Indonesian Journal of Global Health Research
Volume 6 Number S6, December 2024
e-ISSN 2715-1972; p-ISSN 2714-9749
http://jurnal.globalhealthsciencegroup.com/index.php/IJGHR

THE UNIQUE PROPERTIES OF MORINGA OLEIFERA EXTRACT IN SOAP OPTIMIZATION: A SCIENTIFIC APPROACH

Diah Miftahul Aini[1]*, Baiq Desy Ratnasari[2]
[1]Department of Chemistry, Faculty of Mathematics and Natural Sciences, University of Mataram, Jl. Majapahit No.62, Gomong, Selaparang, Mataram, Nusa Tenggara Barat 83115, Indonesia
[2]Department of Chemistry and Biochemistry, University of North Carolina Greensboro, 1400 Spring Garden St, Greensboro, NC 27412, United States
*mita@staff.unram.ac.id

ABSTRACT
Moringa leaves (Moringa oleifera), a valuable source of bioactive compounds, including flavonoids, phenolic acids, tannin, and terpenoids. These compounds provide significant benefits to the skin, due to their antioxidant, anti-inflammatory, and antimicrobial properties. The chemical composition of these leaves has been demonstrated to enhance dermal hydration and provide protection against environmental stressors. By balancing Moringa with other natural ingredients such as coconut, olive, and palm oil, the efficacy of skincare formulation can be optimized, resulting in improved texture, stability, and consumer appeal. This research aims to optimize the soap's effectiveness by enhancing its properties, such as cleansing, moisturizing, and antimicrobial functions, using the unique characteristics of Moringa oleifera. The initial step involved of an ethanol extract of Moringa leaves, which was then subjected to analysis using Gas Chromatography-Mass Spectrometry (GC-MS). The analysis revealed that Moringa leaves contain eight key compounds, including 2.4(1H,3H)-pyrimidineodione, glycerol, 2,3-dihydro-3,5-dihydroxy-6-methyl-, 4,3-allyl-6-methoxyphenol, epoxylinalool, 1H-pyrrole, 2-(2,4,6-heptatrienyl), tetradecanoics acid, and hexadecanoic acid. The aforementioned compounds were used to formulate a soap base containing Moringa leaves. The resulting soap exhibit a pleasant fragrance, a dense texture, yellow slightly white in color, and a pH of 10, as confirmed by organoleptic and pH test. The recent focus resulting in the development of Moringa-based skincare product that are not only effective but also eco-friendly. Present study represents a promising approach to natural solution that cater to diverse skin types and consumer preferences.

Keywords: GC-MS; moringa oleifera; natural soap; organoleptic test

How to cite (in APA style)
Aini, D. M., & Ratnasari, B. D. (2024). The Unique Properties of Moringa Oleifera Extract in Soap Optimization: A Scientific Approach. Indonesian Journal of Global Health Research, 6(S6), 227-238. https://doi.org/10.37287/ijghr.v6iS6.4799.

INTRODUCTION

Moringa oleifera leaves are a powerhouse of bioactive compounds, making them a valuable addition for skincare. They contain a variety of secondary metabolites, such as flavonoids, tannin, phenolic acid, alkaloids which are renowned for their antioxidant properties (Santhi & Sengottuvel, 2016). These antioxidants play a crucial role in shielding the skin from the damaging effect of free radicals and oxidative stress, thereby reducing the visibility of fine lines and wrinkles. Furthermore, Moringa leaves are abundant in flavonoids and phenols acid, which possess anti-inflammatory and antimicrobial properties(Hassan et al., 2021; Oluduro, 2012; Owusu-Ansah et al., 2023; Sudha et al., 2021). These compounds have been demonstrated to have soothing effects on irritated skin, reducing redness and preventing the growth of bacteria that can cause acne and presence of fatty acids, such as oleic acids, contributes to the moisturizing capabilities of Moringa, thereby maintaining skin hydration and softness (Aja et al., 2014; Arendse & Jideani, 2022; Hardiyanti et al., 2022b; Juhaimi et al., 2016). The distinctive combination of vitamin minerals and bioactive compounds present

in Moringa leaves renders them a valuable component in skincare products specifically in soap (Gaffour et al., 2015; Hassan et al., 2021; Srivastava et al., 2023).

Moringa oleifera, commonly known as moringa, is a plant with significant bioactive potential beneficial across various industries, including pharmaceuticals, cosmetics, and personal care. Traditionally, it has been used in medicine due to its rich nutritional profile and abundance of bioactive compounds, such as vitamins, minerals, saponins, and flavonoids, which have antioxidant, anti-inflammatory, and antibacterial properties. In the cosmetics industry, *Moringa oleifera* has been increasingly incorporated into skincare products, including soaps, due to its remarkable skin benefits, such as moisturizing and protecting against the effects of aging(Clark et al., 2018;Rusdianto et al., 2021).

