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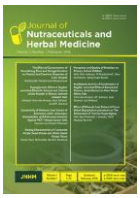

WHITE MANGROVE PIDADA (SONNERATIA ALBA) LEAVES EXTRACT IN HANDBODY LOTIONS: A QUALITATIVE EVALUATION AND ALIGNMENT WITH INDONESIAN NATIONAL STANDARDS

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Abstract

The White Mangrove Pidada Leaves (Sonneratia alba) serve as a source of secondary metabolites, including phenols, tannins, steroids, and flavonoids, known for their high antioxidant content, making them effective in countering free radicals. The choice of a handbody lotion formulation is based on its easy skin absorption, non-sticky nature, and absence of residue upon application. The focus of this study is to evaluate the handbody lotion formulation enriched with White Mangrove Pidada Leaves extract. Utilizing a qualitative approach, this study employed a cycling test conducted over three cycles for the evaluation of handbody lotion formulations. After three cycles, Formula A demonstrated a semi-solid consistency, light green color with a grape scent, pH 6, and homogeneity. Notably, it showcased a spreadability of 4.925 cm, adhesiveness of 1.76 seconds, and viscosity of 6.791 mPa.S. In the case of Formula B, a semi-solid with a light green color and grape scent, despite having pH 6, exhibited a lack of homogeneity, with a spreadability of 5.175 cm, adhesiveness of 1.37 seconds, and viscosity of 6.592 mPa.S. Formula C, characterized as a semi-solid with a dark green color and grape scent, displayed homogeneity, pH 6, a spreadability of 5.25 cm, adhesiveness of 2 seconds, and viscosity of 7.568 mPa.S. The findings lead to the conclusion that, following three cycles, the handbody lotion formulations align with the criteria established by the Indonesian National Standard (SNI).

Keywords: Handbody lotion formula, White Mangrove Pidada Leaves extract, Cycling test, Qualitative evaluation

INTRODUCTION

The integumentary system, comprising the skin, serves as the body's primary barrier, playing a pivotal role in protecting against external threats and maintaining homeostasis. Its multifaceted functions include the prevention of transdermal water loss, the inhibition of free radical damage through its antioxidant properties, and the regulation of body temperature through mechanisms such as sweat production and vasodilation [1]. In the realm of dermatology and cosmetology, the term "cosmetics" finds its etymological

roots in the Greek word "kosmetikos," signifying the art of embellishment and arrangement. Cosmetics encompass a diverse array of substances applied to various external features such as nails, lips, hair, and skin cuticles, with the overarching objectives of enhancing attractiveness, improving aesthetic qualities, and safeguarding against environmental stressors [2].

Furthermore, the maintenance of skin health is imperative, as compromised skin integrity can have profound implications for overall well-being. The dynamic interplay between skincare practices and cosmetic applications is crucial for fostering not only external beauty but also the holistic health of the integumentary system. Research continues to unveil innovative ingredients and formulations that contribute to both cosmetic enhancement and skin health, underscoring the interdisciplinary nature of dermatological and cosmetic sciences.

The utilization of lotions in cosmetic practices is a common approach for enhancing external beauty, altering appearance, increasing attractiveness, and addressing body odor, with a primary focus on aesthetic improvement rather than therapeutic healing [3]. Lotions, characterized as liquid emulsions stabilized by emulsifiers, typically consist of an oil phase and a water phase, often incorporating one or more active ingredients to achieve specific cosmetic objectives [3]. Unlike other cosmetic formulations such as gels and creams, lotions offer practical advantages in terms of ease of application over larger body areas, particularly the hands and feet [4]. Handbody lotion, a subtype of topical lotion formulations, is adaptable to various consistencies, with oil-in-water (O/A) or water-in-oil (A/M) configurations. Its liquid formulation facilitates quick and even spreading on the skin surface, distinguishing it from thicker formulations like creams or ointments [5].

In the context of this study, the focus is on the potential benefits of Sonneratia alba, a mangrove plant indigenous to Klidang Lor Village, Batang Regency. Noteworthy constituents of Sonneratia alba include flavonoids, triterpenoids, saponins, and tannins, with flavonoids recognized for their widespread application in traditional medicine. Flavonoids exhibit antioxidant, anticoagulant, antihypertensive, antiviral, and anti-inflammatory properties, underscoring their significance in medicinal contexts [6]. Motivated by the unique properties of Sonneratia alba, the author seeks to explore the development and evaluation of handbody lotion formulations incorporating extracts from the mangrove plant. This endeavor aims to contribute to the understanding of the potential cosmetic and skin health benefits associated with Sonneratia alba, particularly when applied in lotion formulations, providing a scientific basis for its integration into skincare practices.

