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Fortification of *Moringa oleifera* Flour on Quality of Wet Noodle

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ABSTRACT

Noodles are often consumed by the public and contain a lot of carbohydrate compounds. Human needs are not only for carbohydrates but also for protein, fat, or mineral compounds. The need for macronutrients or minerals is not only found in flour sources, but can be obtained from natural sources such as Moringa oleifera leaves. Moringa oleifera leaves have nutritional, mineral or antioxidant potential and other bioactive. The purpose of this study was to determine the levels of macronutrients, crude fiber, and minerals (Ca and Fe) contained in wet noodles fortified with Moringa oleifera leaves flour. In this study, the experimental design used a completely randomized design (CRD). The treatment carried out in the study was using 100% wheat flour as a control, 5% Moringa oleifera leaves flour, and 95% wheat flour, 10% Moringa oleifera leaves flour and 90% wheat flour, 15% Moringa leaves flour, and 85% wheat flour. The results showed that the addition of higher concentrations of Moringa oleifera flour affected crude fiber, macronutrients, and minerals content in wet noodle products. Based on the previous study that we conducted about sensory evaluation. Different concentration of Moringa oleifera gave different sensory characteristic. For 5% concentration results organoleptic of colours 103.06, aroma 102.34, taste 103.64 and texture 107.71. Whilw in 15% concentration of Moringa oleifera it has 32.09 of colours, 29.44 of aroma, 29.89 of taste and 38.37 of texture. It is recommended that the use of Moringa oleifera flour does not exceed 5% because it is affects the organoleptic of the product. Concentrations of 5%, 10%, and 15% have potential to increase macronutrients and minerals in noodle products.

Key words: *Noodles, Moringa oleifera, macro nutrition, minerals*

INTRODUCTION

Noodles are used as an alternative to the main food (rice), which is preferred by the community because it is easy to serve, tasty, chewy and practical, easy to cook and has a low price and has a long shelf life. This noodle has been around for a long time and plays an essential role in humans' nutritional status and consumption habits (Fu, 2008). The habit of consuming noodles as fast food without adding vegetable ingredients and protein is improper eating habit because not all the nutrients needed by the body can be fulfilled (Susilowati & Rizal, 2018). Noodle products are currently under a lot of development. Various of the mixture such as tubers, vegetables, or legumes can increase the nutritional content of noodles. Noodles are well known to have low fat and sodium content and are rich in carbohydrates which consumers widely accept as in potato flour products, corn flour or soy flour (Olorunsogo et al., 2019). Noodles are processed by adding other cereals such as rice and corn as well as adding eggs and spices (Huang & Lai, 2010) (Li et al., 2014). The use of flour can come from hard or fine flour mixed with water and table salt (Alemayehu et al., 2016).

Actually, noodles are not only served in the form of products that are high in carbohydrates. However, it can be combined with a variety of natural ingredients that are low in carbohydrates and high in other groups of active compounds. Such as from tubers, legumes, vegetables, and even leaves that have the potential as functional plants for health.

One of the plants that can be used as a nutritional supplement is *Moringa oleifera* leaves which have high protein content (27,1 %), carboydrate content (38,2 %), and fiber content (19,2 %) (Dhakar et al., 2011).

In addition, there are also micronutrients such as calcium (991 ppm), potassium (4.710 ppm), iron (13 ppm), magnesium (351 ppm), manganese (11,9 ppm), copper (0,7 ppm), phenolic compounds, as well as vitamins A, B, C, and D as good provitamins (Olson et al., 2016):(Adi et al., 2019). *Moringa oleifera* leaves flour is used in the production of dry noodles to increase nutritional levels in the form of protein and minerals (Chandra et al., 2019). The addition of 10% Moringa *oleifera* leaves flour produces relatively high protein nutrition and micronutrient groups such as vitamins A, C, calcium, and zinc (Adi et al., 2019). In addition, there was an increase in the parameters of ash, crude fiber, protein, fat in flour substitution including Moringa oleifera flour (Catherine A. Orisa & Ukpong S. Udofia (Ph.D), 2019).