Soap is one of the most commonly used personal care products, primarily serving to cleanse the skin of dirt and oils. However, with growing awareness of the importance of natural and environmentally friendly ingredients in personal care products, soaps containing *Moringa oleifera* extract have become an attractive alternative. Research indicates that Moringa extract not only has the potential to improve the cleansing quality of soaps but also provides additional benefits, such as antibacterial effects that help maintain skin hygiene and prevent infections(Rusdianto et al., 2021). *Moringa oleifera* extract is also known for its high moisturizing properties, thanks to the essential fatty acids found in its seed oil. This quality is particularly beneficial for maintaining skin hydration and improving the skin barrier function, making it an excellent choice for soaps intended for dry or sensitive skin. Furthermore, its ability to reduce inflammation and provide antioxidant protection helps to maintain overall skin health(Wigunarti et al., 2019). However, despite numerous claims regarding the benefits of Moringa extract in soap, research exploring the unique properties of this extract in soap optimization remains limited. Therefore, this study aims to provide a scientific approach to uncover the potential of *Moringa oleifera* extract in enhancing soap quality, with a focus on its effects on texture, stability, and the functional benefits of soap for the skin.

To produce a robust soap that maximizes the benefits of Moringa leaves, it is essential to balance it with other complementary natural ingredients. Coconut oil and palm oil, known for its excellent cleansing properties and ability to generate a rich lather, can be combined with Moringa extract to enhance the soap's effectiveness (Ermawati et al., 2022). Essential oil, such as tea tree oil, can be added for their aromatherapeutic benefits and additional antimicrobial properties, creating a more holistic skincare experience. The key to formulating a well-balanced soap lies in achieving the right proportions of these ingredients to ensure a product that is not only effective in cleansing and nourishing the skin but also appealing in texture, fragrance, and overall usability. By carefully selecting and combining these natural compositions. Optimizing Moringa soap involves several key techniques aimed at enhancing its performance, aesthetic appeal, and shelf-life. One critical aspect is the extraction method of Moringa leaves. Proper extraction and saponification, which involve the precise compositions, are essential for achieving the desired soap and hardness. Furthermore, adjusting the pH level of the soap can help ensure it is gentle on the skin while maintaining its cleansing properties.

The Moringa leaves extract analyze using Gas Chromatography-Mass Spectrometry (GCMS) to identify the bioactive compounds. The objective of employing GCMS is to precisely characterize the chemical compositions of Moringa extract, with a particular focus on key compounds such as antioxidants and essential fatty acids, which contributes to the skincare benefits of the soap. This process can confirm that the extracted compounds are potent and

effective for incorporation soap formulation. Moreover, by balancing these extracts with complementary natural ingredients, a robust soap that maximizes cleansing and moisturizing properties can be generated. Ultimately, the objective is to produce a Moringa soap for natural skincare solutions and aligns with modern standards of quality of the soap in SNI 06-3532-2016. This research aims to optimize the soap's effectiveness by enhancing its properties, such as cleansing, moisturizing, and antimicrobial functions, using the unique characteristics of Moringa oleifera.

METHOD

The instrument used were beaker glass, digital scales, pH meter, measuring pipette, petri dish, blen der, rotary evaporator, volumetric flask, GCMS merk Shimadzu,The materials used included Moringa leaves from Lombok, Indonesia, 96 % EtOH, NaOH, distillated water, Olive oil, coconut oil, palm oil, essential oil.
Methods

Extraction of Moringa leaves

The maceration method was applied in order to extract the moringa leaves. The moringa leaves, which had been separated from the branch, were subjected to a drying process at a temperature room for three days. Furthermore, these dried leaves are finely ground into powder. And subjected to an ethanol extraction process to dissolve the active compounds. Subsequently, the samples were weighed in order to obtain 500 grams. The solvent employed was 96% ethanol, with a volume of three-fold of the samples. Maceration was conducted for period of 72 hours. The extract obtained through filtration using filter paper were subsequently subjected to rotary evaporation for period of 15-25 minutes at a temperature of 60 ºC.

GC-MS Analysis of Moringa Extract

The Moringa extract injected into the GC-MS merk Shimadzu, which allows to identify and quantify key bioactive constituents.

1. pH test
   the pH test was carried out on each soap sample of Moringa leaves using pH indicator paper. This research was conducted by triplet.
2. Organoleptic test
   The organoleptic test conducted on solid soap preparation derived from Moringa leaves, focusing on the evaluation of its olfactory, visual, and tactile characteristics by 30 of participants.
3. Formulation of Moringa-based Soap

Table 1.
Production of Moringa-based Soap

No.	Aquades	NaOH	Olive oil	Coconut Oil	Palm Oil
1	50 mL	25 gr	60 gr	60 gr	60 gr
2	50 mL	25 gr	90 gr	90 gr	-
3	50 mL	25 gr	-	90 gr	90 gr
4	50 mL	25 gr	-	-	180 gr
5	50 mL	25 gr	-	180 gr	-
6	50 mL	25 gr	180 gr	-	-

Firstly, added 25 grams of NaOH and dissolved with 50 mL distilled water (aquades). Poured the selected oil as follow on this Table 1. Furthermore, the mixture heated until the temperature of 37 ºC, added with $NaOH_{(aq)}$ and stirred with hand blender until

homogenous. All of the soap were added to 1 mL of essential oil. Poured into molds and leaved it for 7 days until the texture sets. Furthermore, the most suitable soap will be formulated with 1 ml of Moringa extract. This following table illustrates six different types of formulations in soap production according to the materials and quantities.

