Characteristics of Gluten-Free Wet Noodles Substituted with Soy Flour

F Violalita¹, Evawati¹, S Syahrul¹, H F Yanti¹, and K Fahmy²

¹ Department of Food Technology, Agricultural Polytechnic of Payakumbuh, Jalan Raya Negara KM. 7 Tanjung Pati, Kecamatan Harau, Kabupaten Limapuluh Kota, Indonesia
² Department of Agriculture Engineering, Faculty of Agriculture Technology, Andalas University, Kampus Limau Manis Padang, Indonesia

Corresponding author’s email address: violalita@yahoo.com

Abstract Noodles are food products made from flour with or without the addition of other food ingredients and additives that are permitted and have a specific shape of noodles. Generally, noodles made from flour, eggs, and water. The content of gluten in wheat flour can increase intestinal hyperpermeability, which causes gluten was digested properly, and there is flowing into the bloodstream and brain so that it affects the behavior of the autistic child. In this research, noodles were made without wheat flour, which was replaced with mocaf flour, tapioca flour, cornstarch, and soy flour. This research aims to get the best formulation in making gluten-free noodles substituted with soy flour. The stages of this research consisted of: making soy flour, making gluten-free noodles substituted with soy flour, and analyzing gluten-free noodles. The analysis conducted in this study were: water content, fat content, protein content, ash content, carbohydrate content, organoleptic analysis, cooking loss, water absorption, and elasticity of gluten-free wet noodles substituted with soy flour. In this research, soy flour was carried out with 10%, 15%, 20%, 25%, and 30% substitutions. Based on the analysis that has been done, gluten-free noodles with 15% soy flour content is the best treatment and comply with SNI 2987-2015 standards on wet noodles and are accepted by panelists. Gluten-free wet noodles with substitution of 15% soy flour have a moisture content of 61.40%, protein 7.14%, fat 4.68%, ash 0.54%, carbohydrates 23.11%, crude fiber 3.13%, cooking loose 0.646%, water absorption 1.101% and elasticity 0.283%. Based on organoleptic tests, gluten-free wet noodles have a color of 3.28 (neutral), aroma 3.20 (neutral), taste 3.44 (neutral), texture 3.72 (somewhat like), and appearance of 3.76 (somewhat like).

Keywords: Gluten-free Wet Noodles, Mocaf, Soybean, Substitute

1. Introduction
Noodle is a food that is generally made from wheat flour, which is very popular by the people of Indonesia. However, wheat cannot grow well in Indonesia, so it must be imported from wheat-producing countries. Wheat imports in 2018 reach to 10.096.299,2 tons [1]. The increasing consumption of wheat flour in Indonesia will lead to higher imports of wheat from abroad.

Wheat flour also contains gluten, which can cause an excessive immune reaction and damage the
small intestinal wall of people with celiac disease or people with autism. A food needs for children with autism are somewhat different from those consumed by normal children [2]. Food for children with autism should not contain gluten (protein in wheat flour) and casein (protein in milk). This is because autistic people did not have the main enzyme DPP-IV (dipeptidyl peptidase IV) to digest the protein. People with autism who consume gluten and casein can cause sufferers to be unconscious (spaced out) or a tendency not to care about others.

Based on this, to help autistic patients in Indonesia and reduce wheat imports, making noodles can be substituted by using local ingredients that do not contain gluten, namely mocaf flour. Mocaf flour (modified cassava flour) is flour made from cassava that has undergone a fermentation process beforehand using Lactic Acid Bacteria (LAB) [3]. Mocaf flour has physical properties that are almost the same as wheat flour, so that it can be used to make gluten-free wet noodles [4]. Mocaf contains a quite high amylopectin, which is around 83.78 ± 1.29%. Amylopectin content is high enough to provide a sticky texture to the noodles [5].

Noodles made with mocaf flour cannot resemble noodles made from wheat flour. The content of mocaf flour fibers is higher than wheat flour (12% higher than wheat flour), making the resulting noodles become more brittle and less tough [4]. So to improve the texture of the resulting noodles, need the addition of tapioca flour and maize flour. Tapioca flour has thickened characteristics and functions as a binder in the dough, while cornstarch has to soften dough characteristics [6].

