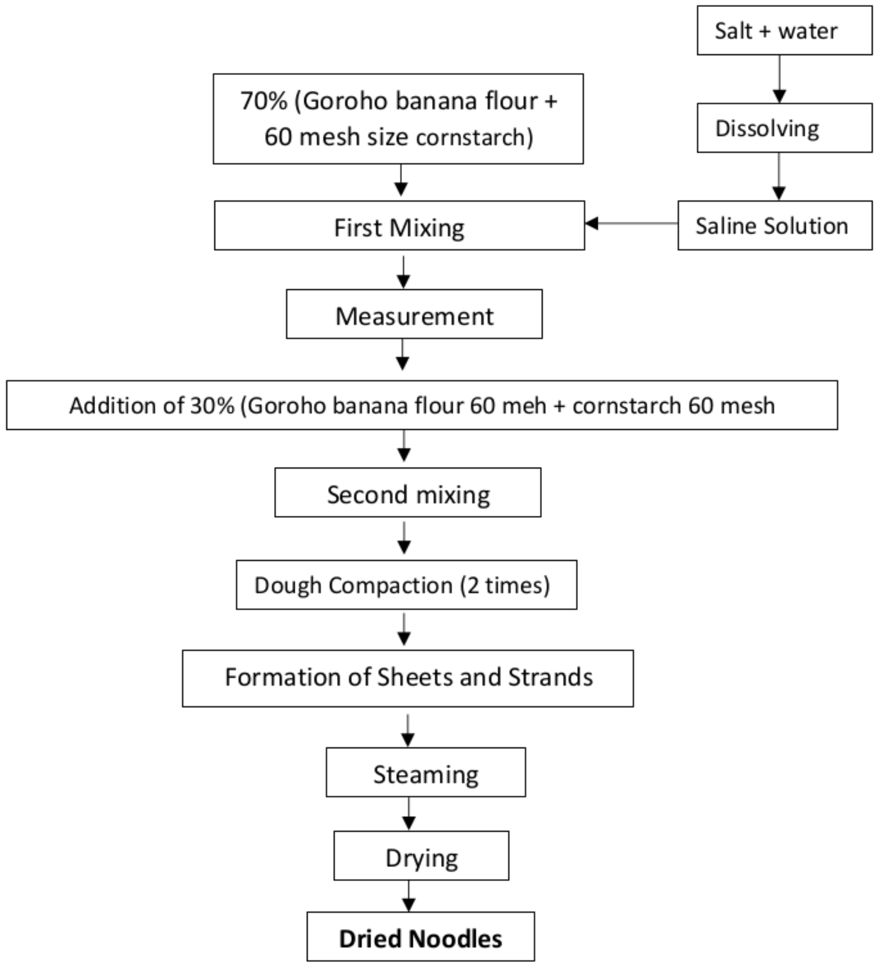

Figure 1. Dry Noodle Making Process

Table 1. Parameters and Categories of Best Treatment Conditions

No	Parameters	Condition Category
1.	Elongation	Highest
2.	Violence	Highest
3.	Stickiness	Lowest
4.	Resilience	Highest
5.	Amendments	Highest

The results of table 1 will be selected the treatment with the highest number of fulfillment of the condition category and then in the chemical properties analysis.

Physical Properties Analysis

Analysis of physical properties includes:

1. Manual elongation is the percent increase in the maximum length amount (ml) that undergoes a pull sehas not broken. Manual elongation measurements are carried out by pulling the noodles that are measured in length (15 cm) and then slowly pulling until they break. Furthermore, the final panjan of mi is measured and calculated the elongation value with the formula:

$$elongation\ (\%) = \frac{(\text{initial length} - \text{final length})}{\text{initial length}}\, x\ 100\%$$

In addition to manually the percent elongation is analyzed also using the TA type Texture Analyzer tool. XT2i (A/SPR probe, probe distance 20 mm, probe speed 3 mm/s; trigger auto 5 g).

2. Texture Profile Analysis (TPA) including hardness, stickiness, suppleness is analyzed using the TA type *Texture Analyzer* tool . X2Ti (SMSP/35 probe; probe distance 20 mm; *probe* speed 1 mm/s; trigger auto 5 g; and distance 50 percent).