RESULT

Ethanol Extract of Moringa Leaves

Moringa leaves are separated from the stalks and subsequently subjected to drying and mashing. A total of 100 grams of moringa leaf powder was macerated with an ethanol extract, then evaporated, resulting in the production of a moringa leaf thick extract. As of 1.5 ml subjected to GC-MS analysis, enabling the determination of the chemical content of moringa leaves (Susanty et al., 2019). The given figures represent in which Moringa extract is generated from dried Moringa leaves.

Figure 1. Moringa leaves that produce ethanol extract

GC-MS analysis

This following table illustrates the percentage of chemical compound in Moringa leaves based on GS-MS analysis

Table 2.
Chemical compound of Moringa leaves in ethanol extract

Chemical compound	Proportion (%)
2,4(1H,3H)-Pyrimidinedione	3.56
Glycerol	17
2,3-Dihydro-3,5-dihydroxy-6-methyl-4	8.67
3-Allyl-6-methoxyphenol	2.76
Epoxylinalool	26.35
1H-pyrrol, 2-(2,4,6-heptatrieny	13.69
Tetradecanoic acid	5.57
Hexadecanoic acid	13.68

The Gas Chromatography-Mass Spectrometry (GC-MS) analysis of Moringa leaves revealed a diverse array of compound with potential biological significance. The data yielded indicates the presence of 8 chemical compounds. The majority components were epoxylinalool and 1H-pyrrol,2-(2,4,6-heptatrieny) with the proportion of 26.35 % and 13.69, respectively. Epoxy linalool is a volatile compound and a member of the monoterpene group of terpenoid compound and suggest on anti-inflammatory system on the plant such as lemongrass (Sforcin et al., 2009). This finding is the new finding on moringa leaves about the epoxy linalool. The lowest compound was 2,4(1H,3H)-Pyrimidinedione as of 3.56%.

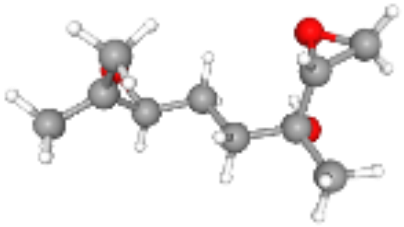


Figure. 2 Epoxy linalool on 3D

Key findings include the presence may contribute to the antioxidant properties of the leaves. Glycerol and 2,3-Dihydro-3,5-dihydroxy-6-methyl-4, indicate the presence of compounds involved in metabolic processes (Rao et al., 2019). The identification of 3-Allyl-6-methoxyphenol suggests possible anticancer and antioxidant activities(Carrasco A. et al., 2008). Additionally, the detection of 1H-pyrrol, 2-(2,4,6-heptatrienyl) implies potential bioactivity in plant defense mechanisms. The fatty acids tetradecanoic acid and hexadecenoic acid (13.68%) to the presence of lipid that could enhance the stability of the Moringa leaves (Atolani et al., 2016; Korassa et al., 2022)

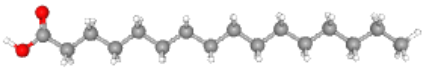


Figure 3. The 3D structure of Hexadecanoic acid

Formulation of Soap

Formulation of the soap by three kinds of oil (olive, coconut, and palm) received various kind of appearance such as different in color, texture, and odor. The table represents the 6 varieties of Moringa Based-Soap based on color and texture

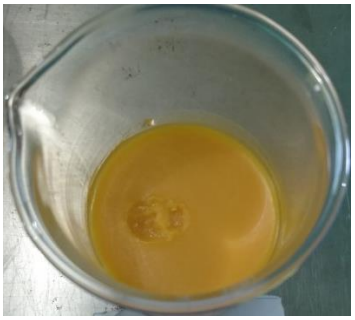
Table 3.
Formulation of Moringa Based-Soap

No.	Color	Texture
1	Light brown	Solid
2	Reddish brown	Slightly thick
3	Cream	Solid
4	Yellow	Slightly liquid
5	Red	Slightly Solid
6	Brown	Liquid

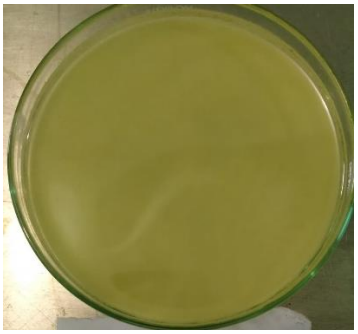
These following figures show the means of Soap according to different oil basis (Olive, Coconut, and Palm)

Soap 1 (olive, coconut, palm oil-based)

Soap 2 (olive and coconut oil-based)

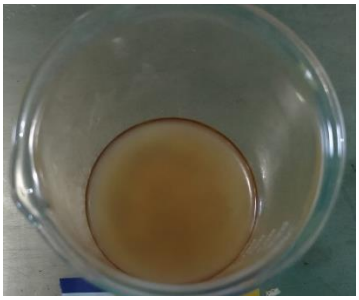


Soap 3 (coconut and palm oil-based)



Soap 4 (palm oil-based)

Soap 5 (coconut oil-based)



