

Development and Characterization of Handmade Soap Using Mulberry (Morus sp.) and Malunggay (Moringa oleifera) Leaf Extracts

Tapado RM^{1*}

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^{1*} Robelle M Tapado, Science Research Specialist II, Research and Development Services, Catanduanes State University, Virac, Catanduanes, Philippines.

The increasing demand for natural and eco-friendly personal care products has spurred research into plant-based ingredients for the formulation of handmade soaps. This study investigates the development and characterization of mulberry-moringa handmade soap, combining the antioxidant-rich properties of mulberry (*Morus sp.*) and moringa (*Moringa oleifera*) leaves. The soap is assessed for its physico-chemical properties (pH, moisture content, foam height and foam stability) and consumer acceptability (appearance, aroma, lather, moisturizing effects, estimated price & overall preference). The findings suggest that the mulberry-moringa handmade soap exhibits promising skin nourishing properties, making it a viable candidate for the natural soap market.

Keywords: handmade soap, mulberry, moringa, leaf extracts

Corresponding Author	How to Cite this Article	To Browse
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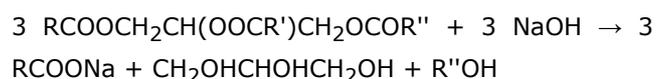
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1. Introduction

Plants with medicinal properties are being used as traditional medicine from time immemorial. Extracts from leaves, stems and roots of various medicinal plants have been employed as a natural remedy in curing various ailments and as ingredients in cosmetics. Even though many plant-based products have already been replaced by synthetic products, the safety and efficacy of natural products still could not find their match. Besides having high nutritional value, many plants are found to possess anti-bacterial, anti-inflammatory and antioxidant properties. The active constituents responsible for these medicinal properties are usually isolated and employed topically as creams, soaps, oils and ointments in treating skin-related diseases such as acne and for cosmetic purposes. From year to year, there has been an increasing tendency to use products of natural origin, especially those that are plant-derived. This is due to the fact that such products have virtually no side effects.

Saponification is a chemical reaction that occurs when oils or fats are mixed with a strong base, typically sodium hydroxide (NaOH) for solid soap or potassium hydroxide (KOH) for liquid soap. When the base mixes with the fats or oils, it creates glycerol and soap molecules through a process called alkaline hydrolysis. The base breaks down the triglycerides in the fats into fatty acid salts (the soap) and glycerin. The chemical equation for the saponification of a triglyceride, like a typical vegetable oil, with sodium hydroxide is:



where R, R', R'' represent hydrocarbon chains in the fatty acids. This creates soap, which has a hydrophilic (water-attracting) head and a hydrophobic (water-repelling) tail, allowing it to interact with both water and oils to help things clean. Once the saponification process is complete, the mixture is allowed to cool and solidify, forming bars or blocks of soap.

The process can vary based on the specific types of oils or fats used, the concentration of the alkali, and other additives introduced to create different properties, such as scents or additional skin care benefits.

The current status of economic growth in the soap industry as well as trends in consumer preferences have led to increased demands for the use of natural ingredients as additives in personal skin and cosmetic products. As such, natural herbal soaps formulated using different oils and plant-based additives are a major segment and have a high demand in the global market (Ainie et al., 1996).

Malunggay (*Moringa oleifera*) is a fast-growing, drought-resistant tree of the family *Moringaceae*. It is widely cultivated in Asia and Africa. It is grown for its edible leaves, nutritious pods and can be utilized as food, medicine, cosmetic oil or forage for livestock. Several studies have demonstrated the beneficial effects in humans. It has been recognized as containing a great number of bioactive compounds. The most used part of the plant is the leaves, which are rich in vitamins, carotenoids, polyphenols, phenolic acids, flavonoids, alkaloids, glucosinates, isothiocyanates, tannins and saponins. The high number of bioactive compounds might explain the pharmacological properties of its leaves. Its leaves are mostly used for medicinal purposes as well as for human nutrition, since they are rich in antioxidants and other nutrients, which are commonly deficient in people living in undeveloped countries. Fresh leaves of *M. oleifera* are good sources of Vitamin A. The leaves are also good sources of carotenoids with pro-vitamin A potential. Its leaves also contain 200 mg/100g of Vitamin C, a concentration greater than what is found in oranges. The leaves protect the body from various deleterious effects of free radicals, pollutants and toxins and act as antioxidants. Its fresh leaves are a good source of Vitamin E, with concentrations similar to those found in nuts (Shivanand, 2010).

