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Preface

The Scientific Project Colloquium offers a platform for publishing Diploma Science final year projects (FYP). The objective is to effectively distribute research findings throughout all scientific disciplines. The primary objective of including final year projects into the course curriculum is to encourage students to put their theoretical knowledge into practical applications.

We would like to express our gratitude to our primary establishment, the Faculty of Applied Sciences and Universiti Teknologi MARA, Perak Branch, for their invaluable assistance.

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DEVELOPMENT AND CHARACTERIZATION OF *KYLLINGA NEMORALIS* SOAP: A PRELIMINARY STUDY

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Abstract: The objective of this preliminary investigation was to create and identify a soap that was made with extract from *Kyllinga nemoralis* (*K.nemoralis*), with an emphasis on its physicochemical properties, performance, and safety for use. The soap was manufactured by employing a conventional saponification process that included *K.nemoralis* extract. The soap that resulted was subjected to a variety of characterization experiments. Organoleptic evaluations were conducted on the color, odor, and texture. Washability was evaluated by observing the simplicity of rinsing, and the pH was measured using a pH meter. The detergent sample's moisture content was ascertained by drying it and calculating the weight difference. In order to assess the foaming properties, foam retention duration and foam height were measured. Volunteers were assessed for skin irritability by administering the soap solution to a small area of their skin and observing for any adverse reactions. The soap had a solid and firm texture, a grassy odour, and a dark green colour. The soap's pH was determined to be 8, which suggests that it is mildly alkaline and suitable for cleansing. The detergent was easily washable and did not leave any residue after rinsing. The bar was robust and durable because of its 10.11 % moisture content. The foam retention time was 150 minutes, and the foam height was 64 mm, indicating exceptional foaming properties. It is crucial to note that the detergent did not induce any skin irritation, which implies that it is suitable for general use. The soap that has been developed with *K.nemoralis* extract exhibits promising qualities, such as outstanding foaming performance, balanced moisture content, effective washability, and appealing organoleptic properties. The product is appropriate for daily use due to its mild alkalinity and absence of skin irritation. It is advised that additional research be conducted to investigate the long-term effects on skin health and the comparative efficacy of commercial soaps. This investigation validates the potential of *K.nemoralis* extract as a valuable component in natural detergent formulations.

Keywords: *Kyllinga nemoralis*, traditional medicine, maceration method, soap formulation, physicochemical

INTRODUCTION

Soap, a fundamental cleansing agent, has been in use since ancient Babylonian times. Modern soaps, both liquid and solid, are widely available and often marketed as medicinal products (Bahari et al., 2021). However, the extensive use of synthetic antibiotics in commercial soaps has raised concerns due to potential side effects such as rashes, skin allergies, fungal infections, psoriasis, and acne (Jithendran, 2021). Furthermore, overusing these synthetic substances can lead to the development of antibiotic-resistant bacteria. In response to these issues, there has been a growing interest in incorporating natural ingredients derived from medicinal plants into soap formulations. These plant extracts can infuse soaps with antibacterial, antifungal, and anti-inflammatory properties (Bahari et al., 2021).

Despite the rich biodiversity of Malaysia's tropical rainforests, which support over 1,300 plants used in traditional medicine, there has been limited development of these resources into pharmaceutical agents. This is largely due to the high cost of research and development, as well as a lack of expertise and technology in natural product research (Wahab & Rahman, 2022). Traditional medicine extensively utilizes *Kyllinga nemoralis* (*K. nemoralis*), also known as white water sedge or whitehead spike sedge, for its leaves and rhizomes, which are rich in biologically active compounds. Researchers have not investigated *K. nemoralis* for soap production, despite its known medicinal properties. Research into plant-based soap formulations has shown the benefits of using natural ingredients to enhance medicinal properties. Researchers have studied various plants for their potential to provide antibacterial, antifungal, and anti-inflammatory effects in soap. However, *K. nemoralis*' potential in this context remains unknown. Traditional uses of *K. nemoralis* include alleviating malarial chills, skin pruritus, diabetes, and fever-induced thirst. Indians also use *K. nemoralis* as an anti-venom for snake bites, utilizing its anti-inflammatory, tranquilizing, and analgesic properties to provide symptomatic relief (Wahab & Rahman, 2022). This research aims to develop and characterize soap using *K. nemoralis* extract. Fresh leaves were washed, dried, and powdered. The extraction was performed using the maceration method with methanol as the solvent. The resulting extract was then incorporated into a melted soap base, which was allowed to harden. The formulated