Soap 6 (Olive oil-based)

Figure 4. Different types of Soap based on Coconut, Olive and Palm Oil

The best formula was on the third soap, in as much as the addition of coconut oil and palm oil have been observed to result in a reduction in the levels of fatty acids present in the soap. The hydrolysis of coconut oil results in the production of free fatty acids and glycerol. The result demonstrated that the saponification reaction is complete, resulting in a solid soap with minimal residue. As opposed to, the soap number six that contain the oleic acid in olive oil approximately ranging from 57.76 until 76.9 %, which is a monosaturated fat (Ipek et al., 2015). It contributes as a gentle cleansing agents and dominant play a significant role in the liquid texture of the soap.

pH test

The pH test aimed to indicates the degree value of the resultant moringa extract soap. The higher the soap with the pH of the skin has an effect on the absorption of the soap into the skin, which can cause irritations and allow the skin to become dehydrated. A pH value is related to that soap to use as cleaning agent. that all soap samples exhibited an identical pH value of 10. In this particular case, this means that Moringa Extract Soap is below the standards set by SNI. This pH will not result in skin irritancy as the increase in skin pH at the time of application is temporary and the raise in skin pH not extending pH 7 (Hilaria et al., 2022; Rusdianto et al., 2022).

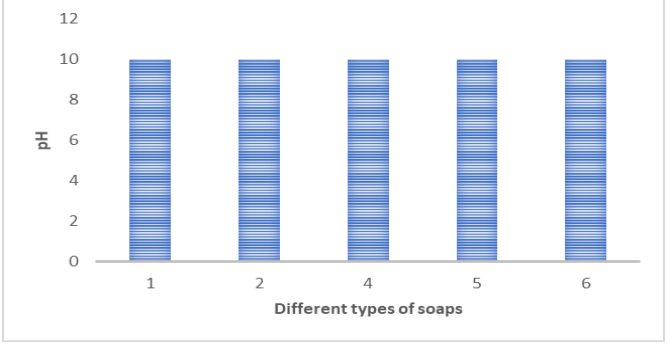


Figure 5. pH of the 6 soaps

Organoleptic test

Organoleptic test conducted those concerned with the olfactory, visual and tactile characteristic of the moringa leaf solid soap.

Table 4.
Organoleptic Test of 6 types of Soap

Odor	Color	Texture	pH
Fragrant	Light brown	Solid	10
Fragrant	Reddish brown	Slightly thick	10
Fragrant	Cream	Solid	10
Less Fragrant	Yellow	Slightly liquid	10
Less Fragrant	Red	Solid	10
Less Fragrant	Brown	Liquid	10

The organoleptic test was conducted with 30 untrained participants who were asked to complete a survey. The participants choose the soap that they like the most. The table illustrates the most popular soap chosen by the participants, according to six varieties of soaps.

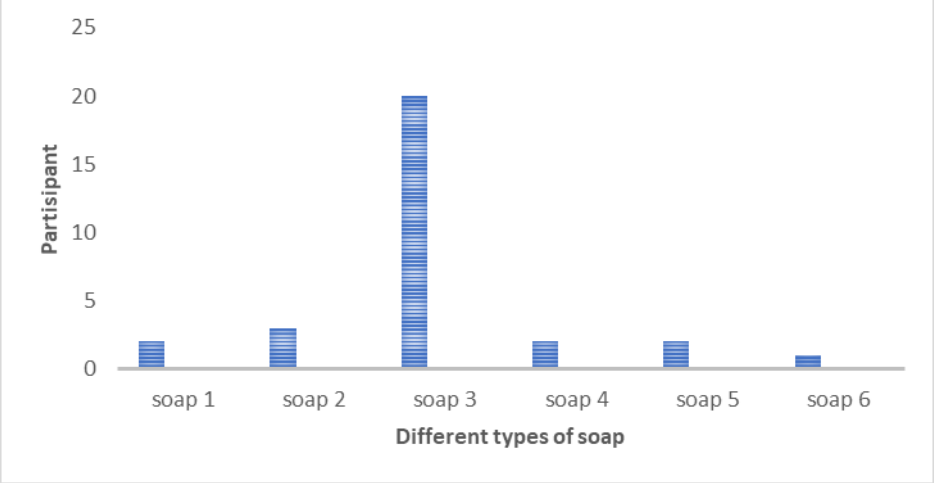


Figure 6. Impression of participant

Production of Soap based on Moringa leaves

The production of Moringa leaf soap adheres to the third formulation, as the resultant texture was solid. The organoleptic evaluation of the soap product yielded positive results, with a pH of 10 and a fragrant odor. The resulting color was yellow slightly white.

Figura 7. Moringa extract soap

DISCUSSION

Moringa oleifera leaves are renowned for their rich nutritional and phytochemical content, contributing to their medicinal properties. The leaves contain various bioactive compounds, including flavonoids, alkaloids, phenolics, saponins, and tannins, which are responsible for its health benefits. The following section details the key compounds and their significance.

