Jurnal Gizi dan Dietetik Indonesia
(Indonesian Journal of Nutrition and Dietetics)
Vol.10, Issue 2, 2022: 71-78

Available online at: https://ejournal .almaata.ac.id/index.php/IJND
DOI : http://dx.doi.org/10.21927/ijnd.2022.10(2).71-78

Nutrient and hedonic value in cookies with Moringa (Moringa oleifera) leaf fortification

Rostika Flora[1], Karin Zikra Nisya[2*], Indah Yuliana[2], Sugito[3]

[1]Magister of Public Health Study Program, Faculty of Public Health, Sriwijaya University
[2]Nutrition Study Program, Faculty of Public Health, Sriwijaya University
[3]Agricultural Technology Program, Faculty of Agricultural, Sriwijaya University
Indonesia

* *Correspondence*: karinzikranisya01@gmail.com

ABSTRAK

Latar Belakang : *Penyakit infeksi merupakan salah satu faktor penyebab terjadinya masalah gizi pada balita. Balita dengan status gizi kurang memiliki sistem imunitas yang lemah sehingga rentan terhadap penyakit. Sehingga, perlu memperhatikan sumber makanan yang dapat membantu pemeliharaan sistem imun balita. Daun kelor diketahui memiliki kandungan polifenol yang berperan sebagai antioksidan. Antioksidan berperan untuk meningkatkan imunitas tubuh dalam melawan penyakit infeksi.*
Tujuan: *Penelitian ini bertujun untuk mengetahui kandungan polifenol dan total fenol pada cookies daun kelor formula terpilih*
Metode: *Penelitian ini bersifat eksperimental dengan menggunakan metode Rancangan Acak Lengkap (RAL). Terdapat 4 perlakuan penambahan tepung daun kelor pada pembuatan cookies yaitu, 0 gram, 3 gram, 5 gram, dan 7 gram. Dilakukan pemeriksaan kandungan polifenol dan total fenol pada cookies daun kelor formula terpilih. Analisis kimiawi dilakukan di Laboratorium Teknologi Pangan Politeknik Negeri Lampung. Analisis data hasil organoleptik menggunakan uji Kruskall-Wallis dan uji lanjut Mann Whitney. Sedangkan analisis data laboratorium menggunakan uji one-way ANOVA.*
Hasil: *Hasil uji organoleptik yang dilakukan oleh 25 orang panelis semi terlatih diperoleh bahwa formulasi F1 yaitu penambahan tepung daun kelor sebanyak 3 gram merupakan formulasi yang paling disukai. Hasil uji Kruskall-Wallis menunjukkan bahwa terdapat pengaruh nyata pada penambahan formulasi tepung daun kelor terhadap parameter warna dan rasa cookies. Sedangkan, pada parameter aroma dan tekstur tidak berpengaruh nyata. Cookies formulasi terpilih F1 memiliki kadar air 3,24%, kadar abu 2,13%, total fenol 9,25 mgGAE/g eks, dan positif (+) memiliki kandungan polifenol.*
Kesimpulan: *Cookies daun kelor formula F1 memiliki kandungan polifenol dengan total fenol sebesar 9,25 mgGAE/g eks.*

KATA KUNCI : *antioksidan; gizi kurang; polifenol; tepung daun kelor*

ABSTRACT

Background: *Infectious diseases are one of the factors that cause nutritional problems in toddlers. Children with poor nutritional status have a weak immune system, so they are more susceptible to disease, thus it is necessary to pay attention to food sources that can help maintain the immune system. Moringa leaves are known to contain polyphenols that act as antioxidants. Antioxidants have a role in strengthening immunity to fight infectious diseases.*
Objectives: *This study aim is to determine the polyphenols and total phenols content in selected moringa leaf cookies formula.*

