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MORINGA LEAF EXTRACT *(Moringa Oleifera Lam.)* AS A NATURAL PRESERVATIVE AND NUTRIENT SOURCE OF WET NOODLES

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ABSTRACT

Moringa leaves are high in nutritional value and contain antimicrobial phenolic chemicals, saponins, flavonoids, tannins, and steroids. Antimicrobials can be used as natural food preservatives. Wet noodles have a short shelf life at room temperature and low nutritional value. This study aims to determine the effect of the concentration of Moringa leaf extract on the durability and nutritional value of wet noodles. The research steps were carried out by making Moringa leaf extract is ussing the boiling method with water as a solvent. Moringa leaf extract concentrations of 0, 50, and 100% were substituted for making wet noodles and their preference level was observed through hedonic test. Furthermore, Moringa wet noodles were stored at room temperature 0, 1, 2, and 3 days and tested for microbial contamination, proximate nutritional value, and pH. The results showed that the best treatment was wet noodles substituted with 100% Moringa leaf extract can reduce the number of bacteria (9.60×10^5 cfu/g) according to SNI 7388-2009 (10^6 cfu/g) at room temperature storage for 1 (one) day, compared with wet noodles without Moringa leaf extract (4.05×10^6 cfu/g). Moringa leaf extract which is substituted can increase the nutritional value of wet noodles including ash content, fat, protein, and carbohydrates. The best treatment for hedonic test results is the 50% Moringa leaf extract substitution treatment because it is preferred by panelists in terms of aroma, color, texture, and taste.

Keywords: *Moringa leaf extract, Natural preservative, Nutrient source, Wet noodles*

INTRODUCTION

Noodles are a popular dish in Indonesia. It is manufactured from wheat flour as the primary ingredient, with or without other food ingredients and permitted food additives, by mixing, sheeting, slitting, and cutting into the typical shape of noodles, either by boiling or steaming (1). Noodles are high in carbohydrates but low in protein, necessitating the addition of nutritionally beneficial ingredients. One of the issues that prevails on wet noodles is the short shelf life of wet noodles. Wet noodles prepared with composite flour have a shelf life of less than 24 hours at room temperature (2). As wet noodles are typically not consumed or sold within a single day, a reliable method of food preservation is required to extend their shelf life. Food additives are frequently used in the production of wet noodles as preservatives to extend their shelf life. Wet noodles' shelf life has been found to be extended by a number of natural ingredients, such as coconut coir ash extract (3), sweet orange peel (4), carrot juice, pumpkin juice, and turmeric juice (5), leaves of gendarusa (Justicia gendarusa Burm. F.) (6). It is reported that formalin and borax are used to preserve many wet noodle products on the market (7). These substances, when used as preservatives, pose a threat to human health, including the development of cancer. Therefore, it is necessary to seek for alternative components that not only serve as natural, safe preservatives but also enhance the nutritional content of wet noodles.

Moringa plants thrive in tropical climates and can be found in nearly most region of Indonesia. Several previous studies have shown the potential and benefits of Moringa leaves due to the content of bioactive compounds and their nutritional value. The content of high nutritional value, properties, and benefits has earned Moringa the nickname Mother's Best. Moringa leaf powder has nutrients per 100 g, namely 38.2 g of carbohydrates, 27.1 g of protein, and 2.3 g of fat (8). Moringa leaves include bioactive flavonoids, phenols, triterpenoids/steroids, saponins, and tannins, according to the results of the aqueous extract test (9, 10). These compounds possess antibacterial and antioxidant characteristics, making them suitable natural food preservatives (11, 12). This demonstrates Moringa's potential role as a natural preservative.

Based on the preceding justification, this study sought to examine how the concentration of moringa leaf extract affects the nutritional content and shelf life of wet noodles at room temperature. This study's findings can be adopted and exploited by the community in the process of modifying wet noodles to enhance their shelf life and nutritional content, particularly for home industry scale production.