Noodles made from composite flour consisting of mocaf flour, tapioca, and maize do not meet protein levels according to the Indonesian National Standard (SNI), which is 8% [7]. Increase the protein content of gluten-free noodles, and it is necessary to add protein sources from other ingredients, including soybeans.

Soybeans are one type of beans that is quite potential to be developed. Soybeans have a high enough protein content of 35-38%, where soy protein is qualitatively composed of essential amino acids that are complete and good quality except sulfuric amino acids, which are limiting factors in soybeans [8]. The fat content in soybeans is also quite high (± 20%), where around 85% is a group of essential fatty acids (linoleic and linolenic). In addition, soy also contains fiber or dietary fiber, vitamins, and minerals.

The purpose of this research is to get the best formulation and to know the physicochemical characteristics of gluten-free noodles substituted with soy flour and is expected to reduce wheat imports to help sustainable development in Indonesia.

2. Methods

2.1 Materials
The ingredients used in making gluten-free noodles are mocaf flour, tapioca flour, maize flour and soybeans, eggs, CMC, salt, and coconut oil. The materials used in the analysis are concentrated HCl, 6.76% HCl, phenolphthalein, 20% NaOH, 0.05 N NaOH, luff reagents, 20% KI, 25% H2SO4, starch indicator, thio 0, 1 N.

The tools used for research included: pots, stoves, crockets, spoons, filters, noodles, mixers, ovens, aluminum plates, desiccators, analytical scales, porcelain cups, furnaces, kjedahl flasks, distillation devices, Erlenmeyers, pipettes drop, volume pipettes, measuring cups, goblets, burettes, funnels, soxhlets, fat flasks, upright coolers, water baths, measuring flasks, spectrophotometers, petridish, vortices, centrifuges, and incubators.

2.2 Methods
The design used in this study was a completely randomized design (CRD) with five treatments and three replications. The treatment in this study is the level of substitution of soy flour used in the manufacture of noodles, namely (10%, 15%, 20%, 25%, 30%). The data obtained were analyzed statistically by the F test, then if it had a significant effect, it was followed by the Tukey test at a 5% significance level.
2.3 Implementation
This research will be carried out in three stages, namely:

2.3.1 Making soy flour
Soybeans cleaned, sorted, washed, and soaked for 8 hours. Then, strip the skin and dried with an oven at 60°C for 12 hours. After that, the grinding process is carried out, sifting with 80 mesh sifter. The soy flour obtained was then subjected to proximate analysis (water, ash, protein, fat, and carbohydrates).

2.3.2 Making Gluten-Free Noodles (Risti, 2013 modified)
In this study, noodles were made by weighing the formulations according to the measurements and mixing the mocha flour, tapioca flour, maize flour, salt, CMC, and soy flour according to the treatment. The eggs are shaken until the process is fluffy. The egg is then put into flour, and coconut oil is added, then the mixture is kneaded until it is spread evenly. The dough that has been formed is then milled with a pasta maker with a thickness of 1 mm, then printed (cut). Printed noodles are boiled for 3 minutes in boiling water.

2.3.3 Analysis of the characteristics of Gluten-free wet noodles
Wet noodles analyzed their physicochemical characteristics including chemical properties (water, ash, protein, fat, and carbohydrates), sensory analysis (color, aroma, taste, texture and overall), crude fiber, cooking loose, water absorption, and elasticity of gluten-free wet noodles substituted with soy flour.