Moringa oleifera leaves contain many important nutritional compounds and phytochemicals needed by the human body. This plant is known as *'drumstick tree'* or *'horseradish tree'* (Gopalakrishnan et al., 2016). *Moringa oleifera* leaves are rich in mineral compounds such as calcium, potassium, zinc, magnesium, iron, and copper (Kasolo et al., 2010). *Moringa oleifera* leaves also contain various vitamins such as beta carotene from vitamin A, group B vitamins such as folic acid, B6, and nicotinic acid, vitamins C, D and E (Mbikay, 2012). In addition, various types of phytochemical compounds play a role in the regulation of body health and antioxidants such as tannins, sterols, saponins, terpenoids, flavonoids, anthraquinones, alkaloids, and reducing sugars which together combine with anticancer agents such as glucosinolates, isothiocyanates, and glycosides and glycerol compounds 1-9 octadecanoates (Berkovich et al., 2013).

Due to the content of nutritional compounds present in *Moringa oleifera* leaves, *Moringa oleifera* leaves flour can be used to manufacture foods such as bread, cakes, pasta, or soup (Oyeyinka & Oyeyinka, 2018). In addition, *Moringa oleifera* can be added to the process of making soy milk which aims to increase the protein content of soy milk products (Dawn Nur Atmaja & Suhita, 2020). Based on the literature above, the researchers wanted to know the nutritional and mineral levels in wet noodle products added with *Moringa oleifera* leaves flour. Thus it can be confirmed that noodle products have potential as a functional food and optimize the utilization of *Moringa oleifera* for food products.

METHODS

Materials and Tools

Ingredient used in this experiments are *wheat flour, Moringa oleifera leaf flour, water, salt, eggs, and garlic* which bought from traditional market at Gresik. For the chemistry analysis use some chemicals like Na_2SO_4HgO, H_2SO_4, Auadest, H_2BO_4, HCl 0,2 N, n-benzena, HCl 25%, NaOH 25%, Ki 20%, H_2SO_4 25%, Na2S2O3 0,1 N, etanol 96%, NaOh 3,25%. Tools used in this experiments are destilation apparatus, beaker glass, decsiccator, extraction tube, Kjeldahl heater, test tube, return cooler, measuring pipette, magnetic stirrer,

Procedure of making wet noodles are mixing all the ingredients and making dough, pressing the dough until thin, shaping noodles, and steaming the noodle.

The research used is experimental. The treatment used in this study was the proportions of wheat flour, and *Moringa oleifera* leaves flour as the basic ingredients for making wet noodles. The proportions of these treatments were 100% wheat flour used as control (P0) , 5% *Moringa oleifera* leaves flour and 95% wheat flour (P1), 10% *Moringa oleifera* leaves flour and 90% wheat flour (P2), and 15% Moringa oleifera leaves flour and 85% wheat flour (P3).

The analysis of macronutrients such as protein was using the Kjeldahl method (%), fat content was determined by using the Soxhlet method, and total carbohydrate content was determined by using the Luff Schroll method (%) described by Sofianti et al, (2020) while crude fibers content was determined by using acid-base hydrolysis method (%) described by Prayitno et al., (2018).

Ca (ppm) and Fe (ppm) content were performed by using the Atomic Absorption Spectrophotometer (AAS) method described by AOAC (2005). The research data were analyzed using a completely randomized design (CRD) experimental design. The significant different among the data were analyzed using ANOVA which followed by Duncan's multiple range test (DMRT) at 5%.

RESULT AND DISCUSSIONS

Based on the previous study conducted by Prayitno et al. (2021) on the sensory evaluation of fortifiied *Moringa oleifera* leaves on wet noodles , the shape of the noodles from the addition of *Moringa oleifera* leaves flour has a similar physical appearance. The increasing concentration of *Moringa oleifera* flour produces darker green color and gives a different impression on the taste. For 5% concentration results organoleptic of taste 103.06 and 103.63 of taste. While in 15% concentration of *Moringa oleifera it has 32.09 of colours and 29.89 of taste.* The results of the analysis of macronutrients, crude fiber, and minerals (Ca and Fe) in the wet noodle products can be seen in table 1.

