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**RESEARCH**

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## Sensory Evaluation and Nutritional Quality of Corn Tortilla Enriched with Moringa Seed Flour

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### Abstract

One of the agricultural product processing industries currently being developed in East Nusa Tenggara is corn. Corn has a relatively high nutritional content, thus it possesses economic value for the community. One of the snack products from corn is tortilla. The tortillas can be modified with other food ingredients that contain good nutrition to increase its nutritional value. Moringa seeds contain carbohydrates, fats and proteins. Hence, moringa seeds can be an alternative food source of a new protein which is able to overcome protein deficiency, particularly in East Nusa Tenggara. The experiment was designed by Completely Randomized Design (CRD) with several formulas for substitution of corn flour with moringa seed flour, which were: P1 (100%: 0%), P2 (95%:5%), P3 (90%:10%), and P4 (85%:15%). An organoleptic test was administered to determine the panelists' preference for tortilla formulas and a proximate test to examine the nutritional value of tortillas. The results of the organoleptic test revealed that corn tortilla substituted with moringa seed flour up to 20% owned a significant effect on the color, aroma, taste and texture of the tortilla with a p-value <0.05. The proximate test results presented that tortillas with moringa seed flour substitution possessed a significant effect on protein, fat, carbohydrate, water, ash and fibre content of tortilla with a p-value <0.05.

**Keywords:** Tortilla, Corn, Moringa Seed Flour.

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## 1. INTRODUCTION

The development of nutritional problems in Indonesia is currently increasingly complex. Furthermore, overnutrition is also a problem that needs to be taken into account seriously. Unfortunately, East Nusa Tenggara has the highest prevalence of nutritional problems (malnutrition, stunting, wasting, and also chronic energy deficiency in pregnant women) compared to other districts in Indonesia (Kementerian Kesehatan Republik Indonesia, 2018). Food diversification is one of efforts to overcome food and nutrition problems which can be performed by reviewing new food ingredients or developing existing food ingredients (Arif, et al., 2020). One agricultural commodity developing in East Nusa Tenggara is corn process. Corn in East Nusa Tenggara is one of the investment opportunities in the farming sector (Adu, et al., 2020). Corn is a food with high nutritional content, mainly carbohydrates. Yellow corn contains rich carotenoids (up to 823  $\mu$ g/100 g DW corn) including lutein (50%), zeaxanthin (40%),  $\beta$ -cryptoxanthin (3%),  $\beta$ -carotene (4%), and  $\alpha$ -carotene (2%). High amylose corn is rich in amylose (up to 70% of all carbohydrates) (Siyuan, et al., 2018).

Corn can be processed for a variety of foods, including tortillas. The tortilla is a food in flattened form. It is made with the mass of cooked corn obtained through the nixtamalization procedure (Guzmán-Soria, et al., 2019). To increase the nutritional value, corn flour in tortillas is substituted with other food ingredients which contain good nutritional value. Hence, moringa seeds contain carbohydrates, fats, and proteins that are able to be the additional ingredients. The total range of carbohydrates in Moringa seeds is 11-15%, fat 30-43%, and protein is around 29-38% (Compaoré, et al., 2011) (Olagbemide, et al., 2014). It makes moringa seeds potential as an alternative food source of a new protein that can be developed to overcome nutritional problems, particularly in East Nusa Tenggara.

Compared to tortillas which is made from corn flour, the addition of moringa seeds flour in tortillas is expected to increase the nutritional value and public acceptance. The use of moringa seed flour and leaves in making tortillas is beneficial because the nutritional content of the two complements each other. Therefore, the objective of this study is to determine the use of moringa seeds flour in the production of corn tortillas.

## 2. RESEARCH METHOD

The experiment was designed by Completely Randomized Design (CRD) by performing 4 treatments and 3 replications. Several formulas for substitution of corn flour with moringa seed flour (table 1) were also applied. Ethical approval for this study was obtained from the Health Research Ethics Committee, Health Polytechnic Ministry of Health, Kupang (LB.02.03/1/0061/2020).