3. Results and Discussion
3.1 Soy flour Proximate Analysis Results
Soy flour is made from pure soybeans. The manufacturing process begins with soaking and stripping the seed coat, drying the seeds and grinding. The results of the proximate analysis of soy flour used as a substitute for making gluten-free wet noodles can be seen in Table 1.

| Composition | Amount (%) |
|-------------|------------|
| Water       | 7.57       |
| Ash         | 3.85       |
| Proteins    | 37.38      |
| Fat         | 20.80      |
| Carbohydrates | 30.39     |

These results are in accordance with [9] which states that the chemical composition of soy flour in 100 g of material is water 6.6 %, ash 1.3 %, protein 41.7 %, fat 27.1 %, carbohydrate 23.3 %, and crude fiber 3.2 %, and added by Cahyadi that soy flour has a high protein content that is equal to 34.8% soy protein has functional properties such as binding properties of water and fat, emulsifying and thickening properties [10], Soybeans also contain 1.5-3% lecithin, which is very useful for the food and non-food industries [9]. Lecithin is also called a natural emulsifier found in saturated fat soy flour. Besides, soy protein has functional properties, including water and fat binding properties, emulsifying and thickening properties, and form a thin layer.

3.2 Wet Noodles Analysis Results
3.2.1 Chemical Characteristic of Gluten-free wet Noodles Substituted with Soy Flour
3.2.1.1 Water Content
The results of the analysis showed that the substitution of soy flour in the manufacture of gluten-free wet noodles did not have a significantly different effect on the water content produced. The more substitute for soy flour, the water content of noodles tends to increase. This is because gluten-free noodles have starch that can absorb water when heated. Starch granules will expand in hot water after passing a certain temperature [11]. The process of developing starch granules can be reversible if it
does not pass the gelatinization temperature and will not be reversible (irreversible) if it has reached the gelatinization temperature. The presence of fiber (polysaccharides) in the material also affects the water absorption process [12]. High fiber content will increase the ability to absorb water. This happens because in the fiber, there are quite a number of polar free hydroxyl groups. The water content of gluten-free wet noodles with substitution of soy flour can be seen in Table 2.

Table 2 water content of gluten-free wet noodles substituted with soy flour

| Treatment                  | Water content (%) |
|----------------------------|-------------------|
| Substitute soy flour 10 %  | 57.98             |
| Substitute soy flour 15 %  | 61.18             |
| Substitute soy flour 20 %  | 61.55             |
| Substitute soy flour 25 %  | 61.82             |
| Substitute soy flour 30 %  | 63.55             |

Note: The numbers on the same line followed by the same lowercase letters show no significant difference at the 5% level.

When compared with SNI 2987-2015 standards on wet noodles, namely the maximum moisture content of wet noodles is 65%. Based on this, gluten-free wet noodles with flour substitution have fulfilled the SNI requirements that have been determined.

3.2.1.2 Ash Content

From the results of the analysis conducted, the substitution of soy flour in the manufacture of gluten-free wet noodles did not have a significantly different effect on the ash content produced. Ash content indicates organic components present in an ingredient [13]. The level of gluten-free wet ash is influenced by the use of raw materials used, such as the use of soy flour, mocaf flour, maize flour, and other ingredients. Based on the results of the analysis, soy flour contains 3.85% ash. In 100 gr soybeans contain 227 mg of calcium, 583 mg of phosphorus, and 8 mg of iron [14]. The content of gluten-free wet noodles with substitution of soy flour can be seen in Table 3.

Table 3 Ash content of gluten-free wet noodles substituted with soy flour

| Treatment                  | Ash content (%) |
|----------------------------|-----------------|
| Substitute soy flour 10 %  | 0.59            |
| Substitute soy flour 15 %  | 0.56            |
| Substitute soy flour 20 %  | 0.62            |
| Substitute soy flour 25 %  | 0.60            |
| Substitute soy flour 30 %  | 0.58            |

Note: The numbers on the same line followed by the same lowercase letters show no significant difference at the 5% level.

3.2.1.3 Protein

The results of the analysis showed that the substitution of soy flour in making gluten-free wet noodles had a significantly different effect on the levels of a protein produced. The more substitutes for soy flour, the protein content of noodles will increase. This is due to the use of soy flour. Soy flour is one of the sources of protein, which is quite high. Based on the results of the analysis of soy flour contains 37.38% protein. Complete and good quality except for sulfuric amino acids as a limiting factor in soy. The important amino acids contained in soybeans, namely isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine are on average high, except methionine and phenylalanine [10]. The addition of soy flour is expected to increase the protein content of gluten-free wet noodles.