Mulberry (*Morus*) belongs to the *Moraceae* plant family and includes several species, such as the black mulberry (*Morus nigra*), red mulberry (*Morus rubra*) and white mulberry (*Morus alba*). Mulberry trees produce flavorful berries that are enjoyed around the world and often deemed as superfood due to their concentration of vitamins, minerals and powerful plant compounds. Mulberry leaves are the sole food source of the silkworm—a caterpillar that produces silk. The leaves are also very palatable and commonly used to make tinctures and herbal teas. The leaves are highly nutritious. They are loaded with powerful plant compounds like polyphenol antioxidants, as well as Vitamin C, zinc, calcium, iron, potassium, phosphorus and magnesium.

According to a four-year research study conducted by the Institute of Clinical Pharmacology of Zhejiang University, it has been confirmed that the mulberry leaf has similar anti-ageing effects as ginseng. It is good for the skin when used externally. Mulberry leaf extract is rich in Vitamin A, C, E and riboflavin, which are highly beneficial vitamins for the skin. Mulberry extract is known for its natural brightening properties and the ability to help fade away dark spots and pigmentation caused by aging and exposure to the sun. It is a natural alternative to skin lightening products that can sometimes contain harsh ingredients such as hydroquinone and mercury. Tyrosinase is the active enzyme that triggers the production of melanin, the brown pigment in our skin. Mulberry extract works as a natural inhibitor of this enzyme and helps to slow down the production of melanin. It is also abundant in vitamins and antioxidants that can help increase the production of resveratrol in the body. Resveratrol helps to strengthen the skin's natural barrier and protect it from UV rays whilst also neutralizing free radicals from environmental factors (Kapoor, 2005).

This study aims to develop a handmade soap by integrating mulberry and moringa leaf extracts and evaluate its potential as a natural skincare product.

2. Research Methodology

The study employed developmental, quantitative and experimental method of research. It was developmental since it aimed to develop a handmade soap using leaf extracts of mulberry and *moringa* which are cultivated in the province of Catanduanes. It was quantitative because the study attempted to quantify the result of the consumer acceptability of the handmade soap. It also employed experimental method of research since different treatments/formulations were utilized in the production of the handmade soap. The Research and Development Services Building at Catanduanes State University in Calatagan, Virac, Catanduanes was the site of the experiment. The study utilized four (4) different treatments, namely: T0- Soap Base (Control), T1- 5% leaf extracts, T2- 10% leaf extracts, and T3- 15% leaf extracts.

Consumer acceptability testing was done employing thirty (30) research participants. A 9-point hedonic scale was used as evaluation tool to assess the degree of consumer acceptance of the different formulations of the handmade soap.

Extraction

50g of *malunggay* and 50g of mulberry leaves were weighed using a top loading balance and washed with water. These were then boiled in 500 ml distilled water for 30 minutes and kept for 24 hours undisturbed and filtered through a sterile filter paper.

Preparation of Soap Base

To prepare the soap base, 100 mL of virgin coconut oil was placed in a 500-mL glass beaker. This was then put in a water bath with a temperature between 40°C to 45°C and the mixture was constantly stirred until a strong consistency formed. Then 18.2g NaOH was dissolved in 41.4 mL distilled water in another 500-mL glass beaker. This solution was slowly incorporated in the coconut oil mixture. This mixture was heated to 40-45°C until base consistency was achieved and this was used as the soap base.

Formulation of Handmade Soap with Mulberry-Moringa Leaf Extracts

50 mL of soap base was placed in a glass beaker and heated to 45°C. The different proportions of leaf extracts, 10 mL of glycerin, 1 mL of fragrance and 0.5 g colorant were slowly incorporated into the soap base with continuous stirring. The prepared soap mixture was finally poured into soap molds and left to cure for 4 weeks.

