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EXTRACTION OF OIL FROM *Luffa cylindrica* L. SEEDS AND APPLICATION IN SKIN CREAM

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ABSTRACT

In this study, oil was extracted from the seeds of *Luffa cylindrica* L. using maceration with *n*-hexane at various material-to-solvent ratios. The 1:5 ratio resulted in the highest oil content, yielding 53.48%. The extracted oil had a density of 0.86 g/cm³, an acid value of 41.978 mg/g, and a saponification value of 232 mg KOH/g. Gas chromatography-mass spectrometry (GC-MS) analysis revealed significant levels of oleic acid (27.66%) and palmitic acid (12.3%). The oil demonstrated antibacterial activity against *Staphylococcus aureus*, with a 7 mm inhibition zone. It was incorporated into a skin cream formulation at a concentration of 5%. The final product exhibited a non-greasy texture, good spreadability, rapid absorption, non-irritating to the skin, and microbiological safety, receiving positive feedback from consumers. These findings suggest that Luffa seed oil is a promising bio-based emollient for skincare applications.

Keywords: Luffa cylindrica L. seed, Luffa seed oil, maceration, skin cream.

1. INTRODUCTION

Luffa cylindrica L., known as sponge gourd, is widely cultivated in tropical regions. Its seeds have been reported to contain a considerable oil content, approximately 31.6% [1]. The oil contains unsaturated fatty acids, mainly linoleic acid (31.47%) and oleic acid, as identified in the seed flour [2]. Studies have demonstrated that Luffa seed oil possesses a high concentration of linoleic acid and exhibits a favorable saturated-to-unsaturated fatty acid ratio [3]. Specifically, the oil comprises 33.07% saturated fatty acids, 14.90% monounsaturated fatty acids, and 52.02% polyunsaturated fatty acids. In terms of physical characteristics, the oil displays a greenish-yellow color, a viscous consistency, and a mildly sweet, fruity aroma [1].

The oil yield from Luffa seeds ranges from 41.6–45% (on a kernel basis) and 20–25% (whole seed basis) [4]. When compared to other commonly used oilseeds, Luffa seed oil

content is lower than that of sesame (50%) [5], almond (48.7–64.5%) [6], peanut (40–50%) [7], macadamia (75%) [8], and sunflower (48–52%) [9], but higher than that of soybean (20–22%) [10] and grape seed (10–20%) [11].

Currently, various natural oil-based moisturizers derived from plant seeds such as sunflower, peanut, soybean, and avocado are commercially available in the Vietnamese market. However, no skin care products utilizing Luffa seed oil have been reported. Luffa seed oil contains essential fatty acids, including linoleic acid (50.3%), oleic acid (27.3%), and palmitic acid (13.3%), with a total unsaturated fatty acid content of 77.8% [12]. These properties suggest its potential as a natural emollient capable of enhancing skin smoothness and hydration.

Given these attributes, this study aims to extract Luffa seed oil using hexane as a solvent, characterize its physicochemical properties and chemical composition, and evaluate its antimicrobial activity prior to its incorporation into the skin cream formulation. The quality of the resulting skin cream is then assessed to explore the applicability of Luffa seed oil in cosmetic formulations for skin care.

2. MATERIALS AND METHODS

2.1. Materials and chemicals

2.1.1. Material

Luffa cylindrica L. seeds were procured from Cho Lon Market, Ho Chi Minh City, Vietnam. The seeds were thoroughly washed, air-dried at ambient temperature, and ground into a fine powder before oil extraction.

2.1.2. Chemicals

n-hexane, 96% ethanol, diethyl ether, potassium hydroxide (KOH), 1% phenolphthalein solution (PP 1%), and hydrochloric acid (HCl). All chemicals were of analytical grade and used without further purification.

2.2 Oil extraction from the Luffa seed

2.2.1. Determination of the moisture content

The moisture content of the Luffa seed powder was determined using a constant-temperature oven drying method. Approximately 1 g of sample was accurately weighed into a pre-dried and pre-weighed moisture dish. The sample was dried at 105 ± 2 °C for 4 hours, then cooled in a desiccator for 30 minutes before weighing. Drying was repeated until a constant weight was achieved. The moisture content was calculated based on the weight loss before and after drying, as shown in Equation (1) [13].

$$W\ (\%)\ = \frac{m_1 - m_2}{m_1 - m_o}.100\% \quad (1)$$

where m_o is the mass of the empty ceramic bowl (g), m_1 and m_2 are the masses of the sample with the ceramic bowl before and after drying, respectively (g).

2.2.2. Oil extraction procedure

Luffa seeds were pre-treated by washing and drying at 105 °C for 2 hours, then ground into a fine powder. Oil extraction was performed using *n*-hexane as the solvent, with an investigation of the material-to-solvent ratio.

