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# Analysis of Physical and Chemical Properties in Comparison Using Goroho Banana Flour (Musa acuminate) and Corn Flour (Zea mays) in the Production of Dry Noodles

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**Annotation:** Goroho banana flour (Musa acuminate) and corn flour (Zea mays) are non-wheat flours which have quite high starch content, so they have the potential to be used as noodles. The quality of goroho banana flour is influenced by its starch content. The higher the level of substitution of goroho banana flour added, the starch content increases, 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 of the comparison of the use of goroho banana flour and corn flour in the manufacture of dry noodles. The process of making noodles consists of mixing ingredients, steaming, compacting dough, forming sheets and strands, steaming noodles, drying and packaging. The treatment used is flour from goroho bananas and corn flour which is 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 resulting noodles, namely elongation of 238.76 percent; hardness of 635.88 gf; elasticity of 0.783 gf; and yield of 77.23 percent. The chemical properties of the noodles produced were 9.83 percent water content, 0.91 percent fat, 7.07 percent protein, 1.29 percent ash, 1.73 percent crude fiber, and 73.84 percent starch. With the physical properties of the resulting noodles, namely elongation of 238.76 percent; hardness of 635.88 gf; elasticity of 0.783 gf; and yield of 77.23 percent. The chemical properties of the noodles produced were 9.83 percent water content, 0.91 percent fat, 7.07 percent protein, 1.29 percent ash, 1.73 percent crude fiber, and 73.84 percent starch. With the physical properties of the resulting noodles, namely elongation of 238.76 percent; hardness of 635.88 gf; elasticity of 0.783 gf; and yield of 77.23 percent. The chemical properties of the noodles produced were 9.83 percent water content, 0.91 percent fat, 7.07 percent protein, 1.29 percent ash, 1.73 percent crude fiber, and 73.84 percent starch.

**Keywords:** Gogoroho banana flour, corn flour and dry noodles

## INTRODUCTION

Noodles are one of the most popular dishes in Asia, one of which is in Indonesia. It is a pity that 100 percent of the raw material for noodles, namely wheat flour, is obtained from imports. To reduce dependence on wheat

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flour, local raw materials have begun to be used to replace wheat flour which can be processed into commercial food products. Local food products that have the potential to substitute wheat include goroho bananas (Musa acuminate) and corn (Zea mays). Goroho bananas are North Sulawesi specific bananas. Processing of goroho bananas into flour is a form of local food diversification which makes goroho bananas have added value, namely they can be used as raw materials for making noodle products. The process of processing goroho banana flour can use relatively simple technology compared to tapioca flour processing so that it can be made easily and quickly and does not require a lot of water and a large processing area. Flour derived from Gogoroho bananas has a fairly high starch content, so it is suitable for meeting the calorie needs of food. In addition to the availability of large 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 its starch content. According to Sondakh (1990), the starch content of Goroho bananas is 80.89%, carbohydrates are 75.18%, protein is 5.16%, fat is 0.9%, water content is 11.99%, total sugar is 1.83% and crude fiber is 2. %. From these data it is evident that the potential for developing goroho bananas as an alternative food sourced from carbohydrates is very large because the starch content is quite high, namely 80.89%, and 1.83% sugar, so it is safe for consumption by people who suffer from diabetes (Diabetes militus). Therefore, goroho banana flour can be used for a variety of processed products, such as cakes and pastries, such as cakes, biscuits, brownies and dry noodles.