Physico-chemical Testing

The handmade soap was analyzed for pH, moisture content, foam height and foam stability.

pH

To determine the pH of the handmade soap, 1% of sample was prepared for pH meter reading. Final reading was determined by taking the average of the three different readings from each treatment.

Moisture Content

About 10g of the handmade soap was heated in a hot air oven and at 100-105°C for an hour. The initial and final weight of the sample after oven drying were recorded, and the formula for calculating the percentage of the moisture content of the sample is shown below:

$$\text{Moisture content} = (\text{Final-Initial Weight}/\text{Initial Weight}) \times 100$$

Foam Height

The cylinder shake method was used to determine the foam height of the samples. 50 mL of 1% sample solution was placed in a 100 mL graduated cylinder. The cylinder was covered and this will be shaken vigorously for 1 minute. The height of the foam that had formed was then measured and recorded.

Foam Stability

1 mL of sample was put into a test tube and then 9 mL of water was added. The mixture was stirred until dissolved, and then shaken for 20 seconds. The initial height of the foam was recorded. This was then left for 5 minutes and then the height of the foam was measured again. Foam stability was calculated based on the following equation:

$$\text{Foam Stability (\%)} = (\text{Final foam height} / \text{Initial foam height}) \times 100$$

Consumer Acceptability Testing

The handmade soap was subjected to consumer acceptability testing in terms of appearance, aroma, lather, moisturizing effects, estimated price and overall preference.

3. Results and Discussion

Handmade soaps, made using natural ingredients, are gaining popularity due to their perceived benefits over commercial, chemically-laden soaps. Natural soaps often include oils, herbs, and extracts known for their skin-nourishing properties. Among the various plant-based ingredients, mulberry and moringa are two potent natural resources recognized for their antioxidant, anti-inflammatory, and antimicrobial properties.

Moisture Content

The inclusion of mulberry and moringa leaf extracts appears to increase the moisture content in soap. This might be due to: (1) the hydrophilic properties of the extracts, which retain water in the soap matrix; and (2) the ability of bioactive compounds in the extracts to influence soap structure and water-holding capacity. Higher moisture content may enhance soap pliability and prevent cracking. However, excessively high moisture can lead to faster degradation, microbial growth, or reduced shelf life. The range in this study seems reasonable for maintaining soap integrity.

pH

A clear trend emerges where increasing the concentration of mulberry and moringa leaf extracts lowers the pH of the soap. This effect is likely due to the slightly acidic nature of the leaf extracts, which counteract the inherent alkalinity of soap. Soaps with lower pH (closer to the skin's natural pH of ~5.5) are gentler and less likely to cause irritation or dryness. The reduction in pH with the addition of extracts makes these formulations potentially more suitable for sensitive skin. While pH values in T1-T3 are lower than T0, they remain slightly alkaline, which is beneficial for cleansing and antimicrobial properties.

Thus, the incorporation of mulberry and moringa leaf extracts lowers the pH of handmade soaps, making them potentially gentler for skin. T3 (15% leaf extracts) shows the most significant reduction, indicating a promising approach for creating milder soaps while retaining their cleansing effectiveness.

Foam Height

Foam height is often associated with a soap's cleansing performance, but it is not the sole indicator of cleaning ability. Even soaps with lower foam can clean effectively. On this study, the addition of mulberry and moringa leaf extracts reduced foam height, with T3 (15% leaf extracts) exhibiting the lowest foam height. While this may impact consumer perception, the benefits of incorporating natural extracts (e.g., improved skin compatibility and nutrient content) can be leveraged to offset potential drawbacks in foam production.

Foam Stability

Foam stability decreases progressively as the percentage of mulberry and moringa leaf extracts increases. This could be due to the chemical properties of the leaf extracts, such as tannins or other compounds, which may weaken the soap's surfactant structure, leading to less stable foam. High foam stability is desirable in soap formulations as it ensures the foam lasts longer during use, enhancing the user experience. Lower foam stability in higher extract concentrations could impact the perceived quality of the soap, even if it remains effective for cleansing. The incorporation of mulberry and moringa leaf extracts reduces foam stability in handmade soaps, with the most significant decline observed in T3 (15% leaf extracts).