soap underwent various physicochemical evaluations, including pH determination, skin irritation tests, washing capability, foamability, foam retention time, and moisture content. The *K. nemoralis* soap demonstrated promising results, meeting acceptable standards in terms of quality and performance. The physicochemical evaluations indicated that the soap possesses beneficial properties, suggesting its potential as a natural alternative to synthetic antibacterial agents. Future research should focus on improving the soap's appearance for marketability, optimizing the formulation for maximum efficacy and safety, and further evaluating its antibacterial properties. By exploring the potential of *K. nemoralis* in soap production, this research contributes to the development of new natural products that harness the medicinal benefits of this plant, offering safer and more effective alternatives to synthetic soaps.

METHODOLOGY

This study aimed to explore the potential of *K. nemoralis* for soap production. The relevance of this research lies in addressing the growing concerns regarding the harmful effects of synthetic antibacterials in commercial soaps and providing a natural alternative. *K. nemoralis*, known for its extensive use in traditional medicine, was investigated for its beneficial compounds and suitability for soap production. The chosen methods were selected for their simplicity, cost-effectiveness, and ability to preserve the properties of the plant extract.

1.0 *K.nemoralis* Extraction

The research began with the collection and preparation of *K. nemoralis* plants. Fresh plants were washed under running tap water and cut into small pieces. They were then dried under shade at room temperature and powdered using a blender, producing a fine powder from a large quantity of plant material (Badave, A. et al., 2023).

The maceration method was employed to extract the beneficial compounds from *K. nemoralis*. This method was selected due to its advantages in terms of simplicity, cost-effectiveness, and control over the ingredient properties. The extract was obtained by soaking 260 g of dried *K. nemoralis* powder in 2.6 L of methanol in a container. The mixture was sealed, soaked for one day, and manually stirred at one-hour intervals to ensure thorough extraction. Vacuum filtration separated any solid residues from the methanolic extract after soaking. To obtain the crude extract, the filtrate was rotary evaporated at 60 °C until the methanol was completely evaporated (Bahari et al., 2021). To prevent light and deterioration, the crude extract was stored in an amber bottle until it was ready to be used again.

2.0 Production of soap with *K.nemoralis* extract

The production of the soap was carried out in accordance with the procedure that was described by Bahari et al. (2021), with a little modification in which the stearic acid, citronella oil, and cinnamon oil were not added to the melted soap. This was done in order to ensure that the antibacterial qualities of the soap were not affected by the ingredients. This is due to the fact that stearic acid (McGaw et al., 2002), citronella oil (R Singh & Agrawal, 2015), and cinnamon oil (Hafeeda Rosdan et al., 2016) have antibacterial properties that may alter the targeted results.

Online shopping was used to purchase the soap base. The first step was to break down ten grams of soap base into smaller pieces, which were then melted in a water bath. After that, two grams of the methanolic extract of *K.nemoralis* were added to the soap that had been melted. The mixture was poured into a soap mold after being gently agitated for approximately 30 minutes. The soap was allowed to solidify at room temperature until it achieved the appropriate texture and thereafter underwent a physical analysis to observe any alterations in its properties (Bahari et al., 2021).

3.0 Characterization of Soap

To characterize soap made using *K.nemoralis* extract, an extensive evaluation approach was used as follows:

*3.1 Physicochemical evaluation of *K.nemoralis* soap (Organoleptic evaluation)*

Soap made with *K.nemoralis* extract is tested for physical and sensory qualities. Consider the soap's colour, texture, and odour, which should be uniform and defect-free. Organoleptic qualities affect consumer perception and acceptability of the product, making this evaluation critical to characterisation. (Badave, A. et al., 2023).

3.2 Determination of pH

2 g of *K.nemoralis* soap was mixed with 10 ml of distilled water and swirled until completely dissolved. The pH of the soap was measured with a universal indicator. (Badave, A. et al., 2023).

