Processing of Non-Gluten Cereal Biscuits with the Addition of Oat Flour and Jali Flour (*Coix lacryma-jobi* L)

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Abstract: Biscuits are one type of bakery product that is produced by baking dough. The use of jali and oats has begun to be developed as a substitute for flour for bakery products. Jali (*Coix lacryma-jobi* L) has a high protein content (13 g) and is being widely developed. Oats contain soluble fibre, namely glucan, to slow the increase in blood sugar. In particular, jali and oats do not contain gluten and can be consumed by people with celiac disease. This study aimed to formulate non-gluten biscuits with a combination of oat flour and jali flour. and to determine the physicochemical and organoleptic characteristics of those biscuits. Non-gluten biscuits is made with five formulations, F1 (100% oat flour: jali flour 0%), F2 (60% oat flour: 40% jali flour), F3 (50% oat flour: 50% jali flour), F4 (40% oat flour: 60% jali flour), and F5 (0% oat flour: 100% jali flour). The research started with making biscuits (creaming, mixing, moulding, and baking), then continued with physical testing using a texture analyzer, proximate testing, and a sensory hedonic rating test (30 untrained panellists). Physical testing with the lowest hardness parameter at F1 was 571.67 gf and the highest was at F5 (1549.43 gf). The results of the proximate test of biscuits from the five formulations had a moisture content of 5.64-5.99%, ash content of 1.76-1.83%, fat content of 0.23%, crude fibre content of 2.26-6.91%, and protein content of 9.04-11.42%. Based on the sensory test, overall, the F1 biscuit

formula was the most preferred by the panelists, with a sensory score of 4 out of 5. The more jali flour is added, the higher the protein content. The best formulation was 60% jali flour and 40% oat flour because the characteristics of texture, taste, color, and aroma were not significantly different from the use of 100% oat flour.

Key words: biscuit, jali, non-gluten, oat

Abstrak: *Biskuit merupakan salah satu jenis produk bakery yang diproduksi dengan cara memanggang adonan. Penggunaaan jali dan oat sudah mulai dikembangkan sebagai bahan substitusi tepung produk bakery. Jali (coix lacryma jobi L) memiliki kandungan protein yang tinggi (13 g) dan mulai banyak dikembangkan. Oat mengandung serat larut air yaitu* β*glucan yang berfungsi untuk memperlambat peningkatan gula darah. Secara khusus, jali dan oat tidak mengandung gluten dan dapat dikonsumsi oleh penderita celiac disease. Tujuan dilakukannya penelitian ini adalah untuk melakukan formulasi biskuit non-gluten dengan kombinasi tepung oat dan tepung jali dan untuk mengetahui karakteristik fisikokimia dan organoleptik biskuit dengan penggunaan tepung oat dan tepung jali pada berbagai komposisi yang berbeda. Pembuatan biskuit non-gluten dibuat dengan 5 formulasi yaitu F1 (tepung oat 100% : tepung jali 0%), F2 (tepung oat 60% : tepung jali 40%), F3 (tepung oat 50% : tepung jali 50%), F4 (tepung oat 40% : tepung jali 60%), F5 (tepung oat 0% : tepung jali 100%). Penelitian dimulai dengan pembuatan biskuit (creaming, mixing, molding, dan baking) kemudian dilanjutkan dengan pengujian fisik menggunakan texture analyzer, pengujian proksimat, dan sensori uji rating hedonik (30 panelis tidak terlatih). Pengujian fisik dengan parameter hardness terendah pada F1 sebesar 571,67 gf dan tertinggi pada F5 sebesar 1549,43 gf. Hasil pengujian proksimat biskuit dari lima formulasi memiliki kadar air 5,64-5,99%, kadar abu 1,76-1,83%, kadar lemak 0,23%, kadar serat kasar 2,26-6,91%, dan kadar protein 9,04-11,42%. Berdasarkan uji sensori, secara keseluruhan (overall) biskuit formula F1 paling disukai oleh panelis dengan skor sensori 4 dari 5. Berdasarkan hasil penelitian, disimpulkan bahwa penambahan tepung oat dan tepung jali berpengaruh terhadap karakteristik fisikokimia dan sensori biskuit (*$p<0.05$*), semakin tinggi penambahan tepung jali maka akan semakin tinggi kadar protein. Formulasi menggunakan 60% tepung jali dan 40% tepung oat karena memiliki karakteristik tekstur, rasa, warna, aroma tidak berbeda nyata dengan penggunaan 100% tepung oat.*

Kata kunci: *biscuit, jali non-glutem, oat*

INTRODUCTION

Indonesian people have a habit of snacking, one of which is biscuits. Biscuits are a dry bakery made from flour and fat with or without BTP (SNI, 2011). Biscuits with wheat flour naturally contain gluten which not all people can consume, especially people with celiac disease. Commercial biscuits contain gluten and have low nutritional value. Nowadays, many Indonesian people are starting to care about their health and lifestyle by consuming healthy foods with high nutritional value. Based on this, food products using raw materials that do not contain gluten with local cereals can be applied. The raw material used is jali.