Methods*: This research is an experimental study with the Completely Randomized Design (CRD) method. Moringa leaf flour was added to the cookie dough and divided into four groups that contained 0 grams, 3 grams, 5 grams, and 7 grams moringa leaf flour. The polyphenols and the total phenol content in the moringa leaf cookies formula were then tested. Chemical analysis was carried out at the Food Technology Laboratory in Lampung Polytechnic. Organoleptic analysis results data were processed with the Kruskal-Wallis test and Mann Whitney follow-up tests and laboratory data analysis with a one-way ANOVA test.*
Results*: Organoleptic test results conducted by 25 semi-trained panellists showed that the F1 formulation formulation with 3 grams Moringa leaf flour is the most preferred. Kruskal-Wallis test results showed a noticeable effect on adding moringa leaf flour formulations to the cookie color and taste parameters and no real effect on smell and texture parameters. Cookies with F1 formulation had a moisture content of 3.24%, ash content of 2.13%, total phenol 9.25 mgGAE / g ex, and positive (+)polyphenol content.*
Conclusions*: Moringa leaf cookies with F1 formula have polyphenol content with a total phenol of 9.25 mgGAE / g ex.*

KEYWORDS: *antioxidant; malnutrition; moringa leaf flour; polyphenols*

Article info:
Article submitted on May 18, 2022
Articles revised on June 10, 2022
Articles received on July 15, 2022

INTRODUCTION

Nutritional problems are usually found in developing countries, such as Indonesia. One of the most common nutritional problems is malnutrition. According to UNICEF (2021), the problem of malnutrition in children is dominantly found in Africa and Asia. In Southeast Asia, the prevalence of wasting in children is 8.2%, which falls into the High category. In Indonesia, children or infants under five years are the age group with malnutrition problems dominantly (1).

Several factors influence malnutrition problems in children. According to UNICEF (1990) and the Indonesian Health Department (2005), the direct cause of children's malnutrition is inadequate nutrient intake and infectious diseases. Infectious diseases are related to nutritional status. As stated by Hadiana (2013) in their study about the relationship of nutritional status to URTI infection in children, there was a significant relationship between the two and undernourished children were 27.5 times more susceptible to contracting URTI disease compared to children with good nutritional status (2). thus, it can be concluded that children with malnutrition had a weak immune system and were susceptible to infectious diseases. Therefore, paying attention to food sources that can help preserve their immune system is necessary (3).

One food source that is considered to be able to meet the needs of nutrients is Moringa leaves. According to Putra et al., Moringa is known as "The Miracle Tree", a medicinal plant with various nutrients and many health benefits (4). The part that is often used is the leaf that is rich in vitamins, carotenoids, polyphenols, phenolic acids, flavonoids, alkaloids, glycosylates, Isothiocyanates, tannins, and saponins (5).

The abundance of bioactive content in Moringa leaves reinforces the theory that Moringa leaves have benefits as antioxidants. One of the antioxidant contents in Moringa leaves is polyphenols. Moringa leaves contain atural polyphenols that have the potential as antioxidants. Antioxidants can be used to improve immunity to fight infectious diseases. In children, infectious diseases is a direct cause of malnutrition problems.

MATERIALS AND METHODS

Material

Moringa leaf flour is the main ingredient used as a fortification material in the functional cookie making. This research is an

experimental study with a Completely Randomized Design (CRD). Moringa leaf flour was added to the cookie dough and divided into four groups, F0: control formulation (no addition), F1: 3 grams of Moringa leaf flour addition, F2: 5 grams of Moringa leaf flour addition, F3: 7 Grams of Moringa leaf flour addition. Based on researched purpose, the most preferred formulation F1 was obtained from the results of organoleptic tests by 25 semi-trained panellists followed by polyphenol content and chemical analysis for water and ash were also conducted. Organoleptic statistical tests used the Kruskal Wallis test and Mann Whitney advanced tests, while laboratory tests used ANOVA tests.

Moringa Leaf Flour Making

Moringa leaves used in this study were planted privately by the researchers. The manufacture of moringa leaf flour begins with the plucking of young and old moringa leaves (2 stalks from the top of the stem to 9 or 10 stalks) Moringa leaves were then separated from the stalks and washed using running water and drained. After that, the cleaned moringa leaves are arranged in a hollow container and aerated for three days. After the Moringa leaves dried, it was ground with a dry blender until powdery smooth and shifted using an 80 mesh sieve to produce a flour-like texture.

