Fortification of moringa leaves (Moringa oleifera) and seaweed (*Eucheuma cottonii*) on the quality of Mocaf- sorgum dried noodles

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Abstract. Mocaf-sorghum noodles have low nutritional content so it is necessary to add food ingredients to produce noodles with high nutritional value. The aim of this study was to evaluate the effect of the various concentration of moringa flour and seaweed flour on the nutritional value of mocaf-sorghum dried noodles. This research was designed by Completely Randomized Design (CRD) with a single factor, namely the concentration of moringa flour and seaweed flour consisting of 6 treatments with 3 replications.. The treatment factors include the concentration of mocaf:sorghum : moringa leaf flour: E.cottoniii flour, namely P1 (60% : 25% : 0% : 15%); P2 (60% : 25% : 3% : 12%); P3 (60% : 25%: 6%: 9%); P4 (60% : 25% : 9%: 6%); P5 (60% : 25% : 12% : 3%); P6 (60% : 25% : 15% : 0%). The parameters observed in this study were moisture content, ash, protein, crude fiber, antioxidant activity, iodine, elongation, cooking loss, cooking time, color, and organoleptic (texture, aroma, and taste). The concentration of moringa flour and seaweed flour gave significantly different effects on moisture content, ash, protein, crude fiber, antioxidant activity, iodine, elongation, cooking loss, cooking time, color, and hedonic organoleptic and scoring. The best treatment was P3 with a moisture content of 7.73%; ash 1.49%; protein 10.36%; crude fiber 29.08%; antioxidant 94.63%; iodine 2.82 ppm; elongation 2.35%; cooking loss 11.66%; cooking time 8.88 minutes; L* before cooking 40.85 and after cooking 45.50 and ^{o}Hue before cooking 138.52 and after cooking 105.46.

1 Introduction

Indonesia ranks as the world's fourth biggest wheat importer. In 2020, Indonesia was noted as among the top wheat importers, with a total import volume of 10.3 million tonnes (Indonesian Ministry of Trade). The cause of high wheat imports in Indonesia is due to the high number of food products that use wheat flour as the main ingredient such as noodles, bread and biscuits. Noodles are manufactured food items created from wheat dough, optionally including the addition of authorized food substances [1]. According to the Global Instant Noodle Association, Indonesia ranks as the world's second-highest consumer of instant noodles, consuming 13.27 billion packs of instant noodles in 2021. Continuous

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importation of wheat can threaten food security, so an alternative material is needed to replace wheat flour which can be used as a raw material for making noodles. Efforts that can be made are by substituting wheat flour with flour derived from local food raw materials such as sorghum and mocaf.

Sorghum has a starch content of 80.42%, making it suitable to be developed into flour products to replace wheat flour because it has a high starch content [2]. Sorghum flour has lower viscosity, swelling power, and gelatinization temperature compared to wheat flour. Therefore, to produce more elastic and compact noodles, basic ingredients such as mocaf are needed. Based on the results of Indrianti's research [3], the use of mocaf substitute flour is thought to increase the total amylose content in the noodle dough to produce chewier noodles. However, in Umri's research [4], the treatment of mocaf flour substitution in making wet noodles has a lower protein content compared to wet noodles without mocaf flour substitution. Therefore, it is necessary to add other food ingredients that can produce noodles with higher nutritional value than noodles made from wheat flour.

Pregnant females are among the categories most vulnerable to undernourishment. According to Lutviana and Budiono [5], There is a connection between the amount of energy and protein intake and the nutritional condition of young children. Toddlers who consume enough protein and meet the body's needs can produce good nutritional status. In addition to protein, a nutrient that is also needed by the body is iodine. Iodine is one of the microelements that is important for the body, especially for physical and mental growth and development. Iodine is needed by the body for the formation of thyroxine, which is a hormone secreted by the thyroid gland, where thyroxine plays a role in regulating the speed of substance exchange processes in the body so that it can affect the speed of growth and development [6]. Improving nutritional status can be directed by reducing the number of malnutrition, especially undernutrition. One of the efforts to improve nutrition can be done by fortifying food ingredients.

Food ingredients that can be utilized as fortification efforts in mocaf and sorghum-based noodles are moringa flour and seaweed flour. Moringa plant (Moringa oleifera) is one of the plants known for its rich nutritional content. Based on analysis in research Augustyn et al. [7], moringa leaf flour contains 9.57% moisture content; 7.85% ash content; 51.91% carbohydrates; 4, 03% fiber; 4.52% fat; 26.02% protein; and 1.92% Vitamin C. Based on research Astutik et al. [8] the addition of moringa extract to wet noodles substituted with mocaf flour can elevate the protein content of wet noodles with the addition of moringa flour.

Seaweed is a superb source of microelements, including folic acid, calcium, magnesium, zinc, iron, and selenium. Seaweed can be processed to extract polysaccharides such as alginate, agar, and carrageenan, which are gel-like substances collectively referred to as hydrocolloids and phycocolloids. These hydrocolloids are used as water pretension gels, emulsifiers and other physical properties [9]. Based on Syarifuddin et al. [10], the result indicated that incorporating seaweed powder into the production of dry noodles can create a gel-like substance and serve as an adhesive, resulting in a chewy texture for the noodles. Septiono [11] states that the inclusion of seaweed flour can raise the value of iodine in instant breadfruit noodle products, where the iodine content can prevent growth and development disorders in living things.

Therefore, a study was conducted on increasing the nutritional value of dried noodles made from mocaf and sorghum through fortification of moringa flour and seaweed flour as a source of protein and iodine in dried noodles. The objective of this study was to assess the effect of moringa and seaweed concentrations on the nutritional value of mocaf- sorghum dried noodles.