METHODS

Materials

The research employed a diverse array of tools to facilitate the investigation, ensuring precision and efficiency in the various stages of formulation and evaluation. Key instruments included glass beakers, measuring cups, 40 mesh sieves, glass funnels, rotary

evaporators (HEIDOLPH) for solvent removal, pH meters for acidity determination, evaporating cups, blenders for homogenization, mortars and stampers for manual processing, water baths for temperature control, ovens for drying, and viscometers for assessing viscosity. Further, the primary material under investigation was the white pidada mangrove leaf extract (Sonneratia alba), extracted from the plant through the maceration method utilizing ethanol as the solvent.

The formulation of the handbody lotion involved a carefully curated selection of ingredients. These included cetyl alcohol, lanolin, stearic acid, glycerol, triethanolamine, methyl paraben, propyl paraben, and distilled water. Each ingredient plays a specific role in the formulation, contributing to the overall characteristics and efficacy of the lotion. Cetyl alcohol and stearic acid, for instance, may function as emollients and thickeners, while glycerol contributes to moisturization. Triethanolamine serves as a pH adjuster, and methyl/propyl parabens act as preservatives to enhance the shelf life of the product. Distilled water is employed as a solvent and base for the formulation.

Dried leaves

The sampling process was conducted in Sidomulyo Village, Klidang Lor District, Batang Regency, with a focus on obtaining samples from the Sonneratia alba plant. Specifically, young leaves of the Sonneratia alba plant were selected for the study. To ensure the cleanliness of the samples, the leaves underwent a preliminary cleaning step using running water, effectively removing any dirt adhering to the surfaces. After the cleaning process, the selected Sonneratia alba leaves were subjected to a drying period of approximately 24 hours. This drying step aims to reduce moisture content in the leaves, facilitating subsequent processing and preserving the integrity of the plant material. Once adequately dried, the Sonneratia alba leaves were processed further by grinding them into a fine powder using a blender. The grinding process served to homogenize the plant material, breaking it down into smaller particles for subsequent extraction. Further, to obtain a refined and uniform powder, the ground Sonneratia alba leaves were then filtered through a 40 mesh sieve. This mesh size ensured the separation of any coarse particles, resulting in a simplicia powder characterized by a consistent and fine texture.

Extract Preparation

In the extraction process, a representative sample weighing 1000 grams of Sonneratia alba leaves was subjected to maceration using 96% ethanol. The maceration involved soaking the samples in 5 liters of ethanol for a duration of 5 days. During this period, the mixture was stirred at regular intervals of 24 hours to facilitate the extraction of bioactive compounds from the plant material. Following the 5-day maceration period, the mixture underwent filtration using filter paper. This filtration process resulted in the production of the first filtrate, which contains the extracted compounds in solution. The remaining residue from the first maceration was subjected to a second round of maceration, this time with 2 liters of ethanol, and left to soak for an additional 3 days. Similar to the first maceration, the mixture was stirred periodically.

After the 3-day maceration, the second mixture was filtered, yielding a second filtrate. Subsequently, the two filtrates from the first and second macerations were combined to consolidate the extracted compounds. The combined filtrates were then subjected to the evaporation process using a Rotary Vacuum Evaporator. This apparatus utilizes vacuum pressure to lower the boiling point of the solvent (ethanol in this case), facilitating the removal of the solvent while leaving behind a concentrated, thick extract.

Statistical Analysis

The statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS), employing the t-test method. In accordance with standard practices, results were considered significant if the p-value obtained was less than 0.05 ($p<0.05$). The significance level of 0.05 serves as a widely accepted threshold, indicating that observed differences are unlikely to have occurred by chance (**Table 1**).

Table 1. Formulation of Sonneratia alba Leaf Extract Handbody Lotion

Material	Content in %)		
	A	B	C
Sonneratia alba Leaf Extract	0,3	0,6	0,9
Cethyl Alcohol	2	2	2
Lanolin	2	2	2
Stearic Acid	6	6	6
Gliserol	4	4	4
Triethanolamin	0,2	0,2	0,2
Methyl Paraben	0,18	0,18	0,18
Propyl Paraben	0,02	0,02	0,02
Aquadest ad	100	100	100

Preparation of the Handbody Lotion

The formulation process for the handbody lotion involves two distinct phases: the oil phase and the water phase. Each phase comprises specific ingredients serving different functions. The oil phase consists of cetyl alcohol, lanolin, and stearic acid, while the water phase incorporates glycerol, triethanolamine, methyl paraben, and propyl paraben. Further, the formulation process begins with heating both the oil phase and the water phase to a temperature of 70℃. This temperature is crucial for achieving proper solubility and homogeneity of the ingredients in their respective phases. Subsequently, the oil phase

is introduced into a hot mortar. Simultaneously, the water phase and distilled water are added gradually to the mortar, all the while stirring continuously. This gradual addition helps in achieving a homogeneous mixture and prevents clumping or separation of the ingredients.