In Indonesia, jali still needs to be optimally developed, and many people only make it as jali porridge. Jali has a good nutritional value, contains 13 g of protein, and contains high vitamins and minerals (Sangwan, 2014). Jali seeds contain phenols which are antioxidants as anti-inflammatory and anti-cancer (Devaraj et al., 2020). Therefore, in this research, the manufacture of non-gluten biscuits was carried out using jali flour and oat flour as a substitute for wheat flour. Oats were chosen as the primary raw material for making biscuits because many Indonesian people are used to consuming them. The function of using jali flour as a substitute for wheat flour, it has a protein content equivalent to wheat. Oat flour can provide a better product appearance and a more prolonged satiety effect (Utami, 2020). Oats contain water-soluble fibre, namely β-glucan, which has good benefits such as slowing the increase in blood sugar and lowering cholesterol and LDL levels. Oats show antioxidant, anti-atherogenic, anti-inflammatory and anti-itch activity on the skin (Ben et al., 2015).

Other ingredients were used besides oat flour and jali flour, such as sorghum flour, corn flour, cornstarch, egg yolks, powdered milk, baking powder, water, salt, and Tropicana slim stevia premix sweetener. Tropicana slim stevia sweetener was chosen as a substitute for sugar because it's sweeter and lower in calories. It is because regular sugar adds 3.94 kcal/gram to calories (Cahyadi in Aini et al., 2016). Sorghum flour and corn flour are substitutes for biscuits because sorghum flour can substitute up to 80% of wheat flour (Suarni, 2009a). While the addition of corn flour can help add biscuit pigment and help the emulsion process in bakery products (Suarni, 2009b). Egg yolks, margarine and powdered milk, can also add value to

nutritional levels such as protein and fat. The biscuit cooking process uses convection heating using an oven with a temperature of 180℃ for 18 minutes. It is determined because the best time for the roasting process is 180 - 200 ℃, and if the temperature exceeds 220 ℃, it will adversely affect the product (Patel et al., 2019). During the roasting process, the Maillard reaction occurs, namely the presence of carbonyl groups found in carbohydrates (reducing sugars) binds to amino acids found in proteins which occurs at high temperatures (Winarni in Fatmala & Adi, 2018)

This research is conducted to produce non-gluten biscuits with variations of jali flour and oats as raw materials. A sensory test is performed to know whether consumers like these biscuits. This study aimed to formulate and to determine the physicochemical and organoleptic characteristics of non-gluten biscuits with oat and jali flour as raw materials.

METHOD

A. Materials

The materials used in this study were rolled oats (Hafer Flocken brand), jali flour (Jo Lali Jali brand), corn flour (Mugo brand), sorghum flour, cornstarch, margarine, egg yolk, milk powder, Tropicana Slim stevia, baking powder, salt, water, Hexane, NaOH, concentrated H_2SO_4 solution, 95% alcohol, filter paper, HgO, K_2SO_4, $Na_2S_2O_3$, 4% boric acid, 0.1N HCl, Zn, methyl red blue indicator, aquadest, and filter paper.

B. Research Design

Diagram 1:
Non-gluten biscuit research design

C. Non-Gluten Biscuit Formulation

The processing of non-gluten biscuits uses 5 formulations with different oat and jali flour compositions.

Table 1:
Non-gluten biscuit formulation composition

Formulation	Oat Flour	Jali Flour
F1	100%	0%
F2	60%	40%
F3	50%	50%
F4	40%	60%
F5	0%	100%

D. Making Non-Gluten Biscuits

Biscuit making begins with the creaming process by mixing sweetener, powdered milk, salt, egg yolks and margarine, then mixing at high speed for 3 minutes. After thoroughly mixing the ingredients, they are added with oat flour, jali flour, sorghum flour, corn flour, and baking powder, kneaded for ± 15 minutes (Saputro et al., 2017) and added water until smooth. The well-mixed dough is then printed with a thickness of 6 mm and baked at 180°C for 18 minutes.

E. Hardness Test on Non-Gluten Biscuits

Baked biscuits were analyzed using a Texture Analyzer tool with TA-18 1/2" Ball Rounded Probe. The sample is placed on the sample table on the Texture Analyzer tool. The probe will move down, touch the biscuit, and press it until it snaps.