MATERIAL & METHODS

The Moringa leaves (*Moringa oleifera* L.) utilized in this study were procured from BALITRO (Center for Spices and Medicinal Plants) in Bogor, Indonesia. It was verified at the Botanical Gardens-Center LIPI for Plant Conservation that the specimen is an authentic Moringa leaf of the type Moringa oleifera Lam. and is a member of the family *Moringaceae*. The plant samples have the voucher number B-2541/IPH.3/KS/VIII/2019. The ingredient in the production of Moringa leaf extract is distilled water, and moringa leaf simplicsia. Wet Noodle are made from wheat flour (16% protein content), salt, distilled water, and sodium carbonate. The required tool for making Moringa wet noodles includes digital scales, noodle makers, blenders, spatulas, dough containers, and rolling pins**.**

The preparation of Moringa leaf extract was the initial step in the implementation of the study project. The second stage consisted of preparing wet noodles with 0, 50, and 100% moringa leaf extract substitution concentrations, storing them at room temperature for 0, 1, 2, and 3 days, and then analysis of Moringa wet noodles includes microbial contamination test (Total Plate Count and Yeast Mold Count), proximate nutritional value (tests for water content, ash, fat, protein and carbohydrates), pH and hedonic test. The hedonic evaluation of Moringa wet noodles was conducted on day Zero by 25 untrained panelists for regarding the panelists' level of preference for the parameters color, aroma, texture, and flavor. Each treatment was done twice (duplo), and the resulting data were analyzed using ANOVA; if a difference was found, the Duncan's test was conducted with a confidence level of 95%. The Simplicsia of Moringa Leaves: The plant material of moringa leaves (*Moringa oleifera* L.) were collected from BALITRO Bogor, West Java. The leaves were cleaned, dried, ground into a powder using a grinder with a sieve size of 40 mesh.

Preparation of Extraction: Moringa leaf extract was obtained by boiling 50 g of The Simplisia of Moringa Leaves in 500 mL of distilled water for 15 minutes at 90 ºC, then filtering using a filter cloth. The obtained filtrate was collected and allowed to cool. The filtrate was then evaporated at 60 °C using rotary evaporation to get a concentrated extract (13). The obtained extract was used as a stock solution with a concentration of 100%, and then diluted with distilled water to achieve a concentration of 50%.

Moringa Wet Noodles: The Moringa leaf extract that is added to wet noodles should be fresh or freshly prepared. The concentrations of Moringa leaf extract were 0, 50, and 100%. The dough for the noodles is stirred by hand until it is silky. The dough is then divided into portions, rolled out using a rolling pin, and printed with a noodle maker. The noodles are then dusted with tapioca flour. The wet noodle formula with moringa leaf extract substitution is shown in Table 1.

Table 1 Formulation design of wet noodles substituted with Moringa leaf water extract.

No	Ingredient Name		Formula		
			F_0	**F_1**	**F_2**
1	Wheat Flour	(g)	1000	1000	1000
2	Salt	(g)	10	10	10
3	Na_2CO_3	(g)	5	5	5
4	Water	(mL)	400	200	0
5	Moringa leaf extract	(mL)	0	200	400

Description: F_0 = wet noodles with 0% concentration of moringa leaf extract substitution
F_1 = wet noodles with 50% concentration of moringa leaf extract substitution
F_2 = wet noodles with 100% concentration of moringa leaf extract substitution

RESULT & DISCUSSION

1. Microbial Contamination Test

Test for bacterial and mold microbial contamination in wet Moringa noodles using the Total Plate Count (TPC) and Yeast Mold Count (YMC) tests. Total plate count (TPC) test results indicated that the TPC of wet noodles was affected by the concentration of moringa leaf extract substitution and the storage time at room temperature (see Table 2). The TPC of wet noodles with moringa leaf extract substitution was lower than TPC of wet noodles without moringa leaf extract substitution. This is influenced by the antimicrobial compounds found in moringa leaf extract. Furthermore, the TPC of wet noodles during storage has increased. The TPC value of moringa wet noodles stored for one day with a concentration of 100%

(0.96 x 10^6 cfu/g), still meets the SNI 2987-2015 criteria for wet noodles (maximum of $1x10^6$cfu/g)[1]. The TPC can be maintained in wet noodles during storage influenced by antimicrobial compounds in moringa leaf extract so that bacterial growth can be inhibited. In moringa leaf extract, there are active compounds that can inhibit microbial activity such as tannins, terpenoids, and saponins (14). These antimicrobial compounds can penetrate the cytoplasm of bacteria so that bacterial growth is inhibited (15).

