Original article:

The Effect of Giving Moringa Leaf Flour to Burger Tempeh on The Content Nutrition And Organoleptic

Ningrum T.M..[1], Yulia Lanti Retno Dewi[2], Ratih Puspita Febrinasari[3]

Abstract

Background: Moringa leaves have a high nutritional content and can be used as food that is rich in nutrients. In 100 grams of Moringa leaves contain 7 mg of iron, and 28.2 mg of Moringa leaf flour. The mineral content in Moringa leaves includes (Calcium 440 mg, Magnesium 42 mg, Phosphorus 70 mg, Potassium 259 mg and Iron 0.85 mg), vitamins (A: 6.78 mg, C: 220 mg, E: 448 mg, and B3 : 0.8 mg) and various other benefits. The addition of Moringa leaf flour is expected to increase the nutritional content of the burger tempeh food product. Organoleptic test is needed to determine the level of preference, taste and texture to get the most preferred burger tempeh moringa product. ***Objective***: This study aims to determine the effect of adding Moringa leaf flour to the nutritional and organoleptic content of burger tempeh. ***Method*****:** Organoleptic tests were carried out at the Nutrition Laboratory of the University of M.H. Thamrin Jakarta. After getting the most preferred burger tempeh product, nutritional content testing was carried out at the Laboratory of Balai Besar Industri Agro (BBIA) in Bogor. ***Results*****:** Burger tempeh moringa selected in the organoleptic test was the tempeh burger which was added with 3 g and 12 g of Moringa leaf flour. The nutritional content of the tempeh burger without the addition of Moringa leaf flour is iron 2.41 mg, folic acid 1.76 mg and vitamin C 0.70 mg. After adding 3 g of Moringa flour, the iron value increased to 2.51 mg, folic acid 1.78 mg. Meanwhile, the addition of 12 g of Moringa leaf flour increased to 2.98 m iron and 1.90 mg folic acid. ***Conclusion***: The addition of Moringa leaf flour affects the nutritional and organoleptic content of tempeh burgers.

Keywords*:* Moringa, Moringa leaf flour, tempeh, Moringa tempeh burger, organoleptic

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Introduction

Moringa has the scientific name Moringa oleifera, the Moringa plant belongs to the Moringaceae family. This plant has a tree height between 7 to 11 meters. Moringa leaves are oval, small, and compound in one stalk. Moringa leaves contain nutrients such as calcium, iron, vitamins, and essential amino acids that are also found in quinoa and animal meats. Moringa leaves are very rich in antioxidants, which include vitamin C, beta carotene, quercetin, and chlorogenic acids.[1,12] Giving moringa leaf extract can also reduce disease activity in people with lupus.[2]

In 100 grams of Moringa leaves contain 7 mg of iron, and 28.2 mg of Moringa leaf flour.[3] The high iron content of Moringa leaves is able to overcome the problem of anaemia in adolescent girls. Mineral content includes (Protein 6.7 g, Calcium 440 mg, Magnesium 42 mg, Phosphorus 70 mg, Potassium 259 mg and Iron 0.85 mg), vitamins

1. Postgraduate Program of Nutrition Science, Sebelas Maret University, Indonesia
2. Department of Nutrition Science, Faculty of Medicine, Sebelas Maret University, Indonesia
3. Department of Pharmacology, Faculty of Medicine, Sebelas Maret University

Correspondence to: Tri Martya Ningrum L.W., Postgraduate Program of Nutrition Science, Sebelas Maret University, Indonesia E-mail: *trimartya@student.uns.ac.id*

(A: 6.78 mg, C: 220 mg, E: 448 mg, and B3: 0, 8mg) and various other benefits.[4] Consuming Moringa leaf extract can increase haemoglobin levels in adolescent girls and can be used as an alternative to overcome the problem of anaemia in adolescent girls.[5] According to research conducted by Indrayani et.al., 2019, Moringa leaves can increase haemoglobin levels to prevent anaemia.[6]

Table 1. Nutritional value of Moringa leaves in 100 g

Nutritional Components	Fresh Leaves
Calcium	94.01
Proteins (%)	22.7
Carbohydrates (%)	51.66
Fibre (%)	7.92
Calcium (mg)	350-550
Energy (Kcal/100g)	-
Fat (%)	4.65

Source: Syarifah Aminah et.al., Litbang Pertanian (2015).[7]

Moringa leaves can be made into flour by several methods, including blending, pounding, or using other grinding machines. Drying is a series of processes in the manufacture of Moringa leaf flour, including drying, which can be in the form of traditional drying or modern drying using electronic devices. Research conducted by Irwan (2020) made Moringa leaf flour through a traditional drying process in 3 ways, namely blanching, withering, and drying. Of the 3 drying methods, the withering method is the recommended choice by researchers, because the highest Ca and Fe content is in the withering method. The following is the nutritional content of Moringa leaf flour.[8]

