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PHYSICAL STABILITY TESTING OF HAND AND BODY LOTION FORMULATIONS WITH LINGZHI MUSHROOM EXTRACT

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ABSTRACT

This study aims to evaluate the physical stability of hand and body lotion formulations containing Lingzhi mushroom (Ganoderma lucidum) extract at various concentrations (0%, 0.25%, 0.50%, and 0.75%). The extract was obtained through maceration using 96% ethanol and incorporated as an active ingredient in lotion formulations. Physical stability parameters assessed over a 28-day storage period included organoleptic characteristics, homogeneity, pH, spreadability, and skin irritation. Results indicated that all lotion formulations exhibited good homogeneity, pH values within the acceptable range (4.95–5.68), and spreadability within standard criteria (5.72–6.27 cm). No skin irritation effects were reported among respondents. The 0.50% extract concentration received the highest user preference in terms of color and aroma. Overall, the study concludes that Lingzhi mushroom extract can be effectively used as a stable, safe, and consumer-acceptable active ingredient in natural skin care product formulations. Among the tested concentrations, the 0.50% extract formulation demonstrated the most optimal balance in terms of user preference and physical properties.

Keywords: *Lingzhi mushroom, hand body lotion, physical stability, pH, spreadability*

INTRODUCTION

The skin is the outermost organ of the body and plays a vital role as a protective barrier against various external factors such as ultraviolet (UV) radiation, pollution, and pathogenic microorganisms (Kurniawati et al., 2022). To maintain the skin's health and its optimal function in facing these exposures, regular care is essential. One common form of skincare is the use of topical preparations such as hand and body lotion, which serves to maintain moisture, hydrate the skin, and protect it from dryness and irritation (Harahap, 2021).

However, prolonged exposure to UV rays not only causes dryness but also induces oxidative stress on the skin due to the formation of free radicals. These free radicals can damage cellular structures such as collagen and elastin, accelerating premature aging and increasing the risk of skin cancer (Aprilliani et al., 2022; Hudairiah et al., 2021). Therefore, the use of active ingredients with antioxidant properties has become a major focus in modern cosmetic formulations.

Amid growing concerns over the side effects of synthetic substances, consumers are increasingly turning to natural-based products, which are considered safer and more environmentally friendly. One natural ingredient gaining attention in the pharmaceutical and cosmetic industries is Lingzhi mushroom (Ganoderma lucidum). This mushroom has been used for thousands of years in traditional Chinese medicine and is known to be rich in bioactive compounds such as triterpenoids, polysaccharides, steroids, phenolics, and flavonoids (Bishop et al., 2015).

Various studies have shown that Lingzhi mushroom extract possesses strong antioxidant activity. Research by Hidayat et al. (2024) reported that the addition of Lingzhi mushroom extract in lotion formulations significantly enhanced free radical scavenging activity, as indicated by a decrease in IC50 values in DPPH tests. Moreover, this extract was also found to increase the Sun Protection Factor (SPF) value, indicating its potential as a natural photoprotective agent (Hidayat et al., 2024). This activity is supported by the presence of active

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compounds such as ganoderic acid, quercetin, and isorhamnetin, which function through proton donation and free radical neutralization mechanisms (Kolniak-Ostek et al., 2022; Qi et al., 2022).

Although the pharmacological and dermatological potential of Lingzhi mushroom has been extensively reported, its application in cosmetic formulations—particularly lotions—is still limited. Furthermore, there are few studies that systematically evaluate the physical stability of lotion preparations with varying concentrations of Lingzhi mushroom extract. In fact, physical stability is a critical quality parameter in cosmetic product assessment. Changes in physical characteristics such as color, aroma, texture, homogeneity, spreadability, and pH can affect product efficacy and consumer acceptance (Bidegain et al., 2020; Taofiq et al., 2017).

Based on this background, this study aims to evaluate the physical stability of hand and body lotion formulated with various concentrations of Lingzhi mushroom extract. The parameters observed include organoleptic properties, homogeneity, spreadability, and pH. The results are expected to provide scientific contributions to the development of natural skincare products that are stable, safe, and effective. Therefore, this study aims to determine the optimal concentration of Lingzhi extract that yields the best physical characteristics and user acceptability in lotion formulations.

RESEARCH METHODS

1. Extraction of Lingzhi Mushroom

Preparation of the Lingzhi mushroom extract began by grinding the dried sample using a blender. This grinding process aimed to reduce the surface area of the simplicia to optimize the extraction of active compounds. A total of 200 grams of the ground simplicia was then placed in a maceration vessel. The extraction was conducted using 500 mL of 96% ethanol (a 1:10 ratio of sample to solvent), with a soaking period of 4 × 24 hours. During this process, the mixture was stirred every 24 hours to improve extraction efficiency, based on the modified method of Dominica & Handayani (2019). After the soaking period, the mixture was filtered to separate the filtrate from the residue. The filtrate was then concentrated using a water bath system at approximately 80 °C to yield a concentrated ethanol extract of Lingzhi mushroom.