Soy protein also contains high isoflavone concentrations, up to 1 g/kg [15]. Iso-flavones have many health benefits, including anti-inflammatory, reduction in cholesterol levels and symptoms of menopause, as well as risk reduction for several chronic diseases, including cancer, heart disease, and osteoporosis.
When compared with SNI 2987-2015 standards on wet noodles, the protein content is at least 6%. Based on this, gluten-free wet noodles with flour substitution have fulfilled the SNI requirements that have been determined. The protein content of gluten-free wet noodles substituted with soy flour can be seen in Table 4.

| Treatment                | Protein (%) |
|--------------------------|-------------|
| Substitute soy flour 10% | 6.24        |
| Substitute soy flour 15% | 6.96        |
| Substitute soy flour 20% | 7.40        |
| Substitute soy flour 25% | 7.88        |
| Substitute soy flour 30% | 8.16        |

Note: The numbers on the same line followed by the same lowercase letters show no significant difference at the 5% level

3.2.1.4 Fat

From the results of the analysis conducted, the substitution of soy flour in the manufacture of gluten-free wet noodles has a significantly different effect on the fat content produced. The more substitutes for soy flour, the fat content of noodles will increase. This is due to soy flour is one source of fat that is quite high. Based on the analysis of soy flour contains 20.80% fat. According to [16], soybean oil is low in saturated fat, which is around 15%, and high in unsaturated fatty acids, 61% polyunsaturated fat (PUFA), and 24% monounsaturated fatty acids. More than 50% of the fatty acids in soybean are linoleic acid, while around 7% are linolenic acids. Lecithin as a component of soybean oil is widely used as an emulsifier, functioning to produce a stable mixture of oil and water in the form of an emulsion food [15]. The fat content of gluten-free wet noodles with soybean substitution can be seen in Table 5.

| Treatment                | Fat (%) |
|--------------------------|--------|
| Substitute soy flour 10% | 4.53   |
| Substitute soy flour 15% | 4.68   |
| Substitute soy flour 20% | 5.37   |
| Substitute soy flour 25% | 6.16   |
| Substitute soy flour 30% | 6.36   |

Note: The numbers on the same line followed by the same lowercase letters show no significant difference at the 5% level

3.2.1.5 Carbohydrate

From the results of the analysis conducted, the substitution of soy flour in the manufacture of gluten-free wet noodles has a significantly different effect on the levels of carbohydrates produced. The more substitutes for soy flour, the carbohydrate levels of noodles will decrease. This is because soy flour is a source of protein and fat that is high enough so that the more use of soy flour and the less tapioca flour will reduce the carbohydrate content of noodles. Based on the analysis of carbohydrate content of soy flour, 30.39%, while the carbohydrate content of tapioca flour is 78.13% [17]. Carbohydrate levels of gluten-free wet noodles with flour substitution can be seen in Table 6.

| Treatment                | Carbohydrate (%) |
|--------------------------|------------------|
| Substitute soy flour 10% | 27.68            |
| Substitute soy flour 15% | 23.30            |
| Substitute soy flour 20% | 21.47            |
| Substitute soy flour 25% | 19.02            |
| Substitute soy flour 30% | 16.51            |

Note: The numbers on the same line followed by the same lowercase letters show no significant difference at the 5% level
3.2.1.6 Crude Fiber
Based on the results of the analysis that has been done, the substitution of soy flour in the manufacture of gluten-free wet noodles has a significantly different effect on the yield of the fibers produced. The more substitute for soy flour, the level of noodles will increase. This is because soybean is a source of fiber in food. The crude fiber content found in soy flour is 3.2% [9]. Soy is a good source of fiber [16]. About half of the carbohydrate content in soy is fiber. The processing process greatly reduces the fiber content in soy products. The crude fiber of gluten-free wet noodles with soy flour substitution can be seen in Table 7.