Table 2. Nutritional value of Moringa leaf flour in 100 g

Nutritional Components	Nutrient Value
Protein	27, 83 g
Calcium (Ca)	1,014.81 mg
Phosphorus (P)	700.65 mg
Iron (Fe)	11.41 mg
Vitamin A	59.2 ug
Vitamin C	716.47 mg
Iodine	703.3 ug

Source: Irwan (2020)[8] and Kusumawardani. et. al (2018)[9]

Burgers usually consist of a burger bun and its filling, the filling is filled with a patty which is usually made from meat such as beef, fish and chicken, there is also a burger stuffing made from tempeh. Stuffing tempeh burgers is an alternative for vegetarians (who only want to eat from plant-based foods). Tempeh is a food ingredient that is easily obtained and the price is affordable, besides that it has high nutritional content, such as protein, calcium, iron and vitamin B12.[10] Because of its high nutritional content, tempeh is an option for burgers, as a substitute for beef, chicken or fish.

To make it easier for people to consume food that can help overcome anaemia, it is necessary to have delicious food that contains sufficient nutrients and can increase blood haemoglobin levels in the body. From some of the literature that has been described in this background discussion, the authors try to make processed foods rich in nutrients and can overcome anaemia in adolescent girls.

The processed food made is the tempeh moringa burger (BTK), where usually the burger is made from processed beef, chicken or fish. The author tries to replace processed meat using tempeh and Moringa leaf flour as additional ingredients for making tempeh burgers.

Table 3. Nutrient Value of Tempeh Burger Stuffing in 100 g

Nutrients	Nutritional Value
Energy	268.56 kcal
Carbohydrate Level	33.37%
Water content	42.86%
Protein Level	6.77%
Ash Level	5.00%
Fat level	12.00 %

Source: Nurwahyu et al., (2013)[11]

Matherial and Methods

This research is an experimental study, using a completely randomized design (RAL) with five treatments, namely making tempeh burgers with 0%, 3%, 6%, 9%, and 12% Moringa leaf flour substitutions.

This research was conducted for 30 days (Mei - June 2022). The organoleptic test was carried out at the Nutrition Laboratory of the University of MH

Thamrin, Jakarta. After getting the most preferred tempeh burger product, nutritional content testing was carried out at the Laboratory of Balai Besar Industri Agro (BBIA) in Bogor.

Manufacturing Stage

The making of Moringa tempeh burger was carried out in four stages, namely: making burger buns, formulating burger fillings, organoleptic testing and nutritional value analysis.

1. Burger Bread Making

Making burger buns using the main ingredient wheat flour and added yeast bread. The initial stage is fermentation, where the flour is sprinkled with bread yeast and sugar, the fermentation time is about 2 hours. The next stage is knead or folding, which is kneading so that the dough is mixed evenly. Then the next stage is the formation of the dough, then after the desired bread dough is formed, the stage is the fermentation process or the final development of the dough. The final stage is the roasting or oven process, the baking process is the last and most important process in making bread. After that the bread is stored in the freezer, to be used in a few days.

2. Burger Stuffing Formula

The formulation of the burger stuffing formula was carried out through a preliminary study. The main ingredient of burger stuffing is tempeh, with the addition of Moringa leaf flour. Moringa leaf flour was added using several experimental formulas, as many as 18 additional formulas, consisting of: 1%, 2%, 3%, 4%, 5%, 6%, 7%, 8%, 9%, 10%, 11%, 12%, 15%, 20%, 25%, 30%, 50%, and 75% Moringa leaf flour.

In the preliminary study, there were 10 (ten) panelists who were asked to taste the most delicious taste, so 4 (four) formulas were produced, namely the addition of 3%, 6%, 9%, and 12% Moringa leaf flour.

3. Organoleptic Test

From the results of the burger stuffing formula obtained in the preliminary study, it was followed by an organoleptic test. The organoleptic test of the moringa tempeh burger was carried out on 30 panelists. The organoleptic test includes parameters of color, aroma, texture, taste, after taste and overall (general acceptance). The organoleptic test was carried out at the Nutrition Laboratory of the University of MH Thamrin, Jakarta.