Table 1. Nutritional quality of wet noodle analysis per 100 grams

Treatment	Protein Content (%)	Fat Content (%)	Carbohydrate Content (%)	Crude Fiber Content (%)	Fe Content (ppm)	Ca Content (ppm)
P0	3.01±0.05a	0.09±0.01a	26.03±0.39a	0.05±0.05a	41.26±0.16a	9.94±0.31a
P1	3.36±0.05b	0.06±0.01b	24.23±0.31b	0.06±0.08b	44.09±0.15b	31.04±0.46b
P2	3.61±0.07c	0.05±0.01c	23.15±0.66c	0.07±0.01b	45.13±0.17c	57.09±0.53c
P3	3.84±0.56d	0.03±0.06d	21.34±0.55d	0.08±0.04c	46.54±0.18d	97.72±0.79d

P0: 100% wheat flour
P1: 5% Moringa oleifera leaves flour and 95% wheat flour
P2: 10% Moringa oleifera leaves flour and 90% wheat flour
P3: 15% Moringa oleifera leaves flour and 85% wheat flour
Means with different letters in the same colomn are significantly different based on DMRT test (P<0,05).

The table above shows that each addition of the concentration of *Moringa oleifera* flour affects increasing macronutrient, crude fiber, and mineral groups in noodle products.

Protein Content

The purpose of analyzing protein content was to determine protein content in unfortified and fortified wet noodles. From the analysis carried out, there are differences in each treatment given to each treatment. The highest protein content was in the P3 treatment with the addition of *Moringa oleifera* leaves flour by 15% with a level of 3.84%. The higher concentration of *Moringa oleifera* leaves flour in line with increasing the protein content of wet noodle products. The research conducted by Prayitno & Rahim (2021) stated that adding *Moringa oleifera* leaves flour by 15% increased the protein content of chicken nuggets. A study reported that fortification of *Moringa oleifera* leaves flour will improve the protein content in noodle products (Zula et al., 2021).

Meanwhile, in the manufacture of wet noodles *unfortified with Moringa oleifera* leaves flour, there is a significant difference in the value of the protein content of noodle products that are added with *Moringa oleifera* leaves flour. Wet noodles which only using wheat flour as main ingredient has protein content by 3,01%.

In comparison to wet noodles with addition of *Moringa oleifera* leaves flour, it has higher protein content which ranged between 3,36-3,38%. Fortification of *Moringa oleifera* gave additional protein content in wet noodles. This was supported by Dhakar et al. (2011) which found that *Moringa oliefera* leaves contain high protein and rich in amino acids such as arginine, and histidine. Apart from Moringa leaves, the use of eggs in each treatment were similar and it also increase the protein content of the wet noodles, because eggs not only contain fat compounds but also contain quite a lot of protein. The number of eggs used in each treatment is the same, but the eggs have protein levels that can increase the amount of protein in noodle products.

Fat Content

The results showed that the higher concentration of Moringa leaves flour used affected reducing fat content in wet noodle products. The increase in fat content is due to the presence of fat components in Moringa oleifera flour, so that it can increase the amount of fat in noodle products. It was expected that protein content has correlation with fat content in food. The higher protein content then the lower fat content. The addition of a high concentration of Moringa leaves flour showed a decrease in fat content. The addition of a concentration of 15% Moringa leaves flour resulted in fat content of 0.03%, while the addition of a 10% concentration of Moringa flour gave a fat value of 0.05%, while a 5% concentration of Moringa leaves flour gave a fat content value of 0.06%. It is clear from the control that the manufacture of noodles unfortified with *Moringa oleifera* leaves flour provides a protein content of 0.09%. It can be concluded that the addition of higher concentrations of Moringa leaves flour will reduce the amount of fat present in wet noodle products. Each treatment with Moringa leaves flour gave a significant value. This study is also supported by research whose results state that increasing the concentration of Moringa flour will decrease the total fat in the product (Arise et al., 2014).