Table 7 The crude fiber of gluten-free wet noodles substituted with soy flour

| Treatment                  | Crude fiber (%) |
|----------------------------|-----------------|
| Substitute soy flour 10%   | 2.99            |
| Substitute soy flour 15%   | 3.33            |
| Substitute soy flour 20%   | 3.61            |
| Substitute soy flour 25%   | 4.54            |
| Substitute soy flour 30%   | 4.88            |

Note: The numbers on the same line followed by the same lowercase letters show no significant difference at the 5% level

3.2.2 Physical Characteristic of Gluten-Free Wet Noodles Substituted with Soy Flour

3.2.2.1 Elasticity
From the results of the analysis conducted, the substitution of soy flour in the manufacture of gluten-free wet noodles has a significantly different effect on the elasticity of the noodles. The highest elasticity is found in wet noodles with substitute soy flour 15%. The more the addition of soy flour, the elasticity tends to decrease. Decreased elasticity can be seen noodles become more easily broken when pulled. On soy flour also contains lecithin, which is useful as an emulsifier in the making of noodles [9], but if the addition of soy flour is increased, the noodles become more easily broken. Decreased elasticity in noodles is due to the decreasing amount of tapioca flour used, which causes a reduced starch content (amylopectin) in the noodles. Tapioca flour contains amylopectin 91.94% [17]. Amylopectin can give sticky/elastic properties to the resulting noodles, so the noodles are not easily broken [18]. The elasticity of gluten-free wet noodles with soy flour substitution can be seen in Table 8.

Table 8 The elasticity of gluten-free wet noodles substituted with soy flour

| Treatment                  | Elasticity (%) |
|----------------------------|----------------|
| Substitute soy flour 10%   | 17.90          |
| Substitute soy flour 15%   | 27.50          |
| Substitute soy flour 20%   | 19.26          |
| Substitute soy flour 25%   | 14.58          |
| Substitute soy flour 30%   | 11.91          |

Note: The numbers on the same line followed by the same lowercase letters show no significant difference at the 5% level

3.2.2.2 Water Absorption
The water absorption capacity of gluten-free wet noodles with substitution of soy flour ranged from 103.18-90.36%. From the results of the analysis conducted, the substitution of soy flour in making gluten-free wet noodles had a significantly different effect on water absorption from noodles. This decrease in water absorption is due to a decrease in starch content in the noodles produced. The more soy flour is added, the starch content in the noodles will decrease so that it will reduce the absorption of water during boiling noodles. Starch granules can undergo gelatinization if the suspension is heated in water [11]. Water absorption of gluten-free wet noodles with soybean substitution can be seen in Table 9.
Table 9 Water absorption of gluten-free wet noodles substituted with soy flour

| Treatment                  | Water absorption (%) |
|---------------------------|----------------------|
| Substitute soy flour 10 % | 103.18               |
| Substitute soy flour 15 % | 102.29               |
| Substitute soy flour 20 % | 71.47                |
| Substitute soy flour 25 % | 94.89                |
| Substitute soy flour 30 % | 90.36                |

Note: The numbers on the same line followed by the same lowercase letters show no significant difference at the 5% level

3.2.2.3 Swelling Index

The swelling index of gluten-free wet noodles with soy flour substitution ranged from 70.28 - 66.47%. Cooking loss of gluten-free wet noodles with soy flour substitution can be seen in Table 10. The more addition of soy flour, the swelling of the index of gluten-free wet noodles with soy flour substitution tends to decrease. This is due to the decrease in starch in the noodles produced. Swelling index analysis functions to find out how much-wet noodles develop when cooked [19]. When starch is heated in water, the water will penetrate the starch granule from the outside to the inside of the starch granule until it is filled with water thoroughly and evenly (hydrated). After the granules are completely filled with water, the hydrogen bonds between the amyllose chain and amylopectin will try to maintain the integrity of the starch granules and begin the swelling process that starts from the core of the starch granules.

