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NUTRITIONAL VALUE OF MACKEREL FISH FLOUR (*RASTRELLIGER SP.*) WET NOODLES FORTIFIED WITH VEGETABLE FLOUR

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ABSTRACT

Wet noodles available on the market are often lacking in adequate nutrition, with higher carbohydrates, lower protein, and fewer vitamins. Thus, develop a healthy, economical, and nutritious wet noodles using local ingredients is needed. The study aimed to investigate the enhancement of nutritional value in wet noodles by fortifying them with vegetable flour and mackerel flour. The study useda true experimental design with a posttest-only control group. The design used a complete randomized design consisting of three treatments and four replications. The three treatments were as follows: F0 (wet noodles with fish flour increased by 10 grams of vegetable flour); F1 (wet noodles with fish flour increased by 15 grams of vegetable flour);and F2 (wet noodles with fish flour increased by 20 grams of vegetable flour). The researchers analyzed the nutritional composition of the noodles, focusing on carbohydrates, proteins, fats, and iron. The findings of the study showed that the carbohydrate content in the three treatments of wet noodles with increased vegetable flour ranged from 14.3% to 16.7%. The protein content in the treatments ranged from 8.61% to 9.22%. The fat content varied from 2.62% to 2.9%. Moreover, the iron content in the treatment of wet noodles with increased vegetable flour ranged from 22.08 mg/kg to 25.76 mg/kg. The result of the ANOVA statistical test showed that there was a significant difference in the addition of vegetable flour to the iron content of mackerel meal wet noodles.

Keywords: *wet noodles, nutritional composition, fortified noodle, fish flour, and mackerel.*

ABSTRAK

Mie basah yang tersedia di pasaran seringkali kurang memiliki gizi yang cukup, dengan kandungan karbohidrat yang lebih tinggi, protein yang lebih rendah, dan vitamin yang lebih sedikit. Untuk itu, perlu dilakukan pengembangan produk mie basah yang sehat, ekonomis, dan bergizi dengan menggunakan bahan lokal. Penelitian ini bertujuan untuk mengetahui peningkatan nilai gizi mie basah dengan cara memfortifikasinya dengan tepung nabati dan tepung ikan kembung. Studi ini dilakukan dengan menggunakan desain eksperimental sejati dengan kelompok kontrol posttest-only. Rancangan menggunakan rancangan acak lengkap yang terdiri dari tiga perlakuan dan empat ulangan. Ketiga perlakuan tersebut adalah sebagai berikut: F0 : Mie basah dengan tepung ikan ditambah 10 gram tepung sayur; F1 : Mie basah dengan tepung ikan ditambah 15 gram tepung sayur; dan F2 : Mie basah dengan tepung ikan ditambah 20 gram tepung sayur. Para peneliti menganalisis komposisi nutrisi mie, dengan fokus pada karbohidrat, protein, lemak, dan zat besi. Hasil uji statistik ANOVA menunjukkan adanya perbedaan yang signifikan pada kandungan besi mie basah bungkil ikan kembung dengan penambahan tepung sayur. Hasil penelitian menunjukkan bahwa kandungan karbohidrat pada ketiga perlakuan mi basah dengan penambahan tepung nabati berkisar antara 14,3% sampai 16,7%. Kandungan protein pada perlakuan berkisar antara 8,61% sampai 9,22%. Kandungan lemak bervariasi dari 2,62% hingga 2,9%. Sedangkan kandungan besi pada perlakuan mi basah dengan penambahan tepung nabati berkisar antara 22,08 mg/kg hingga 25,76 mg/kg. Hasil uji statistic ANOVA menunjukkan bahwa terdapat perbedaan yang signifikan penambahan tepung nabati terhadap kadar besi mie basah tepung ikan ikembung.

Kata kunci: mi basah, komposisi gizi, mi fortifikasi, tepung ikan, ikan kembung

INTRODUCTION

As the Indonesian food industry expands rapidly on a small, medium, and large scale, it is critical to monitor the products produced. In their work, Dwi Jayati and Agustina (2018) asserted that the wet noodle industry is one of Indonesia's fastest-growing food industries.Wet noodles, according to the National Standardization Agency (KD Arsiti Rahayu A, 2016), are wet food products

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prepared from wheat flour with or without the addition of other permissible or impermissible food components; are shaped like non-dried noodles.