**Table 1.** Tortila Formulation with Moringa Seed Flour.

<b>Substitution of Flour</b>	<b>P1</b>	<b>P2</b>	<b>P3</b>	<b>P4</b>
Corn flour	100	95	90	85
Moringa seed flour	0	5	10	15

Moringa seeds were obtained from the city of Kupang. Moringa seeds used were old moringa seeds. Moringa seed flour and tortillas were manufactured in the Food Technology Laboratory, Department of Nutrition, Health Polytechnic Ministry of Health, Kupang. Proximate test was administered at the Laboratory of Center for Excellence in Science and Technology, Health Polytechnic Ministry of Health, Malang. This research was conducted for three months (July-September) 2020.

The process of making tortillas consists of several stages. The first stage is making moringa seed flour. Making moringa seed flour was by sorting the Moringa fruit, then boiling for at least 35 minutes, and draining. Then, it was dried in an oven at 80°C for 8 hours. The dried moringa seeds were blended and sieved using an 80 mesh sieve to obtain a fine flour (Ogunsina, & Radha, 2010) (Ogunsina, et al., 2010). The second step is making the tortilla. The process of making tortillas starts with preparing the dough. The preparation of the dough involves mixing the ingredients in the form of corn flour and moringa seed flour in accordance with the predetermined formula. It is then added 1% salt and 5% garlic. The next step is mixing the dough and covering it with plastic. After that, the dough is flattened using a rolling pin to a thickness of 1 mm. When the dough is thin enough, it is continued by steaming the dough for 10 minutes. Then the dough is printed into a square with a side of 3 cm. After boiling, it is continued by drying the sun for approximately 8-10 hours. The final step is to fry the tortillas at 170-180°C until they are brown. The third stage is organoleptic test. The organoleptic/hedonic test was administered to determine the panellists preference for taste, color, aroma, and texture. In this test, the formula was examined on 30 semi-trained panellists. Panellists are individuals or groups who subjectively assess the organoleptic quality of the product in accordance with the procedure. This panellist is a student of the Nutrition Program, Health Polytechnic Ministry of Health, Kupang, who operates 30 women and is 20 years old. Panellist tastes all types of tortilla formulas which are then assessed according to their level of preference for taste, color, aroma, and texture. The testing method used in this standard is a rating scale ranging from strongly dislike (1), dislike (2), somewhat like (3), like (4), and strongly like (5) (Rahmawati, et al., 2018). The final step is conducting proximate test. After the organoleptic/hedonic test was performed to determine the panellists preference for the tortilla formula, a comparative test was conducted to determine the nutritional content, including carbohydrates, protein, fat, water content, ash content, and fibre.

The results of the organoleptic and proximate tests in this study were examined descriptively based on the average value and the percentage of panellists acceptance of each treatment level. To determine the type of formula on the level of preference (organoleptic) of the panellists on tortilla products, statistical analysis was administered using the ANOVA General Linear Model (GLM) method with a 95% confidence interval level ( $\alpha$ : 0,05)). Likewise, with the results of the proximate test to identify if there is a difference in the nutritional value of the tortilla formula, an ANOVA test was applied. If the ANOVA test results show a significant difference or effect, the Duncan test is continued. The data were processed by employing Microsoft Excel 2010 program and Statistical Product and Service Solution (SPSS 26).

### **3. RESULTS AND DISCUSSION**

The acceptability of tortillas for color, aroma/flavor, taste and texture parameters were obtained through organoleptic tests conducted by 30 semi-trained panellists. Each component of the sensory tests in each formula was examined for variance (ANOVA). The organoleptic test (preference test) is an extensively applied method for determining food product preferences. The organoleptic scale can be converted to a numerical scale in facilitating statistical analysis. This study investigated the color, texture, taste, and aroma of tortillas made with a combination of maize flour and moringa seed flour. Table 2 presents that the combination of corn flour and moringa seed flours treatment owned a significant effect on the color, texture, taste, and aroma score of tortillas when analyzed at the 5% significance level.