The higher the level of substitution of goroho banana flourthe starch content increases, because banana goroho flour has a higher starch content than wheat flour. Suismono and Darmadjati (1992) stated that the higher the starch content in noodles, the higher water absorption due to higher gelatinization. With a high ability to absorb water, you can get noodles with a chewy texture and do not break easily (Rosmeri and Monica, 2013). To utilize goroho banana flour as an ingredient for 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, lutein and zeaxanthin compounds (Juniawati, 2003). So that in making corn noodles there is no need to use additional dyes. Furthermore, according to 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 was 60.07 percent with amylose content of 22.88 percent and amylopectin 37.19 percent (Ekafitri, 2011) Jarnsuwan and Thongngam (2012) stated that the optimum amylose content in flour for making noodles was 28 – 39 percent. 78% consists of 39.59% amylose and 31.19% amylopectin. While the starch content in corn flour was 60.07 percent with amylose content of 22.88 percent and amylopectin 37.19 percent (Ekafitri, 2011) Jarnsuwan and Thongngam (2012) stated that the optimum amylose content in flour for making noodles was 28 – 39 percent. 78% consists of 39.59% amylose and 31.19% amylopectin. While the starch content in corn flour was 60.07 percent with amylose content of 22.88 percent and amylopectin 37.19 percent (Ekafitri, 2011) Jarnsuwan and Thongngam (2012) stated that the optimum amylose content in flour for making noodles was 28 – 39 percent.

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

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## RESEARCH METHODS

1. Time and Location

This research activity was carried out in the Biology Laboratory, Manado State University during research in February - April 2022.

2. Noodle Making Process

The process of making goroho banana noodles begins with the process of weighing the ingredients, namely 350 grams of goroho banana flour with a size of 60 mesh, 150 grams of corn flour with a size of 60 mesh, 5 grams of salt and 200 ml of water. Salt is useful for giving taste, strengthening the texture of noodles, increasing the flexibility and elasticity of noodles and for binding water. Water functions 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 the M. so that too little water is added, the gelatinization process is imperfect so that a little gelatinized starch is produced and cannot bind the dough properly. However, if you add too much water, the dough will be too cooked.

The first mixing process is mixing 70 percent of the goroho banana flour and corn flour, which is as much as 350 grams with 5 grams of salt dissolved in 200 ml of water. The goal is that the steamed dough will produce dough that doesn't stick to the sheeting machine rollers and the sheets are plastic so they can be thinned. Mixing of ingredients is done using a mixer.

The mixed dough is then steamed for 15 minutes using a steambox (Steambox) with the aim of gelatinizing some of the starch (about 70 percent) so that it can act as a binder for the dough. If steaming is not done, the dough cannot be shaped and printed into noodles. This is because the endosperm protein of Goroho banana contains a lot of Zein (60 percent) which cannot form an elastic-cohesive dough mass when only water is added and kneaded, like gliadin and glutelin in wheat (Soraya, 2006).

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

After the mixture is evenly mixed, then the process of compacting the dough is carried out to increase the degree of gelatinization. Dough compaction causes more amylose to come out of the starch granules and serves as a binder for the dough components. In addition, the compaction of the dough also increases the compression of the dough. Compression makes the dough more compact and easier to form into sheets (Susilawati, 2007). The dough was compacted using a compactor with a press-screw system and compaction was carried out 2 times.

Sheet forming and cutting process menjSo the noodle strands are done using a noodle printer. In the sheet forming process, the dough is thinned using a roll press repeatedly (8-10 times) by setting the roll press spacing until it reaches a thickness of 1.6 – 2 mm. During this pressing process, the noodle sheets are pulled in one direction so that the fibers parallel fibers. According to Astawan (2005) fine and unidirectional fibers will produce noodles that are smooth, supple and quite elastic. Furthermore, the dough sheet is cut into noodle strands with a noodle printer (Slitter).

The printed noodle strands are steamed using a steam box at a temperature of 95-100°C for 20 minutes with the aim of perfecting the starch gelatinization process so that the resulting noodles are more elastic and chewy. Strands of noodles that have been steamed are then dried in the sun for approximately 4-6 hours depending on weather conditions. The process of making this goroho banana noodle can be seen in Figure 1.

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**Experimental design**

The treatment used in this study was flour from goroho bananas and corn flour with a ratio of 1) 50 : 50, 2) 60 : 40, 3) 70 : 40, each treatment di repeated 3 repetitions.

