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SUBSTITUTION OF RED AMARANTH FLOUR (AMARANTHUS TRICOLOR L.) IN MANUFACTURE WET NOODLES AS FOODS HIGH IN IRON (FE)

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ABSTRACT

Wet noodles with the addition of Amaranthus tricolor L can be used well as an alternative food source of iron. Amaranthus tricolor L has a high iron content and has the potential to prevent anemia. The aim of this research was to determine the acceptability of wet noodles made from high iron Amaranthus tricolor L flour with the addition of high protein wheat flour and mocaf flour. This research method is experimental research using a Completely Randomized Design (CRD) using 3 treatments. Treatment consisted of adding 0%, 25% and 50% Amaranthus tricolor L. Statistical analysis of data was carried out with SPSS using one-way ANOVA and Duncan's test. The research was carried out in three ways, namely the product development stage, acceptability test and iron content test. Hedonic test data from research on the substitution of Amaranthus tricolor L flour in making wet noodles with 25 untrained panelists, namely students from the Faculty of Public Health, UIN North Sumatra. The test results for the acceptability of processed wet noodles based on the assessment of color, aroma and taste were preferred more by the panelists, namely F1 (Control) without the addition of Amaranthus tricolor L with average results of color of (4.36), aroma of (3.92), taste of (4.48) and texture (4.08). The results of research on Fe levels in wet noodles with the addition of Amaranthus tricolor L which has the highest Fe levels is the addition of 50% red spinach, namely 227 mg/kg (F3) rather than (F2) which is 18.4 mg/kg.

Keywords: red spinach; wet noodle; zat besi (Fe)

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INTRODUCTION

Indonesia is one of the countries with people who like to consume noodles the most. Noodles have become like a second food after rice because of its high carbohydrate content and can be used as an alternative food because the nutritional content of noodles is no less good than rice, where the main raw material is wheat flour (Andrianto et al. 2021) Wet noodles are one of the foods with the main ingredient in the form of processed wheat flour that has existed since ancient times to be popular in Southeast Asia, especially Indonesia, Japan, Thailand, China and Malaysia (Andrianto et al. 2021). This is considering that the fulfillment of wheat flour in Indonesia is still through imports from other countries because of the difficulty of wheat growing in tropical climates. Therefore, wheat flour must be imported in advance according to demand. From BPS data, wheat flour imports in 2020 were 10.28 million tons and increased in 2021 to reach 11.17 million tons. The high demand and need for wheat flour can increase the number of wheat flour imports (BPS, 2021).

Wet noodles are flour-based foods that have undergone a boiling process after the cutting stage and before being marketed (Fadilah 2023). Wet noodles are also known as yellow noodles. In the manufacturing process, raw noodles are boiled before being filtered. Wet noodles are widely sold in markets and traveling vegetable vendors, usually used as a complement to meatballs, rice cakes noodles and other types of food (Yulianti and Safira 2020). Noodles generally contain water, wheat flour and salt (a mixture of alkaline salts consisting of sodium phosphate, potassium and sodium carbonate) or both as the main ingredients. (Adejuwon, Jideani, and Falade 2020). Wet noodles have a moisture content that reaches 52% so for shelf life, these wet noodles can only be stored and held for approximately 40 hours at room temperature. Wet noodles are also a food that is quite popular and in demand by the people of Indonesia and is used as food in the diet pattern. Most wet noodles use additional ingredients that serve to improve the physical properties and durability of wet noodles. Additional materials that are usually used are potassium carbonate (K2CO3), sodium carbonate (NaCO3) and polyphosphates with certain levels that can be used (Anna, Angela, Sitinjak and Simatupang, 2021).