2 Material and method

2.1 Material and tool

The tools used in this research are titration tools, sieve 100, cabinet drieder, calorimeter (MSEZ User Manual), extruder, gas stove, fume hood, distillation machine, oven, volume pipette, UV-Vis spectrophotometer, and analytical balance.

The materials used in this study were Moringa leaf flour, mocaf, sorghum and Eucheuma cottonii seaweed flour.

2.2 Method

The study utilizes laboratory-based experimental techniques. The experiment in this investigation was structured using a Completely Randomized Design (CRD) with a single factor, namely the concentration of moringa flour and seaweed flour consisting of 6 treatments with 3 replications so that 18 experimental units were obtained. The treatment factors include the concentration of mocaf: sorghum starch: Moringa leaf flour: E.cottoniii seaweed flour, namely P1 (60%: 25%: 0%: 15%); P2 (60%: 25%: 3%: 12%); P3 (60%: 25%: 6%: 9%); P4 (60%: 25%: 9%: 6%); P5 (60%: 25%: 12%: 3%); P6 (60%: 25%: 15%: 0%).

2.3 Preparation of Mocaf-sorghum dried noodles

The process of making dried noodles [12] and is to prepare raw materials such as mocaf, sorghum starch, seaweedpulp and moringa flour [13]. Then the ingredients are mixed and steamed for 15 min at 100°C to produce pragelatinized flour. The dough was then put into an extruder machine and stirred for 5 min then molded to form noodle sheets. The molded noodles were then dried using a cabinet drieder at 60°C for 8 hours.

2.4 Parameters

The parameters that will be observed in this study are moisture content, ash, protein, crude fiber, antioxidant activity, iodine, elongation, cooking loss, cooking time, color and organoleptic texture, aroma and taste.

2.5 Data analysis

The analytical data were statistically analyzed by Analysis of Variance (ANOVA) at a significance level of 5% using Co-Stat software. Significantly different data were tested with an Honestly Significant Difference (HSD).

3 Result and discussion

The concentration of moringa flour and seaweed flour had notably divergent effects on the moisture content of mocaf-sorghum dried noodles. The effects of varying concentrations of moringa flou and seaweed flour on the moisture content of dried noodles can be seen in Figure 1.

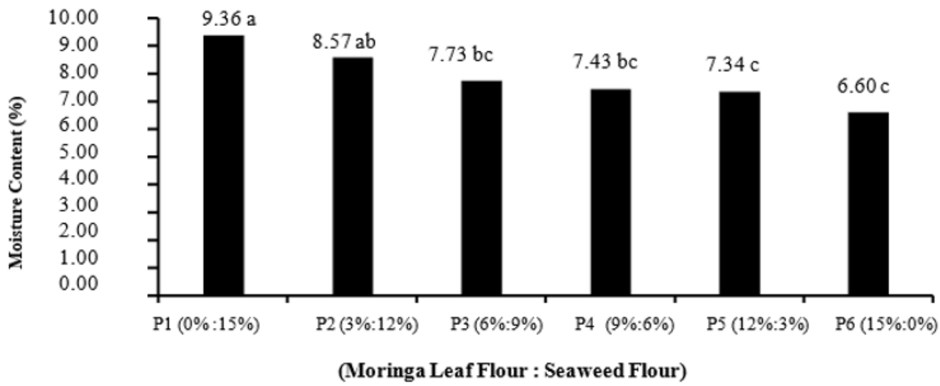

Fig. 1. Effect of moringa leaf flour and seaweed flour concentration on moisture content.

Based on Fig. 1. shows that the moister content of dried noodles increases with the higher concentration of seaweed flour used. This result can be influenced by the water content contained in seaweed flour. Seaweed flour contains a water content of 14.20%. These results are in line with research Aditia [14] which states that the moisture content of dried noodles shows an increase as the substitution of seaweed flour increases because seaweed flour has a fairly high water content. This is also suspected because seaweed contains crude fiber of 46.62%. Insoluble crude fiber can bind water, besides that during the drieding process the mocaf-sorghum noodles added with seaweed will undergo gelatinization which will create a film coating, thereby entrapping water molecules. The water held within this film coating cannot be eliminated, resulting in an increase in water content in instant noodles with the incorporation of seaweed flour [15]. Based on the research that has been done, the value of moisture content of dried noodles obtained from all treatments has met SNI 01-2774-1992, namely the moisture content of dried noodles quality 1 maximum 8% wb and quality 2 maximum 10% wb.

Analysis of ash content shows that thhe concentration of moringa flour and seaweed flour gave significantly different effects on the ash content of mocaf-sorghum dried noodles. The effects of varying concentrations of moringa flour and seaweed flour on the ash content of dried noodles can be seen in Figure 2.

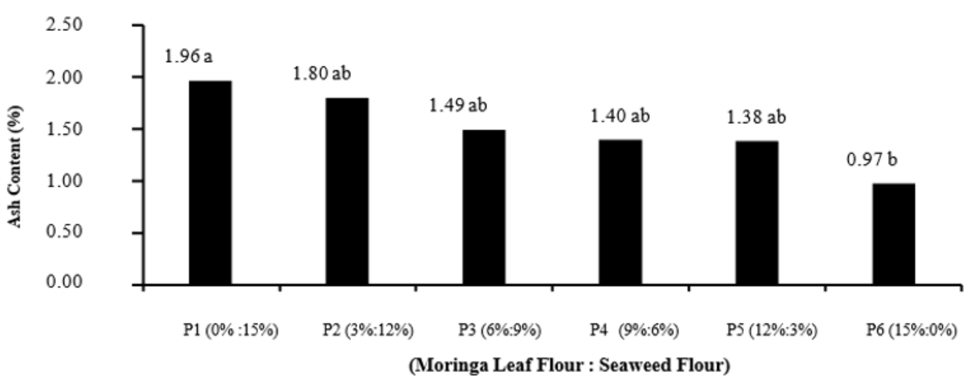

Fig. 2. Effect of moringa leaf flour and seaweed flour concentrations on ash content.