Table 4. Moringa Leaf Flour Substitute Tempeh Burger Formula

Composition	Group				
	F0 (112)	F1 (182)	F2 (220)	F3 (389)	F4 (778)
Tempeh(g)	100	97	94	91	88
Moringa Leaf Flour (gr)	0	3	6	9	12
Salt and Pepper Powder (gr)	10	10	10	10	10
Seasoned Flour (gr)	10	10	10	10	10
Burger Bread (gr)	15	15	15	15	15
Toppings(g)	10	10	10	10	10

Source: Utami et. al. (2013)[11] with Modification

4. Data Analysis

Data analysis used in this study used a computer program. The data from the preference test on acceptability were processed with Microsoft Excel 2019 and then statistically analyzed using SPSS 25.0 with data normality analysis, then if the data distribution showed that it was not normal ($p < 0.05$) then it was continued with Kruskall Wallis analysis. If the results of the Kruskall Wallis analysis show a difference, then proceed with the Mann Whitney follow-up test for each treatment.

5. Nutritional Value Analysis

Analysis of the nutrients of the Moringa tempeh burger included proximate analysis, iron, folic acid and vitamin C. The nutrient analysis was carried out at the Laboratory of Balai Besar Industri Agro

Procedure for Making Tempeh Burger with Moringa Leaf Flour Substitution

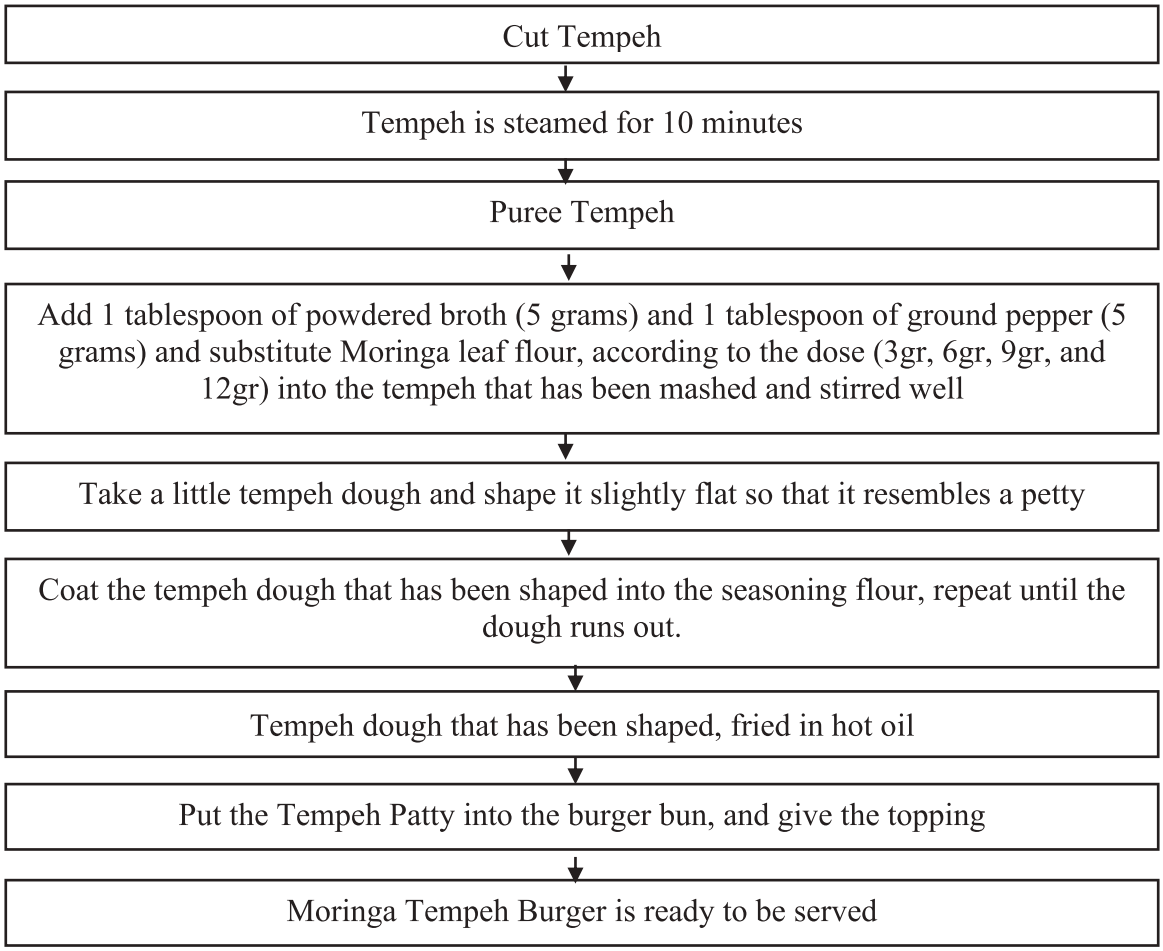

Figure 1. The procedure for making Moringa tempeh burgers

(BBIA) in Bogor. The product that was analyzed for its nutritional value was the Moringa tempeh burger which was the most preferred and had the greatest overall acceptance.