**Table 2.** Results of organoleptic tests on tortilla.

Treatment	Average			
	Color	Flavor	Taste	Texture
P1 (0% Moringa seed flour:100% corn flour)	4.07 <sup>b</sup>	3.70 <sup>ab</sup>	3.63 <sup>b</sup>	4.07 <sup>c</sup>
P2 (5% Moringa seed flour: 95% corn flour)	4.03 <sup>b</sup>	3.92 <sup>b</sup>	4.10 <sup>c</sup>	4.20 <sup>c</sup>
P3 (10% Moringa seed flour: 90% corn flour)	3.83 <sup>b</sup>	3.37 <sup>a</sup>	3.43 <sup>ab</sup>	3.67 <sup>b</sup>
P4 (15% Moringa seed flour: 85% corn flour)	3.43 <sup>a</sup>	3.40 <sup>a</sup>	3.10 <sup>a</sup>	3.23 <sup>a</sup>

Note: Average (1 = Strongly dislike, 2 = dislike, 3 = somewhat like, 4 = like, 5 = Strongly like).

<sup>a,b,c</sup> : means values marked by different letters in verses, differ significantly at  $p < 0,05$ .

The average value of the panellist's preference level on the color parameter of tortilla chips with moringa seed flour substitution ranges from 3.43 to 4.07 (somewhat like to like). The results of the variance test (ANOVA) revealed that the difference in the percentage comparison of moringa seed flour possessed a significant effect on the color preference of tortilla chips ( $p < 0.05$ ). Meanwhile, Duncan's further test was conducted, and it was found that P4 was significantly different from P3, P2, and P1. P1 is the most preferred formula by panellists.

Food considered nutritious, delicious, and has good texture will not be eaten if the color is not pleasing to the eye. Based on organoleptic tests conducted by 30 panellists of the four tortilla samples, P1 had the highest score of 4.07 (like) compared to other formulas. The difference in the color of the tortillas is due to the different concentrations of moringa seed flour. Corn flour is frequently yellow, and moringa seed powder is white, thus, the more substitutes for moringa seed flour, the whiter the tortilla will be, and the more the yellowness of the corn will fade. Panellists like the color of the corn tortilla with formula P1 because it is yellowish-brown, resembling the original product, formula P1 is 100% corn. It is not substituted with moringa seed flour. The color of food owns a significant impact on its quality. The color can be used to examine the severity and predict the nutritional quality degradation of materials from the process treatment (Nurhayati, et al., 2019).

The average value of the panellists' preference level on the aroma parameter of tortilla chips with moringa seed flour substitution ranges from 3.37 to 3.92 (somewhat like). The results of the variance test (ANOVA) presented that the difference in the percentage comparison of moringa seed flour owned a significant effect on the preference for the aroma of tortilla chips ( $p < 0.05$ ). Meanwhile, Duncan's further test was conducted, and it was identified that P3 was significantly different from P2. P2 is the most preferred formula by panellists.

Whether or not consumers accept the aroma of the product influences a food product. The smell is one of the parameters of the food quality. The scent also determines the food delicacy. The smell is difficult to examine because everyone possesses a different preference for making judgments. Everyone owns a distinct smell and a diverse aroma selection (Muchtadi, & Ayustaningwarno, 2010). Aroma determines the delicacy of food, thus, smell is one factor which determines the food quality. The scent is difficult to assess, hence, there is frequently a different opinion when evaluating it. This difference in opinion is because every individual possesses a different smell. Although they can distinguish smells, every person has other preferences. Panellists like the aroma of corn tortillas with formula P1 because the tortillas are yellowish-brown, resembling the original product, formula P2, with a score of 3.92 compared to other formulas. In accordance with research conducted by Meliza, et al, 2019, it is explained that the panelists preferred tortillas with more grits. However, after frying, the color of the

resulting tortillas changed. The resulting tortillas were brownish in color. It was caused by the interaction of amino acids with carbohydrates, hence, it caused a change in color for the tortilla (Meliza, et al., 2019). The constituent ingredients, in general, create the aroma of food products. High frying, boiling, and dry temperatures are able to reduce flavor throughout the manufacturing process. Dehydration owns a number of drawbacks, one of which being the loss of aroma (Nurhayati, et al., 2019).