Based on Fig. 2, it shows that the formulation of moringa flour and seaweed flour with various concentrations affects the ash content of mocaf-sorghum dried noodles. The minimal ash content was achieved with the formulation containing 15% Moringa leaf flour and 0% seaweed flour, resulting in an ash content of 0.97%. Conversely, the maximal ash content was observed in the formulation comprising 0% Moringa leaf flour and 15% seaweed flour, with an ash content of 1.96%. An increase in seaweed flour proportion leads to a rise in the ash content of the dried noodles. These findings are consistent with outcomes from similar studies [16] which states that the increased addition of seaweed flour can enhance the ash content in dodol. This is because seaweed provides a fairly high mineral contribution. Euchuma cottonii seaweed is a carrageenan producer that is rich in minerals and contains salts such as Na, K, Ca, and sulfate. These salts are classified in inorganic compounds that will be left behind after the process of ashing [17]. The high ash content of dried noodles is also caused by the basic ingredients used, namely seaweed flour, which contains 3.09% ash content.

Based on SNI -2774-1992 regarding the quality standard of dried noodles, It has been ascertained that the highest permissible ash content in dehydrated noodles is 3%. In relation to the ash content in dehydrated noodles based on the conducted studies, every procedure complies with the Standards of National Indonesia.

Protein content assays showed the concentration of moringa flour and seaweed flour gave significantly different effects on the protein content of mocaf-sorghum dried noodles. The effect of the concentration of moringa flour and seaweed flour on the protein content of dried noodles can be seen in Fig. 3.

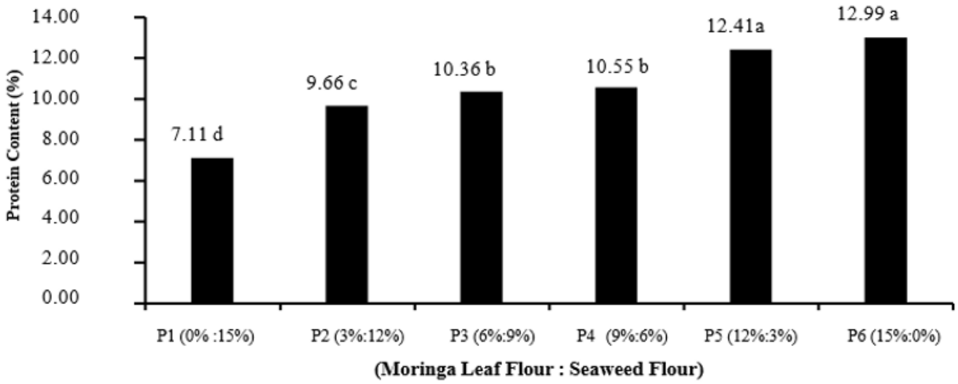

Fig. 3. Effect of moringa leaf flour and seaweed flour concentration on protein content.

Fig. 3 shows that the average protein content of the noodles ranged from 7.11-12.99%. The lowest protein content was obtained in the P1 treatment which amounted to 7.11% and the highest protein content in the P6 treatment which amounted to 12.99%. This shows that the protein content of dried noodles increases along with the inclusion of moringa flour. This increase in protein content can be caused by the higher protein content of moringa flour than seaweed flour, which is 26.25% while seaweed flour is 8.97%. The outcomes of this investigation correspond with studies conducted [18] on damp noodles replacing mocaf flour with the incorporation of moringa leaf extract, which indicates that the greater the addition of moringa leaf extract, the higher the protein content in damp noodles. This research is also supported by research Zakaria and Rauf [19] on wet noodle research with the inclusion of Moringa leaf flour, there is a tendency for protein content to rise proportionally with the increasing concentration of the flour.

Based on the quality criteria for dried noodles according to SNI-2774-1992 regarding the quality benchmarks of dried noodles, it has been established that the minimal protein content in dried noodles is 8%. In mocaf-sorghum dried noodles with moringa flour and seaweed flour fortification, the chemical test results show that dried noodles that meet SNI criteria are P2, P3, P4, P5 and P6.

Assays on Crude Fiber Content showed the concentration of moringa flour and seaweed flour gave significantly different effects on crude fiber content in the noodles. The impacts of different levels of moringa flour and seaweed flour on the crude fiber content in dried noodles are observable in Fig. 4.

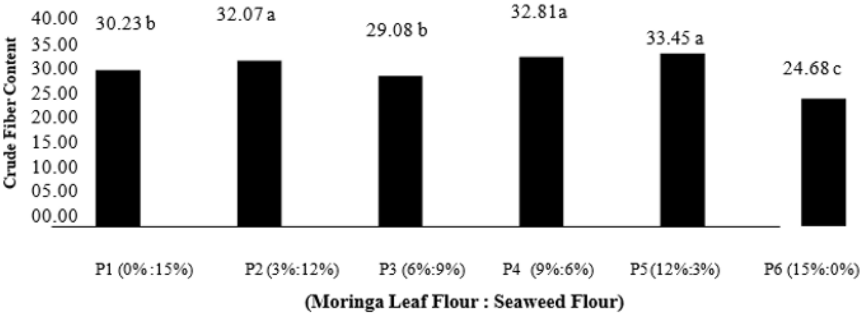

Fig. 4. Effect of moringa leaf flour and seaweed flour concentration on crude fiber content.