Yeast Mould Count (YMC) test results indicated that the YMC of wet noodles was affected by the concentration of moringa leaf extract substitution and the storage time at room temperature (see Table 2). The YMC for wet noodles substituted with moringa leaf water extract was lower than YMC for wet noodles without substitution. Storage treatment for 3 days increased the YMC of wet noodles. The YMC value of wet noodles stored for 1 day for moringa wet noodles with a concentration of 100% (0.69 x 10^4 cfu/g) still meets the SNI 2987-2015 standard regarding wet noodles (maximum of $1x10^4$ cfu/g)(1).

Table 2 Results of TPC test and of YMC test for Moringa wet noodles

Storage Time (Days)	TPC			YMC		
	Concentration of Moringa leaf Water extract ($1x10^6$ cfu/g)			Concentration of Moringa leaf water extract ($1x10^4$ cfu/g)		
	0%	50%	100%	0%	50%	100%
0	0.52 [a]	0.08 [a]	0.05 [a]	n/a	0.01 [a]	0.02 [a]
1	4.05 [b]	3.10 [b]	0.96 [a]	4.50 [b]	2.30 [b]	0.69 [a]
2	440.00 [b]	150.00 [b]	41.00 [b]	15.00 [b]	12.00 [b]	9.80 [b]
3	2000.00 [b]	600.00 [b]	92.00 [b]	77.00 [b]	59.50 [b]	18.50[b]

Note: a = accepted; b = rejected; threshold = max TPC value 10^6 cfu/g and max YMC value 10^4 cfu/g

2. Proximate Nutritional Value

Moisture Content:The moisture content of 0% Moringa wet noodles during 3 days of storage ranged from 31.18– 34.33% while for the wet noodles Moringa 50-100% ranged from 28.09-31.63%. The relationship between storage time at room temperature and moisture content of wet noodles at each concentration of Moringa leaf water extract can be seen in Figure 1.

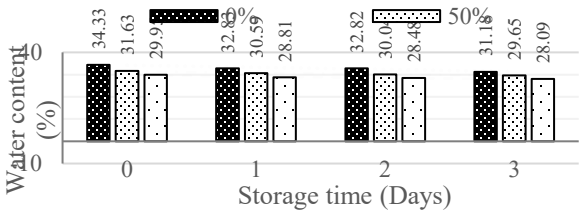

Figure 1 Results of moisture content tests on Moringa wet noodles

Substitution of Moringa leaf extract in making wet noodles can reduce the moisture content. However, the moisture content of each wet noodle produced is below the maximum national standard (SNI 2987-2015), i.e., 35%)(1). The storage time affects the moisture content of wet noodles. The longer it is stored the water content decreases. This is likely due to the evaporation of water from the food to the surrounding environment, due to the influence of ambient humidity which is lower than the humidity of the product. The moisture content of a product is influenced by the humidity of the surrounding air (16). If the humidity of the room is greater than the humidity of the product, the product will absorb water; conversely, if the humidity of the storage room is lower than the product's humidity, the product will evaporate its water.