Table 10 Swelling Index of gluten-free wet noodles substituted with soy flour

| Treatment                  | Swelling index (%) |
|---------------------------|--------------------|
| Substitute soy flour 10 % | 70.28              |
| Substitute soy flour 15 % | 69.18              |
| Substitute soy flour 20 % | 67.72              |
| Substitute soy flour 25 % | 66.75              |
| Substitute soy flour 30 % | 66.47              |

Note: The numbers on the same line followed by the same lowercase letters show no significant difference at the 5% level

3.2.2.4 Cooking Loss

Cooking loss of gluten-free wet noodles with soy flour substitution ranged from 12.43-10.72%. Booking loss of gluten-free wet noodles with soy flour substitution can be seen in Table 11. From the results of the analysis conducted, the substitution of soy flour in making gluten-free wet noodles did not provide a significantly different effect on water absorption from noodles. Increasing the amount of soy flour will cause cooking loss to be smaller. This is due to the addition of soy flour produced will be less elastic and somewhat coarse so that the porosity of the noodles will be lower and cause the water absorbed is also lower. A low water absorber will cause the discharged solids to get lower. The higher the water absorbed, the more solids are lost due to the release of starch in the noodle strands into the cooking water of the noodles [18]. The high cooking loss is also caused by the lack of optimum ability of the gelatinized starch matrix to bind the non-gelatinized starch.

Table 11 Cooking Loss of gluten-free wet noodles substituted with soy flour

| Treatment                  | Cooking Loss (%) |
|---------------------------|------------------|
| Substitute soy flour 10 % | 12.43            |
| Substitute soy flour 15 % | 11.39            |
| Substitute soy flour 20 % | 11.72            |
| Substitute soy flour 25 % | 11.65            |
| Substitute soy flour 30 % | 10.72            |

Note: The numbers on the same line followed by the same lowercase letters show no significant difference at the 5% level
3.2.3 Organoleptic Test

Based on organoleptic tests that have been done, gluten-free wet noodles with soy flour substitution have been received by panelists both for color, aroma, taste, texture, and appearance. The results of organoleptic tests of gluten-free wet noodles with soy flour substitution can be seen in Table 7.

| Treatment                  | Color  | Flavor | Taste  | Texture | overall |
|----------------------------|--------|--------|--------|---------|---------|
| Substitute soy flour 10 %  | 2.80   | 3.00   | 3.20   | 3.12    | 3.24    |
| Substitute soy flour 15 %  | 3.28   | 3.20   | 3.44   | 3.72    | 3.76    |
| Substitute soy flour 20 %  | 3.44   | 3.28   | 3.44   | 3.68    | 3.44    |
| Substitute soy flour 25 %  | 4.08   | 3.48   | 3.60   | 3.44    | 3.56    |
| Substitute soy flour 30 %  | 4.04   | 3.28   | 3.84   | 3.40    | 3.40    |

The highest assessment of color is 4.08 (rather like) for gluten-free wet noodles, which are substituted with 25% soy flour. The more soy flour is added, the color of the resulting noodles tends to be more yellow. Because the color of soy flour is yellowish-white. While the aroma, panelists gave the highest rating of 3.48 (neutral) for gluten-free wet noodles, which were substituted with 25% soy flour. The more addition of soy flour, the aroma of noodles produced can still be accepted by the panelists. For the taste, the panelists gave the highest rating of 3.84 (rather like) for gluten-free wet noodles, which were substituted with 30% soy flour. The more soy flour is added, the noodles become a little sweeter, so they are rather liked by panelists. As for texture, panelists gave the highest rating of 3.72 (rather like) for gluten-free wet noodles, which were substituted with 15% soy flour. More and more soy flour additions, the texture of noodles produced tends to decrease, and the resulting noodles become inelastic and break easily. For appearance, panelists gave the highest rating of 3.76 (rather like) for gluten-free wet noodles, which were substituted with 15% soy flour. The more addition of soy flour the noodles produced, the less good and easily broken.

4. Conclusion

Gluten-free wet noodles with substitution of 15% soy flour is the best treatment that produces noodles with a characteristic water content of 61.18%, ash content of 0.56%, protein content of 6.96%, fat content of 4.68%, carbohydrates 23.30%, crude fiber content of 3.33%, elasticity 27.50%, water absorption 102.29%, index swelling 69.18%, cooking loss 11.39% and sensory tests with a color of 3.28 (neutral), aroma 3.20 (neutral), taste 3.44 (neutral), texture 3.72 (somewhat like) and appearance of 3.76 (somewhat like). Thus, gluten-free wet noodles with soy flour substitution are feasible to be developed and reduce wheat imports in Indonesia.