Specifically, 25 g of powdered Luffa seeds was weighed and mixed with *n*-hexane, followed by maceration for 48 hours. The resulting extract was filtered through filter paper or centrifuged to remove solid residues. The solvent in the filtrate was evaporated to obtain the crude Luffa seed oil. The oil yield (H, %) was calculated using Equation (2).

$$\mathrm{H}\ (\%) = \frac{\mathrm{m_{oil}}}{\mathrm{m_{sample}} \times \left(1 - \frac{\mathrm{W}}{100\%}\right)} \times 100\% \quad (2)$$

where m_{oil} is the mass of extracted oil (g), m_{sample} is the initial mass of the seed powder (g), and w is the moisture content of the sample (%).

2.2.3. Determination of physicochemical properties of Luffa seed oil

2.2.3.1 Density

The density of the oil was measured at 25 °C using a 1 mL medical syringe marked at a fixed volume level. Initially, the empty syringe was weighed and recorded as G. Then, the syringe was filled with distilled water up to the marked line (ensuring no air bubbles), weighed, and recorded as G_1. After removing and drying the water, the syringe was filled with Luffa seed oil to the same mark (also without air bubbles), and weighed again as G_2. The density d (g/cm^3) was calculated using Equation (3) [14].

$$\mathrm{d} = \frac{\mathrm{m}}{\mathrm{V}} = \frac{\mathrm{G_2} - \mathrm{G}}{\mathrm{G_1} - \mathrm{G}} \quad (3)$$

where m is the mass of the oil (g), V is the volume of distilled water (mL), G is the mass of the empty syringe (g), G_1 is the mass of the syringe filled with distilled water (g), and G_2 is the mass of the syringe filled with oil (g).

2.2.3.2. Acid value

To determine the acid value, 5 mL of ethanol and 5 mL of diethyl ether were added to a 250 mL Erlenmeyer flask, followed by 5 drops of 1% phenolphthalein solution. Then, 0.5 g of Luffa seed oil was added and the mixture was shaken until the oil was completely dissolved. The solution was titrated with 0.1 N KOH until a persistent pink color appeared and remained for at least 30 seconds. The titration was repeated three times, and the average volume of KOH used V_{KOH} (mL) was recorded. The acid value (AV, mg KOH/g oil) was calculated using Equation (4) [15].

$$\mathrm{AV} = \frac{5.61 \times \mathrm{V}}{\mathrm{m}} \quad (4)$$

where 56.1 is the equivalent weight of KOH (mg/mmol), used to calculate the acid value when titrated with 0.1 N KOH, V is the volume of 0.1 N KOH used for titration (mL), and m is the mass of the oil sample (g).

2.2.3.3. Saponification value

To determine the saponification value, 0.5 mL of Luffa seed oil and 6.25 mL of 0.5 N KOH were added to a 250 mL Erlenmeyer flask. The mixture was heated under reflux in a water bath for 30–60 minutes, then allowed to cool. After cooling, 1–3 drops of 1% phenolphthalein solution were added, and the flask was shaken until a pink color appeared. The solution was then titrated with 0.5 N HCl until the pink color disappeared. The saponification value (I_S, mg KOH/g sample) was calculated using Equation (5) [15].

$$I_S = \frac{[(CV)_{KOH} - (CV)_{HCl}] \times 56.1}{m_m} \quad (5)$$

where C_{KOH} and C_{HCl} are the concentrations of KOH and HCl solutions (N), V_{KOH} and V_{HCl} are the volumes of KOH and HCl used in the blank and sample titrations (mL), 56.1 is molar mass of KOH, and m_m is the mass of the oil sample (g).

2.2.4. Determination of chemical composition and antimicrobial activity of Luffa seed oil

The chemical composition of Luffa seed oil was analyzed using gas chromatography–mass spectrometry (GC–MS). The sample was prepared at a dilution ratio of 20 µL in 1.0 mL of solvent, and 1.0 µL of the prepared solution was injected. The analysis was performed on an HP-5MS capillary column with helium as the carrier gas at an inlet pressure of 9.3 psi. The temperature program was as follows: initial temperature of 50 °C held for 2 minutes; increased at 3 °C/min to 150 °C, then at 10 °C/min to 200 °C, and finally at 20 °C/min to 280 °C, which was held for 5 minutes. Compound identification was performed by comparing mass spectra with those in the Mass Spectral Library (NIST 2020). The HP-5MS column was used with helium as carrier gas. Retention indices were calculated and matched with literature data to support identification reliability.

The antimicrobial activity of the extracted Luffa seed oil was evaluated against the bacterial strain *Staphylococcus aureus* using standard microbiological procedures [16].