2. Preparation of Lingzhi Mushroom Extract Lotion

The hand and body lotion was prepared using Lingzhi mushroom extract as the main active ingredient. All ingredients were weighed according to the formulation shown in **Table 1**. These ingredients were divided into two phases: oil phase and water phase.

The oil phase consisted of VCO, paraffin, stearic acid, and cetyl alcohol, which were melted by heating to 80 °C. The water phase, comprising TEA, glycerin, methylparaben, and distilled water (Aqua DM), was heated separately to the same temperature. Once both phases reached around 70 °C, the water phase was gradually added to the oil phase with constant stirring using a homogenizer until a stable emulsion was formed.

Next, the Lingzhi mushroom ethanol extract was added according to the designated concentrations (0%, 0.25%, 0.50%, and 0.75%) and stirred again until the mixture was homogeneous. The final lotion formulations were then transferred into closed containers and stored at room temperature (Hidayat et al., 2024).

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Table 1. Hand and Body Lotion Formulation with Lingzhi Mushroom Extract

Ingredient	Function	I	II	III	IV
Lingzhi Extract	Active Ingredient	0	0.25	0.50	0.75
Stearic Acid	Emulsifier	4	4	4	4
Cetyl Alcohol	Softener	2	2	2	2
Paraffin	Moisturizer	1	1	1	1
VCO	Emulsifier	3	3	3	3
TEA	Emulsifier	0.5	0.5	0.5	0.5
Glycerin	Thickener	5	5	5	5
Methyl Paraben	Preservative	0.1	0.1	0.1	0.1
Fragrance	Fragrance	0.10	0.10	0.10	0.10
Coloring Agent	Colorant	0.05	0.05	0.05	0.05
Distilled Water (Aqua DM)	Carrier	q.s.	q.s.	q.s.	q.s.

3. Physical Property Tests

All experimental procedures pH, homogeneity, and spreadability tests, were conducted in triplicate (n = 3). Data are presented as mean ± standard deviation to reflect variability and ensure result reliability. All experimental procedures pH, homogeneity, and spreadability tests, were conducted in triplicate (n = 3). Data are presented as mean ± standard deviation to reflect variability and ensure result reliability

a. Organoleptic Evaluation

To evaluate the lotion formulations, organoleptic screening and user preference tests were conducted. Twenty respondents assessed the appearance, color, and aroma of the lotion samples, both freshly made and after 28 days of storage.

b. Homogeneity Test

To determine homogeneity, 100 mL of each lotion sample was spread on a glass plate and examined for the presence of coarse granules using a transparent mica sheet. A formulation was considered homogeneous if no coarse granules were visible. Observations were made weekly over a 28-day period (Aljanah et al., 2022).

c. pH Test

To ensure compliance with SNI 16-3499-1996 standards (pH 4.5–8.0), the lotion pH was measured using a pH meter. One gram of each lotion formulation was dissolved in 10 mL of Aqua DM, and the pH meter electrode was immersed to record the pH value. This test was repeated weekly for 28 days (Setiawan et al., 2022).

d. Spreadability Test

This test aimed to evaluate how well each lotion formulation spread. Each sample (100 mg) was placed on graph paper, covered with a mica sheet, and the spread diameter was measured. Observations were made weekly for 28 days. According to Vinaeni et al., (2022), good spreadability for lotion is between 5 and 7 cm.

e. Iritation Test

To assess potential skin irritation, lotion samples were applied to the backs of 20 different respondents' hands. This test was conducted once using both fresh and 28-day stored samples. Observations were made for signs of irritation such as burning, itching, redness, or stinging immediately after application (Wulandari et al., 2020).

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RESULTS AND DISCUSSION

1. Results of Lingzhi Mushroom Extraction

The ethanolic maceration of Lingzhi mushroom (Ganoderma lucidum) yielded an extract with a rendement of 14.175%, indicating a relatively efficient extraction process. Ethanol was specifically selected due to its broad solvent capability to dissolve polar and semi-polar compounds, including triterpenoids, flavonoids, and phenolics—compounds well-recognized for their antioxidant and therapeutic properties. The manual stirring every 24 hours ensured optimal contact between the solvent and the sample matrix, maximizing diffusion of active constituents. Furthermore, using a water bath for concentration at 80°C prevented thermal degradation, preserving the integrity of the bioactive compounds.