Moringa leaves are a source of essential amino acids, vitamins, and minerals, making them a valuable dietary supplement, especially for pregnant women and infants (Tripathy et al., 2024). The leaves contain significant amounts of protein and fat, enhancing its nutritional profile (Khalid et al., 2023). Moringa leaves contain flavonoid and are present in varying amounts, these compounds exhibit antioxidant properties. Alkaloids with the highest concentration among the phytochemicals, contributing to the medicinal effects of Moringa leaves. (Pathak & Jain, 2023). Phenol which are also known for their antioxidant activity, they help prevent oxidative stress (Sadiah & Indiarto, 2022). Saponin and tannin also contribute to the therapeutic potential of the leaves, including antimicrobial properties. While Moringa leaves have many health benefits, it is important to realise that bioactive compounds can be sensitive to environmental factors, which may affect their efficacy in therapeutic applications. (Pathak & Jain, 2023; Khalid et al., 2023).

Moringa oleifera extract has been shown to have enormous potential in improving the quality of soap, both in terms of cleansing and additional skin health benefits. Moringa oleifera is known to be rich in bioactive compounds such as essential fatty acids, antioxidants, and anti-inflammatory compounds, which makes it a valuable ingredient in skincare products, particularly for dry or sensitive skin. These compounds have various benefits that not only enhance the performance of the soap but also provide extra protection and care for the skin. One of the main benefits of *Moringa oleifera* extract is its ability to improve skin hydration. The essential fatty acids found in Moringa seed oil, such as oleic and linoleic acids, are highly effective in repairing the skin barrier, maintaining moisture, and preventing trans epidermal water loss (TEWL). Moringa extract is also rich in antioxidants, including vitamin C, flavonoids, and polyphenols, which play an important role in fighting oxidative damage to the skin. This oxidative damage, caused by external factors such as pollution and UV exposure, can accelerate the skin's ageing process. (Avilés-Gaxiola et al., 2021; Yong-Bing et al., 2019). *Moringa oleifera* extract has the potential to reduce free radical damage, provide protection to the skin and maintain its health in the long term. This makes Moringa an effective natural ingredient in preventing premature signs of ageing in the skin. In addition to its moisturizer and antioxidant properties, *Moringa oleifera* extract also has anti-inflammatory effects that are beneficial for skin prone to inflammation or irritation. Active compounds in Moringa, such as isothiocyanates, are known to reduce inflammation, which is especially important for sensitive skin or those suffering from skin conditions such as dermatitis or psoriasis. With these anti-inflammatory properties, *Moringa oleifera* can be used in soaps to relieve skin inflammation and improve user comfort (Cretella et al., 2020; Garg et al., 2024).

Moringa leaves have antioxidant properties, which help combat oxidative stress and improve skin health. Face mask formulations with moringa extract showed antioxidant activity, although less potent than the raw extract. The antibacterial activity of moringa extract against common skin pathogens, such as Staphylococcus aureus, further supports its use in skincare products (Hendrawati et al., 2020). Moringa has been effectively processed into soaps using various methods and components, demonstrating its beneficial properties for skin health and antimicrobial activity. Formulations typically incorporate Moringa seed oil, leaf extracts, and other natural oils, resulting in soaps with favorable characteristics such as moisturizing effects, antibacterial properties, and stability in pH and foam production. The following section details the main aspects of moringa soap production. Commonly used parts include seed oil, leaf powder, and leaf extract, which contribute to the soap's beneficial properties (Nayak et al., 2024; Hardiyanti et al., 2022). Formulations often contain oils such as coconut, olive, and palm oil, enhancing the moisturizing effect and nourishing the skin (Saini et al., 2023).

Moringa, particularly its leaves, is known for its beneficial properties in maintaining skin health due to its rich composition of antioxidants and nutrients. Research shows that Moringa extract can improve skin hydration, provide anti-aging benefits, and exhibit antibacterial properties, making it a versatile ingredient in skincare formulations. Moringa leaves are rich in phenolic acids, flavonoids, and vitamins, which contribute to skin hydration and moisture retention. One study showed that a gel lotion containing Moringa leaf extract significantly increased skin hydration levels, with a 5% concentration showing the highest efficacy(Ariyanti et al., 2023). Moringa leaves contain antioxidants that combat oxidative stress, a key factor in skin aging. Clay masks formulated with Moringa extract have shown promising results in reducing wrinkles and improving skin texture, especially at a concentration of 10% (Nurussakinah et al., 2023). Moringa also demonstrates antibacterial activity against acne-causing bacteria such as *Propionibacterium acnes*, making it a potential treatment for acne-prone skin. Its antibacterial properties can help prevent and treat skin infections, further supporting skin health (Coelho et al., 2024).

Cold Process and Melt-Pour Production Methods have been used to make moringa soap, with the cold process resulting in higher total fat matter (TFM) and better antimicrobial activity. Moringa seed oil has been used to produce transparent soap, achieving high lather stability and low irritation level (Nayak et al., 2024; Hardiyanti et al., 2022). Moringa soap has shown significant antibacterial activity against pathogens such as *Staphylococcus aureus* and E. coli, making it suitable for personal hygiene. Notably, while moringa soap formulations show promising benefits, it is important to consider potential variations in individual skin reactions and the need for further studies to optimize formulations for wider consumer use (Waris et al., 2023). Based on the results and discussion above, *Moringa oleifera* extract offers enormous potential in improving the quality and benefits of soaps. With its combination of antibacterial, anti-inflammatory and moisturizing properties, it can be a key ingredient in the development of more healthy and natural skincare products.