2.3. Application of Luffa seed oil in skin cream formulation

2.3.1. Initial product criteria for skin cream

The formulated skin cream was required to meet the following initial physical and sensory criteria: a cream-like texture, light greenish-yellow color (contributed by the incorporated Luffa seed oil), low to medium viscosity, non-greasy feel, easy spreadability, and smooth application without clogging pores. In terms of stability and safety, the product should remain stable over a 30-day period at room temperature and under refrigerated conditions (below 10 °C). No rancid odor, mold, phase separation, discoloration, clumping, or particulate formation should be observed. Upon application to the wrist, the cream should spread evenly, fully absorb into the skin, and leave no residue. The product was packaged in a 100 g clear plastic jar with a silver aluminum cap. In addition, active ingredients and deep moisturizing agents were incorporated into the formulation to enhance skin protection against environmental factors. Luffa seed oil alone was insufficient to provide full moisturizing effects due to its limited concentration of bioactive compounds.

2.3.2. Formulation of Luffa seed oil skin cream

Natural cosmetic products have become increasingly favored by consumers in recent years. Accordingly, the selection of ingredients for skin cream prioritized plant-derived,

gentle, and non-irritating components, suitable for most skin types, particularly dry and sensitive skin. The key ingredients included in the Luffa seed oil-based skin cream are as follows:

Base (Substrate): Purified or distilled water was used as the main solvent.

Thickener/Emulsifier: The primary emulsifier selected was Multicare HA 40KC. It was used at 5% when serving as the main emulsifier, and 3–5% when used with a co-emulsifier. Cosmagel 305 could be used as an alternative due to its similar functional role.

The selection of ingredient proportions is based on information provided on the websites of raw material suppliers [17], [18]: Luffa seed oil was used as the emollient. The typical usage concentration for face and body creams ranged from 2% to 50%. Occlusive/Lubricant: Cyclopentasiloxane was incorporated as an occlusive and lubricant, used at 3–10%. Humectant: Glycerin was selected as the humectant at a concentration of 0.5–3%. Anti-irritant: Allantoin was used to reduce irritation and enhance skin comfort, at 0.1–2%. Preservative: The preservative system consisted of EHGP, a combination of ethylhexylglycerin and phenoxyethanol, used at 0.5–1.5%.

The proposed formulation of skin cream is presented in Table 1.

Table 1. The formulation of Luffa seed oil skin cream

Phase	Ingredient	Role	Content (%)
Aqueous phase (A)	Aqua	Base	78 - 85
	Multicare HA 40KC	Emulsifier and thickener	3 - 5
	Glycerine	Humectant	2
Oil phase (B)	Luffa seed oil	Emollient	3 - 5
	Cyclopentasiloxane	Lubricant	4
Active ingredient	Allantoin	Anti-irritant	0.2
	EHGP	Preservative	0.8

2.3.3. Skin cream mixing process

Phase A was prepared by mixing distilled water with glycerin under continuous stirring. Multicare HA 40KC was then added to the aqueous solution to form a homogeneous water phase. Phase B consisted of Luffa seed oil and cyclopentasiloxane, which were mixed thoroughly to form a uniform oil phase. The aqueous phase (Phase A) was gradually added to the oil phase (Phase B) with constant stirring to obtain a stable emulsion base. Subsequently, allantoin and EHGP were incorporated into the emulsion, and the mixture was stirred until a homogeneous cream formulation was achieved. The final product was allowed to stabilize before undergoing further quality evaluation.

2.3.4. Evaluation of skin cream product quality

After formulation, the skin cream containing Luffa seed oil was evaluated based on several parameters, including sensory properties (observation of color, scent, texture and feel when used) according to ISO 11036:2020 guidelines [19]; physicochemical properties such as pH measured by pH meter according to ISO 22716:2007 [20] and viscosity determined by rotary needle viscometer according to ISO 21151:2015 [21]. Stability was evaluated according to ISO/TR 18811:2018 [22] by storing the product at room temperature and in a freezer below

10 °C for 5 weeks, to observe changes in color, texture, or separation. In addition, the product was evaluated through a consumer product opinion survey.

A consumer evaluation of the skin cream Luffa seed oil was conducted with 30 volunteers of different age groups using a structured questionnaire consisting of 11 criteria (color, scent, texture, absorption, after-feel, moisture, oiliness, emollient ability, irritation level, overall satisfaction level, and intention to continue using) rated on a five-point scale: 1 – Poor, 2 – Average, 3 – Good, 4 – Very good, and 5 – Excellent [23].