In Indonesia, food availability is a source of vitamins, minerals and dietary fiber. As vitamins, minerals contained in vegetables as antioxidants or as protectors of bad compounds in our bodies. Very adequate vegetables. Spinach with a consumption rate of 9.26 g per capita per day is the second most consumed vegetable in Indonesia after kale with a consumption of 10.46 g per capita per day (Helilusiatiningsih 2023) People in Indonesia, many have cultivated red spinach with various preparations such as red spinach leaf chips. But red spinach vegetables are not much and even rarely cultivated by the community or farmers to beplanted. This is evidenced by the difficulty or even no red spinach vegetables in traditional markets. Red spinach vegetables have not been widely used to be processed healthy foods, even though red spinach vegetables are rich in antioxidants and fiber (Triani, Syafriani, and Uli Alba Somala 2021).

Red spinach (Amaranthus tricolor L) is one vegetable that has many benefits for health and body growth, because the leaves contain nutrients that are quite high such as protein, iron minerals, calcium and vitamins. Vitamins contained in red spinach are vitamins A, C, and E. Red spinach also contains antioxidant components including betalains, carotenoids, vitamin C, flavonoids, and polyphenols (Aprita et al. 2023). Red spinach has a very interesting color, the purplish red color in red spinach is caused by the anthocyanin content. Red spinach has a high iron content. Iron content per 100 grams of red spinach is 7 mg In addition to containing iron, red spinach also contains anthocyanins. Anthocyanins in red spinach leaves are higher than the stem. Red spinach leaves have 6350 ppm, while on the stem only 2480 ppm (Eppang et al. 2020).

Iron is a mineral that is part of hemoglobin and myoglobin which plays a very important role in the distribution of oxygen in the body. Iron is also a coenzyme in many metabolic reactions that play a role in energy production. In addition, iron plays an important role in the process of neurotransmitter synthesis and myelination of neurons (Purnaning et al. 2023). Foods that contain iron are found in animal and vegetable foods, in this case choose vegetable foods that contain iron, namely red spinach. The iron content of red spinach is higher than othervegetables, that the iron in red spinach is 7 mg / 100 grams, green spinach 3.5 mg / 100grams, kale 2.3 mg / 100 grams, fresh mustard greens 2.9 mg / 100 grams and lettuce 0.5 mg /100 grams (Khaffifah and Oktafa 2022).

According to Afriliyanti and Hodijat (2023), previous research has been conducted on making wet noodles with mocaf flour substitution, the treatment of mocaf flour substitution treatment B (10%) has the best development power, the best elasticity, and has the best texture.Previous research conducted by Eppang entitled Review Anthocyanins from Red Spinach Leaf Extract in Wet Noodle Processing are almost the same as this consideration, what is known from previous research from this investigation is that previous researchers made wet noodles by adding cassava flour (mocaf) and wheat flour (Eppang et al. 2020).

The use of red spinach flour and mocaf flour in making wet noodles is limited by functional characteristics, mainly due to the very low content of gluten protein (has elastic and chewy properties), so that small amounts of wheat flour are still needed to meet gluten needs in making wet noodles. The use of red amaranth flour in making wet noodles has the advantage of reducing the cost of raw materials and production, reducing dependence on wheat raw materials, giving advantages to noodles, namely without using synthetic dyes and the presence of antioxidant pigments such as flavonoids and beta-carotene. Meanwhile, mocaf flour in making wet noodles is expected in addition to improving the characteristics of nutritional value and wet noodles produced compared to making wet noodles, the use of100% wheat flour can also reduce the use of wheat flour in large quantities, considering that the procurement of wheat flour must be imported from abroad. In addition to using quality ingredients, attractive packaging design and the process of making wet noodles is not so easy, wet noodles also have good nutritional content, so it can be estimated that the price of wet noodles is around Rp 15,000 / kg (Andrianto et al. 2021).

In this study, the experimental treatment of wet noodles made from red spinach with the addition of high-protein wheat flour and mocaf flour, then all these ingredients were processed into wet noodles. Considering previous studies using true experimental research types using complete randomized designs, but in this study, researchers used experimental research types with quantitative methods. Previous research discussed the content of fiber content, water content, and shelf life in wet noodles while this study discussed the iron content that can potentially increase iron in noodles(Ekafiana et al. 2022). Previous research did not discuss a disease affected by red bean flour and spinach juice. Previous researchers only explained how to make wet noodles with modified brown rice flour and spinach juice and did not explain that there are many benefits of red bean flour and spinach juice (Ekafiana et al. 2022).