**Analysis**

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

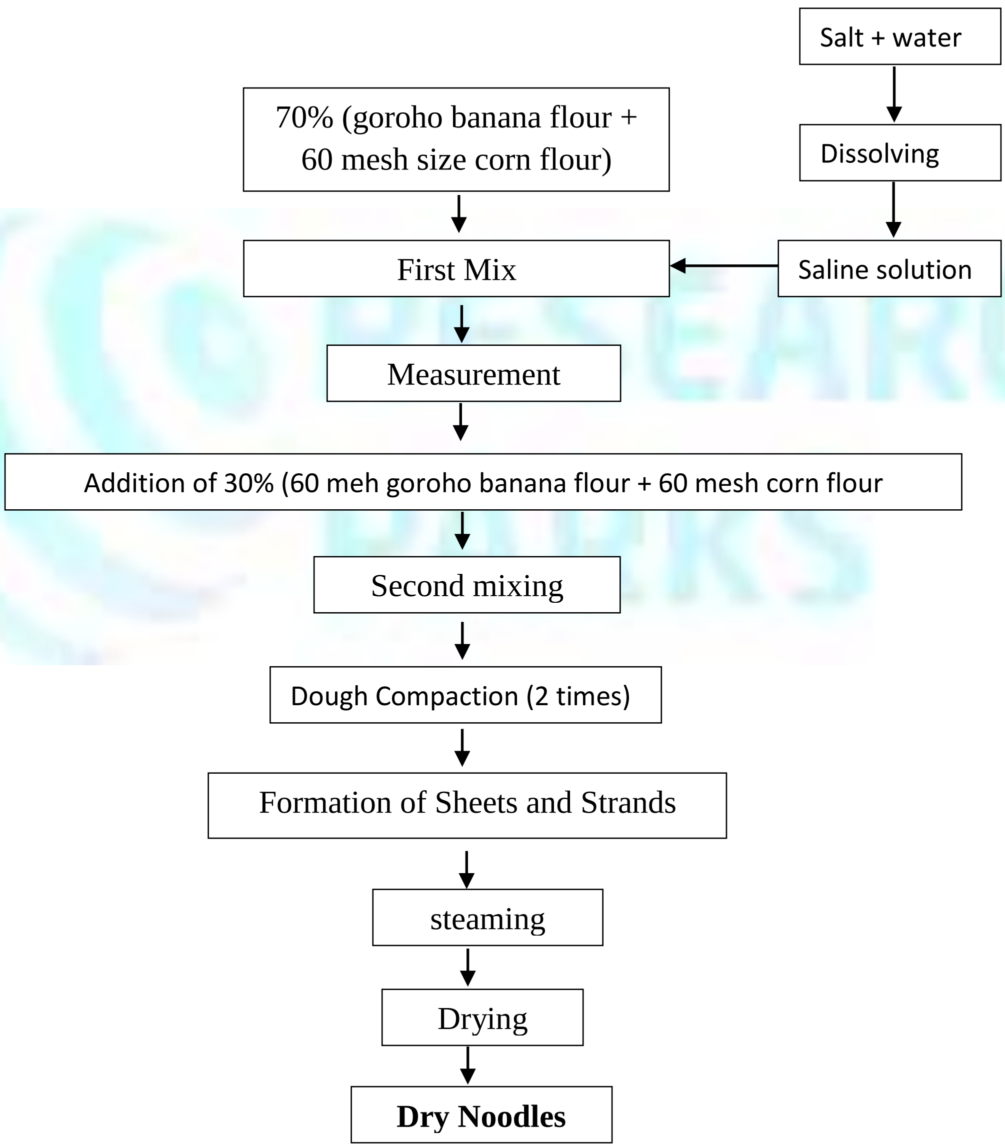


Figure 1. The Process of Making Dry Noodles

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**Table 1.** Parameters and Categories of Best Treatment Conditions

| No | Parameter | Condition Category |
|---|---|---|
| 1. | elongation | The tallest |
| 2. | Violence | The tallest |
| 3. | Adhesiveness | The lowest |
| 4. | Elasticity | The tallest |
| 5. | yield | The tallest |

The results from table 1 will select the treatment that fulfills the highest number of condition categories and then analyze its chemical properties.