Microbiological assessment was performed following ISO 22717:2015 and ISO 18416:2015 standards [24, 25], focusing on the detection of *Pseudomonas aeruginosa* and *Candida albicans.*

The product's performance was also compared to a reference skin cream formulated with a different plant seed oil, as described in the literature [26] and benchmarked against a commercially available skin cream using another type of seed oil.

3. RESULTS AND DISCUSSION

3.1. Oil extraction from the Luffa seed

3.1.1. Effect of the material-to-solvent ratio on the oil extraction yield

The highest oil yield was observed at a material-to-solvent ratio of 1:5, likely due to the optimal balance between sufficient solvent volume for effective oil diffusion and minimal solvent saturation. At a 1:10 ratio, the yield decreased, potentially due to an excessive solvent volume relative to the material, which may reduce the driving force for mass transfer by lowering the concentration gradient. The increase at 1:20 may be attributed to improved solvent penetration, but the subsequent drop at 1:30 could result from solvent saturation or reduced agitation efficiency over prolonged maceration. These fluctuations suggest that beyond a certain ratio, increasing solvent volume does not linearly improve oil yield and may, in fact, hinder extraction efficiency.

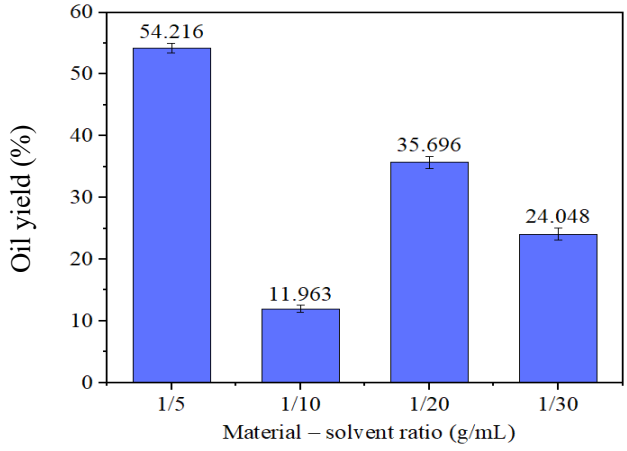

Figure 1. Effect of material–solvent ratio on the oil extraction yield (maceration in *n*-hexane for 48 hours)

3.1.2. Physicochemical properties of Luffa seed oil

3.1.2.1. Density

The density of the extracted oil was determined to be 0.86 g/cm³, higher than that of *n*-hexane (0.655 g/cm³). However, since both are nonpolar, the oil was fully miscible in *n*-hexane during maceration. After extraction, the solvent was evaporated to isolate the oil from the mixture.

3.1.2.2. Acid value

The relatively high acid value (41.978 mg/g) suggests partial hydrolysis or oxidation of triglycerides during extraction or seed storage. While this level is acceptable for non-edible cosmetic applications, it may impact product stability and shelf life. Thus, refining or stabilization of the oil should be considered in future formulation efforts to reduce free fatty acid content and enhance performance [27].

3.1.2.3. Saponification value

The saponification value of the extracted Luffa seed oil was determined to be 232 mg KOH/g sample. This result corresponds to the volume of 0.5 N HCl required to neutralize the remaining alkali after refluxing the oil with 0.5 N KOH, with an average consumption of 3 mL of HCl. A higher saponification value indicates the presence of shorter-chain fatty acids, which tend to react more readily in saponification processes. In contrast, oils with lower saponification values require longer saponification times and may leave residual alkali in cosmetic formulations, potentially leading to skin irritation if not thoroughly removed. The obtained value suggests that Luffa seed oil has suitable characteristics for use in cosmetic formulations.

With the obtained saponification value, Luffa seed oil is considered suitable for cosmetic applications [28].

3.1.2.4. Chemical composition of Luffa seed oil

The chemical composition of the extracted Luffa seed oil was analyzed using GC-MS, and the results are presented in Table 2. The analysis revealed a diverse fatty acid profile, indicating the oil's high potential for cosmetic applications, particularly in moisturizing and skin-care formulations. Notably, the oil contained a high proportion of oleic acid (27.66%), followed by a significant amount of palmitic acid (12.3%). Compared to a previous study on Moringa seed oil, these values are higher (oleic acid ~ 23 %, palmitic acid ~11%) [29]. Oleic acid is known for its excellent emollient and skin-penetrating properties, while palmitic acid contributes to skin softening and barrier reinforcement [30].