The stirring process is continued until the entire formulation becomes a uniform and cohesive lotion. This step is critical for ensuring that the oil and water phases are effectively emulsified, resulting in a stable and well-blended lotion. Once the lotion base is formed, the next step involves incorporating the white pidada leaf extract. This extract, obtained through the meticulous extraction process, is added to the lotion and stirred thoroughly until homogeneity is achieved. The addition of the extract introduces the beneficial compounds from Sonneratia alba leaves into the lotion formulation, providing potential cosmetic and skincare benefits.

Evaluation of the Lotion

The assessment of the handbody lotion formulation involves a series of diverse tests aimed at ensuring its overall quality and effectiveness. In the organoleptic test, the lotion's visual attributes, including shape, color, and odor, are directly observed, providing insights into its sensory characteristics. The pH of the preparation is determined through an etching process using universal pH indicators, with the resulting color change indicating the acidity or alkalinity of the lotion. Homogeneity is visually inspected to ascertain whether the formulation is uniform in composition.

The spread power test involves weighing 0.5 grams of the lotion and assessing its coverage on a glass surface, considering the diameter after the addition of weights. The stickiness of the preparation is evaluated by placing a weighed amount on an object glass, applying a weight for 5 minutes, and measuring the time it takes for the weight to be released. Viscosity, a crucial aspect of texture and consistency, is measured using a Brookfield LV viscometer, providing quantitative data on the formulation's flow characteristics.

Stability is assessed through a cycling test, involving exposure to temperature fluctuations. The lotion is stored at 4℃ for 24 hours and then transferred to an oven at 40℃ for an additional 24 hours, repeated for three cycles. Throughout this process, various parameters such as organoleptic qualities, homogeneity, pH, spreadability, stickiness, and viscosity are closely observed.

RESULTS AND DISCUSSION

Results

Following the research, a concentrated extract weighing 99.7 grams was successfully obtained through the evaporation process. Subsequently, formulations were developed based on the specific ingredients and methods outlined earlier in the study.

These formulations were then subjected to a comprehensive evaluation both before the cycling test and after undergoing three cycles. The evaluation process involved a thorough examination of various parameters, including organoleptic characteristics such as shape, color, and odor. Additionally, assessments were made on the pH levels, homogeneity, spread power, stickiness, and viscosity of the handbody lotion formulations.

Organoleptic

The organoleptic testing of Sonneratia alba leaf extract handbody lotions aimed to evaluate their physical characteristics, including shape, color, and odor. The observations before the cycle and after three cycles revealed that the formulations (labeled A, B, and C) remained consistent. All three formulations exhibited a semi-solid form with light green color and a grape scent, both before the cycling test and after three cycles. Furthermore, pH testing was conducted to assess the acidity or alkalinity of the formulations, crucial for determining skin compatibility. The pH values were measured for each formula, and it was observed that they remained relatively stable (**Table 2**).

Table 2. pH Test Results for Sonneratia alba Leaf Extract Handbody Lotion

Formula	Before the Cycle	After three cycles
A	5.5	5.4
B	5.6	5.5
C	5.7	5.6

The analysis was conducted with three replications, and the results indicated no significant difference with a significance level of $p<0.05$

The pH testing results indicate that the pH values of the lotion formulation, both before the cycle and after three preparation cycles, fall within the recommended range specified in the literature requirements according to SNI 16.4339-1996. The specified pH range for lotions is between 4.5 and 8. The consistent pH values within this range affirm that the lotion preparation is in compliance with safety standards, making it suitable and safe for use on the skin.

Homogeneity

The objective of the homogeneity test is to assess and confirm whether the handbody lotion formulations are evenly mixed. The data indicates that the ingredients in the formulations are uniformly distributed, ensuring a homogeneous texture and composition. The homogeneity testing results for the handbody lotion formulations, as presented in **Table 3**, reveal consistent observations both before the cycle and after three cycles.

Table 3. Homogeneity testing of the lotion

Formula	Before the cycle	After three cycles
A	Homogeneous	Homogeneous
B	Homogeneous	Homogeneous
C	Homogeneous	Homogeneous

Formulations A, B, and C demonstrated homogeneity in their preparation at both testing stages. This uniformity is maintained throughout the cycling test, highlighting the stability and consistent quality of the handbody lotion preparations. The findings from the homogeneity testing further support the formulations' suitability for cosmetic use, emphasizing their reliability and uniform performance over repeated cycles.