Cookies Making

Making Moringa leaf cookies begins with mixing wet ingredients, such as margarine and egg yolk, then adding refined sugar, stirring and using a mixer at medium speed to produce a light yellow color and smooth texture. After that, other ingredients, such as low-protein wheat flour, powdered milk, cornstarch, baking powder, Choco chips, and moringa leaf flour, were added and stirred using a spatula until smooth and became a dough that can be formed. After that, mold the cookie dough using a 2.2 cm cookie cutter and arrange it on a baking sheet that had previously been smeared with margarine. Finally, the cookie dough is baked in the oven at 190°C temperature for approximately 12 minutes.

Data Analysis

Organoleptic results data is analyzed using descriptive analysis of percentages, and then the data is presented in table form and interpreted. Statistical analysis is carried out to determine the effect of fortification on the sensory and chemical quality of Moringa leaf cookies. Organoleptic test results were analyzed using the Kruskal-Wallis test and Mann-Whitney advanced tests. Data from chemical analysis of Moringa leaf cookies was analyzed using analysis of variance (ANOVA) and a follow-up test of Duncan's Multiple Range Test.

RESULTS AND DISCUSSIONS

Based on the results of organoleptic tests, cookies with formulation F1 with 3 grams of moringa leaf flour addition is the most preferred formulation. Thus, formula F1 is the selected formula for laboratory tests. The average value above shows that cookies with F1 formulation obtained an average value of color (4.24), smell (4.32), taste (4.44), and texture (4.56).

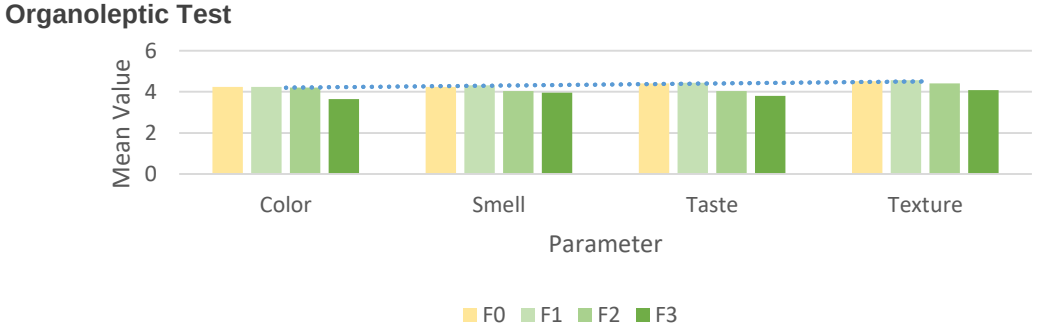

Figure 1. Mean Value of Organoleptic Test Results

Color is a sensory attribute that plays an important role in the acceptance of food, as well as being the quality factor that attracts the most consumer attention, color gives the impression of whether the cookies are liked or not. According to Soekarto in Tarwendah (2017) (6), colored food commodities have an important role for attractiveness, identification, and quality attributes.

Table 1. Mean Value of Color Parameters Hedonic Test

Parameter	Mean Value of Hedonic Test Sample			
	F0	F1	F2	F3
Color	4.24 ± 0.43[a]	4.24 ± 0.66[ab]	4.20 ± 0.57[ab]	3.64 ± 0.56[c]

Description : 1 = "very disliked", 2 = "dislike", 3 = "enough", 4 = "like", 5 = "very like"
a.b = similar letter notation means that there is no noticeable difference in the Mann-Whitney test level having a value of 5%.

The results of the statistical analysis of Kruskal-Wallis showed a noticeable difference (P<0.05) in the color parameters of Moringa cookies. This relates to adding different moringa leaf powder formulations (F1, F2, and F3) in each cookie, thus showing a noticeable influence that produces a different shade of green. The resulting green color is related to the color of natural pigments, which was chlorophyll content in Moringa leaves (Mazidah, etal., 2018). Moringa leaves have a high concentration of chlorophyll content. Chlorophyll is a natural green color substance that is generally found in the leaves, often called the green leafy substance. Moringa leaves contain 6,890 mg/kg chlorophyll in dry form, and 8 grams of moringa leaf powder contains 162 mg chlorophyll (7). Therefore, the more addition of Moringa leaf powder to cookies, the more concentrated the green color produced.