Based on the Fig 4., it shows that the fiber content of dried noodles in the P1, P3 and P6 treatments has decreased, where the less concentration of seaweed flour added, the lower the crude fiber content of the noodles produced. The increase in crude fiber content in mocaf-sorghum noodles can be influenced by the raw materials used, where seaweed contains 98.86% crude fiber content. Crude fiber content increased along with the increase in the concentration of seaweed flour used, align with research performed [20] on the manufacture of wet noodles substituting corn flour which explained that the more the percentage of the addition of wet seaweed, the higher the fiber content in the noodles, These results are supported by Panjaitan et al. [21] on the manufacture of tortillas with the addition of seaweed obtained results that seaweed (Eucheuma cottonii) can increase food fiber content in tortilla products. In Nainggolan et al. [22] on nuget products with the addition of seaweed flour, it was found that nuggets with the addition of higher seaweed concentrations caused the crude fiber content of shrimp nuggets to increase.

The increase in fiber content in the P4 and P5 treatments can be supported by the fortification of moringa leaf flour which has a fiber content of 42.6% so that the noodles with the highest fiber content are obtained in the P5 treatment with a concentration of moringa leaf flour and seaweed flour of 12% and 3%. These results are supported by Rahmi et al. [23] on making wet noodles With the incorporation of moringa flour, it's emphasized that a rise in the proportion of moringa flour within the noodle blend results in a proportional increase in the fiber composition of the moist noodles.

Antioxidant Content assays showed the concentration of moringa flour and seaweed flour gave significantly different effects on the antioxidant content of mocaf-sorghum dried noodles. The effect of the concentration of moringa flour and seaweed flour on the antioxidant content of dried noodles can be seen in Fig. 5.

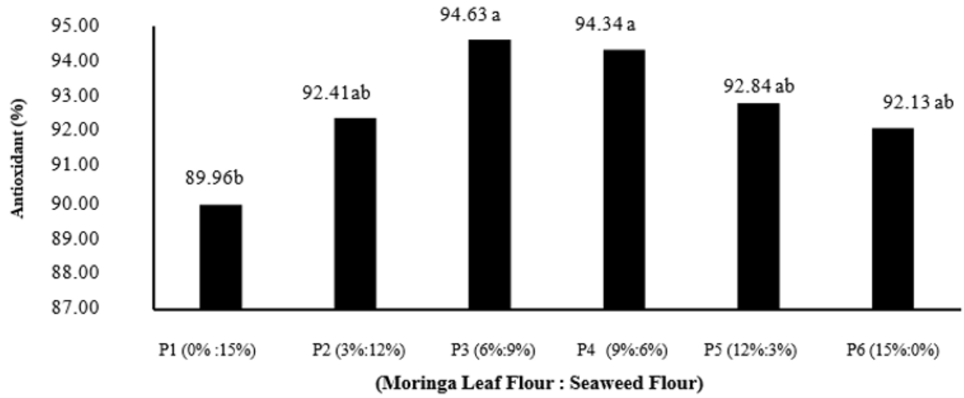

Fig. 5. Effect of moringa leaf flour and seaweed flour concentration on antioxidant levels.

Based on Fig. 5, it was found that the treatment of P1, P2 and P3 increased with the addition of moringa leaf flour concentration. In Ismawati et al. [24] on the manufacture of arrowroot tuber noodles with the addition of moringa flour, it was found that the addition of 2% moringa flour was able to produce antioxidant levels of 64.57 ppm. This research is also supported by Astutik et atl. [8] which states that the more the addition of moringa leaf powder can increase the antioxidant activity of dried noodles. This is because antioxidant activity contains phenolic compounds which are a class of flavonoids to minimize the hazards posed by free radicals and to act as an antagonist to these free radicals.

Treatments P4, P5 and P6 decreased as the concentration of seaweed flour decreased. This is because seaweed flour also contains antioxidants of 69.23%. In Nosa et al. [25] states that kappa carrageenan E. cottonii has the potential to be used as a source of antioxidants. This is also supported by Loho et al. [26] which examines the content and antioxidant activity of red seaweed stating that in Eucheuma cottonii a high enough total flavonoids are obtained so that methanol extracts in e.cottonii can act as antioxidants. Afiani et al. [27] found that the addition of 30% seaweed was the formulation that had the highest total phenol compound content and antioxidant activity.

Iodine Content assays showed the concentration of moringa flour and seaweed flour gave significantly different effects on the iodine content of mocaf-sorghum dried noodles. The effect of moringa flour and seaweed flour concentration on iodine content of dried noodles can be seen in Fig. 6.

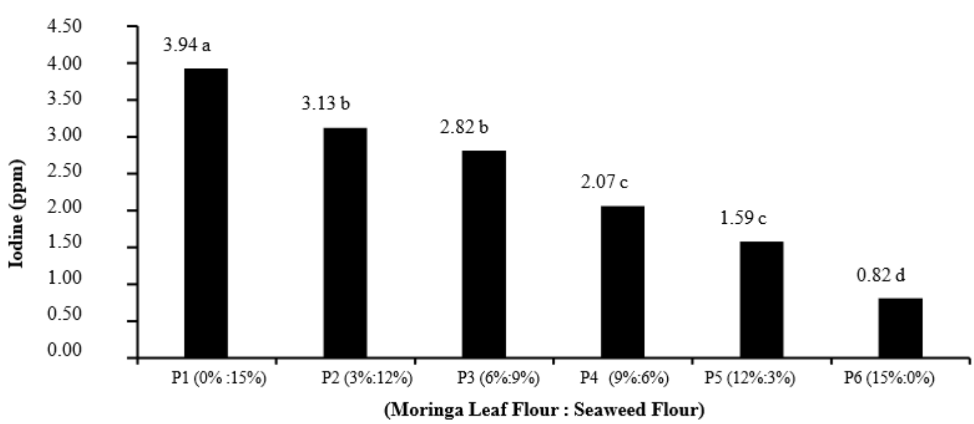

Fig. 6. Effect of moringa leaf flour and seaweed flour concentration on iodine content.