2. Evaluation of the Quality of Lingzhi Mushroom Extract Lotion

Four lotion formulations were prepared with varying concentrations of Lingzhi mushroom extract: 0% (control), 0.25%, 0.50%, and 0.75%. Visual examination revealed that increasing extract concentration resulted in a progressively deeper color, indicating the presence of natural pigments or polyphenolic compounds from the extract (**Figure 1**). Importantly, no separation or syneresis was observed, suggesting the stability of the emulsion system across all formulations.

a. Organoleptic Test Results

Organoleptic evaluation was conducted by 20 respondents focusing on visual appeal (color), olfactory perception (aroma), tactile impression (texture), and post-application sensation (irritation or comfort) (**Table 2**). The 0.50% extract formulation consistently received the highest preference with more than 50% of participants, particularly for its balanced rose-pink coloration—likely due to optimal pigment concentration without overpowering visual intensity. Aroma consistency before and after 28 days suggests that the formulation resisted oxidative degradation, which can cause unpleasant off-odors in cosmetic products.Texture was noted to remain smooth across all samples, further supporting the stability of the emulsification. The absence of irritation responses in all tested samples confirms that the Lingzhi extract, even at higher concentrations (0.75%), did not provoke adverse skin reactions, reinforcing its safety as a cosmetic active. These findings align with prior reports stating that Ganoderma lucidum has soothing and anti-inflammatory properties beneficial for sensitive skin types (Taofiq et al., 2017).

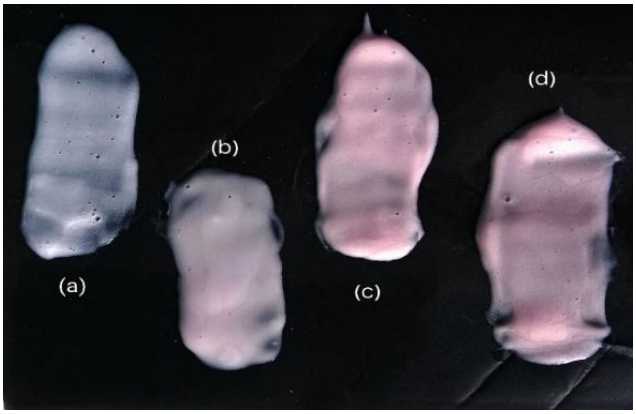

Figure 1. Hand and Body Lotion Formulations with Varying Lingzhi Extract Concentrations: (a) 0%, (b) 0.25%, (c) 0.50%, (d) 0.75%.

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Table 2. Organoleptic Test Results of Hand and Body Lotion with Lingzhi Mushroom Extract

Lotion Type	Preference (A) (n = 20)	Preference (B) (n = 20)	Color (A) (n = 20)	Color (B) (n = 20)	Aroma (A/B)	Texture (A/B)	Effect After Application (A/B)
0%	0 (0%)	1 (5%)	1 (5%)	1 (5%)	Fragrant	Smooth	No Burning and No Itching
0.25%	1 (5%)	4 (20%)	2 (10%)	1 (5%)			
0.50%	12 (60%)	11 (55%)	11 (55%)	11 (55%)			
0.75%	7 (35%)	4 (20%)	6 (30%)	7 (35%)			

b. Homogeneity Test

All formulations remained homogeneous over the 28-day observation period, demonstrating no particle aggregation or phase separation (**Table 3**). The uniformity of texture reflects the effective role of emulsifiers used—namely stearic acid, VCO, and TEA—which create a robust oil-in-water emulsion system. The consistency of homogeneity also indicates compatibility between the Lingzhi extract and the other excipients. As shown in related studies (Husni et al., 2023; Zulfaidah & Rusydan, 2024), emulsion stability is often sensitive to temperature and ingredient interactions, thus, the lack of instability symptoms is a positive indicator for real-world product shelf life.

c. pH Test Results

The pH values of all lotion samples (**Table 4**) were within the SNI 16-3499-1996 recommended range (4.5–8.0), specifically between 4.95 and 5.68. These values are compatible with the natural pH of human skin (approximately 4.7–5.5), supporting the suitability of the product for daily application. The gradual decline in pH over 28 days may result from slow hydrolysis of some extract components or continued buffering interaction among excipients. Nonetheless, the formulations remained within the functional stability zone for methylparaben, which is known to work effectively as a preservative in the pH range of 4–8 (Fadhilah & Rusmana, 2021). The slightly more acidic pH observed at higher extract concentrations suggests that Lingzhi mushroom extract may contribute mildly acidic constituents, such as phenolic acids, which can have dual roles—supporting product stability and inhibiting microbial growth.