The average value of the panellists' preference level on the taste parameters of tortilla chips with moringa seed flour substitution ranges from 3.10 to 4.10 (somewhat like to like). The results of the variance test (ANOVA) revealed that the difference in the percentage comparison of moringa seed flour possessed a significant effect on the taste preferences of tortilla chips ( $p < 0.05$ ). Meanwhile, Duncan's further test was conducted, and it was discovered that P4 was significantly different from P2. P2 is the most preferred formula by panellists.

The sensory responses to the taste, aroma, color, and texture of foods determine the food preferences and the eating habits of the consumers (Pires, et al., 2020). The taste makes food preferred by consumers because, with bite, consumers are able to identify and judge whether or not a food tastes good. Panellists liked the taste of corn tortillas with P2 formula with a score of 4.10 compared to other formulas. P2 is a tortilla substituted with 5% moringa seed flour. Although there is an addition of moringa seed flour, the panellists liked the taste, and it was not found bitter taste at all on the tongue. It is because moringa seeds were removed from the bitter taste according to the procedure for making moringa seed flour DBMS (Debittered Moringa Seed)(Ogunsina, & Radha, 2010)(Ogunsina, et al., 2011).

The average value of the panellists' preference level on the texture parameter of tortilla chips with moringa seed flour substitution ranges from 3.23 to 4.20 (somewhat like). The results of the variance test (ANOVA) revealed that the difference in the percentage comparison of Moringa seed flour possessed a significant effect on the texture preference of tortilla chips ( $p < 0.05$ ). Meanwhile, Duncan's further test was conducted, and it was discovered that P4 and P3 were significantly different from P1 and P2. P2 is the most preferred formula by panellists.

The excellent surface is influenced by the essential ingredients employed. The texture of the food influences consumer interest in a portion of food. The texture of dry foods like tortillas is more crunchy. The crispness of a dry food product is a factor causing consumers to like the food because it displays the quality of the product (Muchtadi, & Ayustaningwarno, 2010). The texture is affected by the moisture content in foodstuffs. Water activity owns a great influence on product storage stability and may cause changes in texture. The more water coming out of the material, the more space existing in the network, the more crunchy the product will be (Tu, et al., 2021). Panellists liked the taste of corn tortilla with P2 formula with a score of 4.20 compared to other procedures. The more substitution of moringa seed flour reduces the preference of the panellists in terms of texture because the resulting tortilla is less crunchy.

After the organoleptic test was administered, an analysis of the nutritional value (proximate test) of each formula including the protein, fat, carbohydrates, water content, ash content, and fibre content, is presented in table 2.

**Table 2.** Average proximate composition (%) of tortilla containing different ground of moringa seed flour levels.

Proximate composition	Sample			
	P1	P2	P3	P4
Protein content	4,00 <sup>a</sup>	4,55 <sup>b</sup>	5,33 <sup>c</sup>	7,42 <sup>d</sup>
Fat content	24,35 <sup>a</sup>	26,09 <sup>b</sup>	27,12 <sup>c</sup>	27,3 <sup>d</sup>
Carbohydrate content	66,05 <sup>d</sup>	64,81 <sup>c</sup>	63,54 <sup>b</sup>	59,4 <sup>a</sup>
Water content	2,28 <sup>a</sup>	2,82 <sup>b</sup>	2,85 <sup>c</sup>	3,68 <sup>d</sup>
Ash content	3,02 <sup>d</sup>	2,27 <sup>c</sup>	2,01 <sup>b</sup>	0,59 <sup>a</sup>
Fibre content	2,63 <sup>a</sup>	2,79 <sup>b</sup>	3,63 <sup>c</sup>	4,49 <sup>d</sup>

<sup>a,b,c,d</sup>: means values marked by different letters in verses, differ significantly at  $p < 0,05$ .

Based on the variance test (ANOVA), it is unveiled that the difference in the percentage of moringa flour possessed a significant effect on protein content ( $p < 0.001$ ), fat ( $p < 0.001$ ), carbohydrates ( $p < 0.001$ ), water ( $p < 0.001$ ), ash ( $p < 0.001$ ), and tortilla fibre ( $p < 0.001$ ). Then, a follow-up test was performed, that was Duncan's test on each parameter, and the results presented that there were differences in all treatments.

The results of the ANOVA test unveiled that the treatment of corn tortilla substituted with moringa seed flour possessed a significant effect on carbohydrate content, ash content, water content, protein content, fat content, and fibre content.