This research was conducted because red spinach vegetables are very rarely liked by teenagers so I have an alternative to red spinach vegetables is used as a food that can be consumed like other foods. In addition, the iron content in red spinach has the benefits of hemoglobin levels to prevent anemia, maintain blood sugar levels, increase endurance, and vegetable protein sources. This is very interesting to listen to because of the many benefits of iron, one of which has the potential to prevent anemia. Anemia is a public health problem worldwide. According to WHO, anemia affects 1.62 billion people (24.8%) of the world's population. In Indonesia, nutritional anemia is one of the main nutritional problems until now it is still a top priority to be overcome. The prevalence of anemia in Indonesia is still quite high. Based on Riskesdas 2018 data, the prevalence of anemia in adolescents is 32%, meaning that 3-4 out of 10 adolescents suffer from anemia This means that it is estimated that as many as 3-4 adolescents out of a total of 10 adolescents suffer from anemia. The proportion of anemia in women (27.2%) is higher than in men (20.3%). Adolescent girls are one of the populations that are vulnerable to anemia problems (Riskesdas) 2018. This is influenced by non-optimal nutritional intake habits and lack of physical activity (Novita Sari 2020).

Anemia in adolescents can cause a decrease in adolescent productivity and academic ability, besides that it can inhibit adolescent physical growth including weight and height compared to adolescents at their age. Factors that can affect anemia in adolescents include physical activity, menstruation, nutritional status and diet. One of the good consumption patterns in adolescents is to choose nutritious snacks, containing high dietary fiber and iron (Nur Gianing and Public Health 2023).

METHOD

Design, Place and Time

This type of research is quantitative research using Complete Randomized Design (RAL). In testing, there was a treatment group and a control group with 3 (three) times the formula.

1. Formula (1) 0% Mocaf flour 350 gr + tapioca flour 350 gr
2. Formula (2) 25% Spinach flour 175 gr + Mocaf flour 262.5 gr + tapioca flour 262.5 gr
3. Formula (3) 50% Spinach flour 350 gr + Mocaf flour 175 gr + tapioca flour 175 gr

In the study being reviewed, or experimental research on the processing of wet noodles processed with red spinach flour or modified with wheat flour and mocaf, the researchers previously processed wet noodles not processed into spinach flour but only took the juice to make wet noodles (Ekafiana et al. 2022). Research is carried out in three ways, namely the product development stage, acceptability test and iron content test. The research conducted was the substitution of red spinach flour in making wet noodles with untrained panelists. Samples of wet noodle products were given to panelists to conduct acceptability tests which were used were hedonic tests which were assessed in terms of taste, aroma, color. and texture,using 5 scales, namely dislike, dislike, like, very like, and very, very like. The untrained panelists of this research were 25 students of the Faculty of Public Health UIN North Sumatra. This research will be carried out on February 22, 2024 in Tuntungan, Pancur Batu.

Tools and Materials

The tools used for the process of making wet noodles are digital scales, basins, grinders (ampia), sarigan (sieve), blenders, pots, laurels, plates, stoves, napkins, ovens, spatulas, pans, knives.