Based on Fig. 6, it shows that the lowest iodine content was obtained in the P6 treatment at 0.82%, while the highest iodine content was in P1 at 3.94%. Iodine levels were influenced by the use of seaweed flour. The higher the concentration of seaweed flour, the higher the iodine content of dried noodles. The iodine content increased due to the iodine content of the raw materials used, namely the iodine content of seaweed flour of 0.10 ppm. The moringa flour does not contain iodine known from research Gopalakrishnan et al. [28] which analyzed the nutritional content of dried moringa leaves or moringa flour. The results of this study align with research Manurung et al. [29] which states that the iodine content of composite dried noodles is strongly influenced by the iodine content of seaweed flour. The results of this study are supported by research [30] on the manufacture of tempeh with the addition of seaweed flour obtained the results that the higher the addition of seaweed flour concentration, the higher the iodine content in tempeh. The results of this study are also supported by Safitri et al. [31] on the manufacture of seaweed dodol reported that the higher the seaweed pulp used, the higher the iodine content in dodol.

According to WHO, the iodine requirement of adults is 150μg per day. In mocaf-sorghum dried noodles with moringa flour and seaweed flour fortification, the chemical test results show that mocaf-sorghum dried noodles can help meet a small part of the iodine requirement in adults.

The concentration of moringa flour and seaweed flour gave significantly different effects on the elongation of mocaf-sorghum dried noodles. The effect of the concentration of moringa flour and seaweed flour on the elongation of dried noodles can be seen in Fig. 7.

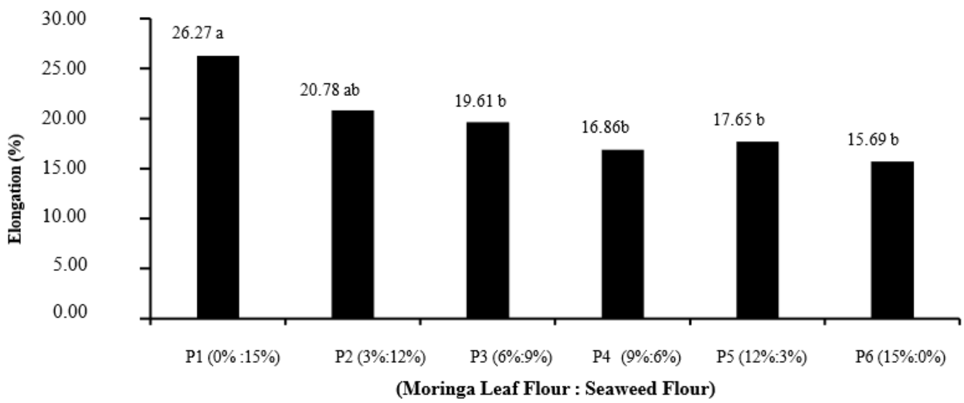

Fig. 7. Effect of moringa leaf flour and seaweed flour concentration on noodle elongation.

Based on Fig. 7, it shows that the average elongation is 15.69 - 26.27%. The lowest elongation was found in the P6 treatment at 15.69% and the highest in the P1 treatment at 26.27%. The result indicated that the interplay between each dosage level of moringa powder and seaweed powder had a distinctly divergent impact on the lengthening of mocaf-sorghum noodles. The outcomes of the analysis revealed that as the concentration of seaweed powder increased, so did the stretchability of the noodles. These findings are consistent with investigations conducted by Atiqoh et al. [32] which states that the addition of higher levels of seaweed and carrageenan affects gel strength. The results of this study are also supported by rese Putri and Harijono [33] which states that the increase in elongation value indicates that the more percentage of carrageenan addition can produce noodles that are more elastic or easy to break. Carrageenan is a hydrocolloid compound that has the property of being able to bind water and form a solid gel so that the noodles produced have a firm texture and are not easily broken or destroyed during cooking. Nevertheless, The concentration of moringa flour and seaweed flour gave a significantly different effect on the cooking loss of mocaf-sorghum dried noodles. The effect of the concentration of moringa flour and seaweed flour on the cooking loss of dried noodles can be seen in Fig. 8.

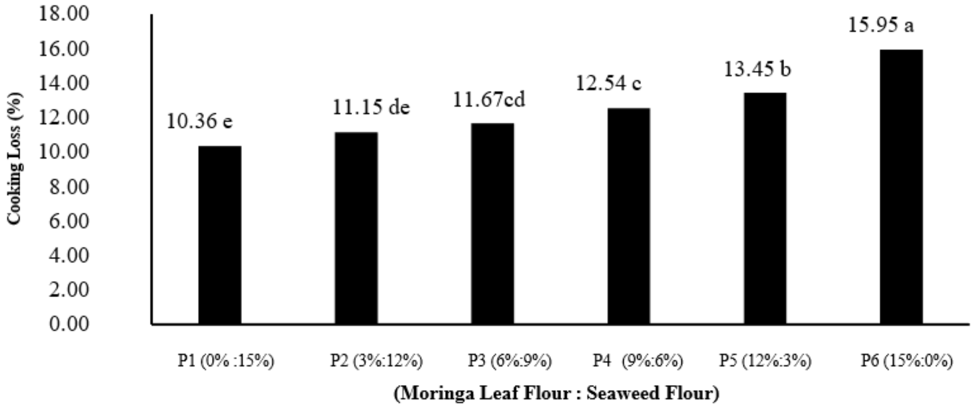

Fig. 8. Effect of moringa leaf flour and seaweed flour concentration on noodle cooking loss

Fig. 8 shows that the average cooking loss ranged from 10.36 - 15.95%. The lowest cooking loss was found in the P1 treatment at 10.36% and the highest in the P6 treatment at 14.53%. The results showed that an increase in the concentration of moringa flour, the higher the cooking loss of the noodles. The results of this study align with research performed [34] on the manufacture of moringa instant noodles which found that the higher the percentage of moringa flour addition, the higher the cooking loss value of instant noodles. Firdaus et al. [35] also reported that the manufacture of dried noodles with Eucheuma cottonii fortification obtained the results that the higher the percentage of seaweed flour, the lower the cooking loss of the noodles. Seaweed flour can bind macromolecules such as proteins so as to increase the viscosity of the dough and the gelatinization process becomes more optimum and produces compact noodles. The results of this study align with research performed [36] on the manufacture of fish cob amplang with the addition of seaweed flour obtained the results that the dough on fish amplang with the addition of seaweed has a more compact dough.