Results

1. Organoleptic Test Results

The organoleptic test involved 30 semi-trained panelists, namely panelists who had previously been given training on the components of the acceptance of the moringa tempeh burger. accept in general).

The control tempeh burger (without the addition of Moringa leaf flour) for the parameters of color, aroma, texture, taste, after taste and overall has the highest score. As for the tempeh burger with the addition of 3g of Moringa leaf flour, it ranks second with the level of preference on the parameters of color, aroma, texture, taste, after taste and overall. The next sequence is the addition of 12g of Moringa leaf flour, which has the highest over all value compared to the addition of 6g and 9g of Moringa leaf flour, and has a higher after-taste and taste. The tempeh burger with the addition of 9g became the most disliked tempeh burger because it had the lowest over all value compared to other tempeh burger products. This study is in line with other studies that the addition of moringa leaf flour to mocaf biscuit products produced good organoleptic characteristics.[12]

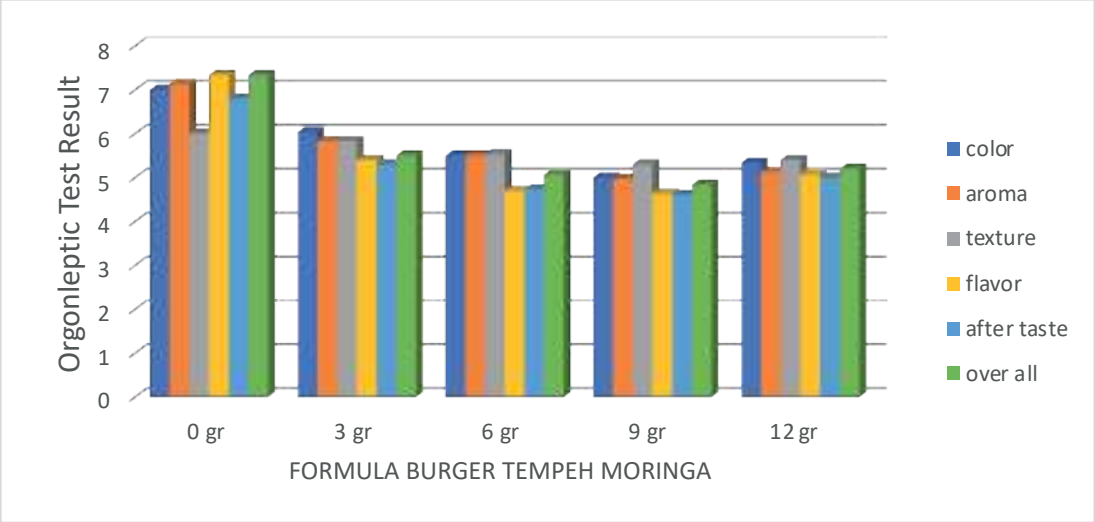

Figure 2. Graph of organoleptic test results of Moringa tempeh burger

Table 5. Orgonleptic Test Result

Characteristics	ORGANOLEPTIC																		TOTAL	
	1		2		3		4		5		6		7		8		9			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
COLOR																				
K	0	0	0	0	0	0	0	0	4	13	3	10	14	47	7	23	2	7	30	100
P1	0	0	0	0	3	10	3	10	5	17	4	13	9	30	6	20	0	0	30	100
P2	0	0	0	0	4	13	3	10	5	17	10	33	8	27	0	0	0	0	30	100
P3	0	0	0	0	7	23	6	20	4	13	8	27	4	13	0	0	1	3	30	100
P4	0	0	1	3	4	13	3	10	6	20	9	30	6	20	1	3	0	0	30	100
AROMA																				
K	0	0	0	0	0	0	1	3	4	13	1	3	13	43	6	20	5	17	30	100
P1	0	0	0	0	3	10	6	20	3	10	5	17	9	30	2	7	2	7	30	100
P2	0	0	0	0	5	17	4	13	3	10	9	30	7	23	2	7	0	0	30	100
P3	1	3	0	0	4	13	8	27	6	20	5	17	4	13	2	7	0	0	30	100
P4	0	0	1	3	5	17	5	17	7	23	4	13	6	20	2	7	0	0	30	100
TEXTURE																				
K	0	0	0	0	1	3	6	20	2	7	9	30	8	27	3	10	1	3	30	100
P1	0	0	0	0	3	10	4	13	4	13	8	27	6	20	5	17	0	0	30	100
P2	1	3	0	0	2	7	4	13	6	20	10	33	4	13	2	7	1	3	30	100
P3	0	0	0	0	5	17	4	13	6	20	10	33	2	7	3	10	0	0	30	100
P4	0	0	1	3	1	3	6	20	7	23	8	27	6	20	1	3	0	0	30	100
FLAVOR																				
K	0	0	0	0	0	0	1	3	5	17	12	40	6	20	6	20	0	0	30	100
P1	0	0	1	3	4	13	6	20	4	13	5	17	6	20	4	13	0	0	30	100
P2	1	3	1	3	4	13	9	30	4	13	7	23	4	13	0	0	0	0	30	100
P3	1	3	1	3	6	20	8	27	4	13	5	17	4	13	1	3	0	0	30	100
P4	1	3	0	0	7	23	2	7	4	13	10	33	6	20	0	0	0	0	30	100
AFTER TASTE																				