3.3 Moisture content

A small amount of soap (3 g) was weighed, and the initial weight was recorded. The soap sample was dried in an oven at 100-115°C until get constant weight. After drying, the sample was cooled in a desiccator and then weighed again. The moisture content was calculated using the formula in equation 1 (Ruckmani et al., 2015).

$$\text{Moisture content (\%)} = \frac{\text{Initial weight (g)} - \text{dry weight (g)}}{\text{initial weight (g)}} \times 100 \quad \text{Equation (1)}$$

3.4 Washing capability

The washability of *K.nemoralis* soap was investigated (Badave, A. et al., 2023). The soap was massaged into the skin for 5 minutes. After 5 minutes, the soap's ability to be rinsed off with water with no residual color or texture was identified.

3.5 Foamability

To test the soap's ability to form foam, approximately 1.0 g of *K.nemoralis* soap was placed in a 100 mL conical flask and dissolved in 50 mL of distilled water. It was vibrated for approximately 10 minutes during the measuring cycle. After 10 minutes, the foam's height was measured. The mean was derived after recording the observations from five consecutive experiments (Badave, A. et al., 2023)

3.6 Foam retention time

Foam retention time refers to how long the soap's foam lasts. To test this, a soap solution was shaken to create foam, and then it was left to sit. The amount of foam was measured every 5-10 minutes until it disappeared. This helped determine how long the foam lasted (Badave, A et al., 2023).

3.7 Irritation of the skin test

A patch test of the skin was performed. A small amount of *K.nemoralis* soap was rubbed into the skin for five minutes. It was removed after 5 minutes, and signs of discomfort and rashes were observed (Badave, A. et al., 2023).

This study involved two participants in a preliminary skin irritation test. The small sample size was chosen due to the exploratory nature of the study. Future studies with larger sample sizes will be conducted to validate these findings.

FINDINGS

Soap characterization

The soap characterisation evaluation findings are in Table 1. The soap made with *K.nemoralis* extract showed numerous remarkable features and possible consumer benefits.

Table 1. Characterization and physicochemical tests of *K.nemoralis* soap

Parameters	Evaluation
Colour	Dark green
Odour	Grassy
Texture	Solid, hard
pH	8
Washability	Easily washable
Moisture content (%)	10.11%
Foam height	64mm
Foam retention time	150 minutes
Irritability	No skin irritation

Physicochemical test

The dark green color of the soap suggests that the natural pigments from the plant extract were effectively incorporated into the soap, which may appeal to consumers seeking products with a natural appearance. This colour also indicates the potential presence of chlorophyll and other plant compounds, which could have additional skin benefits. The soap's grassy smell goes with the idea that it is pure and organic because it uses plant extracts. Some people might like this scent if they like earthy or herbal scents in their personal care items. The smell also shows that the aromatic compounds in the extract are still present in the soap after it is made, which could make using the soap more enjoyable overall.

Figure 1 shows that the solid, hard shape of the soap shows that the saponification and curing processes went well, which is necessary to make a bar that will last. If the soap has a hard feel, it probably won't dissolve quickly in water, so it will last longer and be more valuable to customers. A strong and firm bar is also easier to store and handle, which makes it better for everyday use.



Figure 1. *K.nemoralis* soap

pH and moisture content

The pH value of 8 indicates that the soap is mildly alkaline, which is normal for both homemade and store-bought bar soaps. The pH level at this point cleans well and kills germs, so it's safe to use on the skin regularly. It is still within a range that is usually thought to be safe and not irritating for most skin types, which fits with the fact that the soap did not irritate the skin. The pH range for human skin is 4.1 to 5.8 (Proksch, 2018).

The amount of moisture in the soap (10.11%) is about right for bar soaps, which means it has been properly cured and has a stable makeup. The right amount of wetness is important for keeping the soap's shape because it stops it from getting too dry and brittle or too wet and mushy. This balance makes sure that the soap lasts and works well for a long time. According to Devi et al. (2023), the normal amount of water in soap is between 5.40 and 15.12 %. It is normal for foam to be stable between 35 and 80 mm (Devi et al., 2023)

Washing capability, foamability and foam retention time

The washability of the soap, being easily washable, suggests that it rinses off quickly and does not leave a residue. This property enhances user experience by providing a clean and fresh feeling post-wash, reducing the likelihood of soap buildup on the skin or bathroom surfaces. This can be particularly appealing to consumers who prioritize convenience and effectiveness in their personal care products.