Table 2. Chemical composition of Luffa seed oil

No.	Compounds	Chemical formula
1	Palmitic acid	$C_{16}H_{32}O_2$
2	Stearic acid	$C_{18}H_{36}O_2$
3	Oleic acid	$C_{18}H_{34}O_2$
4	9-Octadecenoic acid (Z)-, 2,3- dihydroxypropyl ester	$C_{21}H_{40}O$

3.1.3. The antimicrobial activity of Luffa seed oil

Figure 2 illustrates the antibacterial effect of Luffa seed oil against *Staphylococcus aureus* using the agar diffusion method. The oil produced a 7 mm inhibition zone, indicating moderate antibacterial activity. The negative control (sterile water) showed no inhibition, while the positive control (chloramphenicol 100 ppm) exhibited a significantly larger zone, as expected. The observed activity may be attributed to the presence of unsaturated fatty acids, particularly oleic acid, which has been reported to disrupt bacterial membranes [31]. Although the inhibition zone is smaller than that of chloramphenicol, the result suggests potential use of Luffa seed oil as a natural antibacterial agent in cosmetic formulations. Further studies on synergistic effects and formulation optimization are recommended.

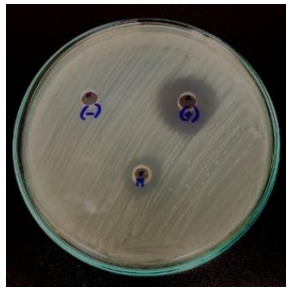

Figure 2. Antibacterial activity evaluation
(-) Negative control: Sterile distilled water, (+) Positive control: Chloramphenicol 100 ppm (M), Test sample: Luffa seed oil

3.2. Evaluation results of skin cream quality

3.2.1. Sensory evaluation

The sensory evaluation results of skin cream containing Luffa seed oil are presented in Table 3.

Table 3. The results of the sensory evaluation

Requirement		Result
Appearance	Homogeneous, no phase separation, free of impurities	The sample is completely homogeneous, free from impurities
Cream texture		
Color	Luffa seed oil typically exhibits a yellow to yellow-green color	The yellow-green color of Luffa seed oil
Scent	Scent of Luffa seed oil	Natural scent of the oil
Visual inspection	No foreign particles in the product	No abnormalities observed
Application on skin	Smooth, silky, with a slight gloss, non-irritating to the skin	Achieved

Table 3 confirms that the skin cream met essential sensory criteria, showing stable structure, desirable consistency, and compatibility with skin use. The visual and tactile attributes were appropriate, and the presence of the oil's natural characteristics was maintained without adverse effects.

In addition, the formulated cream was compared with a commercial product (Table 4). While both products met basic cosmetic quality expectations, differences were noted in texture-related aspects. The formulated cream demonstrated faster absorption and lower stickiness, which may enhance user comfort, especially in hot or humid climates. In contrast, the commercial product, though effective, showed a slightly heavier feel upon application. These differences likely stem from variations in oil composition and formulation strategies. Overall, the comparison highlights the potential of Luffa seed oil as a promising ingredient in skincare, offering a lightweight, non-greasy alternative without compromising moisturization

Table 4. The results of the comparison between the formulated cream and commercial products

Product	Centella soothing cream skin ever	Luffa seed oil skin cream
Skin prior to product application	Normal	Normal
Apply a thin layer to the skin	A thin layer of the cream	A thin layer of the cream
After 20 minutes of product application	Wide spreadability Non-irritating Tacky Slow absorption	Wide spreadability Non-irritating Non-tacky Fast absorption

3.2.2. Physicochemical properties

The physicochemical characteristics of the Luffa seed oil-based skin cream are presented in Table 5.

Table 5. The results of the physicochemical property evaluation

Test parameter	Test conditions	Result
Photostability	The product was exposed directly to light and air for 24 hours	The product remained in a normal state
Cold resistance	Store the product at a temperature below 10°C for 24 hours	The product remained in a normal state
Viscosity	5000 - 8000 cP	7821 ± 0.967 cP
pH	4.5–6.5	5.65

The results in Table 5 show that the product meets the criteria for physical and chemical properties. The measured viscosity (7821 ± 0.967 cP) is within the allowable limit for cream cosmetics (5000–8000 cP), ensuring structural stability and distribution when used. The pH value reached 5.65, consistent with the physiological pH range of the skin (4.5–6.5), helping to reduce the risk of skin irritation and maintain the natural protective barrier [32, 33]. In addition, the product showed no signs of state change when challenged with light and low temperature for 24 hours, reflecting good stability under normal storage conditions.

3.2.3. Stability evaluation

Table 6. Product stability over 5 weeks at (a) room temperature, and (b) 10°C

Temperature \ Week	1	2	3	4	5
(a)					
(b)					

The stability of the Luffa seed oil-based skin cream was assessed at room temperature (32 °C) and at temperatures below 10°C over a 5-week period, as shown in Figure 4. Under both conditions, the product maintained its initial appearance, with no discoloration, phase separation, mold growth, or rancid odor. These results indicate that the product is stable and potentially marketable.