**Physical Properties Analysis**

Analysis of physical properties includes:

1. Manual elongation is the percent increase in the maximum length (ml) that experiences tension before breaking. Manual measurement of elongation is carried out by pulling the noodles whose length is measured (15 cm) and then slowly pulling them until they break. Then the final length is measured and the elongation value is calculated using the formula:

$$elongasi\ (\%) = \frac{(\text{panjang akhir} - \text{panjang awal})}{\text{panjang awal}}\, x\ 100\%$$

Apart from manually analyzing the percent elongation, we also used a Texture Analyzer type TA.XT2i (A/SPR probe, 20 mm probe distance, 3 mm/s probe speed; 5 g auto trigger).

2.Texture Profile Analysis (TPA) including hardness, tackiness, elasticity was analyzed using a Texture Analyzer type TA.X2Ti (Probe SMSP/35; probe distance 20 mm; probe speed 1 mm/s; trigger auto 5 g; and distance 50 percent).

3. The yield is calculated from the comparison between the yield and the starting material multiplied by 100 percent.


Figure 2. Percent Elongation of Dry Noodles

Hardness is defined as the highest peak, which is the maximum force describing the force of the probe to suppress noodles. The higher the peak of the curve (Peak), the higher the noodle hardness value.

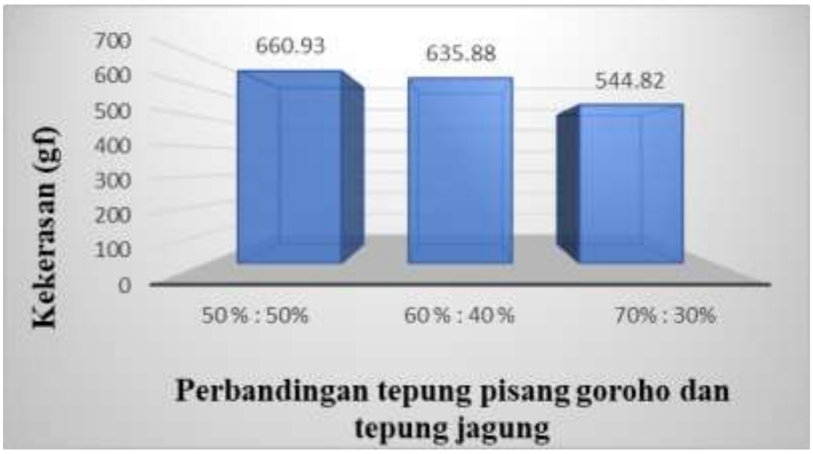


**Figure 3. Hardness of Dried Noodles**

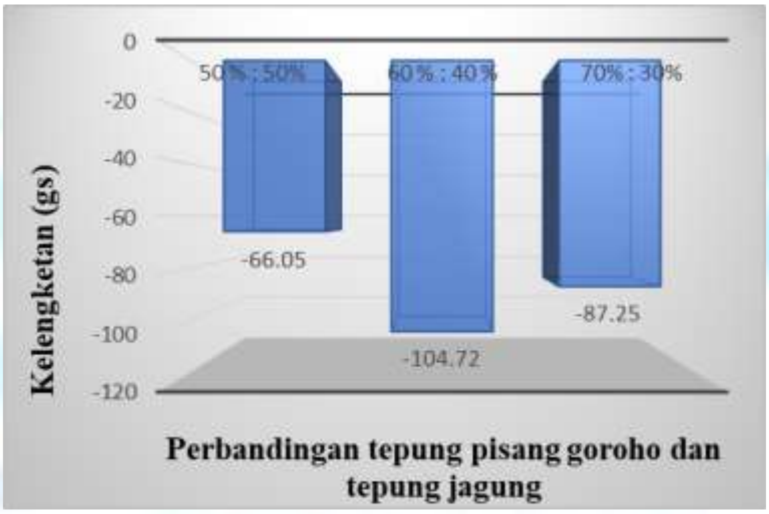


**Figure 4. Stickiness of Dry Noodles**

The stickiness is defined as the absolute (-) peak which describes the amount of effort to pull the probe off the sample. The greater the area of the negative area shown by the curve, the higher the noodle's adhesiveness value. Meanwhile, elasticity (choesiveness) is the ability of a material to return to its original shape when given a force and then the force is released again.