F. Water Content Analysis (AOAC 2005, in Kusumawardani et al., 2018)

Moisture content measurement is carried out using an oven. Initially, the empty cup was heated at 102-105°C for 60 minutes, then cooled in a desiccator and weighed. A sample of 5 grams was put into a cup that had been weighed, and then heated in an oven at 105 °C for 1 night, then cooled in a desiccator until it reached a constant weight. Calculation of the percentage of water content is done by the following formula:

$$Water\ content\ (\%) = \frac{b - c}{b - a}\ x\ 100\%$$

Notes:
A = empty cup weight (g)
B = weight of the cup + sample (g)
C = weight of the cup + sample after heating (g)

G. Ash Content Analysis (AOAC 2005, in Sari et al., 2020)

Samples that have been tested for water content are weighed as much as 1 gram. The empty cup (A) is weighed, then the sample is inserted into the cup (B). Furthermore, the sample in the cup is put into a furnace at a temperature of 500-600°C for 3 hours. After 3 hours, the sample and the cup were transferred to a desiccator and weighed until they reached a constant weight (C).

$$Ash\ Content\ (\%) = \frac{C - A}{B - A}\ x\ 100\%$$

H. Fat Content Analysis (Sutarjo, 2017)

A sample of 2 grams that has been mashed (B) is put in filter paper. The fat flask that had been heated in the oven at 105℃ for 1 hour was put in a desiccator for 20 minutes (A) and weighed. The sample in the filter paper is then put in a Soxhlet and added with ether solvent. The extraction process lasted for 4 hours. After the extraction process was completed, the sample was put in an oven at 105℃ for 1 hour. The fat flask that had been put in a desiccator for 20 minutes was then weighed until it was constant (C). Fat content is calculated by the following formula:

$$\%\ crude\ fat = \frac{C - A}{B} \times 100$$

Notes:
A = empty weight
B = sample weight
C = the weight of the fat flask and the sample after being in the oven

I. Analysis of Crude Fiber Content (Setyowati et al., 2014)

A sample of 2 grams of the sample was crushed and then transferred into a 250 ml Erlenmeyer and added with 200 ml of H2SO4 solution, and 5 drops of antifoam later. The sample was heated for 30 minutes at 250℃. The solution was filtered using filter paper and a funnel. Filter the residue with 200 ml of hot distilled water, transfer the residue solution into an erlenmeyer, add 200 ml of NaOH and 5 drops of antifoam and boil for 30 minutes. The residue was then filtered again with filter paper that had been oven-baked and weighed. Furthermore, washing with 95% alcohol 15 ml. The residue formed on the filter paper was put into a porcelain dish and dried for 1 night then cooled in a desiccator. The residual weight obtained is the weight of crude fiber in biscuits. Calculations are carried out as follows:

Crude fiber weight = (filter paper + residue after oven) – empty filter paper weight

$$\%\ crude\ fiber = \frac{crude\ fiber\ weight}{initial\ weight} \times 100\%$$

J. Analysis of Protein Levels (Rau et al., 2019)

Analysis for protein levels was carried out using the Kjeldahl method. 1 g of sample that has been mashed is put into the Kjeldahl flask, then added with 7.5 grams of K2SO4, 0.35 grams of CuSO4 and 15 ml of concentrated H2SO4 solution. The sample is destructed until it is clear green in color. The sample was added 100 ml of distilled water and 50% NaOH slowly. Then 0.2 gram of Zn was added. The Kjeldahl flask was then installed with a distillation apparatus, the distillate results were accommodated in an Erlenmeyer containing 50 ml of 0.1 N HCl and 3 drops of 1% phenolphthalein indicator. The distillation process ends when the distillate drops are gone. Then, the titration was carried out with a standard solution of 0.1 N NaOH. The titration was stopped when the solution in the Erlenmeyer turned pink. Calculation of protein content is done by the following formula:

$$\%\, Nitrogen = \frac{(ml\ NaOH\ blanko - ml\ NaOH\ sample) \times N\ NaOH \times 14{,}008}{sample\ weight \times 1000} \times 100\%$$

Notes: conversion factor = 6,25.

K. Organoleptic Analysis (Meilgaard et al., 1999)

Organoleptic analysis aims to test the level of acceptance of non-gluten biscuits by panelists using the hedonic rating test. The selected panelists were 30 untrained panelists with adolescents to early adulthood. Each panelist was given 5 non-gluten biscuit formulations. The parameters tested in the organoleptic test were taste, color, texture, aroma and overall. The test uses a scale of 1-5, namely 1 (dislike very much), 2 (dislike), 3 (neutral), 4 (like), and 5 (very like).

RESULTS AND DISCUSSIONS

A. Visual Appearance of Non-Gluten Biscuits

The results of the biscuits can be seen in Figure 1.

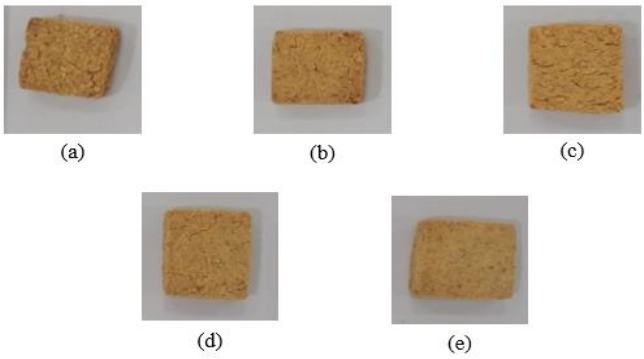

Figure 1:
Visual appearance of non-gluten biscuits

Notes:
(a) F1 : Oat Flour 100%, Jali Flour 0%
(b) F2 : Oat Flour 60%, Jali Flour 40%
(c) F3 : Oat Flour 50%, Jali Flour 50%
(d) F4 : Oat Flour 40%, Jali Flour 60%
(e) F5 : Oat Flour 100%, Jali Flour 0%