Ash Content: The greater the concentration of substituted Moringa leaf extract and the longer the storage, the higher the ash content value of wet noodles. The highest ash content (2.58%) was found in wet noodles with a concentration of 100% for 3 days of storage, and the lowest ash content (1.35%) was in wet noodles with a concentration of 0% for 0 day of storage. The relationship between storage time at room temperature and the ash content of wet noodles at each concentration of Moringa leaf aqueous extract (see Figure 2). The ash content result for all wet noodle samples complies with the national standard (SNI 2987-2015), i.e., maximum 3%)(1). The value of wet noodle ash increases with the substitution concentration of Moringa leaf extract and the storage time. The high ash content of Moringa wet noodles is influenced by organic materials used in making wet noodles such as wheat flour, salt, and carbonate natrium which mostly contains minerals as well as Moringa leaf water extract.

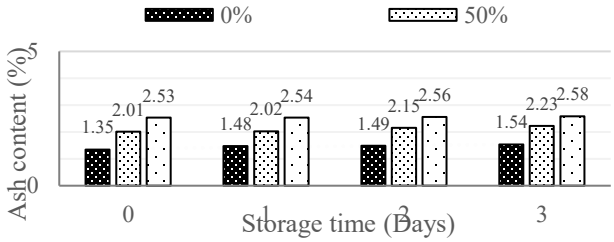

Figure 2 Results of ash content tests on Moringa wet noodles

Fat Content: The highest fat content (1.36%) was in wet noodles with a concentration of 0% at 3 days of storage, and the lowest fat content (1.13%) in wet noodles with a

concentration of 100% at 3 days of storage. Based on the test results of the effect of storage time on the fat content of wet noodles, showed that there was a decrease in fat content in 50% and 100% Moringa wet noodles**.** This is consistent with the view expressed by (17), who claims that the impact of storage duration on milk fat content demonstrates a reduction in fat content due to environmental temperature-induced damage to the fat, allowing the fat to undergo free oxygen oxidation (see Figure 3).

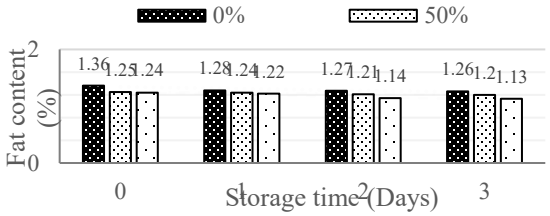

Figure 3 Results of fat content tests on Moringa wet noodles

Protein Content: The highest protein content (11.21%) was found in wet noodles with a concentration of 100% at 3 days of storage, and the lowest protein content (9.25%) was found in wet noodles with a concentration of 0% for 1 day of storage. The protein content of the wet noodles produced meets the minimum standards (SNI 2987- 2015), i.e., 9.0% (see Figure 4).

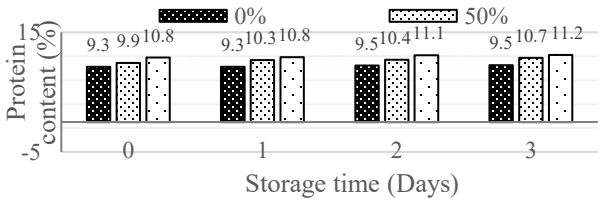

Figure 4 Results of protein content tests on Moringa wet noodles

Moringa leaf extract substitution increases the level of protein produced. The protein content increases in proportion to the amount of Moringa leaf water extract applied and the length of storage. The high protein content of Moringa wet noodles is influenced by Moringa leaf extract. This trend emerges as moringa leaves are rich in protein (28.44%) (18) and contain the same amount of protein as twice as much yogurt (19).

Carbohydrate Content: The highest carbohydrate content (56 .94%) was in wet noodles with a concentration of 100% at 3 days of storage, and the lowest carbohydrate content (53.81%) was in wet noodles with a concentration of 0% for 1 day of storage. The relationship

between storage time at room temperature and carbohydrate content in wet noodles at each concentration of Moringa leaf water extract can be seen in Figure 5.