K	0	0	0	0	0	0	0	0	2	7	4	13	22	73	2	7	0	0	30	100
P1	0	0	0	0	2	7	9	30	4	13	9	30	5	17	1	3	0	0	30	100
P2	1	3	0	0	5	17	9	30	4	13	7	23	4	13	0	0	0	0	30	100
P3	1	3	1	3	5	17	8	27	6	20	6	20	2	7	1	3	0	0	30	100
P4	1	3	0	0	9	30	1	3	4	13	7	23	8	27	0	0	0	0	30	100
OVER ALL																				
K	0	0	0	0	0	0	0	0	2	7	1	3	16	53	7	23	4	13	30	100
P1	0	0	1	3	2	3	6	20	6	20	5	17	8	27	1	3	1	3	30	100
P2	0	0	0	0	5	4	7	23	7	23	5	17	5	17	1	3	0	0	30	100
P3	0	0	1	3	6	7	7	23	5	17	6	20	4	13	1	3	0	0	30	100
P4	1	3	0	0	7	4	2	7	5	17	6	20	8	27	0	0	1	3	30	100

*Obtained from Microsoft Excel test results

Table 6. Color Statistical Test Results P1 with P2

Test Statistics[a]

	Warna
Mann-Whitney U	348,000
Wilcoxon W	813,000
Z	-1,542
Asymp. Sig. (2-tailed)	0,123

a. Grouping Variable: Kode

Table 7. Color Statistical Test Results P1 with P3

Test Statistics[a]

	Warna
Mann-Whitney U	283,500
Wilcoxon W	748,500
Z	-2,500
Asymp. Sig. (2-tailed)	0,012

a. Grouping Variable: Kode

Table 8. Color Statistical Test Results P1 with P4

Test Statistics[a]

	Warna
Mann-Whitney U	331,500
Wilcoxon W	796,500
Z	-1,784
Asymp. Sig. (2-tailed)	0,074

a. Grouping Variable: Kode

Table 9. Color Statistical Test Results P2 with P3

Test Statistics[a]

	Warna
Mann-Whitney U	355,000
Wilcoxon W	820,000
Z	-1,439
Asymp. Sig. (2-tailed)	0,150

a. Grouping Variable: Kode

Table 10. Color Statistical Test Results P2 with P4

Test Statistics[a]

	Warna
Mann-Whitney U	420,500
Wilcoxon W	885,500
Z	-0,448
Asymp. Sig. (2-tailed)	0,654

a. Grouping Variable: Kode

Table 11. Color Statistical Test Results P3 with P4

Test Statistics[a]

	Warna
Mann-Whitney U	386,000
Wilcoxon W	851,000
Z	-0,966
Asymp. Sig. (2-tailed)	0,334

a. Grouping Variable: Kode

Table 12. Aromatic Statistical Test Results P1 with P2

Test Statistics[a]

	Aroma
Mann-Whitney U	398,000
Wilcoxon W	863,000
Z	-0,785
Asymp. Sig. (2-tailed)	0,433

a. Grouping Variable: Kode

Table 13. Aromatic Statistical Test Results P1 with P3

Test Statistics[a]

	Aroma
Mann-Whitney U	329,500
Wilcoxon W	794,500
Z	-1,811
Asymp. Sig. (2-tailed)	0,070

a. Grouping Variable: Kode

Table 14. Aromatic Statistical Test Results P1 with P4

Test Statistics[a]

	Aroma
Mann-Whitney U	352,000
Wilcoxon W	817,000
Z	-1,473
Asymp. Sig. (2-tailed)	0,141

a. Grouping Variable: Kode

Table 15. Aromatic Statistical Test Results P2 with P3

Test Statistics[a]

	Aroma
Mann-Whitney U	367,500
Wilcoxon W	832,500
Z	-1,241
Asymp. Sig. (2-tailed)	0,215

a. Grouping Variable: Kode

Table 16. Aromatic Statistical Test Results P2 with P4

Test Statistics[a]