Table 3. Homogeneity Test Results of Hand and Body Lotion with Lingzhi Mushroom Extract

Lotion Sample	Week 1	Week 2	Week 3	Week 4	Description
0%	V	V	V	V	Homogeneous
0.25%	V	V	V	V	Homogeneous
0.50%	V	V	V	V	Homogeneous
0.75%	V	V	V	V	Homogeneous

Table 4. pH Test Results of Hand and Body Lotion with Lingzhi Mushroom Extract

Lotion Type	Week 1 (Mean ± SD)	Week 2 (Mean ± SD)	Week 3 (Mean ± SD)	Week 4 (Mean ± SD)	Average pH (Mean ± SD)
0%	6.62 ± 0.08	5.50 ±0.07	5.46 ± 0.06	5.14 ± 0.09	5.68 ± 0.560
0.25%	5.82 ± 0.05	5.24 ± 0.06	5.20 ± 0.07	5.04 ± 0.08	5.33 ± 0.295
0.50%	5.58 ± 0.04	5.19 ± 0.05	5.10 ± 0.06	4.95 ± 0.07	5.21 ± 0.233
0.75%	5.15 ± 0.03	4.94 ± 0.04	4.89 ± 0.05	4.82 ± 0.06	4.95 ± 0.123

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Table 5. Spreadability Test Results of Hand and Body Lotion with Lingzhi Mushroom Extract

Lotion Sample	Week 1 (cm) (Mean ± SD)	Week 2 (cm) (Mean ± SD)	Week 3 (cm) (Mean ± SD)	Week 4 (cm) (Mean ± SD)	Average Spreadability (cm) (Mean ± SD)
0%	5.33 ± 0.15	5.37 ± 0.10	5.97 ± 0.12	6.20 ± 0.08	5.72 ± 0.377
0.25%	5.47 ± 0.10	5.47 ± 0.11	6.07 ± 0.13	6.63 ± 0.15	5.91 ± 0.482
0.50%	5.57 ± 0.09	5.80 ± 0.10	6.33 ± 0.12	7.07 ± 0.14	6.19 ± 0.577
0.75%	5.60 ± 0.08	5.97 ± 0.10	6.40 ± 0.11	7.13 ± 0.13	6.27 ± 0.569

d. Spreadability Test Results

Spreadability values across formulations ranged from 5.72 to 6.27 cm, aligning with the ideal spreadability range for lotion products (5–7 cm). A good spread diameter indicates the ease of application and effective coverage on the skin surface. Interestingly, spreadability improved slightly with increasing extract concentration, potentially due to a mild reduction in viscosity attributed to ethanol-soluble components in the extract. Higher spreadability is typically desirable, as it reflects enhanced consumer usability and may also correlate with better bioactive delivery over the skin surface (Garg et al., 2002). **Table 5** shows that spreadability slightly increased over time.

3. Overal Analysis

The cumulative data demonstrate that the addition of Lingzhi mushroom extract to lotion formulations—especially at the 0.50% concentration—results in an optimal balance of physical stability, safety, and user acceptability. This supports previous findings (Hidayat et al., 2024) regarding the biofunctional potential of Lingzhi in topical products, including its SPF value, antioxidant, photoprotective, and anti-inflammatory properties.

Notably, the extract did not disrupt emulsion stability or product texture, and its organoleptic impact was either neutral or beneficial. These findings suggest that Lingzhi mushroom extract is not only compatible with standard cosmetic bases but also adds functional and aesthetic value. For future work, extended stability testing under accelerated conditions (e.g., elevated temperature, light exposure) and efficacy evaluation would further validate its commercial potential as a natural cosmeceutical agent.

CONCLUSION

This study shows that Lingzhi mushroom extract (*Ganoderma lucidum*) can be formulated into hand and body lotion preparations with stable physical properties. The addition of extract at various concentrations (0%, 0.25%, 0.50%, and 0.75%) did not negatively affect the homogeneity or texture of the lotion. All formulations demonstrated good homogeneity, pH values within the standard range (4.5–8.0), spreadability consistent with quality criteria (5–7 cm), and no observed skin irritation.

Based on organoleptic tests, the lotion with 0.50% extract concentration was the most preferred by respondents, especially in terms of color and fragrance. The addition of Lingzhi extract gave the lotion a deeper color, but it remained well-accepted by users. These findings underscore the potential for Lingzhi mushroom extract as a valuable, stable, and consumer-preferred active ingredient in commercial natural skincare products. Future research should focus on extended stability testing under accelerated conditions and comprehensive bioactivity evaluations to further validate its efficacy and long-term commercial potential as a cosmeceutical agent.

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