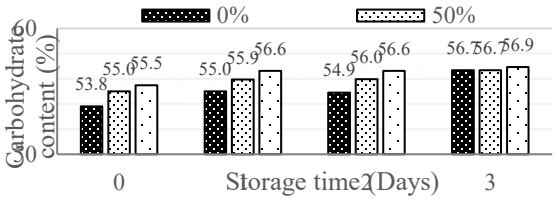

Figure 5 Results of carbohydrate content tests on Moringa wet noodles

3. pH Value

The pH values of wet noodles were influenced by the substitution treatment of Moringa leaf extract and storage time as shown in Figure 6. Moringa leaf extract substitution and storage time decrease the pH value. The highest pH value (8.64) was found in wet noodles with a concentration of 0% at 0 days of storage, and the lowest pH (6.37%) was found in wet noodles concentration of 100% for 3 days of storage. The decrease in pH value during storage is due to the increasing growth of microbes during storage. Microbial growth will affect the pH of the product (20).

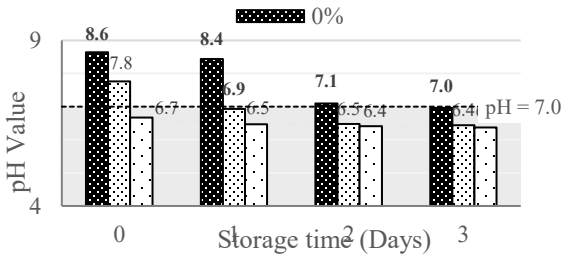

Figure 6 Results of pH content tests on Moringa wet noodles

4. Hedonic Test

Moringa wet noodles are wet noodles that are processed with the addition of Moringa leaf extract of 0%, 50%, and 100%. The addition of Moringa leaf extract with different concentrations in each treatment may affect the level of preference for aroma, colour, texture, and taste produced (See Figure 7).

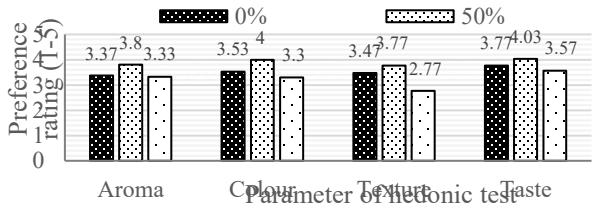

Figure 7 Results of hedonic tests on Moringa wet noodles

Aroma: The results of hedonic test on the aroma of wet noodles showed that the substitution of moringa leaf extract had a substantial effect on the aroma. The aroma produced by the substitution of Moringa leaf extract according to the treatment has a distinctive aroma of Moringa. Based on the results of Duncan's further test, the aroma most preferred by the panelist was 50% Moringa wet noodle.

Color: The results of hedonic test on the colour of the wet noodles showed that the substitution of moringa leaf extract had a large effect on the colour of the resulting wet noodles. Based on the results of Duncan's further test, the most preferred colour by the panelist was 50% Moringa wet noodles. The colour of the wet noodles with the substitution of Moringa leaf extract has a brownish colour.

Texture: The results of hedonic test on the texture of wet noodles showed that the substitution of moringa leaf extract had a substantial effect on the texture of the resulting wet noodles. Based on the results of Duncan's further test, the texture most preferred by the panelist was 50% Moringa wet noodles.

Taste: The results of hedonic test on the taste of wet noodles showed that the substitution of moringa leaf extract had a substantial effect on the taste of the resulting wet noodles. Based on the results of Duncan's further test, the panellist's favourite flavour was 50% Moringa wet noodles.

CONCLUSIONS

The extract of Moringa leaf water can improve the nutritional value of wet noodles namely the ash, protein, and carbohydrate content while decreasing their fat and water content. The use of 100% Moringa leaf extract at room temperature storage for a day can reduce the number of bacteria (9.60×10^5 cfu/g) compared to wet noodles without extract Moringa leaf (4.05×10^6 cfu/g). The 100% substitution of moringa extract identified as the best usage of moringa as a

natural preservative and nutritional source for wet noodles. However, the results of the hedonic test showed that the substitution treatment of 50% moringa leaf extract was the most favoured by the panelist in terms of aroma, colour, texture, and taste.

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