CONCLUSION

The Moringa-based soap containing 8 chemical compounds demonstrates promising qualities. The soap's organoleptic properties include a pleasant fragrance, a solid texture, and a yellow slightly white in color, which suggest it is aesthetically pleasing. The observed pH value of 10 indicates that the soap is on the alkaline side, which may have implications for its suitability for individuals. *Moringa oleifera* extract has remarkable potential to enhance soap quality, not only in terms of cleansing but also in providing additional skin health benefits. Its bioactive properties, such as essential fatty acids, antioxidants, and anti-inflammatory compounds, make it a valuable ingredient in soap production, especially for dry or sensitive skin. Existing research shows that *Moringa oleifera* can improve skin hydration, enhance skin barrier function, and offer protection against free radicals and infections. It is also easy to scale up commercially. The soap holds potential for a desirable and effective product.

REFERENCES

Aja, P. M., Nwachukwu, N., Ibiam, U. A., Igwenyi, I. O., Offor, C. E., & Orji, U. O. (2014). Chemical Constituents Of Moringa Oleifera Leaves And Seeds From Abakaliki, Nigeria. *Am J Phytomedicine Clin Ther*, *2*.

Arendse, W., & Jideani, V. (2022). Effects Of Some Weak Acids And Moringa Oleifera Leaf Extract Powder On The Colour Of Dried Apple. *Processes*, *10*(2). Https://Doi.Org/10.3390/Pr10020206

Ariyanti, A., Masruriati, E., Setyowati, D., & Nurulita, F. M. (2023). Effect Of Using

Moringa Leave (Moringa Oleifera L.) And Pineapple (Ananas Comosus) Leaf Lotion Gel Lotion On Skin Moisture. *Proceedings Of The International Conference On Nursing And Health Sciences*, *4*(1), 127–136. Https://Doi.Org/10.37287/Picnhs.V4i1.1717

Atolani, O., Olabiyi, E. T., Issa, A. A., Azeez, H. T., Onoja, E. G., Ibrahim, S. O., Zubair, M. F., Oguntoye, O. S., & Olatunji, G. A. (2016). Green Synthesis And Characterisation Of Natural Antiseptic Soaps From The Oils Of Underutilised Tropical Seed. *Sustainable Chemistry And Pharmacy*, *4*. Https://Doi.Org/10.1016/J.Scp.2016.07.006

Avilés-Gaxiola, S., León-Félix, J., Jiménez-Nevárez, Y. B., Angulo-Escalante, M. A., Ramos-Payán, R., Colado-Velázquez, J., & Heredia, J. B. (2021). Antioxidant And Anti-Inflammatory Properties Of Novel Peptides From Moringa Oleifera Lam. Leaves. *South African Journal Of Botany*, *141*, 466–473. Https://Doi.Org/Https://Doi.Org/10.1016/J.Sajb.2021.05.033

Carrasco A., H., Espinoza C., L., Cardile, V., Gallardo, C., Cardona, W., Lombardo, L., Catalán M., K., Cuellar F., M., & Russo, A. (2008). Eugenol And Its Synthetic Analogues Inhibit Cell Growth Of Human Cancer Cells (Part I). *Journal Of The Brazilian Chemical Society*, *19*(3). Https://Doi.Org/10.1590/S0103-50532008000300024

Clark, Y. N. B., Jimenez, M., Raso, E., Antwi, L., Ofosu-Appiah, L. H., Opare, D., & Torondel, B. (2018). Evaluation Of Key Antimicrobial Properties Of Moringa Oleifera In Relation To Its Use As A Hand-Washing Product. *Water (Switzerland)*, *10*(9). Https://Doi.Org/10.3390/W10091154

Coelho, N., Pereira, A. S., & Tavares, P. (2024). Moringa Oleifera Seed Cake: A Review On The Current Status Of Green Nanoparticle Synthesis. *Applied Biosciences*, *3*(2), 197–212. Https://Doi.Org/10.3390/Applbiosci3020013

Cretella, A. B. M., Soley, B. Da S., Pawloski, P. L., Ruziska, R. M., Scharf, D. R., Ascari, J., Cabrini, D. A., & Otuki, M. F. (2020). Expanding The Anti-Inflammatory Potential Of Moringa Oleifera: Topical Effect Of Seed Oil On Skin Inflammation And Hyperproliferation. *Journal Of Ethnopharmacology*, *254*, 112708. Https://Doi.Org/Https://Doi.Org/10.1016/J.Jep.2020.112708

Ermawati, D., Ayu Wardani, E. A. T., & Rahmasari, D. (2022). The Effect Of Variations Of Coconut Oil And Palm Oil On The Characteristics Of Soap Bars Containing 7% Concentration Of Moringa Oleifera Oil. *Kne Medicine*. Https://Doi.Org/10.18502/Kme.V2i3.11879

Gaffour, H., Boulal, A., Djaafri, M., Khelafi, M., Bakache, Y., Yakoubi, M., Kaidi, K., & Boukli Hacene, M. (2015). Soap Production Using A Mixture Of Moringua Leaves And Olive Oil. *Phytochem & Biosub Journal*, *9*(1).