These days, wet noodles available on the market are not nutritionally adequate since they contain higher carbohydrates, lower protein, and fewer vitamins. Conforming to the Directorate of Nutrition of the Ministry of Health of the Republic of Indonesia (2005), the nutritional content, particularly the protein level, of noodle products and preparations remains relatively poor (KD Arsiti Rahayu A, 2016).

Statistical data on marine capture fisheries production of Gorontalo province, shows that fish production in Gorontalo province is 126,099 tons in 2021. The production commodity of mackerel in Hulonthalangi sub-district of Gorontalo city is 978 tons. Based on data from the Gorontalo city Marine Fisheries and Agriculture Office in 2022, the mackerel taken is limited, bearing in mind that the fish is prone to decay and the quality to be achieved is good mackerel quality. Mackerel is a species of marine fish that is generally obtainable and consumed by the general populace because of its affordable price. Considering mackerel is a perishable commodity, one of the treatments is to grind it into a fish meal. According to Ntau et al. (2022), the excellent nutritional value of mackerel flour was discovered in mackerel flour with steaming and pressing of water and oil at 90 °C to generate the optimum nutritional value: water content (%) 3.81; protein (%) 83.37; fat (%) 5.05; carbohydrates (%) 2.85; Calcium (ppm) 83.43; iron (ppm) 14.49.The addition of mackerel flour to biscuit manufacturing, as indicated by Fitri and Purwani (2017), can augment the protein content in biscuits, with 15% mackerel flour producing 11.37 g of protein.

Carrots, a yellowish-orange vegetable known for its high quantities of vitamin A, which is beneficial to eye health, are a popular type of vegetable consumed by the wider public in the form of cooked or salads. Carrots additionally carry Beta-carotene, which can serve as an antidote to cancer-causing free radicals (Lidiyawati et al., 2013). According to the 2017 Indonesian Food Composition Table (TKPI), 100 grams of carrots contain the following nutritional value: water (89.9 g), energy (36 cal), protein (1.0 g), fat (0.6 g), carbohydrates (7.9 g), fiber (1.0 g), calcium (45 mg), phosphorus (74 mg), iron (1.0 mg), beta-carotene (3.784 mcg), total carotene (7.125 mcg), vitamin C (18 mg). According to research, nutritional content of carrot flour water (5.6%), Protein (7.89%) Fat (1.13%) Ash (2.56%) Crude Fiber (7.79%) Carbs (17.63%), Vitamin A (1990 RE) Beta-carotene (11.94mg/g). (Rohman, 2022)

Green spinach is one sort of vegetable high in iron and fiber; is inexpensive, making it accessible to people of all socioeconomic backgrounds. As a result, the product created by the inclusion of spinach is likely to contain high iron (Fe) levels (Yuddhistira, Tepung and Affandi, 2019). Nutritional content according to the Indonesian Ministry of Health for every 100 grams of spinach green is Ash (1.30 g), Water (94.50 g), Beta carotene (pro-vitamin A) (2.69 mcg), Energy (16.00 cal), Phosphorus (76.00 mg), Potassium (456.40 mg), Calcium (166.00 mg), Carbohydrate (2.90 g), Fat (0.40 g), Sodium (16.00 mg), Niacin (1.00 mg), Proteins (0.90 g), Riboflavin (0.10 mg), Fiber (0.70 g), Thiamin (0.04 mg), Vitamin C (41.00 mg), Iron (3.50 mg), Zinc (0.40 mg).

Based on the foregoing, it is necessary to conduct research on the nutritional composition of mackerel fish flour (*Rastrelliger sp.*) wet noodles fortified with vegetable flour, with the goal of producing wet noodles that are not only high in carbohydrates but also contain protein and other nutrients.