This suggests a trade-off between foam-related properties and the added benefits of the extracts. Optimizing the formulation and educating consumers about the benefits of natural additives could address these challenges.

Consumer Acceptability Test Results

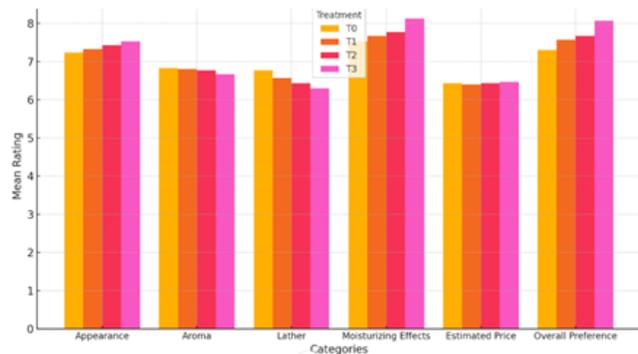


Figure 1: Consumer acceptability ratings of handmade soap utilizing different concentration of mulberry-moringa leaf extracts

Figure 1 shows the bar chart representing the consumer acceptability ratings of handmade soaps incorporating mulberry and moringa leaf extracts. As shown in the figure, there’s a gradual and consistent increase in appearance ratings as the concentration of leaf extracts increases. The highest rating (7.53) is achieved by T3 (15%), suggesting that consumers find higher extract concentrations visually appealing. Aroma scores decreased slightly from T0 (6.83) to T3 (6.67). This may indicate that higher concentrations of mulberry and moringa leaf extracts impact the soap's scent negatively or make it less appealing to consumers. Ratings for lather decreased as extract concentrations increased, from 6.77 in T0 to 6.30 in T3. This suggests that the leaf extracts might interfere with foaming properties or give the perception of reduced lather. A significant increase in ratings for moisturizing effects is seen with higher concentrations of leaf extracts. T3 scores the highest (8.13), indicating enhanced moisturizing properties, likely due to the nutrients or compounds in the extracts. The ratings for estimated price remained relatively stable, ranging from 6.40 to 6.47 across treatments. This consistency may mean that consumers perceive no significant cost difference regardless of extract concentration. The overall preference shows a strong positive correlation with increasing extract concentration, reaching 8.07 for T3.

This reflects that while attributes like aroma or lather may not perform as well, the improvements in appearance and moisturizing effects outweigh these concerns for consumers. The rising moisturizing effects appear to drive the overall preference, showing that consumers highly value this attribute in soaps. Lather and aroma show slight declines with higher extract concentrations, which could indicate room for improvement to optimize these attributes without compromising on the beneficial aspects.

4. Conclusions and Recommendations

The study on mulberry-moringa handmade soap showed promising results as a natural alternative to conventional soaps. The use of mulberry and moringa in soap-making aligns with the growing demand for eco-friendly, natural, and effective skincare products. The study reveals that incorporating mulberry and moringa leaf extracts into handmade soaps significantly impacts consumer acceptability, with noticeable trade-offs among attributes. T3 (15% leaf extracts) achieved the highest overall preference (8.07), primarily driven by its superior moisturizing effects (8.13) and improved appearance (7.53). Attributes like aroma and lather showed slight declines as extract concentrations increased, highlighting areas for potential optimization in formulation. Consumer perception of the estimated price remained consistent across all treatments, indicating that higher extract levels do not deter cost acceptability. This data suggests that soaps with higher concentrations of mulberry and moringa extracts, such as T3, are well-suited for consumers prioritizing moisturizing properties and overall aesthetic appeal. For broader market acceptance, future iterations can focus on enhancing aroma and maintaining lather without compromising the benefits provided by the leaf extracts. Future studies could also explore the optimization of soap formulations to enhance skin benefits while minimizing potential irritation.

Based on the findings of the study, the following are recommended:

- 1. Further Optimization.** A more refined balance of oils and extract concentrations could be explored to improve the soap’s texture, longevity, and gentleness on the skin.

2. Commercial Production. Scaling up the production process while maintaining the natural properties could make this product viable for commercial markets.

3. Consumer Awareness. Promoting the health benefits of mulberry and moringa extracts in skincare could enhance the appeal of this handmade soap.

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