Garg, P., Pundir, S., Ali, A., Panja, S., Chellappan, D. K., Dua, K., Kulshrestha, S., & Negi, P. (2024). Exploring The Potential Of Moringa Oleifera Lam In Skin Disorders And Cosmetics: Nutritional Analysis, Phytochemistry, Geographical Distribution, Ethnomedicinal Uses, Dermatological Studies And Cosmetic Formulations. *Naunyn-Schmiedeberg's Archives Of Pharmacology*, *397*(6), 3635–3662. Https://Doi.Org/10.1007/S00210-023-02862-2

Hardiyanti, P., Nurhaeni, N., & Hardi, J. (2022a). Pemanfaatan Minyak Biji Kelor (Moringa Oleifera L.) Pada Pembuatan Sabun Padat Transparan: Utilization Of Moringa Seed Oil (Moringa Oleifera L.) In Making Transparent Solid Soap. *Jurnal Teknologi Agro-Industri*, *9*(2).

Hardiyanti, P., Nurhaeni, N., & Hardi, J. (2022b). Pemanfaatan Minyak Biji Kelor (Moringa Oleifera L.) Pada Pembuatan Sabun Padat Transparan. *Jurnal Teknologi Agro-Industri*, *9*(2). Https://Doi.Org/10.34128/Jtai.V9i2.156

Hassan, M. A., Xu, T., Tian, Y., Zhong, Y., Ali, F. A. Z., Yang, X., & Lu, B. (2021). Health Benefits And Phenolic Compounds Of Moringa Oleifera Leaves: A Comprehensive Review. In *Phytomedicine* (Vol. 93). Https://Doi.Org/10.1016/J.Phymed.2021.153771

Hendrawati, Azizah, Y. N., & Hapsari, N. K. (2020). Facial Mask Formulation Enriched With Moringa Leaves (Moringa Oleifera) Extract And Their Activity As Antioxidants And Antibacterials. *Jurnal Kimia Valensi*, *6*(2), 198–207. Https://Doi.Org/10.15408/Jkv.V6i2.16982

Hilaria, M., Tenda, P. E., & Maakh, Y. F. (2022). Formulation Of Moringa Soap As An Antioxidant To Protect Free Radicals On The Skin. *Health Technology*, *1*(2986-917X).

Ipek, M., Ipek, A., Seker, M., & Gul, M. K. (2015). Association Of SSR Markers With Contents Of Fatty Acids In Olive Oil And Genetic Diversity Analysis Of An Olive Core Collection. *Genetics And Molecular Research*, *14*(1). Https://Doi.Org/10.4238/2015.March.27.10

Juhaimi, F. Al, Babiker, E. E., Ghafoor, K., & Ozcan, M. (2016). Fatty Acid Composition Of Three Different Moringa Leave Oils. *Rivista Italiana Delle Sostanze Grasse*, *XCIII*.

Khalid, S., Arshad, M., Mahmood, S., Ahmed, W., Siddique, F., Khalid, W., Zarlasht, M., Asar, T. O., & Hassan, F. A. M. (2023). Nutritional And Phytochemical Screening Of Moringa Oleifera Leaf Powder In Aqueous And Ethanol Extract. *International Journal Of Food Properties*, *26*(1), 2338–2348. Https://Doi.Org/10.1080/10942912.2023.2246685

Korassa, Y. B., Saptarini, N. M., Mustarichie, R., & Hendriani, R. (2022). The Potential Of Moringa (Moringa Oleifera Lamk) Seed Oil As Anti-Alopecia. *Pharmacognosy Journal*, *14*(2). Https://Doi.Org/10.5530/Pj.2022.14.49

Nayak N, S., Akanksha, A., S K, A., M J, M., B, S., S, S., K, K., & J, T. (2024). Formulation And Evaluation Of Antibacterial Moringa Soap Prepared By Melt Pour And Cold Process Method. *Research Journal Of Topical And Cosmetic Sciences*, *15*(1), 20–26. Https://Doi.Org/10.52711/2321-5844.2024.00004

Nurussakinah, N., Fhitriana, S., Khairani, T. N., & Utari, S. (2023). MORINGA LEAF (Moringa Oleifera L.) ETHANOL EXTRACT CLAY MASK FORMULATION AS ANTI-AGING. *Jurnal Farmasimed (Jfm)*, *6*(1), 1–8. Https://Doi.Org/10.35451/Jfm.V6i1.1193

Oluduro, A. O. (2012). Evaluation Of Antimicrobial Properties And Nutritional Potentials Of Moringa Oleifera Lam. Leaf In South-Western Nigeria. *Malaysian Journal Of Microbiology*, *8*(2).