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**Figure 5. The elasticity of dry noodles**

The yield is related to the amount of bioactive content contained. The higher the yield, the higher the content of the substance interested in a raw material.


**Figure 6. Yield of Dry Noodles**

**Chemical Properties Analysis**

Analysis of chemical properties includes: Moisture content using SNI.01-2891-1992 point 5.1 method; ash content using SNI.01-2891-1992 method point 6.1; fat content with SNI method. 01-2891-1992 point 8.1; protein content by SNI method. 0.1-2891-1992 point 7.1; and carbohydrate content by reduction method.

**RESULTS AND DISCUSSION**

1. Elongation

Noodles with a high percent elongation show the characteristics of noodles that are not easily broken. This property is important because consumers do not want the noodles to disintegrate when cooked. Percent elongation manually and using the Texture Analyzer tool can be seen in Figure 1.

The percent elongation of noodles ranged 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 the noodles produced, with the

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highest ratio being 60%: 40%. The highest percentage of elongation both manually and using the Texture Analyzer tool was produced by the treatment of using goroho banana flour and corn flour 60% : 40%, namely 57.69% and 238.76% respectively.

The higher the ratio of goroho banana flour and corn flour causes the higher the noodle elongation. According to Susimo and Damardjati (1992) the higher the starch content in the noodles, the higher the water absorption due to the higher occurrence of gelatinization. With a high ability to absorb water, you can get noodles with a chewy texture and do not break easily (Rosmeri, 2013). In addition, amylose also plays a role in forming the texture of noodles. High levels of amylose will form a solid and strong structure so that water cannot be absorbed into the starch molecules. Therefore, if the amylose content in the flour is lowered, the noodles that are formed will have a better texture (Toyokawa, et al., 1989). Corn 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, banana goroho flour has an average starch content ranging from 76.74 – 81.35 percent and an average amylose content of goroho banana flour is between 39.59 percent and amylopectin 31.19 percent (Nurali, et al., 2012). It is suspected that the ratio of goroho banana flour and corn flour 60 : 40 produces the highest elongation because of the optimum amylose content in noodle making. Jarnsuwan and Thongngam (2012) stated that the optimum amylose content in flour for making noodles was 28-39 percent. 40 produced the highest elongation due to the optimum amylose content in noodle production. Jarnsuwan and Thongngam (2012) stated that the optimum amylose content in flour for making noodles was 28-39 percent. 40 produced the highest elongation due to the optimum amylose content in noodle production. Jarnsuwan and Thongngam (2012) stated that the optimum amylose content in flour for making noodles was 28-39 percent.

**Hardness, Tackiness, and Stickiness of dry noodles.**

The hardness of the noodles 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 tends to decrease. Whereas in the treatment the use of flour from goroho bananas tends to increase as the ratio of goroho banana flour and corn flour increases.

In researchNurali, et al., (2012) stated that the amylose content of Goroho banana flour was 39.59 percent. While the amylose content of corn flour is 22.88 percent (Ekafitri, et al., 2011). The amylose content of goroho banana flour was higher than the amylose content of corn. The amylose component is related to water absorption and the perfection of the product gelatinization process (Andrawulan, et al., 1997). The higher the amylose content, the higher the product rehydration power. 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 containing high amylose will produce noodles with high hardness, chewiness, and gumminess (Guo, et al., 2003).

The hardness of the standard wheat flour noodles obtained from Diniyati's research (2012) which is 100 percent wheat flour noodles obtained a valuehardness 618.64 gf. The hardness value of the noodles that is closest to the standard of wheat noodles is obtained from the treatment of using goroho banana flour and 60%: 40% corn flour, which is 635.88 gf.

Shown in Fig5 that, the elasticity of the noodles produced ranged from 0.737 – 0.783. The higher the ratio of the use of goroho banana flour and corn flour, the higher the elasticity of the noodles produced. The higher the starch content in the noodles, the higher the water absorption due to the gelatinization process. With a high ability to absorb water, you can get noodles with a chewy texture and do not break easily (Rosmeri, 2013). The highest elasticity was produced by the treatment using goroho banana flour and 60%: 40% corn flour, which was 0.783.