Meanwhile, The concentration of moringa flour and seaweed flour gave a significantly different effect on the cooking time of mocaf-sorghum dried noodles. The effect of the concentration of moringa flour and seaweed flour on the cooking time of dried noodles can be seen in Fig. 9.

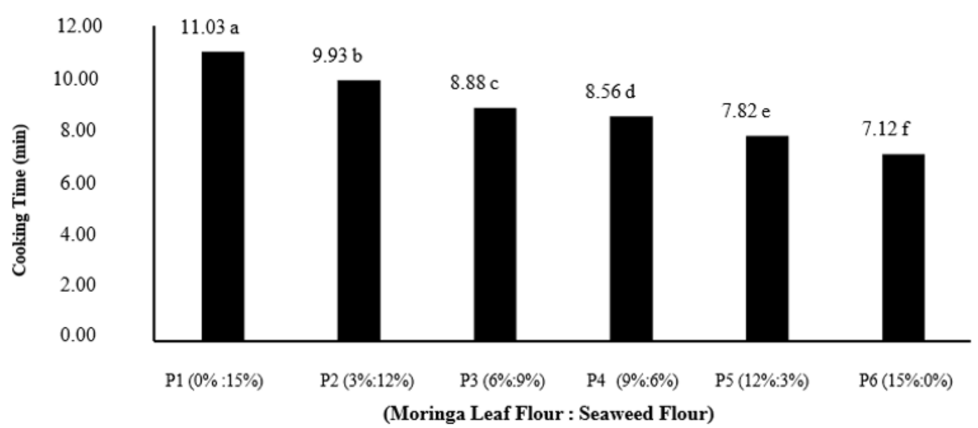

Fig. 9. Effect of moringa leaf flour and seaweed flour concentration on cooking time of noodles.

Based on Fig. 9, it shows that the shortest cooking time is in treatment P6 for 7.12 min and the longest cooking time is shown by treatment P1 for 11.03 min. Mocaf-sorghum noodles with the highest concentration of seaweed flour have a higher average cooking time value compared to other treatments. This is align with Trisnawati and Nisa [37] which states that the more concentration of seaweed flour added to mocaf-substituted dried noodles, the time used until the noodles are fully gelatinized tends to increase. This is thought to be due to the formation of a solid bonding structure between the hydrocolloid and the starch and protein molecules used. Carrageenan hydrocolloids have a high dietary fiber content. Seaweed contains high fiber so that it can inhibit the gelatinization process and inhibit cooking time [38].

Color assays showed that the color test of mocaf-sorghum noodles was conducted on L* and oHue values.

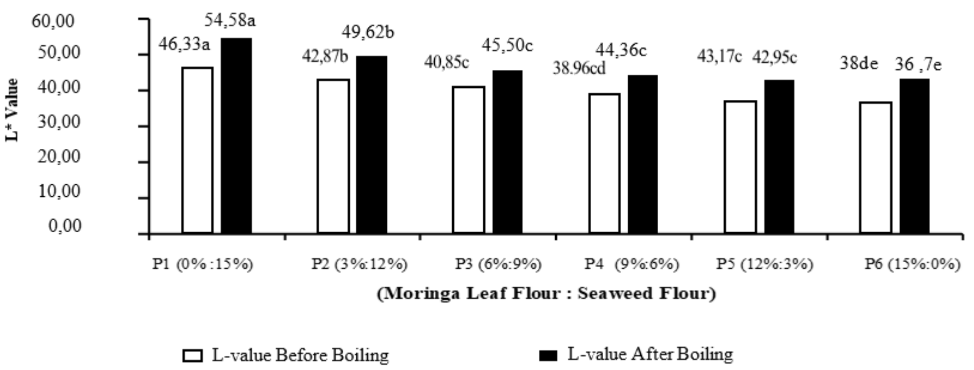

Fig. 10a. Effect of moringa leaf flour and seaweed flour concentration on the color of mocaf-sorghum noodles.

Based on Fig. 10a, the results of color measurement before and after cooking show that the average L* value before cooking ranges from 36.79-46.33. The average L* value of mocaf-sorghum noodles after cooking ranged from 42.95-54.58. The degree of brightness value of mocaf-sorghum noodles tends to decrease due to the higher addition of moringa flour. This happens because moringa flour has chlorophyll green pigment so that the more concentration added, it will produce a concentrated green color that tends to be dark. These results are in accordance with research conducted [37] which states that the more the addition of moringa leaf concentrate, the darker the color of the noodles produced. This is due to the concentration of protein derived from moringa leaves where the green pigment chlorophyll is dominant to the color of the resulting concentrate causing the more concentration added will produce a concentrated green color that tends to be dark. The added seaweed flour will bind water, thus reducing the brightness of the dried noodles produced. The brightness of the noodles before and after cooking can be influenced by the absorption of water that can break down the color of the noodles after cooking so that the color of the noodles after cooking is brighter than the noodles before cooking. The results of this study align with research performed by Yuniarsih et al. [39] on the substitution of moringa flour in the manufacture of cookies obtained the results that the more moringa flour substitution, the brightness of the cookies decreases.