References

[1] The Indonesian Statistics Center 2019 Impor Biji Gandum dan Meslin Menurut Negara Asal Utama, 2010-2018 [Accessed on October 20th 2019 at https://www.bps.go.id/]
[2] Herminiati A 2009 Diet Makanan untuk Penyandang Autis Pangan Ed. Number 54/XVIII/April-Juni/2009
[3] Subagio A 2007 Industrialisasi Modified Cassava Flour (MOCAF) sebagai Bahan Baku Industri Pangan untuk Menuju Diversifikasi Pangan Pokok Nasional Jember: Fakultas Teknologi Pertanian, Universitas Jember
[4] Yeni D S P 2012 Tepung Mocaf Alternatif Pengganti Terigu Balai Pendidikan dan Pelatihan Daerah Provinsi Jawa Barat.
[5] Putri N A, Diniyah N, Subagio A 2015 Sifat pasta Mocaf (modified cassava flour) menggunakan rapid visco analyser Prosiding Seminar Nasional PATPI Inovasi Teknologi untuk Memperkuat Peran Industri Menuju Akselerasi Pemenuhan Pangan Nasional 20-21 Semarang: UNIKA p928-932
[6] Kusumaningrum M 2013 Pengaruh Berbagai Macam Filler terhadap Kadar Air, Rendemen dan Sifat Organoleptik (Warna) Chichen Nugget Animal Agriculture Journal 2 370-376
[7] Risti Y 2013 Pengaruh Penambahan Telur terhadap Kadar Protein, Serat, Tingkat Kekenyalan dan Penerimaan Mi Basah Bebas Gluten Berbahan Baku Tepung Komposit

[8] Afandi S 2001 Mempelajari Pembuatan Tepung Kedelai (Glycine max Merr) Bogor : Fakultas Teknologi Pertanian, Bogor Agriculture Institute

[9] Wirdaningrum, Widowati S, and Soekarto S T 2005 Pengayaan Tepung Kedelai pada Pembuatan Mie Basah dengan Bahan Baku Tepung Terigu yang Disubstitusi Tepung Garut Jurnal Pascapanen 2(1) 41-48

[10] Cahyadi W 2007 Teknologi dan Khasiat Kedelai Jakarta: Bumi Aksara

[11] Kusnandar F 2012 Kimia Pangan Komponen Makro Jakarta: Dian Rakyat

[12] Danar P, Aviany T P, and Parnanto N H R 2016 Pengaruh Penambahan Gum Arab Terhadap Karakteristik Fisikokimia Dan Sensoris Fruit Leather Nangka (Artocarpus heterophyllus) Jurnal Teknologi Hasil Pertanian IX(1)

[13] Winarno F G 2002 Kimia Pangan dan Gizi Jakarta: Gramedia Pustaka Utama

[14] Ministry of Health of the Republic of Indonesia 1996 Daftar Komposisi Bahan Makanan Jakarta: Bhratara Karya Aksara

[15] Krisnawati A 2017 Kedelai sebagai Sumber Pangan Fungsional Iptek Tanaman Pangan 12(1)

[16] Anonymous 2006 Karakteristik Kedelai Sebagai Bahan Pangan Fungsional [Accessed on October 20th 2019 at E-BookPangan.com]

[17] Gardjito M, Djuwardi A, and Harmayani E 2013 Pangan Nusantara Karakteristik dan Prospek untuk Percepatan diversifikasi Pangan Jakarta: Kencana Prenada Media Grup

[18] Winarti S, Murtiningsih, and Listyawati F D 2018 Karakteristik Mie merah Gluten Free dari Tepung Gadung (Dioscorea Hispida Dennst) dan Tepung Mocaf Dengan Penambahan Gliserol Jurnal JITIPARI 3 137-145

[19] Setiyoko, Agus L, Nugraeni, and Hartutik S 2018 Karakteristik Mie Basah Dengan Substitusi Tepung Bengkuang Termodifikasi Heat Mositure Treatment (HMT) Jurnal Teknologi Pertanian Andalas 22(2)