Smell

The provision of different moringa leaf powder formulations have no noticeable effect (P>0.05) on the aroma of cookies (F1, F2, and F3). It is influenced by the use of several other ingredients, such as sugar, margarine, eggs, and milk powder. According to Millah in Dewi (2016), the ingredients used can affect the aroma of cookies, such as eggs and milk. In different formulations, the use of eggs, margarine, milk powder and sugar are the same. In addition, bad smell on Moringa leaves will evaporate in the roasting process because Moringa leaves contain volatile compounds that are able to evaporate due to heating (8). Thus, different formulas did not influence the aroma parameters of the cookies.

The results of the favorability test showed that the most preferred aroma parameter was the treatment of F1 (3 grams) because the typical smell of Moringa is not too bad compared to F2 (5 grams) and F3 (7 grams). The decrease in the favorability level is due to the increase in the concentration of Moringa leaf powder. With the addition of Moringa leaf powder, the peculiar bad smell of moringa leaf produced is stronger. This is because Moringa leaves contain saponin compounds that can give a bad smell to cookies. According to Indriasari et al. (2019) (9), the bad smell on Moringa leaves is caused by several components of secondary metabolites contained in Moringa leaves such as saponin compounds. According to Mazidah et al. (2018) (10), saponin compounds are steroid compounds/triterpenoid glucosides that are bounded to carbohydrates.

Table 2. Mean Value of Smell Parameters Hedonic Test

Parameter	Mean Value of Hedonic Test Sample			
	F0	F1	F2	F3
Smell	4.24 ± 0.59[a]	4.32 ± 0.62[a]	4.04 ± 0.73[a]	3.96 ± 0.73[a]

Description: 1 = "very disliked", 2 = "dislike", 3 = "enough", 4 = "like", 5 = "very like"
a.b = similar letter notation means that there is no noticeable difference in the Mann-Whitney test level having a value of 5%.

Taste

The peculiar taste caused by the adding Moringa leaf powder is the bitter taste. The results of the favorability test for the taste of Moringa cookies that most panelists liked the taste of cookies with F1 formula because cookies are not too bitter. So that if more formulations are added, the bitter taste produced is stronger. This is related to the content of tannins and saponins that can cause a bitter taste (9). According to Ismarani in Mazidah et al. (2018), tannins are astringent compounds that have a bitter taste derived from polyphenol groups to give a dry and smooth taste in the mouth after consumption (10).

Table 3. Mean Value of Taste Parameters Hedonic Test

Parameter	Mean Value of Hedonic Test Sample			
	F0	F1	F2	F3
Taste	4.4 ± 0.50[a]	4.44 ± 0.65[ab]	4.04 ± 0.97[ab]	3.80 ± 0.76[c]

Description : 1 = "very disliked", 2 = "dislike", 3 = "enough", 4 = "like", 5 = "very like"
a.b = similar letter notation means that there is no noticeable difference in the Mann-Whitney test level having a value of 5%.

Texture

The addition of Moringa leaf flour affects the texture of *the* cookies produced. The addition of Moringa leaf flour makes the texture *of cookies* harder. This happens because moringa leaf flour has a high enough protein content. Meanwhile, low protein flour is usually used to produce a crisp texture (11). According to Krisnadi (2015), the protein content in Moringa leaf flour per 100 grams is 27.1 grams higher than that in wheat flour which is 9 grams per 100 grams. In addition, the texture of a food can be influenced by the fiber content contained in food ingredients. Moringa leaves have a higher fiber content compared to wheat flour. According to Krisnadi (2015), the fiber in Moringa leaf flour is 19.2 grams per 100 grams, higher than the fiber content in wheat flour which is as much as 0.3 grams per 100 grams (7). Thus, the high fiber in Moringa leaf flour causes the texture of *cookies* to be denser and harder.