Carbohydrate Content

The results of the study in table 2 show that the administration of Moringa leaves flour affects the carbohydrates of noodle products, which is decreasing. It is related to the number of additions to the given substance, namely 5%, 10%, and 15%. The control (unfortified with *Moringa oleifera* leaves flour) showed a high carbohydrate content of 26.03%. Along with the addition of 5% Moringa leaves flour concentration, the carbohydrate content produced was 24.23%. At the same time, the addition of 10% and 15% flour and Moringa concentrations resulted in a decrease in carbohydrates, namely 23.15% and 21.34%, respectively. The addition of Moringa leaves flour in the production of wet noodles causes decreasing in carbohydrate levels. The decrease in carbohydrate content was in line with the increase in the amount of substance given (the concentration of Moringa leaves flour) in the wet noodle dough. The substance given gave the effect of increasing carbohydrate levels in each treatment. Overall, in treatment P0, P1, P2, and P3, there was a decrease in carbohydrate content because *Moringa* leaves flour contained lower carbohydrate compounds than the carbohydrates in the wheat flour. This study is in line with Sinaga et al., (2019) research, which states that fortification of *Moringa oleifera* leaves with a concentration of 4% in onde-onde cake reduced carbohydrate content compared to lower concentration. It is expected that it happens due to higher other components such as protein and mineral content.

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Crude Fiber Content

Fiber is a compound needed to facilitate metabolism in the human body. In this study produced different levels of crude fiber. In control, wet noodles unfortified with *Moringa oleifera* leaves flour produced a crude fiber content of 0.05%. While the addition of 5% and 10% Moringa leaves flour resulted in no different fiber content. The crude fiber content was 0.6% and 0.7%, while the addition of 15% Moringa leaves flour resulted in crude fiber content of 0.08%. The increase in crude fiber in the use of Moringa leaves flour added to the dough for wet noodle products was higher than the control that only used wheat flour, unfortified with *Moringa oleifera* leaves flour. This is presumably because there are a number of fibers in Moringa leaves that, if added in the processing of wet noodles, will increase the crude fiber content. The percentage of crude fiber increased along with the increase in the concentration of added Moringa leaves flour. This study is also supported by Zula et al., (2021), which state that the addition of Moringa leaves flour will increase the crude fiber content of the product. High fiber content in a product is expected to be in pasta or other cereal products.

Fe and Ca content

Mineral content in the form of calcium (Ca) and iron (Fe) in wet noodles produced by adding Moringa leaves flour had a significant effect and yield. Prayitno and Rahim's research (2020) states that minerals are a group of macro-mineral compounds needed by the human body. The study results showed that there was an increase in the mineral content of Ca and Fe. All treatments adding Moringa leaves flour concentrations of 5%, 10% and 15% gave significant results in Fe minerals with levels of 44.09 ppm, 45.13 ppm and 46.54 ppm. While the control unfortified with *Moringa oleifera* leaves flour produced Fe levels of 41.26 ppm. This study was similar to another study conducted by Govender & Siwela, (2020) which found that the Fe content in bread fortified with *Moringa oleifera* 5% and 10% were significantly increased compared to unfortified bread.

This increase in Fe mineral levels is supported by the presence of Fe levels which are naturally found in Moringa leaves. In addition, it is also supported by the presence of Fe, which is naturally present in the wheat flour used. The higher concentration of Moringa leaves flour used gave significant results on Fe mineral. The combination of Fe compounds in wheat flour and Moringa leaves flour makes it possible to increase Fe levels in wet noodle products. However, in comparison to control, Fe compounds only appeared due to the presence of only wheat flour used.

Meanwhile, the statistical test indicated that there was a significantly different of Ca mineral. As we can see in table 1, it is clear that there is an increase in Ca levels. The addition of Moringa leaves flour can increase Ca in wet noodle products. In control (unfortified with *Moringa oleifera* leaves flour), it produced 9.90 ppm Ca, this was significantly different from fortified Moringa leaves flour. The increasing concentration of *Moringa oleifera* leaves resulted in Ca levels of 31.04 ppm, 57.09 ppm, and 97.72 ppm. This study was similar to another study conducted by Sengev et al., (2013) which found that the mineral content such as iron, calcium, magnesium, and copper increase significantly in fortified bread with different levels of *Moringa oleifera leaves* concentration. Increased Ca levels in food products can be used to prevent various diseases such as gout and osteoporosis.

CONCLUSION

The higher addition of Moringa leaves concentration affects the crude fiber content, macronutrients (fat, carbohydrates, and protein), and mineral content (Fe and Ca). Moringa leaves have substantial potential when added to product processing at certain levels because they can increase essential nutrients and minerals in processed food. It is also possible to improve the visual (organoleptic of the product) with a maximum usage limit of up to 5%.

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