Spread Power

The objective of the dispersion power test is to assess the quality of dispersion in the three formulations. A higher dispersion power suggests that the preparation can be readily spread and absorbed into the skin upon application. The test aims to evaluate whether the dispersion power of the three formulations is satisfactory, as a superior dispersion power is indicative of improved release and absorption characteristics into the skin. The results of this test demonstrated in **Table 4**.

Table 4. Spreadability Assay of the lotion

Formula	Before the cycle (cm)	After three cycles (cm)
A	5,37	4,92
B	4,75	5,17
C	4,92	5,25

The analysis was conducted with three replications, and the results indicated no significant difference with a significance level of $p<0.05$

The obtained values fall within the specified requirements of 5-7 cm, demonstrating that the lotion can be easily and effectively spread on the skin. This favorable spreadability is a key attribute, contributing to the user-friendly application and absorption of the lotion. The formulation's ability to meet the specified spreadability range enhances its practicality and user experience, making it well-suited for skincare applications.

Stickiness

Table 5 presents the results of the adhesion tests conducted to assess the duration of adhesion when the handbody lotion is applied to the skin. This test aims to evaluate the

lotion's ability to adhere to the skin over a specified period. The duration of adhesion is a crucial factor in determining the longevity of the lotion's effectiveness after application.

Table 5. The adhesion assessment of the lotion

Formula	Before the cycle (s)	After three cycles (s)
A	1,94	1,76
B	1,14	1,37
C	1,53	2,00

The analysis was conducted with three replications, and the results indicated no significant difference with a significance level of $p<0.05$

Among the three formulations, Formula 2 exhibited lower adhesive power, lasting for 1.37 seconds compared to the other formulas. Adequate adhesion is vital for ensuring a more prolonged contact time with the skin, ultimately enhancing the lotion's ability to deliver maximum effectiveness. Despite differences in adhesive power among the formulations, it's noteworthy that all three handbody lotion formulations still comply with the specified requirements for the adhesion test for topical preparations, which is less than 4 seconds. This adherence to the defined standards indicates that each formulation meets the desired criteria for skin contact time, reinforcing their suitability for topical application.

Viscosity

The viscosity examination was conducted to ascertain the viscosity values of the substances within the handbody lotion formulations. The viscosity test is crucial for understanding the thickness and flow characteristics of the lotion. **Table 6** presents the results of the viscosity test, providing insights into how the formulations perform in terms of their viscosity properties.

Table 6. The viscosity testing of the lotion

Formula	Before the cycle (cPs)	After three cycles (cPs)
A	9.618	6.791
B	10.521	6.592
C	10.827	7.568

The analysis was conducted with three replications, and the results indicated no significant difference with a significance level of $p<0.05$

The obtained results reveal that Formula 1 exhibits a viscosity value of 6,791 cPs, while Formula 3 demonstrates a viscosity value of 7,568 cPs. Both of these formulations exhibit relatively high viscosity values. Importantly, all three formulations, including the unspecified Formula 2, fall within the required range according to the Indonesian National

Standard (SNI), which specifies a viscosity range of 2,000-50,000 cPs for such topical preparations. This adherence to the defined standards indicates that the handbody lotion formulations possess viscosities suitable for their intended use, ensuring optimal texture and consistency for effective application on the skin.

Discussion

The results provided illustrates the distinctive characteristics of each handbody lotion formulation, where variations in color, consistency, and fragrance are attributed to the different concentrations of extract used in each formula. Formula A exhibits a light green color, a semi-solid form, and a grape fragrance. Formula B, with a higher extract concentration, displays a more intense color, maintains a semi-solid consistency, and carries a grape scent. Formula C, featuring a 0.9% extract concentration, presents a dark green color, a semi-solid texture, and a grape odor.

Through storage across three preparation cycles, these formulations demonstrated stability with no significant changes. Subsequent pH testing aimed to assess acidity or alkalinity, crucial for preventing skin irritation. The observed pH values, consistently at 6 for all preparations, indicate adherence to the specified pH requirements for skin safety. According to SNI 16.4399-1996, the acceptable pH range for lotions is between 4.5 and 8, confirming the safety of these handbody lotion preparations for skin application. The findings collectively affirm the stability, safety, and consistent quality of the formulations throughout the testing cycles.