Owusu-Ansah, P., Alhassan, A. R., Ayamgama, A. A., Adzaworlu, E. G., Afoakwah, N. A., Mahunu, G. K., & Amagloh, F. K. (2023). Phytochemical Analysis, Enumeration, Isolation, And Antimicrobial Activity Of Lemongrass And Moringa Leaves Extracts. *Journal Of Agriculture And Food Research*, *12*. Https://Doi.Org/10.1016/J.Jafr.2023.100579

Pathak, S., & Jain, B. (2023). Phytochemical Analysis Of Dried Moringa Oleifera Leaf Powder. *The Journal Of Plant Science Research*, *39*(1), 177–184. Https://Doi.Org/10.32381/Jpsr.2023.39.01.17

Rao, M. R. K., Vijayalakshmi, N., Prabhu, K., & Sathish Kumar, M. (2019). The Gas Chromatography-Mass Spectrometry Study Of Moringa Oleifera Seeds. *Drug Invention Today*, *12*(10).

Rusdianto, A. S., Nizhomia, F., Giyarto, G., & Wiyono, A. E. (2022). The Characteristics Of Liquid Soap With Varied Additions Of Moringa Leaf Extract (Moringa Oleifera L.).

International Journal On Food, Agriculture And Natural Resources, *3*(1). Https://Doi.Org/10.46676/Ij-Fanres.V3i1.38

Rusdianto, A. S., Yulianti, A., Suwasono, S., & Wiyono, A. E. (2021). International Journal On Food, Agriculture, And Natural Resources The Characteristics Of Liquid Soap With Additional Variations Of Moringa Seed Extract (Moringa Oleifera L.). *International Journal On Food, Agriculture, And Natural Resources*, *02*(03), 5–11. Https://Doi.Org/10.46676/Ij-Fanres.V2i3.43

Sadiah, I., & Indiarto, R. (2022). KARAKTERISTIK DAN SENYAWA FENOLIK MIKROKAPSUL EKSTRAK DAUN KELOR (Moringa Oleifera) DENGAN KOMBINASI MALTODEKSTRIN DAN WHEY PROTEIN ISO. *Jurnal Teknologi Industri Pertanian*, *32*(3), 273–282. Https://Doi.Org/10.24961/J.Tek.Ind.Pert.2022.32.3.273

Saini, K., Yadav, T., Dubey, G., & Singh, R. P. (2023). Application Of Phytoconstituents In Herbal Soap Formulation. *J. Adv. Res. In Pharmaceutical Sciences And Pharmacology Interventions*, *6*(2), 1–16.

Santhi, K., & Sengottuvel, R. (2016). Qualitative And Quantitative Phytochemical Analysis Of Moringa Concanensis Nimmo. *International Journal Of Current Microbiology And Applied Sciences*, *5*(1). Https://Doi.Org/10.20546/Ijcmas.2016.501.064

Sforcin, J. M., Amaral, J. T., Fernandes, A., Sousa, J. P. B., & Bastos, J. K. (2009). Lemongrass Effects On IL-1β And IL-6 Production By Macrophages. *Natural Product Research*, *23*(12). Https://Doi.Org/10.1080/14786410902800681

Srivastava, S., Pandey, V. K., Dash, K. K., Dayal, D., Wal, P., Debnath, B., Singh, R., & Dar, A. H. (2023). Dynamic Bioactive Properties Of Nutritional Superfood Moringa Oleifera: A Comprehensive Review. *Journal Of Agriculture And Food Research*, *14*. Https://Doi.Org/10.1016/J.Jafr.2023.100860

Sudha, R., Philip, X. C., & Suriyakumari, K. (2021). Phytochemical Constituents Of Leaves Of Moringa Oleifera Grow In Cuddalore District, Tamil Nadu, India. *SBV Journal Of Basic, Clinical And Applied Health Science*, *3*(4). Https://Doi.Org/10.5005/Jp-Journals-10082-02270

Susanty, Yudistirani, S. A., & Islam, M. B. (2019). Metode Ekstraksi Untuk Perolehan Kandungan Flavonoid Tertinggi Dari Ekstrak Daun Kelor (Moringa Oleifera Lam). *Konversi*, *8*(2).

Tripathy, C. S., Mishra, A., Behera, S. K., & Parida, S. (2024). Ethnomedicinal Uses Of Moringa Oleifera Lam. And The Phytochemicals In Regulating Type 2 Diabetes And Inflammation. *Plant Science Today*, *11*(2), 197–206. Https://Doi.Org/10.14719/Pst.3549

Waris, D. I., Yanti, S. I., Okzelia, S. D., & Amirulah, F. (2023). Formulasi Sabun Cair Cuci Tangan Dan Uji Aktivitas Bakteri Staphylococcus Aureus Dari Ekstrak Daun Kelor (Moringa Oleifera Lam.). *Sinteza*, *3*(1), 29–40. Https://Doi.Org/10.29408/Sinteza.V3i1.7890

Wigunarti, A. H., Pujiyanto, S., & Suprihadi, A. (2019). Antibacterial Activity Tested Of Moringa Seed Extract (Moringa Oleifera L.) Staphylococcus Aureus And Escherichia Coli Bacteria. *Berkala Bioteknologi*, *2*(2).

Yong-Bing, X., Gui-Lin, C., & Ming-Quan, G. (2019). Antioxidant And Anti-Inflammatory Activities Of The Crude Extracts Of Moringa Oleifera From Kenya And Their Correlations With Flavonoids. *Antioxidants*, *8*(8). Https://Doi.Org/10.3390/Antiox8080296.