	Aroma
Mann-Whitney U	392,000
Wilcoxon W	857,000
Z	-0,872
Asymp. Sig. (2-tailed)	0,383

a. Grouping Variable: Kode

Table 17. Aromatic Statistical Test Results P3 with P4

Test Statistics[a]

	Aroma
Mann-Whitney U	427,000
Wilcoxon W	892,000
Z	-0,346
Asymp. Sig. (2-tailed)	0,730

a. Grouping Variable: Kode

Table 18. Taste Statistical Test Results P1 with P2

Test Statistics[a]

	Rasa
Mann-Whitney U	351,000
Wilcoxon W	816,000
Z	-1,488
Asymp. Sig. (2-tailed)	0,137

a. Grouping Variable: Kode

Table 19. Taste Statistical Test Results P1 with P3

Test Statistics[a]

	Rasa
Mann-Whitney U	342,000
Wilcoxon W	807,000
Z	-1,621
Asymp. Sig. (2-tailed)	0,105

a. Grouping Variable: Kode

Table 20. Taste Statistical Test Results P1 with P4

Test Statistics[a]

	Rasa
Mann-Whitney U	402,000
Wilcoxon W	867,000
Z	-0,722
Asymp. Sig. (2-tailed)	0,470

a. Grouping Variable: Kode

Table 21. Taste Statistical Test Results P2 with P3

Test Statistics[a]

	Rasa
Mann-Whitney U	432,500
Wilcoxon W	897,500
Z	-0,264
Asymp. Sig. (2-tailed)	0,792

a. Grouping Variable: Kode

Table 22. Taste Statistical Test Results P2 with P4

Test Statistics[a]

	Rasa
Mann-Whitney U	389,500
Wilcoxon W	854,500
Z	-0,914
Asymp. Sig. (2-tailed)	0,361

a. Grouping Variable: Kode

Table 23. Taste Statistical Test Results P3 with P4

Test Statistics[a]

	Rasa
Mann-Whitney U	381,500
Wilcoxon W	846,500
Z	-1,032
Asymp. Sig. (2-tailed)	0,302

a. Grouping Variable: Kode

Table 24. Texture Statistical Test Results P1 with P2

Test Statistics[a]

	Tekstur
Mann-Whitney U	400,000
Wilcoxon W	865,000
Z	-0,755
Asymp. Sig. (2-tailed)	0,450

a. Grouping Variable: Kode

Table 25. Texture Statistical Test Results P1 with P3

Test Statistics[a]

	Tekstur
Mann-Whitney U	358,000
Wilcoxon W	823,000
Z	-1,389
Asymp. Sig. (2-tailed)	0,165

a. Grouping Variable: Kode

Table 26. Texture Statistical Test Results P1 with P4

Test Statistics[a]

	Tekstur
Mann-Whitney U	374,000
Wilcoxon W	839,000
Z	-1,146
Asymp. Sig. (2-tailed)	0,252

a. Grouping Variable: Kode

Table 27. Texture Statistical Test Results P2 with P3

Test Statistics[a]

	Tekstur
Mann-Whitney U	404,000
Wilcoxon W	869,000
Z	-0,698
Asymp. Sig. (2-tailed)	0,485

a. Grouping Variable: Kode

Table 28. Texture Statistical Test Results P2 with P4

Test Statistics[a]

	Tekstur
Mann-Whitney U	425,000
Wilcoxon W	890,000
Z	-0,379
Asymp. Sig. (2-tailed)	0,705

a. Grouping Variable: Kode

Table 29. Texture Statistical Test Results P3 with P4

Test Statistics[a]

	Tekstur
Mann-Whitney U	425,000
Wilcoxon W	890,000
Z	-0,379
Asymp. Sig. (2-tailed)	0,705

a. Grouping Variable: Kode

Table 30. Aftertest Statistical Test Results P1 with P2

Test Statistics[a]

	Aftertest
Mann-Whitney U	358,000
Wilcoxon W	823,000
Z	-1,398
Asymp. Sig. (2-tailed)	0,162

a. Grouping Variable: Kode

Table 31. Aftertest Statistical Test Results P1 with P3

Test Statistics[a]

	Aftertest
Mann-Whitney U	334,500
Wilcoxon W	799,500
Z	-1,748
Asymp. Sig. (2-tailed)	0,080

a. Grouping Variable: Kode

Table 32. Aftertest Statistical Test Results P1 with P4

Test Statistics[a]

	Aftertest
Mann-Whitney U	416,000
Wilcoxon W	881,000
Z	-0,514
Asymp. Sig. (2-tailed)	0,608

a. Grouping Variable: Kode

Table 33. Aftertest Statistical Test Results P2 with P3

Test Statistics[a]