The protein content of corn tortilla substituted with moringa seed flour varies. Protein content ranges from 4.00-7.42%. The higher the number of substitute materials, the higher the protein. It is because moringa seed flour possesses a high protein content. Corn itself also contains 9.8% protein content. Protein in corn consists of five fractions, which are albumin, globulin, prolamin, glutelin and non-protein nitrogen. Furthermore, corn kernels generally contain 8–11% protein with 0.05% of the amino acid lysine and 0.225% tryptophan (Karneta, et al., 2018).

The fat content of corn tortilla substituted with moringa seed flour also varies. The fat content ranges from 24.3-27.3%. The higher the number of substitute ingredients, the higher the fat content of the tortilla. It is because moringa seed flour also has a high fat content.

Meanwhile, the carbohydrate content ranges from 59.4-66.05%. The higher the substitution of moringa seed flour, the fewer carbohydrates tortilla. It is caused as the concentration of corn flour is also reduced, in which the most nutritional content in corn flour is carbohydrates.

The moisture content of corn tortilla substituted with moringa seed flour ranges from 2.28 to 3.68%. These results were then compared with the water content based on the Indonesian National Standard for marning corn, which is a dry product with SNI 01-4300-1996 (Badan Standarisasi Nasional, 1996), and the Indonesian National Standard for Tempe chips which is also a dry food product SNI 012602-1992 in which the maximum moisture content of a chip is 1.5-3% (Badan Standarisasi Nasional, 1992). The water content of corn tortilla substituted with moringa seed flour varies. After being compared with the water content according to SNI, P1, P2, and P3, it meets the requirements in terms of water content as it is not up to 3%. At the same time, P4 is more than 3% which is 3.68%. Hence, the higher the amount of substitute material, the higher the water content. The more substitutions of moringa seeds, the higher the water content of the tortilla. It is due to the high crude fibre content in moringa seed flour. The physiological properties of dietary fibre bind water to a material, and the bound water is challenging to evaporate again (Istiqomaturrosyidah, & Murtini, 2021). Moisture content

is an essential part of food ingredients because water content affects food's appearance, texture, and taste. The water content in foodstuffs also determines the acceptability, freshness, and durability of these ingredients (Lubis, et al., 2021)

The ash content ranges from 0.59-3.02%. The higher the substitution of Moringa seed flour, the lower the ash content of the tortilla. This is because the concentration of corn flour is also reduced so that the ash content is also reduced.

The fibre content of corn tortilla substituted with moringa seed flour also varies. Fibre content ranges from 2.63-4.49%. The higher the number of substitute ingredients, the higher the fibre content of the tortilla. It is because moringa seed flour also possesses a high fibre content. Moringa oleifera seeds have been the subject of many research activities. Moringa seeds are sources of proteins, lipids, fats, soluble vitamins, and antioxidants (Saa, et al., 2019).

These results are in agreement with (Rabie, et al., 2020) which made cookies from moringa oleifera leaves and powdered seeds in different proportions that could increase the nutritional value of bakery products and into a significantly higher proportion of nutrients important to human health such as fiber, minerals (Fe, Ca, K, and Zn), protein and fats). Adding moringa oleifera leave sand powdered seeds to cookies is able to increase essential and non-essential amino acids such as leucine, isoleucine, glutamic acid, proline, and lysine, which possess great nutritional benefits for developing countries and help reduce malnutrition diseases (Rabie, et al., 2020) (Nour, et al., 2018).

#### 4. CONCLUSION

The organoleptic (hedonic) test results presented that corn tortilla substituted with moringa seed flour up to 20% owned a significant effect on the color, aroma, taste, and texture of the tortilla with  $p < 0.05$ . In terms of color, the panellists' favorite tortilla was P1. In terms of aroma, the panellist's favorite tortilla was P2. In terms of taste, the panellists' favorite tortilla was P2. In terms of texture, the panellists' favorite tortilla was P2. The proximate test results presented that tortillas with moringa seed flour substitution possessed a significant effect on protein, fat, carbohydrate, water, ash and fibre content of tortilla with a p-value  $< 0.05$ .

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