Table 4. Mean Value of Texture Parameters Hedonic Test

Parameter	Mean Value of Hedonic Test Sample			
	F0	F1	F2	F3
Texture	4.52 ± 0.43[a]	4.56 ± 0.65[a]	4.04 ± 0.64[a]	4.08 ± 0.86[a]

Description: 1 = "very disliked", 2 = "dislike", 3 = "enough", 4 = "like", 5 = "very like"
a.b = similar letter notation means that there is no noticeable difference in the Mann-Whitney test level having a value of 5%

Moisture content

The provision of different formulas influences the moisture content of *cookies*, which is related to the carbohydrate content in Moringa leaf flour, which is more dominant than protein. The carbohydrate and protein content of Moringa leaf flour is 38.2 grams and 27.1 grams, respectively, with higher carbohydrate content than protein. Carbohydrates are weaker at binding water to protein.

Table 5. Mean Value of Moringa Leaves Cookies Moisture Content

Component	Moisture Content Sample Results	
	Control (F0)	Selected (F1)
Moisture Content	4.86 ± 0.08[a]	3.24 ± 0.12[b]

Description: a.b = similar letter notation means there is no real difference in Duncan test level has a value of 5%

Thus, the moisture content in a cookie will evaporate at high temperatures and have low moisture content. In addition, the decrease in moisture content due to the addition of Moringa leaf flour is because the moisture content of Moringa leaf flour is lower than wheat flour. According to Krisnadi (2015), the moisture content in Moringa leaf flour is 7.8% per 100 grams, while the moisture content of wheat flour is 11.4% per 100 grams. When compared to the quality requirements, the obtained moisture content of the selected F0 control and F1 cookies met the quality requirements of cookies where the maximum moisture content is 5% (7).

Ash level

Table 5. Mean Value of Moringa Leaves Cookies Moisture Content

Component	Ash Level Sample Results	
	Control (F0)	Selected (F1)
Ash Level	1.71 ± 0.07[a]	2.13 ± 0.08[b]

Description: a.b = similar letter notation means there is no real difference in Duncan test level has a value of 5%

The *cookies* ash level with the addition of Moringa leaf flour, selected F1, obtained higher results than cookies formulation control of F0. This is related to the high mineral content of Moringa leaves compared to the mineral content in wheat flour. Based on the 2017 Indonesian Food Composition Table, the content of wheat flour ash per 100 grams is 1 gram (12). Thus, providing a noticeable difference between control *cookies* and *cookies* with the fortification of Moringa leaf flour (F1). In comparing ash levels, both control cookies and Moringa leaf fortification cookies (F1) with ash levels based on SNI 2974: 2011 (2011) standard do not meet the quality requirements of cookies, because they have a standard value of >1.5% (13).

Polyphenol Content and phenol total

Based on the results of observations made in determining the content of polyphenols in Moringa cookies using FeCl3 reagents, there was a change in greenish-yellow color, indicating that cookies with moringa leaf flour formulations contain phenolic compounds or polyphenols. Polyphenols are bioactive compounds derived from phenol compounds that have the characteristics of aromatic rings with more than one hydroxyl (OH) group. Dried leaves on Moringa are the best source of polyphenol compounds, such as flavonoids and phenolic acids (5).

The total measurement of phenols in selected Moringa leaf flour formulation cookies (F1) was carried out with three times

replication to obtain a result of 9.25 mgGAE / g ex. In addition to phenol compounds, F-C solution also reacts with other antioxidant compounds such as, carbohydrates, proteins, amino acids, unsaturated fatty acids, and vitamins (14). The total phenol control (F0) has a total phenol of 4.07 mgGAE / g ex. However, with the addition of the formulation of moringa leaf flour, the total phenol obtained is higher compared to the control formulation. This is because Moringa leaves have a high content of phenolic compounds.

CONCLUSIONS AND RECOMMENDATION

The formula selected based on the favorability test on 25 panelists is F1 formulation *cookies* with the addition of 3 grams of moringa leaf flour. *Selected cookies* F1 (3 grams) have qualitative polyphenol content with a total phenol of 9.25 mgGAE / g ex. From the results of this study, it is recommended to:

1. *Blanch* moringa leaves for 3-5 minutes and makes a new formulation with additional ingredients (vanilla flavor, cinnamon powder) to minimize the bad smell and bitter taste in the formulation of Moringa leaf *cookies*.
2. Conduct a complete proximate analysis to better understand the overall nutritional content in moringa leaf formulation cookies.
3. Test antioxidant activity to determine whether the total content of phenol in Moringa leaf cookies is directly proportional to its antioxidant activity