Biscuit color characteristics F1 has the darkest color and F5 has the lightest color compared to other formulations, F1 has many cracks on the surface compared to other formulations. F1 biscuits have a texture that crumbles more easily and F5 has a texture that is not easily crushed and is harder than the other formulations. On F2 it has the same color as F3. On has a texture that is almost similar to F5. It's just that the texture on F5 is harder than F4.

B. Hardness of Non-Gluten Biscuits

The results of testing the texture of non-gluten biscuits showed an increase in hardness along with the addition of jali flour used.

Table 2:
Hardness value of non-gluten biscuits

Formulation	Parameter
	Texture
F1	571,67±16,904[a]
F2	821,840±6,078[a]
F3	968,162±13,594[a]

F4	988,687±14,110[a]
F5	1549,433±15,022[a]

The results of the hardness test using a Texture Analyzer did not have a significant difference (p>0.05). However, the test results showed an increase in the hardness value and the addition of jali flour. Hardness is the durability characteristic of a food product that will break due to a compressive force (Andarwulan in Istinganah et al., 2017). The value of hardness in biscuits is influenced by the components of the biscuits, temperature and baking time (Pratama et al., 2014).

Jali flour can also give a hard texture to biscuits at room temperature due to the presence of starch and protein structures (Syahputri & Wardani, 2015). Using jali flour, which is high in jali, will increase the hardness of the biscuits, and the lower the water content due to the high-water absorption index will reduce the hardness level due to the more water absorbed, the softer the texture of the biscuits. In addition, jali flour has a weakness, namely the absence of gluten-forming proteins, causing the product to have a hard texture (Fafo et al., 2018). The high use of oats causes the biscuit dough to become inhomogeneous so that it will cause a texture that breaks easily due to the difference in particle size of oat flour with other flours (Rahardjo et al., 2020). The texture that breaks easily in oat flour biscuits is higher due to the absence of gluten content, causing a decrease in the binding power of the product and having a cracked surface (Chauhan et al., 2018). Gluten is a protein that gives elastic properties to help dough expand when added to water (Subagjo in Fafo et al., 2018). When interacting with starch, protein content will form a complex that blocks water entry into the dough, causing hardness in biscuits (Wani et al in Rahardjo et al., 2021). The texture of the biscuits can also be caused by other supporting ingredients, such as baking powder which causes CO2 to produce gas in the biscuit product. The number of cavities in biscuits is caused by the amount of water that evaporates during the baking process so that the product expands (Setyowati et al., 2014).

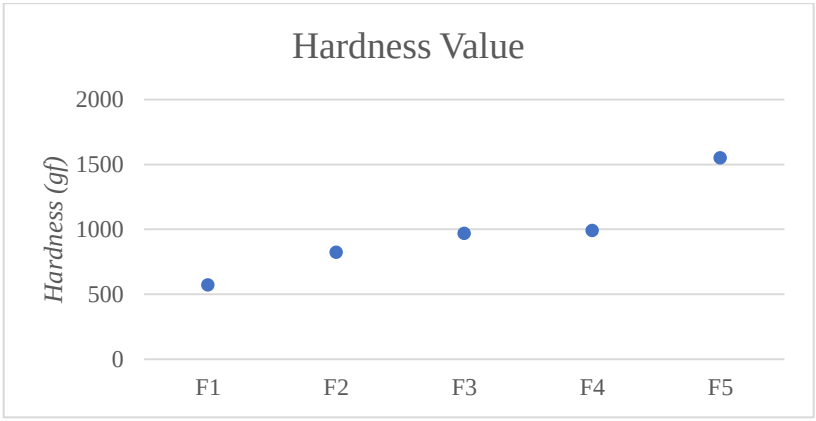

Figure 2:
Hardness value of non-gluten biscuits

C. Proximate Analysis Results

The results of testing the content of water, ash, fat, fiber, and protein can be seen in Table 3.