Table 1.
Composition of wet noodles

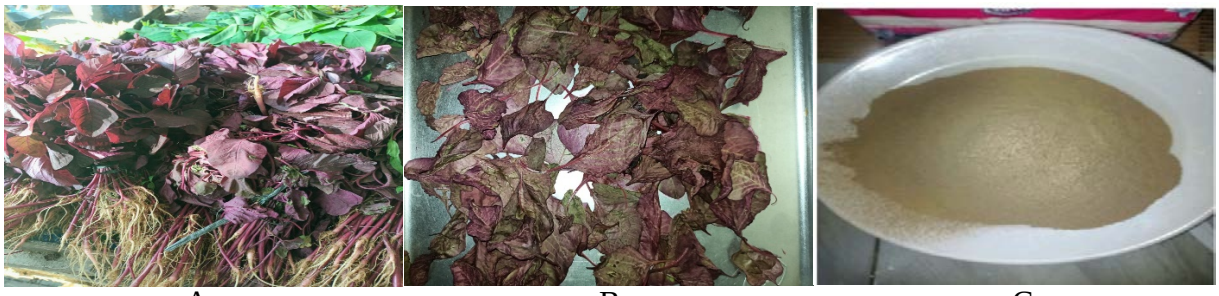
Bahan	Kelompok Eksperimen			
	F1	F2	F3	Total keseluruhan/formula
Red Spinach Flour	0 gr	175 gr	350 gr	700 gr
Wheat Flour 'Twin Chakra'	350 gr	262,5 gr	175 gr	700 gr
Mocaf Flour	350 gr	262,5 gr	175 gr	700 gr
Vegetable oil	2 sdm	2 sdm	2 sdm	2 sdm
Chicken Eggs	2 btr	2 btr	2 btr	2 sdm
Water	100 ml	100 ml	100 ml	100 ml
Salt	5 gram	5 gram	5 gram	5 gr
Baking Soda	½ sdt	½ sdt	½ sdt	½ sdt

Table 2.
Composition of Fried Noodles

Material	F1 measure	F2 measure	F3 measure
Garlic	4 cloves	4 cloves	4 cloves
Red onion	3 cloves	3 cloves	3 cloves
Fine shrimp	1 oz	1 oz	1 oz
Sweet mustard greens	2 bulbs	2 bulbs	2 bulbs
Sugar	1 tsp	1 tsp	1 tsp
Sop/leaf leaves	1 strand	1 strand	1 strand
Salt	½ tsp	½ tsp	½ tsp

Spinach Flour Making Process

The process of making wet noodles made from red spinach is divided into two, namely the process of making flour and the process of making wet noodles. In making red spinach flour, first clean the red spinach then separate the spinach leaves from the stem because the large spinach stems will dry for a long time in the ovening process. After that, wash the spinach leaves thoroughly. Furthermore, drying spinach leaves using (oven) with a temperature of 150 degrees C for 30 minutes conditionally with spinach if less than 30 minutes is dry then red spinach can be removed. Grind dried spinach leaves using a blender for 5 minutes. Next, sieving red spinach flour that has been mashed using a sieve / flour sieve to separate red spinach flour from the fiber (Rauf et al. 2022).



A Fresh spinach simplicia | B Spinach simplicia in the oven | C Simplisia spinach powder

Figure 1. Raw Materials and Process of Making Spinach Flour

Wet Noodle Making Process

The second process is making wet noodles, all the wet noodle dough goes through a cooking process. For the F1 ingredient mixture, prepare 350 gr of wheat flour, 350 gr of mocaf flour. Ingredients F2 prepare 175 grams of spinach flour, 262 grams of mocaf flour, 262 grams of wheat flour. Ingredients F3 350 gr spinach flour, 175 gr mocaf flour, 175 gr wheat flour. In each formula the dough is mixed then add 5 grams of salt, and 100 ml of water, 2 eggs, ½ teaspoon baking soda then stir slowly until the dough is smooth, leave the dough for 15-20 minutes so that the texture of the dough expands, Put the dough in press machine (ampia) for forming the dough into sheets, start with the largest number first then the small number, attach the tool then the dough will stretch 0.5 cm wide, roll the dough until it looks like noodles (Elfi Anis Saati, 2019) . When it is in the form of noodles, sprinkle wheat flour over the noodles so that the noodles don't stick and will be easy to boil later. Then boil the noodles in water for 1-3 minutes, mixed with water and oil so that the boiled noodles don't stick and clump, drain, soak in cold water so that they don't stick (Triastuti 2021).