Homogeneity assessments play a crucial role in ensuring the thorough dispersion or dissolution of the active substance within the vehicle, maximizing its efficacy upon application. A homogeneous preparation signifies an even distribution of the active substance in the base, enhancing the formulation's potential for optimal effects [9]. The data presented indicates that the handbody lotion preparations, both before the cycle and after three cycles, achieved homogeneity. The criteria for a homogeneous preparation involve having the same color and the absence of particles, aiming to prevent color degradation and ensure even mixing to avoid skin irritation [10]. Additionally, it is essential to highlight that the homogeneity maintained across the three cycles underscores the stability of the formulations. This stability is pivotal for ensuring that the active ingredients remain evenly distributed, providing consistent quality and efficacy over extended periods. The absence of color variation and particles in the preparations further reinforces their safety and reliability for skin application.

The spreadability test is designed to assess the skin lotion preparation's ability to evenly spread upon application. A formulation with insufficient spreading power may require excessive pressure during use, impacting user experience. Conversely, a formulation with robust spreading power ensures that application is gentle, promoting an even distribution of active ingredients on the skin, thereby optimizing the desired effects [11]. Further, analyzing the data presented, it's evident that each preparation exhibited different spreadability values. After the cycling test, Formula A demonstrated a

spreadability of 4.925 cm, Formula B exhibited 5.175 cm, and Formula C showed 5.25 cm. These results indicate varying spreadability among the formulations. Notably, the data confirms that all three skin lotion formulations fall within the specified requirements for topical preparations, with a spreadability range of approximately 5-7 cm. This suggests that the formulations are well-suited for application, providing an optimal spread to enhance their effectiveness and user satisfaction.

The adhesive test serves the purpose of gauging the extent to which a skin lotion adheres to the skin surface upon application. Striking a balance is crucial, as excessively strong adhesive force may impede skin breathing, while weak adhesion may compromise the desired effectiveness [12]. Among the three formulations, Formula B exhibited lower adhesive power, lasting for 1.37 seconds compared to the other formulas. Despite displaying slightly unstable results, Formula B still complies with the specified requirements for the adhesion test. Furthermore, the adhesion test results are closely tied to the viscosity value, where higher viscosity contributes to a longer adhesion time during testing. Optimal adhesion ensures a lengthier contact time with the skin, enhancing the lotion's potential for maximum effectiveness. Importantly, all three handbody lotion formulations meet the requirements stipulated for the adhesion test for topical preparations, which necessitates a duration of less than 4 seconds [13]. This reaffirms the suitability of these formulations for topical use, ensuring adherence to safety and efficacy standards.

Viscosity in preparations is influenced by various factors such as mixing conditions during the preparation process, the choice of thickening agents and surfactants, as well as particle size and the nature of dispersed materials [14]. The viscosity examination is conducted to determine the thickness and flow characteristics of a substance. Analyzing the data presented, the viscosity values for Formulas A, B, and C before the cycling test were 9,618 cP, 10,521 cP, and 10,827 cP, respectively. Post-cycling test, the viscosity values were observed to decrease, with results for Formula A at 6,791 cP, Formula B at 6,592 cP, and Formula C at 7,568 cP. Lower viscosity values indicate thinner preparations with faster flowing properties. However, despite the observed decrease, all three formulations still fall within the specified quality requirement range of 2000-50,000 cPs. This suggests that the formulations maintain suitable viscosity levels, ensuring their practicality and adherence to quality standards. The variations in viscosity values also provide valuable insights into the flow characteristics and user experience of the handbody lotions.

The assessment of the handbody lotion formulations involved various tests to evaluate their physical and chemical properties. The spreadability test indicated that all three formulas met the requirements, demonstrating effective spreading abilities. Adhesion tests revealed slightly less adhesive power in Formula B but still within acceptable limits. The formulations remained stable, meeting homogeneity requirements both before and after three cycles. Viscosity tests showed a decrease in viscosity after the cycling test, yet all three formulas still fell within the acceptable range of 2000-50,000 cPs. The pH values remained within the safe range (pH 6), complying with SNI standards. Overall, the

formulations demonstrated good performance, meeting quality criteria for skin safety and effectiveness.

CONCLUSION

Based on the conducted research, the conclusion can be drawn that the Sonneratia alba leaf extract, following evaluations over three cycles using parameters such as pH, organoleptic characteristics, homogeneity, viscosity, spreadability, and adhesiveness, meets the standards set by the Indonesian National Standard (SNI). The assessments conducted on the preparations indicate that they adhere to the specified criteria, affirming their compliance with established quality and safety standards. This suggests that the handbody lotion formulations, incorporating Sonneratia alba leaf extract, demonstrate favorable characteristics and are suitable for use according to recognized standards.

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