Table 3:
Non-gluten biscuit proximate value

Parameter	Proximate Test Value				
	F1	F2	F3	F4	F5
Water content (%)	5,99±0,37[a]	5,89±0,77[a]	5,85±0,23[a]	5,74±0,11[a]	5,64±0,06[a]
Ash Content (%)	1,76±0,08[a]	1,78±0,15[a]	1,79±0,17[a]	1,83±0,13[a]	1,80±0,05[a]
Fat Content (%)	0,23±0,002[a]	0,23±0,02[a]	0,23±0,007[a]	0,23±0,01[a]	0,23±0,005[a]
Fiber (%)	6,91±0,11[b]	6,13±1,42[b]	3,59±1,56[a]	3,25±0,95[a]	2,26±0,62[a]
Protein (%)	9,04±0,46[a]	9,27±0,23[a]	9,83±0,17[b]	10,56±0,13[c]	11,42±0,22[d]

1. Water Content

Based on the results of the water content test, the biscuits for each formulation were not significantly different ($p>0.05$). There was a decrease in water content with increasing concentration of jali flour but had an insignificant change. The decrease in water content in biscuits can be caused

by the jali flour used undergoing a fermentation process so that there is a change in bound water to free water which is more volatile, so that the use of high jali flour has a low water content (Syahputri & Wardani, 2015). Therefore, biscuits with high use of jali flour have lower water content compared to biscuits with high use of oat flour. The desired moisture content in biscuits is determined by two factors, namely if the water content is too low, the biscuit will have a dark color and bitter taste, while if the water content is too high, the texture isn't crispy and changes in flavor occur during storage (Pratama et al., 2014).

When compared to SNI biscuits 2973:2011, the non-gluten biscuits in this study didn't meet the moisture content standard where the maximum moisture content for biscuits was 5%. This can be presumed by the amount of water in the biscuits is still not evaporated optimally, the lack of long baking time, and the use of low temperatures when drying biscuit products so that it can slow down the drying process of the moisture content test. According to Riansyah et al. (2013), the higher the drying temperature and the longer the drying time, the greater the effect on the speed of water transfer. This is because more and more water molecules evaporate from the material so that the water content in the material is getting lower.

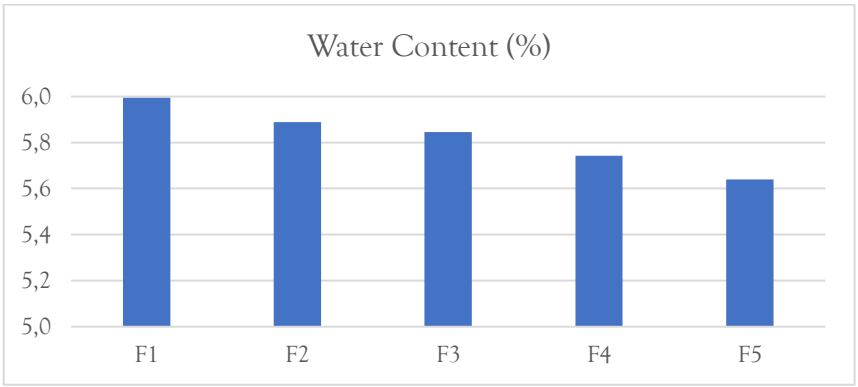

Figure 3:
Moisture content value of non-gluten biscuits

2. Ash Content

Based on the results of the ash content test, the results for the formulation did not show a significantly different ash content ($p>0.05$). According to Primary et al. (2014), ash content is the amount of minerals in a

food that cannot be burned and becomes a vapor substance. The ash content value indicates the amount of mineral content in the food.

According to FAO, the ash content of jali flour is 1.5 g/100 g while oat flour has a higher ash content of 1.9 g/100 g. (USDA (2005) in Sangwan et al., 2014) also stated that 156 g (1 cup) of oats has a high content of vitamins and minerals such as 816 mg of phosphorus, 669 mg of potassium and 276 mg of magnesium. The mineral content of jali contains phosphorus, magnesium which is lower than the mineral content in oats, namely the phosphorus content of jali is 2235 mg/kg, potassium is 5227 mg/kg, and the magnesium content is 1841 mg/kg (Liu in Zhu, 2017). This is not in accordance with the table of observations where the highest ash content was found in F4 and the lowest in F1. The increase in ash content can be caused by the addition of other supporting materials which can increase the yield of ash content (Sabir et al., 2020). According to Sudarmadji in Riansyah et al. (2013), ash content is also affected by the method of ashing, temperature, length of time for ashing, and the type of material used. This is supported by the statement of Erni et al. (2018), that the longer the drying time, the greater the water will evaporate so that the ash content will increase.

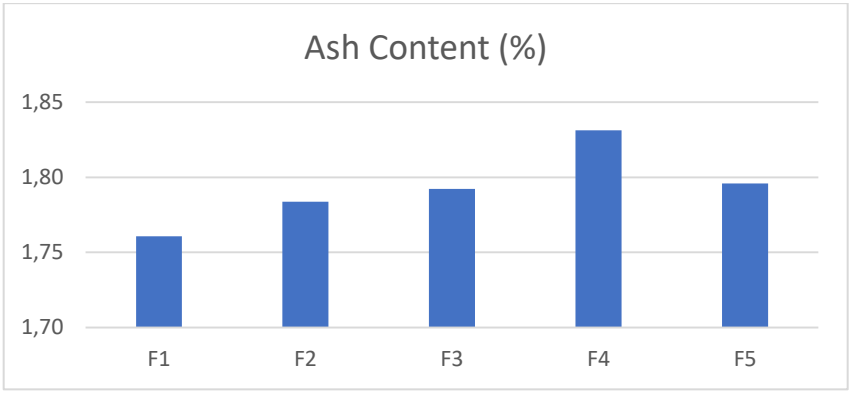

Figure 4:
Ash content value of non-gluten biscuits

3. Fat Content

Fat content indicates the amount of fat contained in a food ingredient. Fats have hydrophobic properties that cannot be dissolved in water (Susilawati BS et al., 2018). The value of fat content in non-gluten biscuits for each formulation was not significantly different ($p>0.05$).