F1 F2 F3

Figure 2. Wet Noodle Formula

The stage of serving to the panelists, after boiling wet noodles for 1-2 minutes, the noodles can be directly cooked with garlic seasoning 4 cloves, shallots 3 cloves, fine shrimp 1 ounce then blender, then cut into small pieces 2 sweet mustard weevils, soup leaves and salt prei 1/2 tsp, sugar 1 tsp, add oil 2 tbsp stir-fry the seasonings, add F1 noodles first, stir until cooked and serve with small mica (adjust to the number of panelists), if F1 is finished then repeat the thing that put F2 and F3 alternately but with a note that the pan that previously had to be washed thoroughly this is so that the taste of F1, F2, F3 to remain neutral (Rara, Koapaha, andRawung 2020).

Data Collection

The organoleptic data that has been collected will be processed using *Microsoft Excel* and *SPSS (Statistical Package for the Social Sciences) 20*, to assess the mean, SD, P value and get the results that the panelists like. The method used in testing Fe levels carried out at the Center for Standardization and Industrial Services uses the AAS (Atomic Absorption Spectrophotometry) method, this method is widely used in the analysis of metal contamination both in water, waste, food samples and even in medicinal products. Analysis ofFe result data using One Way Anova *(Analysis of Variance) test.* If the data shows there is a real effect, then a further DMRT *(Duncan Multiple Range) test is carried out.*

RESULTS

Table 1.
Anova One Way Test Results 0.05

Component	Sample Iron Content Results 100 mg/kg			
	F1	F2	F3	*p*
Iron Content	18,4	162	227	0,000

Table 1. Based on table 1 of the Anova One Way Test Results *(Analysis of Variance)* shows that the mean of the results of F1 iron levels shows 18.4 mg / kg. F2 shows 162 mg/kg. F3 shows 227 mg/kg. Then the p result shows 0.000 where (<0.05), H0 is rejected which means there is a real difference between (F1, F2, and F3), to iron levels. If there is a difference, it is necessary to test further DMRT *(Duncan Multiple Range)* which will later see differences from F1, F2, F3. Based on Table 1 shows that with 3 formula samples, namely the F1 control formula, the 25% F2 formula, the 50% F3 formula with each sample of 100 grams produces various Fe levels. The highest iron levels were found in F3 (227 mg / kg) and F2 (162 mg / kg) while the lowest iron levels were found in F1 (control) noodles without the addition of redspinach (18.4 mg / g).

Tabel 2.
Hasil Uji Lanjut Duncan Zat Besi

Treatment	n	Iron Levels (Fe)	DMRT α0,05		
F1	25	18,400	a		
F2	25	162,000		b	
F3	25	227,000			c

Table. 2 Results from the Duncan test showed that F1 iron levels were significantly different from F2, F3 iron levels. F2 iron levels differ markedly from F1, F3 iron levels. F3 iron levels differ markedly from F1, F2 iron levels.

Table 3.
Duncan's Advanced Test Results on Color, Texture, Aroma, Taste

Parameter	F1	F2	F3
Color	4,36a	2,12b	2,00b
Texture	3,92a	2,12b	1,84c
Aroma	4,48a	2,60b	2,16c
Flavor	4,08a	2,04b	1,72c

Table 3. The results statistically obtained Duncan's test value that there are different subset values that show the level of difference in color, aroma, texture and taste formulas in (F2 and F3) are the same as the formula (F1) which does not use red spinach flour at all. While in wet noodles, each formula has differences in texture, aroma, and taste.

Table 4.
Average Level of Likeability of Red Spinach Noodle Organoleptic Test

Parameter	F1	F2	F3
Color	4,36	2,12	2,00
Aroma	3,92	2,12	1,84
Flavor	4,48	2,60	2,16
Texture	4,08	1,72	2,04
Average	4,21	2,14	2,01

Table 4. showed that the panelists' response to the level of preference of red spinach noodles in terms of color, aroma and taste was the most preferred F1 (wet noodles without theaddition of red spinach) but between the two formulas with the addition of red spinach (F2and F3) obtained the highest average level of preference of panelists for color, aroma, taste and texture at F2 (addition of red spinach 25%) with a score of 2.14 (less like) compared to F3(addition of red spinach 50%) with a score of 2.01 (less like).