REFERENCES

1. Lutviana E, Budiono Jurusan Ilmu Kesehatan Masyarakat I, Ilmu Keolahragaan F, Negeri Semarang U. Prevalensi dan determinan kejadian gizi kurang pada balita. KEMAS J Kesehat Masy [Internet]. 2019 Mar 8;5(2):138–44. Available from: https://journal.unnes.ac.id/nju/index.php/kemas/article/view/1872
2. UNICEF. UNICEF-WHO-World Bank: Joint Child Malnutrition Estimates - 2021 edition interactive dashboard - UNICEF DATA [Internet]. Available from: https://data.unicef.org/resources/joint-child-malnutrition-estimates-interactive-dashboard-2021/
3. Widodo P, Anang G, Hadiana SYM. Hubungan status gizi terhadap terjadinya infeksi saluran pernapasan akut (ISPA) Pada Balita di Puskesmas Pajang Surakarta. [Surakarta]: Universitas Muhammadiyah Surakarta; 2013.
4. Dwika W, Putra P, Agung A, Oka Dharmayudha G, Sudimartini LM. Identifikasi Senyawa Kimia Ekstrak Etanol Daun Kelor (Moringa oleifera L) di Bali (Identification of Chemical Compounds Ethanol Extract Leaf Moringa (Moringa oleifera L) in Bali). Indones Med Veterinus Oktober. 2016;5(5):464–73.
5. Vergara-Jimenez M, Almatrafi MM, Fernandez ML. antioxidants Bioactive Components in Moringa Oleifera Leaves Protect against Chronic Disease. [cited 2023 Jan 23]; Available from: www.mdpi.com/journal/antioxidants
6. Tarwendah IP. Studi Komparasi Atribut Sensori dan Kesadaran Merek Produk Pangan. J Pangan dan Agroindustri. 2017;5(2):66–73.
7. Krisnadi A. Kelor super nutrisi. Blora: Blora: Pusat informasi dan pengembangan tanaman kelor Indonesia; 2015.
8. Kusuma Dewi F, Neneng Suliasih I, Ir Yudi Garnida D. Pembuatan Cookies dengan Penambahan Tepung Daun Kelor (Moringa Oleifera) pada Berbagai Suhu Pemanggangan (Making Cookies With Addition of Wheat Leaf Moringa (Moringa oleifera) At Various Temperature Roasting). 2021.
9. Indriasari Y, Basrin F, Salam HB, Teknologi J, Bumi PH, Palu P, et al. Analisis Penerimaan Konsumen Moringa Biscuit (Biskuit Kelor) Diperkaya Tepung Daun Kelor (Moringa oleifera). Agrol J Ilmu-ilmu Pertan [Internet]. 2019 Dec 16;26(3):221–9. Available from: http://jurnal.faperta.untad.ac.id/index.php/agrolandnasional/article/view/996
10. Mazidah YF, Kusumaningrum I, Safitri DE. Penggunaan Tepung Daun Kelor pada Pembuatan Crackers Sumber Kalsium. ARGIPA (Arsip Gizi dan Pangan). 2019;3(2):67–79.
11. Kurnia Sari Y, Catur Adi A, Studi PS. Daya terima, kadar protein dan zat besi cookies subtitusi tepung daun kelor dan

tepung kecambah kedelai. Media Gizi Indones. 2017;12:27–33.
12. Direktorat Jenderal Kesehatan Masyarakat, Direktorat Gizi Masyarakat. Tabel Komposisi Pangan Indonesia 2017. Jakarta: Kementerian Kesehatan RI; 2018.
13. BSN (Badan Standarisasi Nasional). Biskuit. 1992;
14. Salim SA, Saputri FA, Saptarini NM, Levita J. Review Artikel: Kelebihan dan Keterbatasan Pereaksi Folinciocalteu dalam Penentuan Kadar Fenol Total Pada Tanaman. Farmaka [Internet]. 2020;18(1):46–57. Available from: http://jurnal.unpad.ac.id/farmaka/article/view/21909/pdf