3.2.4. Microbiological criteria

The product meets the requirements for microbial limits when the presence of *Pseudomonas aeruginosa* and *Candida albicans* is not detected in 0.1 g of the skin cream Luffa seed oil sample, following the microbiological safety standards for cosmetics.

3.2.5. Consumer survey

Product quality was assessed from a sensory perspective and consumer feedback to predict market potential. The satisfaction level of consumers with the Luffa seed oil-based skin cream is presented in Figure 3, which shows that most users responded positively, with 75% rating the product as “Good” or “Excellent.” Only 4% gave negative feedback. However, 21% rated it as “Moderate,” suggesting room for improvement. Notably, the natural color of the cream derived from Luffa seed oil may affect consumer preference and should be considered for adjustment to enhance overall acceptance.

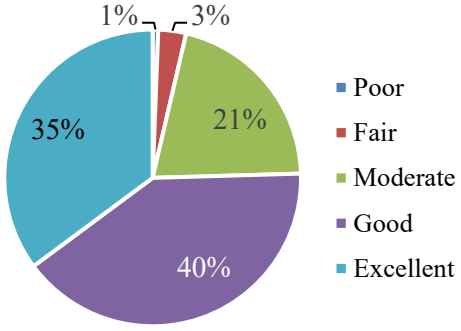

Figure 3. The results of the consumer satisfaction survey for the product

3.2.6. Comparison with skin cream from another seed oil

The product was compared with a skin cream formulated from another type of seed oil based on the study by Sirivan Athikomkulchai, as presented in Table 7.

Table 7. Comparative analysis between the formulated skin cream and a cream formulated with a different seed oil

Comparison with skin cream from another seed oil	Luffa seed oil cream	Moringa seed oil cream
Thermal stability	Maintained its initial state	Maintained its initial state
Skin irritation	Did not cause skin irritation	Did not cause skin irritation
pH	5.65	5.43
Viscosity	7821 ± 0.967 cP	17786 ± 1.442 cP
Skin hydration	Good	Good
Skin elasticity	Did not alter skin elasticity	Skin became softer and firmer

The differences in raw materials, testing protocols, equipment, and environmental conditions between the current study and that of Athikomkulchai et al. may contribute to variations in measured parameters beyond the inherent differences between Luffa seed oil and Moringa oil. Therefore, the comparison is relative. The most notable differences observed include viscosity, pH, and post-application skin elasticity. Specifically, the test cream exhibited a viscosity of 7821 ± 0.97 cP, whereas the reference product showed a significantly higher value of 17786 ± 1.44 cP. This difference may result from variations in oil phase content and the concentration or type of emulsifiers and thickeners used, all of which influence emulsion structure and rheology. Importantly, both viscosity values fall within the typical acceptable range for cosmetic creams (2000–50000 cP) [34], indicating their suitability for topical application. However, the reference product not only had a much higher viscosity but also failed to enhance skin firmness and smoothness to the same extent as the current formulation. These findings suggest that the developed Luffa-based cream offers a more balanced texture and better overall performance, thereby providing a competitive advantage and meeting market expectations more effectively.

4. CONCLUSION

Luffa seed oil was successfully extracted by maceration using n-hexane at a material-to-solvent ratio of 1:5 for 48 hours, achieving a yield of 53.48%. The extracted oil exhibited key physicochemical parameters including density (0.86 g/cm^3), acid value (41.978 mg/g), and saponification value (232 mg KOH/g). GC-MS analysis revealed a high oleic acid content (27.66%), indicating potential for cosmetic applications. The oil was incorporated at 5% into the skin cream formulation. The final product met quality standards based on physicochemical, microbiological, and consumer evaluations, demonstrating favorable characteristics such as non-greasy texture, rapid absorption, and skin compatibility. These results suggest that Luffa seed oil is a promising natural ingredient for use in cosmetic formulations, contributing to the valorization of Luffa plant components in both domestic and international markets.