DISCUSSION

Iron Level Analysis

Based on the results of the study, it can be seen from the results of statistical analysis of iron levels (Fe) using the anova one way test α0.05 and continued the duncan test obtained (P<0.000) which shows that there is a significant real difference which means there is a difference in the addition of red spinach to iron levels in making wet noodles. This is due to the addition of red spinach, the iron levels produced increase. This result is similar to the results of previous studies which stated that the more red spinach added to a formula, the higher the iron (Fe) levels in wet noodles that will be produced (Garmini et al. 2023).

Organoleptic Test

Based on organoleptic test results, the color acceptability most preferred by panelists for F1 (control) with a score (4.36), F2 with a score (2.12) and F3 with a score (2.00). In F1, it has a distinctive color of wet noodles, which is white, while F2 has a color that changes to dark

reddish brown, which is slightly pale compared to F3, wet noodles change color to deep brown, more concentrated after the addition of red spinach and processing. The reddish- brown color of wet noodles after the addition of red spinach is caused because red spinach contains antonsianin compounds which have water-soluble properties so that it is very easy for red spinach to fade reddish brown during the processing and boiling process (Garmini and Vernanda 2023). This is in line with previous research on the addition of red spinach juice 50%, showing 21 panelists (96%) think the color quality of red spinach rice crackers is red and 1 panelist (4%) thinks the color quality of red spinach rice crackers is quite red, so the brightness value level is darker because of the boiling process (Dea Ayu Saputri and Yulia Mandasari 2022).

Based on organoleptic test results, the aroma acceptance was most preferred by panelists for F1 (control) with a score (3.92), F2 with a score (2.12) and F3 with a score (1.84). On F1 it has a characteristic aroma of wet noodles. While F2 and F3 with the addition of 25% and 50%red spinach have almost the same aroma in both formulas, the difference is that in F2 the aroma of red spinach is slightly smelled compared to F3 which is more attached to the aroma of red spinach like henna leaf aroma. This is in line with previous research that the aroma of red spinach pempek increases with the addition of spinach, however, the increase in red spinach added to pempek results in a decrease in the level of liking for the aroma of red spinach pempek. This is because the aroma of pempek smells typical of spinach so that panelists do not like the aroma of red spinach pempek (Garmini and Vernanda 2023).

Based on organoleptic test results, the most preferred taste acceptability by panelists for F1 (control) with a score (4.48), F2 with a score (2.60) and F3 with a score (2.16). In F1, it feels chewy like noodles in general, while in F2 and F3 with the addition of red spinach, the typical taste of wet noodles is generally reduced due to the amount of red spinach added, but the difference is that in F2, the taste of red spinach in wet noodles is not too strong compared to F3 which has a stronger red spinach taste. This is in line with previous research that the less the proportion of spinach added, the taste of red spinach in wet noodles is still felt and preferred by panelists. Meanwhile, the more spinach mixture, the taste of wet noodles is lostso that the acceptability of wet noodle flavor is less liked by the panelists (Hidayati et al. 2022).

Based on organoleptic test results, the texture acceptability most preferred by panelists for F1 (control) with a score (4.08), F2 with a score (1.72) and F3 with a score (2.04). In F1 it has a texture that is too chewy while in F2 with the addition of 25% red spinach has a slightly chewy texture, in F3 with the addition of 50% red spinach has a less chewy texture because a little more proportion of spinach in the product affects the chewiness of the texture of pempek products this is in line with previous research (Garmini and Vernanda 2023).

CONCLUSION

The results of the research showed that the wet noodles preferred by the panelists were substituted with formula 1 adding 0% red spinach. It is known based on laboratory test results that the level of noodles with the addition of red spinach which has the highest iron content is noodles with the addition of 50% red spinach (F3), which is 227 mg/kg, while (F2), which is 162 mg/kg, is significantly different from (F1).) 18.4 mg/kg.

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