METHODS

Mackerel flour wet noodles (*Rastrelliger sp.*) are noodles produced by substituting mackerel fish flour, which is prepared by steaming and pressing fat and water for 5 hours at 80°C. The noodles that result is therefore reinforced with vegetable flour (carrot and green spinach). The nutritional value of carbohydrates, protein, fat, and iron was determined in this study, which was carried out at Laboratorium Penguji Balai Standarisasi dan Pelayanan Jasa Industri Manado. The collected results were statistically processed using the ANOVA test.

Steps for making carrot flour are presented below:

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1) Sorting. A process of selecting goods or things by quality. It is intended to Selecting good quality carrots is judged by its freshness and the health of carrots because of the freshness of carrots affect the aroma, color and texture of carrot flour resulting from.
2) Washing. After the sorting process and produce fresh carrots which is of good quality then the death is washed with water flowing until the dirt that sticks to the carrots comes along wasted.
3) Shredding. The washed carrots are then finely grated to produce carrot granules. This is done to speed up the drying process and make it easier the process of crushing carrots when blended.
4) Drying. The purpose of the drying process is to reduce the water content in carrots using heat energy. Drying can be done in two ways, the first Wash Sorting Carrots Grinding Drying Grating Sieving (100 mesh) Flour Carrot by using an artificial dryer such as spray dryer, tray dryer, drum dryer, oven and the second using a sun dryer or natural drying ie directly in the sun. But method direct drying in the sun it has drawbacks such as difficult to control the temperature and easy Consumed by microbes due to direct exposure to free air. Meanwhile, using a dryer Such modern ovens have advantages such as temperature and air pressure can be adjusted, thereby minimizing insertion of microbes in the process of drying carrots, besides that the drying time as well as the cleanliness of carrot flour remains awake. The results of research on drying carrots with. Tray Dryer with an air drying speed of 1.5m/s conducted by Amiruddin (2013) states that Carrot flour drying process must be heated to a temperature 60 °C then dried again in the oven for 3 hours at 102 °C to reduce the water content in Root so that the desired carrot flour is obtained.
5) Grinding or crushing. The grinding process is carried out after the water content is in Carrots are gone then grinding is done using blender to obtain fine carrot flour.
6) Sieving. It was carried out in such a way that get the same refined carrot flour. Chicken size used is 100 mesh to produce flour finely chopped carrots. Carrot flour used in this study is carrot flour that is ready to use with the brand Products of My Earth merchandise produced by CV Kusuka Ubiku, Yogyakarta Bantul. The source of carrot production comes from the garden Banjarnegara carrot farm with production process in March 2022.

Process of making green spinach flour are as follows: green spinach that has been prepared, plucked the stalks, and leaves then washed using clean water, then dried. Green spinach leaves put in the Kirin (Indonesia) oven and bake at 95ºC with using an aluminum pan for 2 hours. Green spinach leaves that have been dry put into a Philips blender (Netherlands) and blended for ± 2 minutes until the spinach leaves become smooth. Flour that has been formed is filtered by using a filter. (Munira., et all, 2022)

This research is a follow-up study of research conducted by Ayu et al in 2021, namely research on the acceptability test of wet noodles with the addition of pressed and unpressed mackerel flour (Ayu, et all, 2022). For the current research, the difference in treatment is by adding carrot flour and green spinach.

The True Experimental Design Posttest-Only Control Design with a Completely Randomized Design with three treatments and four replications was employed in this study.

Table 1. Products formulation

Substance	piece	F0	F1	F2
Wheat flour	gr	20	20	20
Fish flour	gr	80	80	80
Carrot flour	gr	5	7.5	10
Green spinach flour	gr	5	7.5	10
Egg	item	1	1	1
Salt	gr	5	5	5
Water	ml	50	50	50

RESULTS AND DISCUSSION

Table 2 displays the results of a measurement of the proportions of carbohydrate, protein, fat, and iron (Fe) in mackerel flour wet noodles enriched with vegetable flour.