3. The amendment is calculated from the ratio between the result and the starting material multiplied by 100 percent.

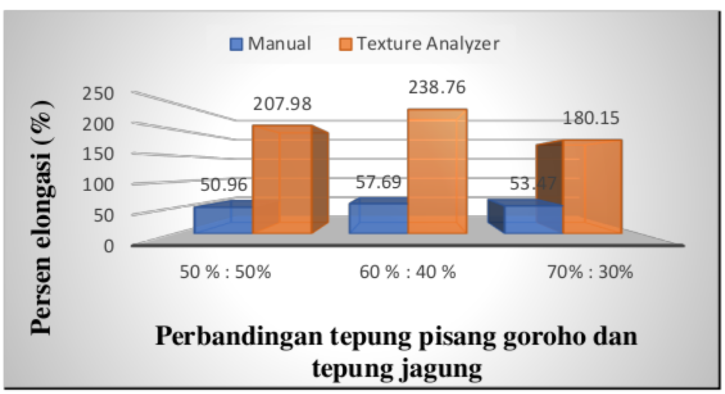

Figure 2. Percent Elongation of Dry Noodles

Hardness is defined as the highest peak, i.e. the maximum force describes the forceof the probe to press the mi. The higher the peak of the curve (*Peak*), the higher the hardness value of the noodles.

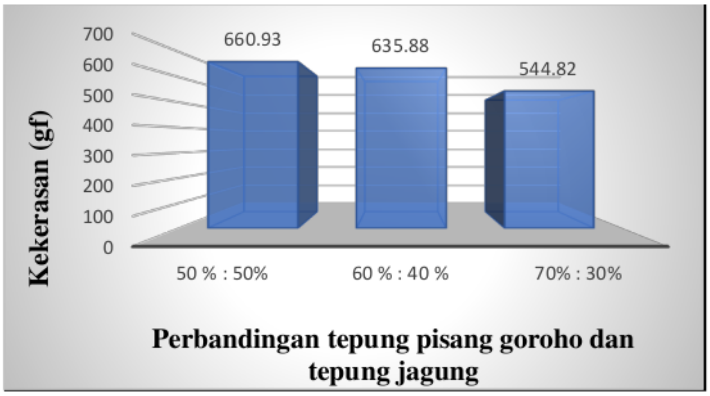

Figure 3. Dry Noodle Hardness

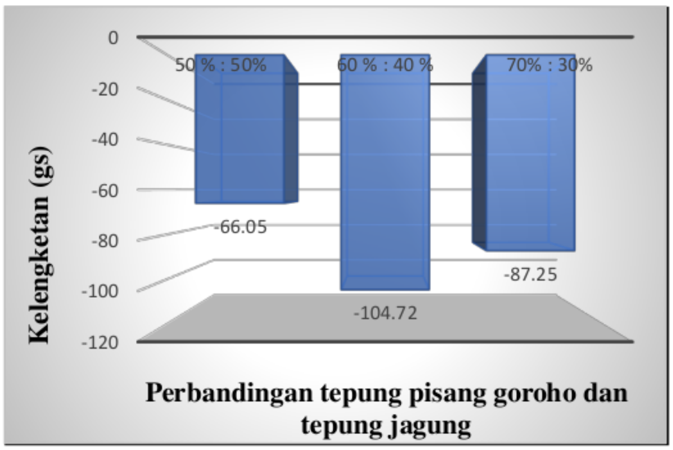

Figure 4. Stickiness of Dried Noodles

Stickiness is defined as absolute (-) *peak* which describes the magnitude of the effort to pull the *probe* off the sample. The larger the negative area shown by the curve, the higher the stickiness value of the noodles. Meanwhile, *choesiveness* is the ability of a material to return to its original shape if given a force and then the force is removed again.

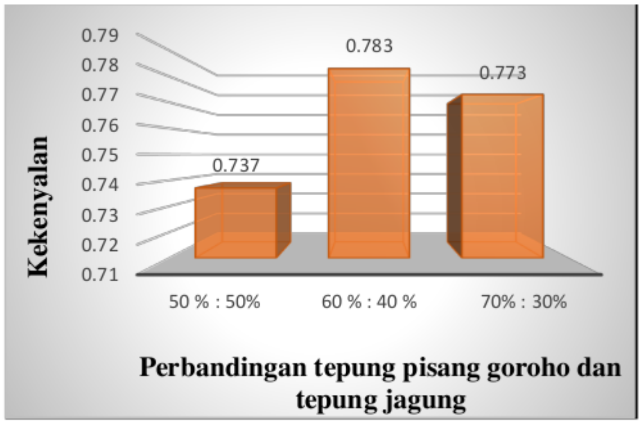

Figure 5. Chewiness of Dried Noodles

The amendment relates to the large amount of bioactive content contained. The higher the yield, the higher the content of substances that are interested in a raw material.