The value of fat content in biscuits is influenced by the raw materials used where oats have a fat content of around 6.9% - 18.1% (Ben Halima et al., 2015), and jali contains a fat content of 5.1% - 9.4% (Zhu, 2017). There was no significant difference in the fat content of non-gluten biscuits. This is due to other supporting ingredients such as margarine and egg yolks (Widyastuti et al., 2015). In the manufacture of biscuits margarine, egg yolks, and powdered milk are used in equal amounts so that they do not have a real effect. Margarine contains lipids and some of the lipids are bound as lipoproteins which will add a high fat content to biscuits. The decrease in fat content can occur because it is influenced by the roasting process due to coagulation of protein so that a lot of fat comes out (Windsor in Pratama et al., 2014).

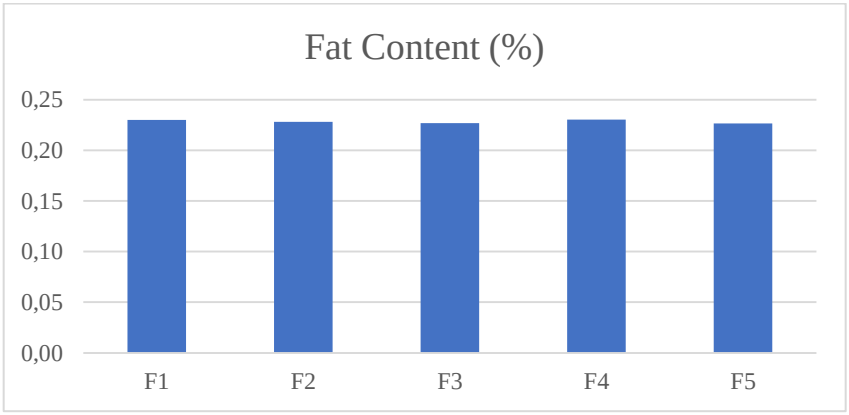

Figure 5:
Fat content value of non-gluten biscuits

4. Crude Fiber Content

Based on the results of the crude fiber test, the highest fiber content was found in F1 (100% oat flour: 0% jali flour) which was 6.91% and the lowest fiber content was in F5 (0% oat flour: 100% jali flour) of 2.26%. Based on the observations in Table 3. it can be seen that the fiber content of biscuits between F1 and F2 was significantly different ($p<0.05$) with F3, F4, and F5. This indicates an increase in crude fiber content is proportional to the addition of the concentration of oat flour. Fiber in jali only ranges from 1.3-3% (Ben Halima et al., 2015) while fiber in oats is 2.5-8% (Zhu, 2017). This is also in accordance with Varma et al. (2016) which states that the fiber content in oats is higher than other cereals.

Coarse crude fiber is a compound that cannot be hydrolyzed by acids and bases. Crude fiber content can be used as an index of dietary fiber because

crude fiber contains around 0.2 – 0.5 of the amounts of dietary fiber (Korompot et al., 2018). Fiber levels can decrease which can be caused by non-fiber components such as sugar acids, simple sugars, and other components. In addition, processes involving high temperatures will affect the fiber content in foodstuffs (Mahirdini & Afifah, 2016).

Jali contains dietary fiber and phenols which are good for the body. Fiber will form bonds with cholesterol and then reabsorb cholesterol in the intestinal lumen, while phenol functions as an antioxidant and can reduce LDL (Qurnaini, N. R., & Nasrullah, 2021). High dietary fiber in oats is **β**-glucan which can slow the increase in blood sugar and contains the antioxidant avenanthramides (Fulgoni et al., 2015). According to Zhu (2017), **β**-glucan contained in oats can significantly reduce cholesterol and LDL levels when consumed regularly. Apart from that, oats can also be consumed by people with celiac disease and autoimmune gastrointestinal disorders due to the absence of gluten.