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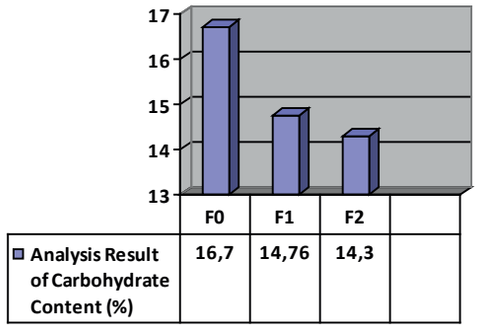
Table 2. Results of Nutrient Level Analysis in Wet Noodles Mackerel Flour Fortified with Vegetable Flour

Analysis Results	Treatments			ANOVA 5%	Tukey HSD 5%
	F0	F1	F2		
Carbohydrate (%)	16,7 [c]	14,76 [b]	14,3 [a]	0,000*	tn
Protein (%)	8,6 1 [a]	8,65 [b]	9,22 [c]	0,000*	tn
Fat (%)	2,62 [b]	2,24 [a]	2,9 [c]	0,000*	tn
Iron (Fe) (mg/kg)	24,20 [b]	22,08 [a]	25,76 [c]	0,000*	tn

Desc.: * = Significantly different in the ANOVA test at the 0.05 level
a,b,c = different notations show significant differences in the LSD test with a level of 0.05
tn = actual difference

The ANOVA test analysis revealed that the quantities of carbohydrate, protein, fat, and iron (Fe) in the three treatments for the preparation of mackerel flour wet noodles enriched with vegetable flour were substantially different. Based on the Tukey HSD follow-up test, carbohydrate, proteins, fat, and iron were substantially different in each treatment, notably wet mackerel flour noodles with 5 grams of fortified vegetable flour, 10 grams of fortified vegetable flour, and 15 grams of fortified veggies. The result obtained based on the advanced Tukey HSD test notation for treatments F0, F1, and F2 differs.

Diagram 1. Carbohydrate Content Analysis of Wet Noodles Mackerel Flour Fortified with Vegetable Flour



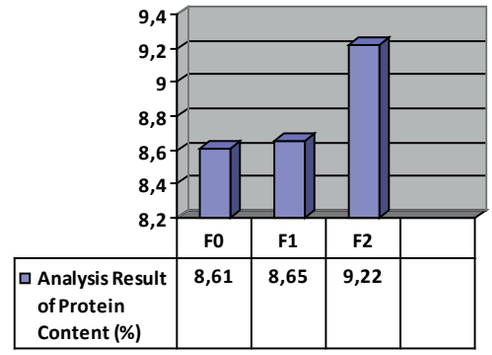
Carbohydrate Content

Diagram 1 depicts the carbohydrate content, which ranges from 14.3% to 16.76%. The carbohydrate content test technique employed was SNI 01-2891-1992 Point 9. The formula with the highest carbohydrate level in the F0 treatment was 16.76%, whereas the formula with the lowest was 14.3% in the F2 therapy. The mackerel flour wet noodles with 10 grams of fortified vegetable flour had the highest carbohydrate level. In contrast, the mackerel flour wet noodles with 20 grams of fortified vegetable flour had the lowest carbohydrate quantity.

The carbohydrate content was reduced after treatment F0 with the addition of 10 grams of vegetable flour, treatment F1 with the addition of 15 grams of vegetable flour, and treatment F2 with the addition of 20 grams of vegetable flour. There is a substantial genuine difference. The more vegetable flour is utilized, the lower the carbohydrate content. This is supported by the ANOVA test findings, which revealed that the carbohydrate analysis values for the three treatments differed significantly.

Furthermore, the vegetable flours utilized, especially spinach flour and carrot flour, include carbohydrates, but the total quantities are lower when compared to wheat flour (Directorate of Community Nutrition, 2018).

Diagram 2. Protein Content Analysis of Mackerel Flour Wet Noodles Fortified with Vegetable Flour



Protein Content

Diagram 2 illustrates protein content values ranging from 8.61% to 9.22%. The SNI 355:2018 Appendix A.4 technique was used to determine