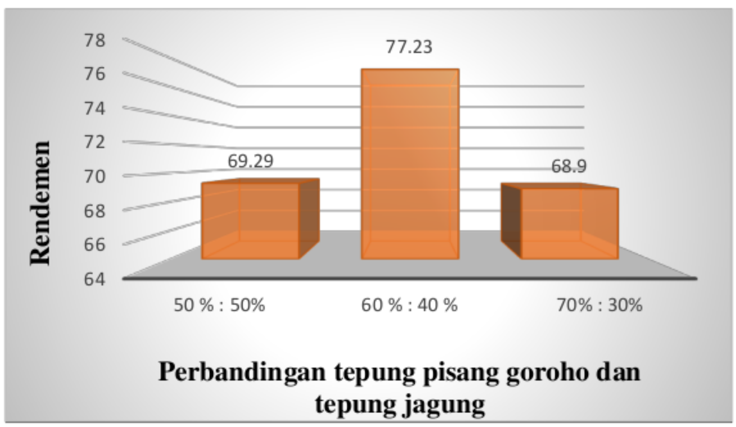

Figure 6. Dry Noodle Amendment

Analysis of chemical properties

Analysis of chemical properties includes: Water content with the SNI.01-2891-1992 method item 5.1; ash content with the SNI.01-2891-1992 grain 6.1 method; fat content with the SNI method. 01-2891-1992 grain 8.1; protein content by the SNI method. 0.1-2891-1992 grain 7.1; and carbohydrate levels by the reduction method.

RESULTS AND DISCUSSION

1. Elongation

Mi with high elongation percent shows the characteristics of noodles not easily broken. This trait is important because consumers don't want noodles that crumble when cooked. Percent elongation manually and using the Texture Analy zer toolcan be seen in Figure 1.

The percent of mi elongation ranges from 180.15 to 238.76 percent. From Figure 2, it shows that the higher the ratio of goroho banana flour and corn flour, the higher the elongation of noodles produced with the highest at a ratio of 60 percent: 40 percent. The highest percent of elongation both manual and using the Texture Analyzer tool was produced by the treatment of the use of flour from goroho bananas and corn flour 60 percent: 40 percent, respectively, 57.69 percent and 238.76 percent.

The higher the ratio of goroho banana flour and cornstarch causes the higher elongation of noodles. According to Susimo and Damardjati (1992), the higher the starch content in noodles, the higher the water absorption because the gelatinization is higher. With the ability torap high water, noodles with a chewy texture and not easily broken can be obtained (Rosmeri, 2013). In addition, amylose also plays a role in shaping the texture of noodles. Highamylose acid will form a steep and strong structure so that water cannot be absorbed into starch molecules. Therefore, if the amylose content in the flour is lowered, the noodles formed will have a better texture (Toyokawa, et al., 1989). Maize flour has a starch content of 60.07 percent, amylose of 22.88 percent and amylopectin of 37.19 percent (Ekafitri, et al., 2011). Meanwhile, goroho banana flour has an average starch content ranging from 76.74 – 81.35 percent and the average amylose content of goroho banana flour is between 39.59 percent and amylopectin is 31.19 percent (Nurali, et al., 2012). It is suspected that the comparison of goroho banana flour and 60: 40 corn flour produces the highest elogation due to the optimum amylose content in noodle making. Jarnsuwan and Thongngam (2012) stated that the optimum level of amylose in flour in noodle making is 28 – 39 percent.

Hardness, Suppleness, and Stickiness of dried Noodles.

The hardness of mi yang produced ranged from 544.83 gf to 869.44 gf (Figure 3). The higher the ratio of the use of goroho banana flour and corn flour, the hardness of the noodles produced tends to decrease. Meanwhile, the treatment of the use of flour from goroho bananas tends to increase along with the higher ratio of goroho banana flour and corn flour.

In the study of Nurali, et al., (2012) it was stated that theamylose content of goroho banana flour was 39.59 percent. Meanwhile, the amylose content of corn flour is 22.88 percent (Ekafitri, et al., 2011). The amylose content of goroho banana flour is higher than the amylose content of corn. Amylose components are related to water absorption and the perfection of the product gelatinization process (Andrawulan, et al., 1997). The higher the amylose content, the higher the rehydration power of the product. It is suspected that the more use of goroho banana flour in the ratio of corn flour the amylose content in mixed flour will decrease. Noodles made from flour that contains high amylose, will produce noodles with high hardness, *chewiness*, and *gumminess* Guo, et al., 2003).

The hardness of the wheat flour noodle standard obtained from the research of Diniyati (2012) which is wheat flour noodles 100 percent obtained a hardness value of 61 8.64 gf. The hardness value of the noodles produced is closest to the wheat noodle standard obtained from the treatment of the use of flour from goroho bananas and corn flour 6 0 percent: 40 percent, which is 635.88 gf.

It appears in Figure 5 that, the chewiness of the noodles produced ranges from 0.737 – 0.783. The higher the ratio of the use of goroho banana flour and corn flour, the higher the chewiness of the noodles produced. The higher the starch content in the noodles, the higher the water absorption due to the gelatinization process. With the ability to absorb high water, noodles can be obtained with a chewy texture and not easily broken (Rosmeri, 2013). The highest chewiness was produced by the treatment of the use of goroho banana flour and corn flour 60 percent: 40 percent, which was 0.783.