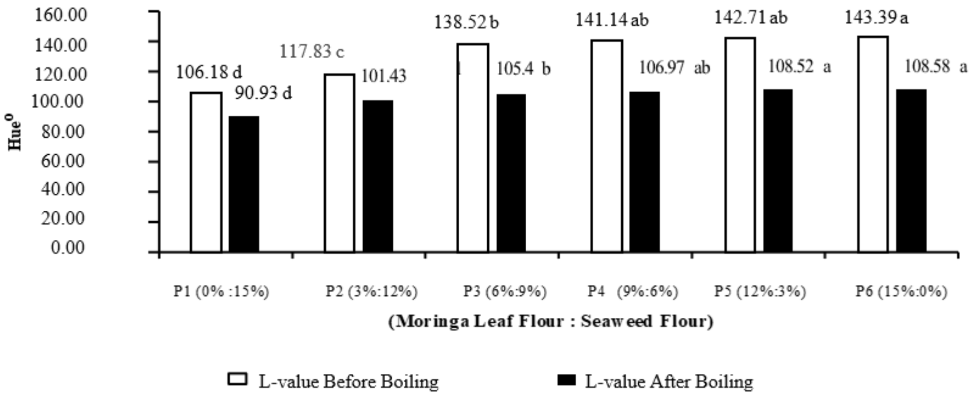

Fig.10b. Effect of moringa leaf flour and seaweed flour concentration on the color of mocaf-sorghum noodles.

Based on Fig. 10b, the color measurement results were obtained before and after cooking. The average oHue value of mocaf-sorghum noodles after cooking ranged from 90.93 - 108.85. This result shows that the sorghum mocaf noodles after boiling obtained the results that P1, P2, P3, P4, P5 and P6 tend to be yellow in color. The measurement results of the Hueo value before cooking showed that the average Hueo value ranged from 106.18 - 143.39. The measurement results showed that mocaf-sorghum noodles in the P1 and P2 treatments obtained a yellowish green color, while in the P3, P4, P5 and P6 treatments showed a green color. These results indicate a change in color as the concentration of moringa flour added increases. This is because the moringa flour used has a more concentrated color so that a darker noodle color is produced [40].

Organoleptic tests on mocaf-sorghum noodles were carried out on aroma, texture and taste by hedonic and scoring. The concentration of moringa flour and seaweed flour had a significant effect on the organoleptic aroma, texture and taste of mocaf-sorghum noodles.

Based on Fig. 11a. the hedonic test obtained a value between 2.75 - 3.6. The average panelist's level of liking shows from the range of somewhat like to like. The level of panelist liking continued to decrease from treatment P1 to P6. The higher the concentration of moringa flour, the lower the level of panelist liking for the noodles. The results of this study align with research performed by Rahmi et al. [23] which found that the organoleptic quality of noodles decreased as the concentration of moringa added increased. The results of the hedonic test on the aroma of the noodles showed that the average liking for the noodles was the highest, namely the noodles in the P2 treatment of 3.6. This means that mocaf-sorghum noodles with a concentration of moringa flour of 3% and 12% tend to be the most preferred. This is because the addition of moringa flour at a concentration of 3% is still acceptable, so that at this concentration it meets SNI 01-3551-2000.

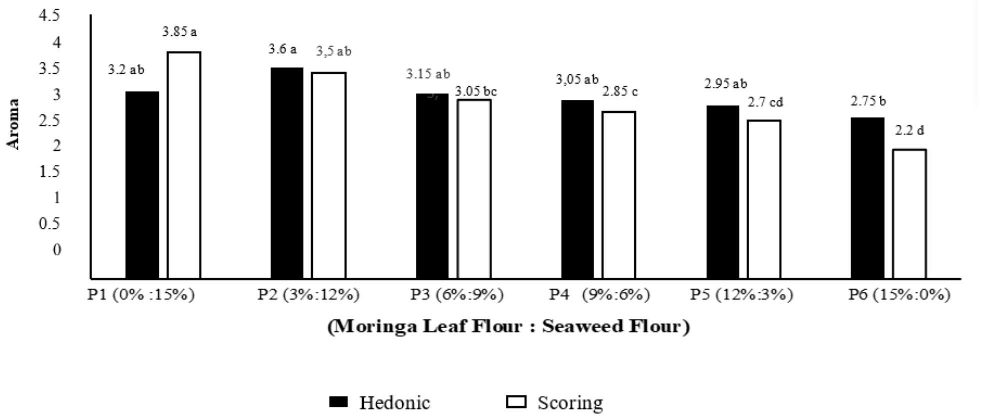

Fig. 11a. Effect of moringa leaf flour and seaweed flour concentration on organoleptic aroma of mocaf-sorghum noodles.

Based on the panelists' assessment of the scoring test, the scores ranged from 2.20-3.85. The average panelist scoring level shows from strong aroma to no strong aroma. This is because noodles with a higher concentration of moringa flour cause a stronger moringa aroma. The results of this study align with research performed [41] which states that the higher the concentration of moringa flour added, the stronger the moringa aroma will be. The strong odor in moringa leaf powder is caused by moringa leaves containing the enzyme lipoxidase, which is an enzyme found in green vegetables because the enzyme lipoxidase hydrolyzes or decomposes fat into compounds that cause strong odor [8].