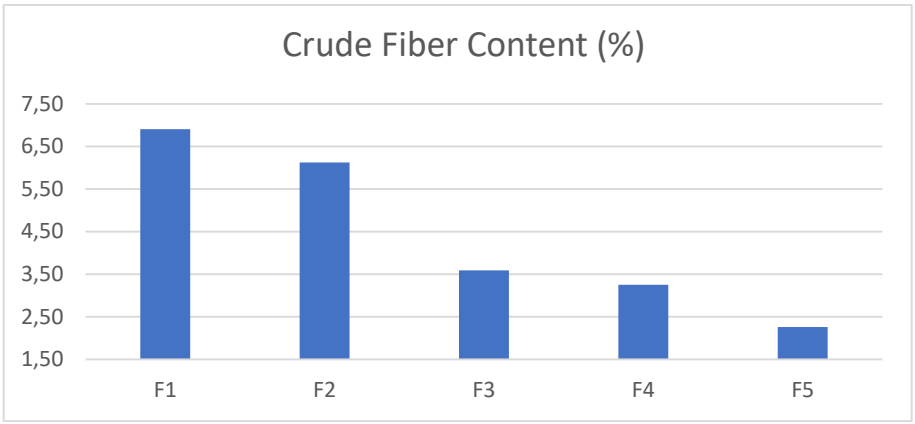

Figure 6:
Crude fiber content value of non-gluten biscuits

5. Protein Content

Based on the results of the protein content test, the highest protein content was found in F5 (0% oat flour: 100% jali flour) which was 11.42%, while the lowest protein content was found in F1 (100% oat flour: 0% jali flour) which was 9. 04%. In F1 and F2 there was no significant difference ($p>0.05$), but in F3, F4 and F5 they were significantly different ($p<0.05$). Based on the observations that can be seen in Table 3. it can be seen that the increasing concentration of jali flour will increase the protein content.

According to the FAO, the protein content of jali flour is 13 g, or slightly higher than oats, which is 12.6 g.

Based on SNI 2973:2011 non-gluten biscuits with oat flour and jali flour from F1 to F5 have met the requirements, namely at least 5% and have a better protein content. The protein content contained in the material helps the browning process after heating or is referred to as non-enzymatic browning or Maillard reaction. The Maillard reaction occurs due to the presence of carbonyl groups found in carbohydrates (reducing sugars) binding to amino acids found in proteins which occur at high temperatures (Winarni in Fatmala & Adi, 2018). According to Primary et al. (2014), the increase in protein content is affected by the amount of water content that is lost from the material. This is in accordance with the observations which can be seen in Table 3. that in F5 (0% oat flour: 100% jali flour) it has the lowest water content and has the highest protein content. Protein content is also found in other ingredients such as egg yolks, egg yolks can increase the protein content because it has functional properties depending on the type of product (Claudia et al., 2015).

D. Organoleptic Analysis Results

Organoleptic testing on non-gluten biscuits uses a hedonic rating of 5 scales with 30 untrained panelists. The results of organoleptic analysis can be seen in Table 4.

Table 4:
Hedonic Rating Value on Non-Gluten Biscuits

Parameter	Sample Hedonic Test Mean Value				
	F1	F2	F3	F4	F5
Texture	3,77±1,19[a]	3,50±1,14[a]	3,80±1,031[a]	3,83±0,99[a]	3,50±1,14[a]
Taste	3,77±1,17[b]	3,00±1,05[a]	3,27±1,05[ab]	3,63±1,07[b]	2,73±1,29[a]
Color	3,97±0,96[b]	3,87±0,82[b]	3,20±1,32[a]	3,57±1,04[ab]	3,10±1,03[a]
Aroma	4,10±1,13[b]	3,70±0,95[b]	3,77±1,01[b]	3,63±1,07[b]	2,97±1,25[a]
Overall	4,00±0,91[b]	3,47±1,07[b]	3,47±1,04[b]	3,70±1,06[b]	2,83±1,21[a]

Biscuits with 5 formulations were tested using a hedonic rating test with a scale of 1 being the least preferred and a scale of 5 being the most preferred. Organoleptic test is a method used to analyze, measure, and interpret the response to a product through the senses of sight, smell, taste, touch, and hearing (Lawles in Juliana et al., 2020). The parameters used are texture, taste, color, aroma, and overall (overall).

Texture is an important parameter for types of dry products such as biscuits, as seen in Table 4. The value of panelist acceptance of biscuit textures F1 to F5 did not show a significant difference. This is also shown in Table 2. where the biscuit texture also did not show a significant difference in testing using a texture analyzer. The use of high jali flour will produce a hard texture so that panelists do not like F5 non-gluten biscuits due to the use of 100% jali flour. The higher the use of jali flour will produce a hard and gritty texture due to the presence of protein and starch matrices which produce a hard texture (Syahputri & Wardani, 2015).

In the taste parameter, the results were significantly different from F1 and F4 with F2 and F5, but at F3 the results were not significantly different for each formulation ($p>0.05$). The taste that was most favored by the panelists was F1 with the use of 100% oat flour. This is because oat flour will produce a taste similar to roasty popcorn because of the 2-acetyl-1-pyrroline component and also the vanillin component, so it has a delicious taste in the mouth (Dach & Scheberle, 2021). While the most disliked taste is F5 with the use of 100% jali flour, this is due to the presence of a gritty mouthfeel in the mouth (Syahputri & Wardani, 2015).