	Aftertest
Mann-Whitney U	426,000
Wilcoxon W	891,000
Z	-0,363
Asymp. Sig. (2-tailed)	0,717

a. Grouping Variable: Kode

Table 34. Aftertest Statistical Test Results P2 with P4

Test Statistics[a]

	Aftertest
Mann-Whitney U	408,000
Wilcoxon W	873,000
Z	-0,634
Asymp. Sig. (2-tailed)	0,526

a. Grouping Variable: Kode

Table 35. Aftertest Statistical Test Results P3 with P4

Test Statistics[a]

	Aftertest
Mann-Whitney U	384,000
Wilcoxon W	849,000
Z	-0,993
Asymp. Sig. (2-tailed)	0,320

a. Grouping Variable: Kode

Table 36. OverAll Statistical Test Results P1 with P2

Test Statistics[a]

	OverAll
Mann-Whitney U	373,000
Wilcoxon W	838,000
Z	-1,160
Asymp. Sig. (2-tailed)	0,246

a. Grouping Variable: Kode

Table 37. OverAll Statistical Test Results P1 with P3

Test Statistics[a]

	OverAll
Mann-Whitney U	312,000
Wilcoxon W	777,000
Z	-2,075
Asymp. Sig. (2-tailed)	0,038

a. Grouping Variable: Kode

Table 38. OverAll Statistical Test Results P1 with P4

Test Statistics[a]

	OverAll
Mann-Whitney U	412,500
Wilcoxon W	877,500
Z	-0,565
Asymp. Sig. (2-tailed)	0,572

a. Grouping Variable: Kode

Table 39. OverAll Statistical Test Results P2 with P3

Test Statistics[a]

	OverAll
Mann-Whitney U	384,500
Wilcoxon W	849,500
Z	-0,987
Asymp. Sig. (2-tailed)	0,324

a. Grouping Variable: Kode

Table 40. OverAll Statistical Test Results P2 with P4

Test Statistics[a]

	OverAll
Mann-Whitney U	417,500
Wilcoxon W	882,500
Z	-0,489
Asymp. Sig. (2-tailed)	0,625

a. Grouping Variable: Kode

Table 41. OverAll Statistical Test Results P3 with P4

Test Statistics[a]

	OverAll
Mann-Whitney U	358,000
Wilcoxon W	823,000
Z	-1,382
Asymp. Sig. (2-tailed)	0,167

a. Grouping Variable: Kode

1. Nutritional Value Analysis Results

The results of the nutritional analysis carried out for the Moringa tempeh burger product showed an increase in the nutritional value of the addition of Moringa leaf flour. The nutritional content of the tempeh burger without the addition of Moringa leaf flour is 11.7 g protein, 13.4 g fat, 28.0 g carbohydrate, 279 kcal energy, 2.41 mg iron, 1.76 mg folic acid and 0 vitamin C. ,70 mg. After adding 3 g of Moringa flour, the protein value was 11.4 g, fat was 13.0 g, carbohydrates were 28.3 g, energy was 276 kcal, iron increased to 2.51 mg, folic acid was 1.78 mg. Meanwhile, the addition of 12 g of Moringa leaf flour contained 11.6 g of protein, 12.7 g of fat, 29.8 g of carbohydrates, 280 kcal of energy, iron increased to 2.98 m and folic acid was 1.90 mg.

Discussion

The making of the Moringa tempeh burger is carried out in several stages and the last stage is the presentation. The presentation is in the form of arranging the burger buns that have been baked, then placing the stuffing of the burgers between the buns that have been divided into two parts, and adding vegetables, chili sauce and mayonnaise.

To determine the acceptability of the Moringa tempeh burger product, organoleptic tests were carried out including the parameters of color, aroma, texture, taste, after taste and overall (general acceptance).

In the organoleptic test, the most preferred moringa tempeh burger product in general which includes color, aroma, texture, taste, after taste and overall is the addition of 3g of Moringa leaf flour. Furthermore, the formula for adding Moringa leaf flour was taken with a higher concentration, which was obtained by adding 12g which had more color, texture, taste and overall values than other formulas.

After obtaining the correct Moringa tempeh burger formula, then an analysis of the nutritional content of the control product (without the addition of Moringa leaf flour), addition of 3g, and the addition of 12g of Moringa leaf flour was carried out.

The results of the nutritional analysis showed that the iron content (fe) in all additions of Moringa leaf flour to tempeh burgers had a higher value than tempeh burgers that had not been added with Moringa leaf flour. That is 2.51 mg with the addition of 3g of Moringa leaf flour, and 2.98 mg on the addition of 12g of Moringa leaf flour, where the iron (fe) value before adding Moringa leaf flour is 2.41 mg.