This is thought to be due to the content of amylose and amylopectin in the raw materials used. Basically, amylose will play a more role during the gelatinization process and determine the character of the starch paste more. Amylose can also strengthen the strength of the gel because the durability of the molecules inside the granules increases (Satin, 2001). The higher the amylose content, the easier it will be for the product to retrograde. The ratio between goroho banana flour and cornmeal is 60 percent: 40 percent is thought to increase amylose levels until it reaches optimum amylose levels in noodle dough so as to produce chewier noodles (Rosisah, 2009). This is supported by smith (1982) also shows that high amylose starchy ang has a greater hydrogen binding strength due to the large number of straight chains in the granules, so it requires greater energy for gelatinization so that the noodles that are crushed are more chewy.

It appears in Figure 4 that the stickiness of the resulting noodles ranges from (-66.05) to (-104.72) gf. The larger the negative area indicated by the curve, the higher the stickiness value of the noodles. Figure 4 shows that the higher the ratio of goroho banana flour and corn flour, the higher the stickiness value of the noodles produced. Consumers want noodles that are not sticky with other strands of noodles (lumpy), noodles that are not sticky in the cutlery, and noodles that are not sticky when chewed. The lowest stickiness is produced by the treatment of the use of flour from goroho banana and corn flour in a ratio of 50 per cent: 50 percent, which is -66.05 gf.

The higher the ratio of goroho banana flour is thought to cause high levels of amylopectin in the flour mixture. Stickiness on the surface of the noodles is caused because the amylopectin molecules form *amorphous* or less compact regions so that they are easier to penetrate water, enzymes, and chemicals (Alam et al., 2008). Amylopectin levels that are too high will cause the noodle dough made to be too sticky. This is because amylopectin is difficult to retrograde to maintainn mi structure (Tam, et al., 2004).

Amendments

The yield of mi yields ranges from 69.29 percent to 77.23 percent (Figure 6) the higher the comparison of the use of goroho banana flour , the higher the yield of noodles. The highest yield was produced by the treatment of the use of flour from banana goroho and corn flour with a ratio of 60 percent: 40 percent , which is 77.23 percent. According to Susimono and Damardjati (1992), the high yield of noodles produced indicates the ability of starch to absorb high water as well. It is suspected that the higher the ratio of goroho banana flour and corn flour, the higher the starch content in the mixed flour. After analyzing the physical parameters of each treatment as presented in Figure 2 to figure 6, a treatment that meets the category of conditions is obtained as shown in table 1.

From table 1, that treatment with the ratio of goroho banana flour and corn flour 60 percent: 40 percent is the best. The noodles from the best treatment are then analyzed for chemical properties as listed in table 2.

Table 2. Chemical Analysis of Dried Noodles

No	Analysis	Unit	Result
1.	Water	Percent (w/w)	9,83
2.	Fat	Percent (w/w)	0,91
3.	Starch	Percent (w/w)	73,84
4.	Protein	Percent (w/w)	7,07
5.	Crude Fiber	Percent (w/w)	1,73
6.	Ash	Percent (w/w)	1,29

The best mi chemical analysis results were water content of 9.83 percent, fat 0.91 percent, protein 7.07 percent, ash 1.29 persen, crude fiber 1.73 percent, and starch 73.84 percent (Table 2). The results showed that the noodles produced had met the requirements of the noodle quality standards contained in SNI 01-2974-1996. SNI Mi dry (01-2974-1992) provides the following limitations: maximum moisture content of 10 percent (w/w); maximum ash content of 1.5 percent (w/w) and protein (non-wheat) of at least 4 percent (w/w). This study also compared with the research of Ratnaningsih, et al., (2010) with noodle products made from composite flour (corn, cassava, sweet potatoes, and wheat) with the results of chemical analysis: water (6.40 – 8.43 percent), ash (1.48 – 2.23 percent), fat (0.55 – 1.93 percent) and protein (9.32 – 11.85 percent). The moisture content of the mi from the study was higher when compared to the moisture content ofcomposite flour noodles. The ash and fat content of the noodles produced is within the range of ash and fat content of composite flour noodles. As for the protein content, it is lower than the protein content of composite flour noodles.

Conclusion

The use of flour from goroho bananas with a ratio of goroho banana flour and cornmeal 60 percent: 40 percent produces the best dry noodles. The physical properties of the noodles produced were elongation of 238.76 percent; hardness of 635.88 gf; suppleness of 0.783 gf; and amendments of 77.23 per cent. The chemical properties of the noodles produced are water content of 9.83 percent, fat 0.91 percent, protein 7.07 percent, ash 1.29 percent, crude fiber 1.73 percent, and starch 73.84 percent.

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