The color produced by non-gluten biscuits is light brown to dark brown and the brownest color is found on F1 and the F5 pad is the lightest color. In F5 the panelists did not like it because the jali seeds did not have pigment so that the higher the use of jali flour the product would be pale to white in color and could reduce the level of preference of the panelists (Mutiaraningtyas & Kuswardinah, 2018). Meanwhile, panelists preferred F1 because oat flour can increase the reddish color to brown and reduce brightness (Zaki et al., 2018).

In the aroma parameter, the panelists most disliked F5 due to the high use of jali flour, where jali flour has a nutty or nutty aroma (Cahyani, 2010). The addition of jali flour up to 60% had no effect on the panelists, this was shown in F1 to F4 there was no significant difference ($p>0.05$), but the use of 100% jali had an effect on the panelists.

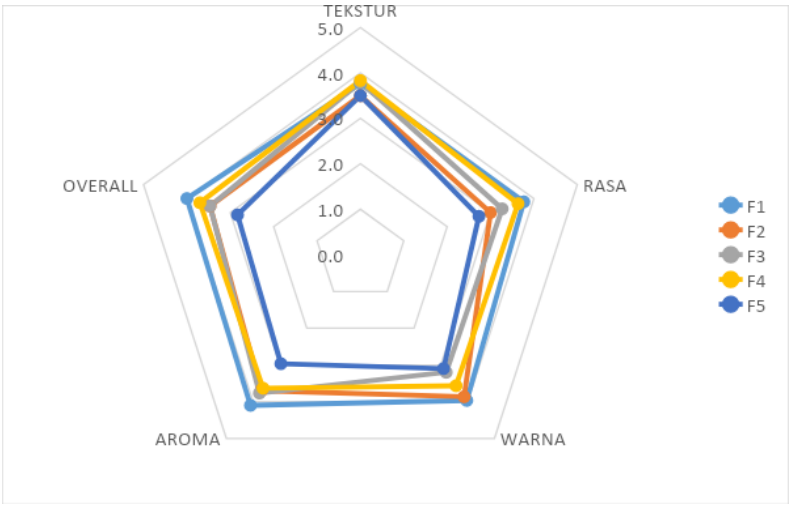

Figure 7:
Hedonic Rating Value on Non-Gluten Biscuits

Based on Figure 7. that the panelists preferred F1 non-gluten biscuits on the parameters of taste, color, aroma, and overall (light blue), while on the texture parameters the panelists preferred F4 non-gluten biscuits (yellow). Overall, the sample that was liked by the panelists was F1 with a value of 4.00 but this value was not significantly different from the values of F2, F3 and F4. The biscuit that the panelists disliked the most was F5. The panelists liked F1 the most because it tasted like roasted popcorn, the texture was not too hard, and the color was brown. Meanwhile, F5 produced biscuits that were pale in color, had a nutty aroma, and had a hard and gritty texture, so panelists did not like non-gluten biscuits with formulation 5. There was no significant difference between F1 and F4 because the panelists used were untrained panelists. so that the assessment is not based on sensitivity (Mutiaraningtyas & Kuswardinah, 2018).

CONCLUSION

The use of jali flour and oat flour affected the physicochemical and organoleptic characteristics of non-gluten biscuits. This is indicated by the absence of significant differences in crude fiber content and protein content. Significant differences were shown in the moisture content, ash content, and fat content. The addition of jali flour increased the hardness value of non-gluten biscuits. The results of organoleptic testing of non-gluten biscuits using oat flour and jali flour were significantly different in the parameters of taste, color, aroma, and overall (overall). The selected formulation used 40% oat

flour and 60% jali flour due to the similarity in texture, taste, color, aroma, and overall characteristics with non-gluten biscuits using 100% oat flour.

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APPENDICES:

Part 1:

Discourse Completion Test

Directions: Please ***write your response*** *in the blank area.* ***Do not spend a lot of time thinking about what answer you should provide****; instead, please* ***respond as naturally as possible*** *and write your response as* ***you feel you would say it*** *in the situation.*

A classmate that you have known for a couple of years stops by your desk at the library and invites you to lunch. You want to leave school early today, so you would rather work through lunch to get ahead on your project.

Classmate: *"Hi. How have you been? Hey, do you want to go to the cafeteria and get a bite to eat?"*

You: _____

~~~~~~DELETED FOR SAMPLE TEMPLATE PURPOSE~~~~~~

Part 2.

Demographic Information

1. Age and Gender:
2. Nationality:
3. Occupation:
4. Educational background:
5. First language:

Thank You

_____

IN SUBMITTING YOUR MANUSCRIPT, PLEASE ALSO WRITE 15-20 WORDS TO USE AS SUBJECT INDEX. EXAMPLES OF THE CHOICE OF WORDS AND HOW IT WOULD LOOK LIKE IS BELOW:

competence
- grammatical competence
- language competence
- pragmatic competence

complaints
- direct complaints
- indirect complaints
- speech act of complaints

culture
cultural aspect

English
- EFL learner
- English native

globalization
hybridity
speaker
- eloquent speaker
- foreign language speakers
- native speaker
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