Table 42. Nutritional Content of Moringa Tempeh Burger

No.	Parameter	Tempeh Burger	Moringa Tempeh Burger (3g)	Moringa Tempeh Burger (12g)
1	Water (g)	42.8	43.7	41.2
2	Ash (g)	2.21	2.44	2.87
3	Protein (g)	11.7	11.4	11.6
4	Fat (g)	13.4	13.0	12.7
5	Crude Fiber (%)	1.85	1.14	1.83
6	Carbohydrates (g)	28.0	28.3	29.8
7	Energy (kcal)	279	276	280
8	Iron (Fe) (mg)	2.41	2.51	2.98
9	Folic Acid (mg)	1.76	1.78	1.90
10	Vitamin C (mg)	0.70	0.70	0.70

Source : Data Primer (2022)

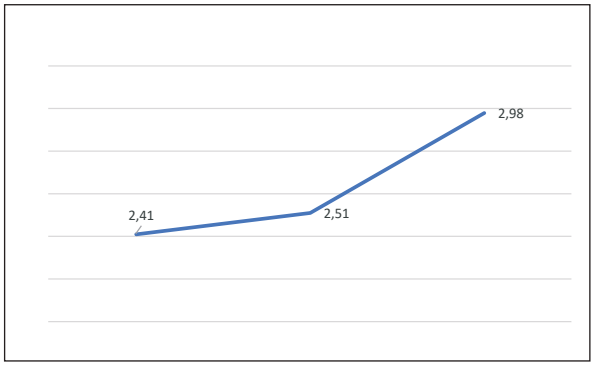

Figure 3. Graph of the increase in iron (fe) in the Moringa tempeh burger

This is in accordance with other studies. The addition of Moringa leaf flour increased iron (fe) levels in biscuits substituted with Moringa leaf flour.[13]

Likewise, the folic acid content in tempeh burgers increases with each addition of Moringa leaf flour. That is 1.78 mg with the addition of 3g of Moringa leaf flour, and 1.90 mg on the addition of 12g of Moringa leaf flour, where the value of folic acid before adding Moringa leaf flour is 1.76 mg. this is in accordance with other studies that the addition of moringa leaf flour to fish nugget products can increase folic acid levels.[14]

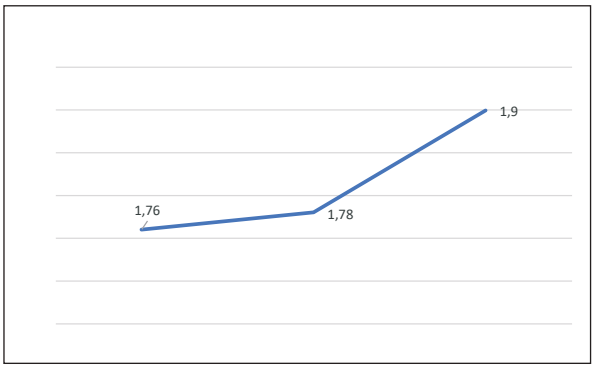

Figure 4. The graph of the increase in folic acid in the Moringa tempeh burger

Other nutritional value analysis showed an increase in carbohydrate content and ash content in the Moringa tempeh burger with the respective increasing values: tempeh/control burger (carbohydrate 28.0g, ash 2.21g), Tempeh burger with the addition of 3g Moringa leaf flour (28.3g carbohydrates, 2.44g ash), tempeh burger with the addition of 12g moringa leaf flour (29.8g carbohydrates, 2.87g ash).

Other nutritional content such as protein, fat, crude fiber, energy and vitamin C did not show a significant increase in nutrients, and even tended to decrease after the addition of Moringa leaf flour to the tempeh burger. For example, the fat content decreased with each addition of Moringa leaf flour (tempeh burger/control: 13.4g, tempeh burger with the addition of 3g Moringa leaves: 13.0g, and tempeh burger with the addition of 12g Moringa leaves: 12.7g).

Conclusion

The addition of Moringa leaf flour affects the nutritional content of the Moringa tempeh burger. Namely the content of iron (fe), folic acid, carbohydrates and ash content. Meanwhile, the nutritional content of other nutrients did not increase significantly and even tended to decrease after the addition of Moringa leaf flour, namely the fat content.

The organoleptic test results of the Moringa tempeh burger showed that the addition of Moringa leaf flour affected the level of preference which included color, aroma, texture, taste, after taste and overall.

Suggestion

Research can be continued with research on the effect of giving moringa tempeh burgers on increasing haemoglobin levels in anemic young

women or anemic pregnant women. Further research is needed on the nutritional content of vitamin B12 in the moringa tempeh burger product.

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