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REFERENCES

1. Bamgboye A.I., Oniya O.O. - Fuel properties of loofah (*Luffa cylindrica* L.) biofuel blended with diesel, African Journal of Environmental Science and Technology **6** (9) (2012) 346352, https://doi.org/10.5897/AJEST11.364
2. Lucy, O. F., Abidemi, O. B. - Food value and phytochemical composition of Luffa cylindrica seed flour, American Journal of Biochemistry **2** (6) (2012) 98-103.
3. Oboh, I. O., Aluyor, E. O. - Luffa cylindrica-an emerging cash crop, African Journal of Agricultural Research **4** (8) (2009) 684-688
4. Anaun, T. E., Ogundele, O. D. - Physicochemical analysis and functional properties of sponge gourd (*Luffa cylindrica* Linn.) seed oil obtained from Owo, Ondo State Nigeria, Achievers Journal of Scientific Research **3** (1) (2021) 97-104
5. Elkhaleefa, A., Shigidi, I. - Optimization of sesame oil extraction process conditions, Advances in Chemical Engineering and Science **5** (3) (2015) 305, https://doi.org/10.4236/aces.2015.53031
6. Kodad, O., Estopañán, G., Juan, T., Socias i Company, R. - Protein content and oil composition of almond from Moroccan seedlings: Genetic diversity, oil quality and geographical origin, Journal of the American Oil Chemists' Society **90** (2013) 243-252.
7. Sharma, A., Khare, S. K., Gupta, M. N. - Enzyme-assisted aqueous extraction of peanut oil, Journal of the American Oil Chemists' Society **79** (3) (2002) 215-218, https://doi.org/10.1007/s11746-002-0463-0
8. Akhtar, N., Ahmad, M., Madni, A., Bakhsh, M.S. - Evaluation of basic properties of macadamia nut oil, Gomal University Journal of Research **22** (1) (2006) 21-27.
9. Balalić, I., Zorić, M., Branković, G., Terzić, S., Crnobarac, J. - Interpretation of hybrid× sowing date interaction for oil content and oil yield in sunflower, Field Crops Research **137** (2012) 70-77, https://doi.org/10.1016/j.fcr.2012.08.005
10. Sultan, S. M., Dikshit, N., Vaidya, U. J. - Oil content and fatty acid composition of soybean (*Glysine max* L.) genotypes evaluated under rainfed conditions of Kashmir Himalayas in India, Journal of Applied and Natural Science **7** (2) (2015) 910.
11. Baydar, N. G., Akkurt, M. - Oil content and oil quality properties of some grape seeds, Turkish Journal of Agriculture and Forestry **25** (3) (2001) 163-168.
12. Kawale, R., Bajpai, N., Mangtani, N. - A review on cosmeceutical perspective of Luffa cylindrical, World Journal of Pharmaceutical Research **9** (8) (2020) 2296-2308
13. Karrar, E., Mahdi, A. A., Sheth, S., Ahmed, I. A. M., Manzoor, M. F., Wei, W., Wang, X. - Effect of maltodextrin combination with gum arabic and whey protein isolate on the microencapsulation of gurum seed oil using a spray-drying method, International Journal of Biological Macromolecules **171** (2021) 208-216, https://doi.org/10.1016/j.ijbiomac.2020.12.045
14. Kooiman, K., Böhmer, M. R., Emmer, M., Vos, H. J., Chlon, C., Shi, W. T., Van Wamel, A. - Oil-filled polymer microcapsules for ultrasound-mediated delivery of lipophilic drugs, Journal of Controlled Release **133** (2) (2009) 109-118, https://doi.org/10.1016/j.jconrel.2008.09.085
15. Triyasmono, L., Schollmayer, C., Schmitz, J., Hovah, E., Lombo, C., Schmidt, S., Holzgrabe, U. - Simultaneous determination of the saponification value, acid value, Ester value, and iodine value in commercially available red fruit oil (*Pandanus conoideus*, lam.) using 1H qNMR spectroscopy, Food Analytical Methods **16** (1)

(2023) 155-167.