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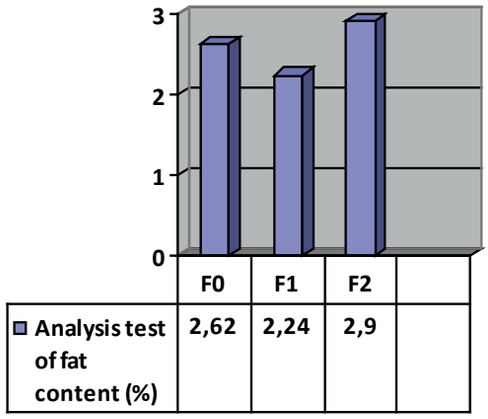
protein content. The protein content of wet mackerel flour enhanced vegetable flour differed significantly in three samples of 10 grams, 15 grams, and 20 grams, according to the ANOVA statistical test. The wet mackerel flour noodle sample fortified with 10 grams of vegetable flour, or the F0 treatment, had the lowest protein content of 8.61%, while the treatment of mackerel wet noodles fortified with 20 grams of vegetable flour, or the F2 treatment, had the highest protein value of 9.22%. This elevation in protein levels is due to the protein content of the vegetables utilized, such as carrots and spinach, which can boost the protein content in mackerel flour wet noodles. In section F2, 10 grams of carrot flour was added which significantly increased the protein content in the noodles. this is because carrots that have been processed into flour produce protein of 7.89% (Rohman, 2022).

Diagram 3. Fat Content Analysis of Mackerel Flour Wet Noodles Fortified with Vegetable Flour



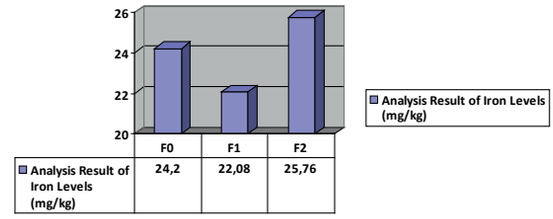
Fat Content

The three treatments' fat contents, which range from 2.24% to 2.9%, are shown in Diagram 3. The test procedure described in SNI 01-2891-1992 point 8.1 is used to determine how much fat is in this wet noodle. The F1 treatment had the lowest value of 2.24% in wet mackerel flour noodles fortified with vegetable flour 15 grams, whereas the F2 treatment had the maximum fat content of 2.9% in wet mackerel flour noodles fortified with vegetable flour up to 20 grams. According to the ANOVA statistical test findings, which reported a significant difference in adding vegetable flour to the three treatments of mackerel flour wet noodles, this proves how fortification of vegetable flour with different magnitudes affects the value of the resulting fat content.

Iron Content

The results of the iron content test using the SNI 01-2896-1998 Point 7 test method for the treatment of puffed flour-enriched wet noodles with vegetable flour ranged from 22.08 mg/kg to 25.76 mg/kg, as shown in diagram 4.4. Wet mackerel flour noodles treated with either the F2 treatment had the maximum iron concentration, measuring 25.76 mg/kg. Whereas the F1 treatment had the lowest iron concentration at 22.08 mg/kg. Wet noodles treated with mackerel flour and reinforced with vegetable flour to a greater extent than the other 2 treatments—up to 20 grams—produced the highest iron concentration.

Diagram 4. Iron Content Analysis of Mackerel Flour Wet Noodles Fortified with Vegetable Flour



Spinach is a vegetable with the most iron or iron content compared to other green vegetables. Spinach flour is produced from spinach leaves that are washed and dried and then ground. because the content of spinach as the most iron, then when made into flour and processed at a concentration of 20 grams can produce the highest iron. This is comparable to the properties of spinach vegetables.

This demonstrates how the iron concentration that results from varying levels of fortification of vegetable flour fluctuates. This was supported by the findings of the ANOVA statistical test, which revealed that the three treatments of mackerel flour wet noodles differed significantly when vegetable flour was included (Salim, *et al*, 2019).

CONCLUSION

The three treatments of fish flour wet noodles with vegetable flour addition had carbohydrate contents ranging from 14.3% to 16.7%, protein

contents range 8.61% to 9.22%, fat content range 2.62 to 2.9%, iron levels ranging from 22.08 mg/kg to 25.76 mg/kg. The ANOVA statistical test findings revealed a significant variation in the amount of vegetable flour added to the mackerel flour wet noodles' carbohydrate, protein and iron content, but not different for fat content base on ANOVA test

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