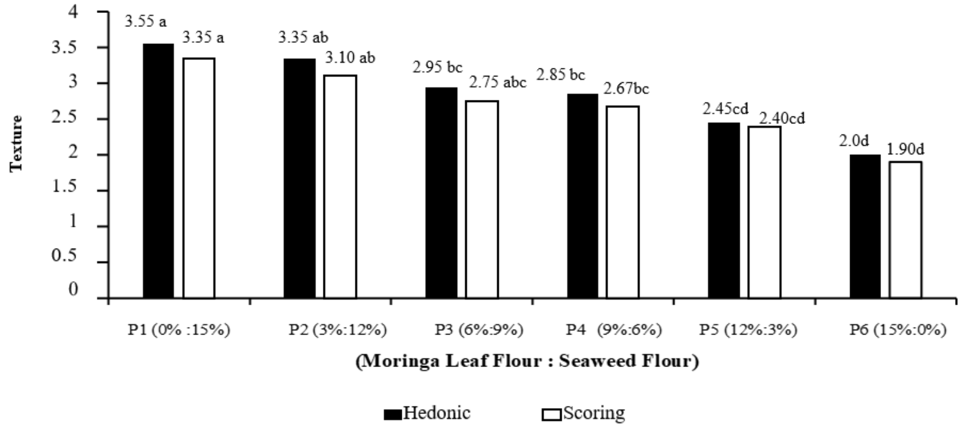

Fig.11b. Effect of moringa leaf flour and seaweed flour concentration on organoleptic texture of mocaf-sorghum noodles.

Based on Fig 11b. shows that the level of panelists' liking for the hedonic parameters of the texture of mocaf- sorghum noodles ranged from 2.00 - 3.55. The average panelist's level of liking shows from the range of dislike to somewhat like. This indicates that the noodles with 0% moringa flour concentration and 15% seaweed flour tended to be the most preferred. The more the addition of seaweed flour shows the value of liking for the texture of the noodles is increasing. Rahmi et al. [23] states that the panelists' level of preference for the texture of moringa wet noodles tends to decrease as the concentration of moringa flour added increases, this statement is in accordance with the results of the tests that have been carried out.

Based on the panelists' assessment of the scoring test, the highest score was obtained in the P1 treatment at 3.35 and the lowest was obtained in the P6 treatment at 1.90. The average panelist scoring level shows from not chewy to somewhat chewy. The inclusion of moringa flour in higher concentrations leads to the noodles' texture becoming more prone to breaking. Non-starch elements present in the moringa leaf extract reduce the noodles' elasticity, making them susceptible to breaking easily under any pressure, such as pulling or stretching [42]. Hydrocolloids in seaweed, especially carrageenan, function in making noodles to increase the elasticity, cohesiveness, and strength of noodles.

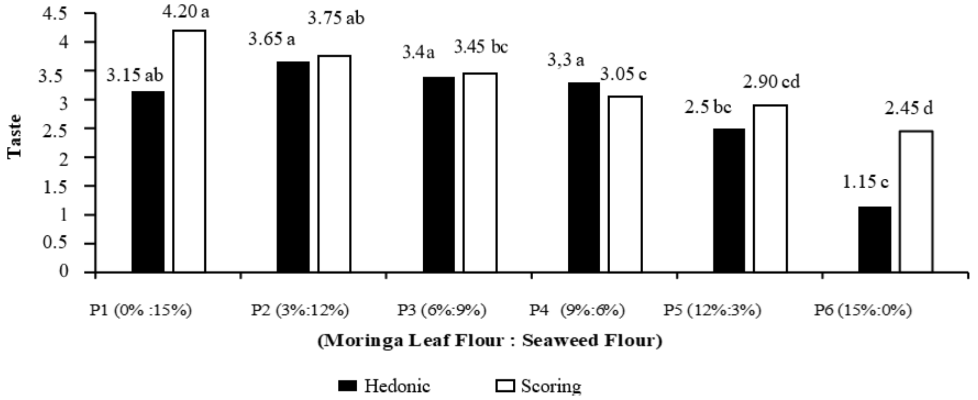

Fig.11c. Effect of moringa leaf flour and seaweed flour concentration on organoleptic taste of mocaf-sorghum noodles.

Based on Fig. 11c. shows that the formulation of adding moringa flour and seaweed flour affects the taste of mocaf-sorghum noodles. In panelists from the hedonic test, the panelists' level of liking for the taste of mocaf-sorghum noodles ranged from 1.15-3.15. The average level of panelist preference shows from the range of somewhat like to like. The stronger the bitterness in the noodles, the lower the panelists' liking. The results of the hedonic test on the taste of the noodles showed that the average liking for the noodles was the highest, namely the noodles in the P2 treatment of 3.65. This means that mocaf-sorghum noodles with a concentration of moringa flour of 3% and 12% tend to be the most preferred. This is because the addition of moringa flour at a concentration of 3% is still acceptable, so that at this concentration it meets SNI 01-3551-2000.

Based on the panelists' assessment of the scoring test, the scores ranged from 2.45-4.20, namely bitter to no bitter taste. The bitter taste of the noodles is due to the higher concentration of moringa added. Moringa leaf flour has a distinctive bitter taste. The results of this study align with research performed [41] on the manufacture of instant noodles with the substitution of moringa leaves and milkfish bones which states that the more moringa leaves added, the more bitter the taste of the noodles will be. This is also supported which reported that moringa instant noodles have different flavors due to the addition of moringa leaf concentration.

4 Conclusion

Based on the results of the analysis and discussion, the following conclusions can be drawn that the concentration of moringa flour and seaweed flour gives a significantly different effect on water content, ash content, protein content, fiber content, antioxidant content, iodine content, elongation, cooking loss, cooking time, color, and organoleptic mocaf-sorghum noodles. The proposed hypothesis is rejected because it is not in line with the results of the research that has been done. Based on the research that has been done, the best treatment is obtained in the P3 treatment with the addition of 6% moringa leaf flour concentration and 9% seaweed flour so that the moisture content is 7.73%; ash 1.49%; protein 10.36%; crude fiber 29.08%; antioxidant 94.63%; iodine 2.82 ppm; elongation 2.35%; cooking loss 11.66%; cooking time 8.88 min.; L* before cooked 40.85 and after cooked 45.50 and oHue before cooked 138.52 and after cooked 105.46.

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