16. Balouiri, M., Sadiki, M., & Ibnsouda, S. K. - Methods for in vitro evaluating antimicrobial activity: A review, Journal of Pharmaceutical Analysis **6** (2) (2016) 71-79, https://doi.org/10.1016/j.jpha.2015.11.005
17. Lotioncrafter - https://lotioncrafter.com, Accessed: 2025. Online. Available: https://lotioncrafter.com.
18. Making Cosmetics - https://www.makingcosmetics.com, Accessed: 2025. Online. Available: https://www.makingcosmetics.com
19. ISO 11036:2020, Sensory analysis - Methodology - Texture profile, International Organization for Standardization, 2020.
20. ISO 22716:2007, Cosmetics - Good Manufacturing Practices (GMP) - Guidelines on Good Manufacturing Practices, International Organization for Standardization, 2007
21. ISO 21151:2015, Cosmetics - Analytical methods - Rheological properties of cosmetic products, International Organization for Standardization, 2015.
22. ISO/TR 18811:2018, Cosmetics - Guidelines on the stability testing of cosmetic products, International Organization for Standardization, 2018.
23. Mildau, G., Burkhard, A., Daphi-Weber, J., Große-Damhues, J., Jung, J., Schuster, B., Walther, C. - Basic requirements for safety assessments of cosmetic products, Sofw Journal **133** (6) (2007) 16.
24. Zeitoun, H., Kassem, M., Raafat, D., AbouShlieb, H., Fanaki, N. - Microbiological testing of pharmaceuticals and cosmetics in Egypt, BMC Microbiology **15** (2015) 1-13.
25. Dashen, M. M., Chollom, P. F., Okechalu, J. N., Ma'aji, J. A. - Microbiological quality assessment of some brands of cosmetics powders sold within Jos Metropolis Plateau State, Journal of Microbiology and Biotechnology Research **1** (2) (2011) 101-106.
26. Athikomkulchai, S., Tunit, P., Tadtong, S., Jantrawut, P., Sommano, S. R., Chittasupho, C. - Moringa oleifera seed oil formulation physical stability and chemical constituents for enhancing skin hydration and antioxidant activity, Cosmetics **8** (1) (2020) 2, https://doi.org/10.3390/cosmetics8010002
27. Iyasele, J. U., Uadia, J. O., Akhigbe, I. U., Jacob, J. N., Ogbeide, O. K. - Physico-chemical properties, chemical composition and antimicrobial activity of *Adonidia merrillii* kernel seed oil, Tropical Journal of Natural Product Research **6** (4) (2022) 599-605.
28. Elemo, G. N., Elemo, B. O., Erukainure, O. L. - Characterization of sponge gourd (Luffa aegyptiaca Mill.) seed oil, Journal of Tropical Agriculture **49** (2011) 128-130
29. Adegbe, A. A., Larayetan, R. A., Omojuwa, T. J. - Proximate analysis, physicochemical properties and chemical constituents characterization of Moringa oleifera (Moringaceae) seed oil using GC-MS analysis, American Journal of Chemistry **6** (2) (2016) 23-28
30. Kumar, B., Pandey, M., Aggarwal, R., Sahoo, P.K. - A comprehensive review on invasomal carriers incorporating natural terpenes for augmented transdermal delivery, Future Journal of Pharmaceutical Sciences **8** (1) (2022) 50.
31. Desbois, A.P., Smith, V.J. - Antibacterial free fatty acids: activities, mechanisms of action and biotechnological potential, Applied Microbiology and Biotechnology **85** (2010) 1629-1642.
32. Zothanpuii, F., Rajesh, R., Selvakumar, K. - A review on stability testing guidelines

of pharmaceutical products, Asian Journal of Pharmaceutical and Clinical Research **13** (10) 3-9. http://dx.doi.org/10.22159/ajpcr.2020.v13i10.38848

33. Zhai, H., Maibach, H. I. - Occlusion vs. skin barrier function, Skin Research and technology **8** (1) (2002) 1-6.
34. Indriatmoko, D., Suryani, N., Rudiana, T., Kurniah, M. - IAI Conference: Formulation and physical evaluation of facial cream preparations from Ceremai fruit juice (*Phyllanthus acidus* (L.) Skeels), Pharmacy Education **21** (2) (2021) 87-92, https://doi.org/10.46542/pe.2021.212.8792

TÓM TẮT

CHIẾT XUẤT DẦU TỪ HẠT MƯỚP (*Luffa cylindrica* L.) VÀ ỨNG DỤNG TRONG KEM DƯỠNG DA

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Trong nghiên cứu này, dầu được chiết từ hạt mướp (*Luffa cylindrica* L.) bằng cách ngâm với n-hexan ở nhiều tỷ lệ vật liệu/dung môi khác nhau. Tỷ lệ 1:5 cho hàm lượng dầu cao nhất, đạt 53,48%. Dầu chiết được có tỷ trọng 0,86 g/cm³, chỉ số axit là 41,978 mg/g và chỉ số xà phòng hóa là 232 mg KOH/g. Phân tích sắc ký khí-phổ khối (GC-MS) của dầu cho kết quả thành phần chính gồm acid oleic (27,66%) và acid palmitic (12,3%). Dầu hạt mướp thể hiện hoạt tính kháng khuẩn đối với *Staphylococcus aureus*, với vùng ức chế 7 mm. Dầu chiết từ hạt mướp được ứng dụng vào công thức kem dưỡng da, ở nồng độ 5%. Sản phẩm có kết cấu không nhờn rít, khả năng lan tỏa tốt, thẩm thấu nhanh, không gây kích ứng da và an toàn về mặt vi sinh, nhận được phản hồi tích cực từ người tiêu dùng. Những phát hiện này cho thấy dầu hạt mướp đóng vai trò chất làm mềm giữ ẩm tự nhiên đầy tiềm năng trong các sản phẩm chăm sóc da.

Từ khóa: Hạt mướp *(Luffa cylindrica* L.), dầu hạt mướp, ngâm chiết, kem dưỡng da.