The foam height of 64 mm and foam retention time of 150 minutes demonstrate the soap's excellent foaming properties. As shown in Figure 2, high foam height and prolonged foam retention are desirable traits, as they suggest the soap can produce a rich, creamy lather that lasts, enhancing the cleansing experience. This is particularly important for consumers who associate abundant foam with effective cleaning and a luxurious feel.

The soap is easily washable, which means it comes off quickly and doesn't leave behind any residue. This trait improves the user experience by making the skin feel clean and fresh after washing, which makes it less likely that soap will build up on the skin or bathroom surfaces. This can be especially appealing to people who want their personal care products to be both easy to use and efficient. The soap foams very well, as shown by the 64 mm foam height and 150 minutes of foam retention. As can be seen in Figure 2, high foam height and long foam retention are good qualities because they mean the soap can make a rich, smooth lather that lasts, which makes washing more enjoyable. People who believe that a lot of foam equals good cleaning and a pleasant feel will find this to be very significant.

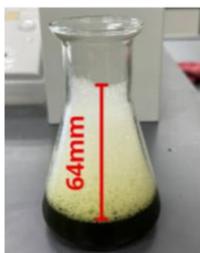


Figure 2. *K.nemoralis* soap foam height

Skin irritation

Subsequently, a significant finding is that it does not cause any skin discomfort when applied. This implies that the soap is mild, making it suitable for use by individuals with a variety of skin types, including the most sensitive ones. This makes it a more adaptable product for a wider range of buyers, which increases its market potential.

It looks good, smells good, and feels good, which means that the soap made from *K.nemoralis* material is a good product. The smell and natural color may appeal to people who care about the environment. It's also useful and durable because it's hard. Soap that is natural, lasts a long time, and smells good can meet the needs of people who read this description. The soap will work better and safer if we do more tests on it, such as checking the pH, seeing how foamy it is, and seeing if it affects the skin. Finally, soap made from *K.nemoralis* extract has a good pH level, is simple to clean, has the right amount of wetness, foams well, and doesn't hurt the skin. Based on these findings, the soap seems like it could be a nice, useful, and safe bathroom item. All of these things make it a great choice for people who want clean products that are both pure and efficient. It needs more study to see how it works compared to store-bought products and how it impacts skin health over time.

CONCLUSIONS

The soap produced using extract from *K.nemoralis* demonstrates desirable physicochemical properties, including a dark green colour, grassy odour, and solid, hard texture. It has a mildly alkaline pH of 8, is easily washable, and maintains a balanced moisture content of 10.11 %. The soap shows excellent foaming properties with a foam height of 64 mm and a foam retention time of 150 minutes. Importantly, it caused no skin irritation, indicating it is gentle and safe for use on various skin types.

While the soap exhibits many favourable properties, there are a few limitations to consider. The mildly alkaline pH, although typical for many soaps, may still be unsuitable for individuals with highly sensitive skin or conditions like eczema. Additionally, the natural colour and odour, while appealing to some consumers, might not be

preferred by others who favour synthetic fragrances and colours. Further, the study did not assess the long-term effects of the soap on skin health or its performance compared to commercially available alternatives.

The findings suggest that *K.nemoralis* extract can be effectively used in soap production, providing a natural alternative to synthetic ingredients. This has implications for the growing market of natural and eco-friendly personal care products. The soap's good washability and foaming properties, combined with its lack of irritability, make it a practical option for everyday use. The study supports the potential for further development and commercialization of natural soaps with beneficial properties.

In conclusion, the soap made from *K.nemoralis* extract is a promising natural product with excellent physicochemical properties, effective cleansing capabilities, and safety for general use. Future research should focus on long-term skin health effects, consumer preferences, and comparisons with commercial soaps. Additionally, exploring other plant extracts in combination with *K.nemoralis* could further enhance the soap's benefits and appeal.

COMPLIANCE OF ETHICAL STANDARDS

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional. Informed consent was obtained from all individual participants included in the study.

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Tarikh : 20 Januari 2023

Prof. Madya Dr. Nur Hisham Ibrahim
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Cawangan Perak



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Sekian, terima kasih.

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Saya yang menjalankan amanah,

Setuju.

27.1.2023

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