This is presumably due to the content of amylose and amylopectin in the raw materials used. Basically amylose will play a greater role during the gelatinization process and determine more the character of the starch paste. Amylose can also strengthen the strength of the gel because the resistance of the molecules in the granules increases (Satin, 2001). The higher the amylose content, the easier the product will experience retrogradation. The ratio between goroho banana flour and corn flour 60 percent: 40 percent is thought to increase the amylose content until it reaches the optimum amylose content in noodle dough so as to produce noodles that are more chewy (Rosisah, 2009). This was supported by Smith (1982) who also showed that starch with high amylose content had greater hydrogen binding strength due to the large number of straight chains in the granules.

It can be seen in Figure 4 that the stickyness of the noodles produced ranged from (-66.05) to (-104.72) gf. The greater the area of the negative area shown by the curve, the higher the noodle's adhesiveness value. Figure 4 shows that the higher the ratio of goroho banana flour and corn flour, the higher the sticky value of the noodles produced. Consumers want noodles that are not sticky with other noodle strands (clumped), noodles that are not sticky on cutlery, and noodles that are not sticky when chewed. The lowest stickiness was produced by the treatment using flour from goroho bananas and corn flour with a ratio of 50 percent: 50 percent, namely -66.05 gf.

The higher ratio of goroho banana flour is thought to cause high levels of amylopectin in mixed flour. The stickiness on the noodle surface is caused by the amylopectin molecules forming amorphous or less compact areas making it easier for water, enzymes and chemicals to penetrate (Alam et al., 2008). Too high levels of amylopectin will cause the noodle dough to be too sticky. This is because it is difficult for amylopectin to undergo retrogradation to maintain noodle structure (Tam, et al., 2004).

**yield**

Yields of noodles ranged from 69.29 percent to 77.23 percent (Figure 6). The higher the ratio of the use of goroho banana flour, the higher the yield of noodles produced. The highest yield was produced by the treatment using flour from goroho bananas and corn flour with a ratio of 60 percent: 40 percent, namely 77.23 percent. According to Susimono and Damardjati (1992) the high yield of noodles indicates the ability of starch to absorb water is also high. It is suspected that the higher the ratio of goroho banana flour and corn flour causes the higher starch content in the mixed flour. After analyzing the physical parameters for each treatment as presented in Figure 2 to Figure 6, the treatment that meets the condition category is obtained as shown in Table 1.

From the table1, that treatment with a ratio of goroho banana flour and corn flour 60 percent: 40 percent is the best. Noodles from the best treatment were then analyzed for their chemical properties as listed in table 2.

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**Table 2.**Dry Noodle Chemical Analysis

| No | Analysis | Unit | Results |
|---|---|---|---|
| 1. | Water | Percent (w/w) | 9,83 |
| 2. | Fat | Percent (w/w) | 0.91 |
| 3. | Starch | Percent (w/w) | 73,84 |
| 4. | Proteins | Percent (w/w) | 7.07 |
| 5. | Coarse Fiber | Percent (w/w) | 1.73 |
| 6. | Ash | Percent (w/w) | 1.29 |

The best results of chemical analysis of noodles are 9.83 percent water content, 0.91 percent fat, 7.07 percent protein, 1.29 p ashpercent, crude fiber 1.73 percent, and starch 73.84 percent (Table 2). The results showed that the noodles produced had fulfilled the quality standard requirements for noodles contained in SNI 01-2974-1996. SNI for dry noodles (01-2974-1992) provides the following limits: maximum water content of 10 percent (w/w); maximum ash content of 1.5 percent (w/w) and protein (non-wheat) at least 4 percent (w/w). This study also compared research with Ratnaningsih, et al., (2010) with noodle products made from composite flour (corn, cassava, sweet potato, and wheat) with chemical analysis results: 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 water content of the noodles from the research results was higher when compared to the water content of composite flour noodles. The ash and fat content of the noodles produced were within the range of the ash and fat content of composite flour noodles. Meanwhile, the protein content is lower than the protein content of composite flour noodles.

## CONCLUSION

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

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