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Original Article

Comparative efficacy of bakuchiol oil and encapsulated bakuchiol cream on facial skin quality: A 28-day pilot study

[Eficacia comparativa del aceite de bakuchiol y la crema de bakuchiol encapsulado en la calidad de la piel facial: Un estudio piloto de 28 días]

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Abstract

Context: Along with the rapid growth of the beauty product industry, the community highly favors the use of plants as beauty ingredients and facial treatments. Bakuchiol, a lipid-soluble compound derived from *Psoralea corylifolia* is a gentle alternative to retinol in anti-aging skincare. To enhance its penetration into the skin, bakuchiol is formulated in liposomes through encapsulation technology.

Aims: To compare the efficacy of 0.5% bakuchiol oil and encapsulated 0.5% bakuchiol cream formula on facial skin quality.

Methods: The subjects consisted of 17 respondents, aged 25-45 years, with various skin types. Two creams, 0.5% bakuchiol oil cream and encapsulated 0.5% bakuchiol cream, were applied twice daily in the split face for 28 days. The study utilized the A-One Tab Skin Analyzer device to measure facial skin quality by scanning facial moisture, pores, sebum, and wrinkles levels on days 0, 14, and 28. Data obtained in the form of numerical values were analyzed using a comparative method employing both parametric and non-parametric methods with the aid of the SPSS software.

Results: The study results indicated that both creams enhanced skin moisture, reduced pore size, and improved wrinkle scores. However, the encapsulated bakuchiol cream performed better in minimizing pore size, sebum levels, and wrinkle scores.

Conclusions: The study findings imply that the use of encapsulated 0.5% bakuchiol cream formulation had a more pronounced effect on improving facial skin quality compared to the 0.5% bakuchiol oil cream formulation, signifying the superior efficacy of the former.

Keywords: anti-aging; bakuchiol oil; encapsulated; skin quality.

Resumen

Contexto: Junto con el rápido crecimiento de la industria de productos de belleza, la comunidad está muy a favor del uso de plantas como ingredientes de belleza y tratamientos faciales. El bakuchiol, un compuesto liposoluble derivado de la *Psoralea corylifolia*, es una alternativa suave al retinol en el cuidado antienvejecimiento de la piel. Para mejorar su penetración en la piel, el bakuchiol se formula en liposomas mediante tecnología de encapsulación.

Objetivos: Comparar la eficacia del aceite de bakuchiol al 0,5% y la fórmula en crema de bakuchiol encapsulado al 0,5% en la calidad de la piel del rostro.

Métodos: Los sujetos fueron 17 encuestados, de entre 25 y 45 años, con diversos tipos de piel. Se aplicaron dos cremas, crema de aceite de bakuchiol al 0,5% y crema de bakuchiol encapsulado al 0,5%, dos veces al día en la cara dividida durante 28 días. El estudio utilizó el dispositivo A-One Tab Skin Analyzer para medir la calidad de la piel del rostro mediante el escaneado de los niveles de humedad, poros, sebo y arrugas en los días 0, 14 y 28. Los datos obtenidos en forma de valores numéricos se analizaron mediante un método comparativo que empleaba métodos paramétricos y no paramétricos con ayuda del programa informático SPSS.

Resultados: Los resultados del estudio indicaron que ambas cremas mejoraron la hidratación de la piel, redujeron el tamaño de los poros y mejoraron la puntuación de las arrugas. Sin embargo, la crema de bakuchiol encapsulado obtuvo mejores resultados en la reducción del tamaño de los poros, los niveles de sebo y las puntuaciones de las arrugas.

Conclusiones: Los resultados del estudio implican que el uso de la formulación en crema de bakuchiol encapsulado al 0,5% tuvo un efecto más pronunciado en la mejora de la calidad de la piel facial en comparación con la formulación en crema de aceite de bakuchiol al 0,5%, lo que significa la eficacia superior de la primera.

Palabras Clave: antienvejecimiento; aceite de bakuchiol; encapsulado; calidad de la piel.

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INTRODUCTION

The skin is an important organ that protects the body from external stressors, such as physical trauma, radiation, and microbial invasion. As the body ages, the skin changes both structurally and functionally, resulting in wrinkles, age spots, and other signs of aging (Rinnerthaler et al., 2015).

Skin aging is a complex process that involves different factors, such as cellular senescence, oxidative stress, inflammation, and telomere shortening. Cellular senescence can cause cells to stop dividing and slow tissue regeneration. Oxidative stress happens when an imbalance between reactive oxygen species and antioxidant defenses damages cells and speeds up aging. Chronic inflammation is also related to aging and can lead to tissue damage and dysfunction. Lastly, telomere shortening, which refers to the loss of telomere length with each cell division, has been associated with cellular aging and age-related diseases (Farage et al., 2008).

Several extrinsic factors contribute to skin aging, including UV radiation, pollution, smoking, and poor lifestyle choices, such as a diet lacking essential nutrients and excessive alcohol consumption. UV radiation is a major contributor to skin aging, as it damages DNA and accelerates the breakdown of collagen and elastin. Pollution and cigarette smoke also generate ROS and promote inflammation, leading to oxidative stress and tissue damage. Poor lifestyle choices can also contribute to skin aging by impairing skin cell function and reducing the body's ability to repair damage (Farage et al., 2008; Rinnethaler et al., 2015; Rittié and Fisher, 2002).

Loss of elasticity, fine lines, and wrinkles on the skin are common signs of aging. Anti-aging cosmetic products aim to minimize or reverse the signs of aging. Retinoids, antioxidants, AHAs, peptides, and hyaluronic acid are commonly used anti-aging cosmetic ingredients (Baumann, 2007; Carlomagno et al., 2022; Michalak, 2022). Retinol, a widely used anti-aging ingredient, improves fine lines, wrinkles, and hyperpigmentation by boosting collagen production and skin cell turnover. However, excessive use can cause skin irritation, sun sensitivity, and potential toxicity (Fisher et al., 1996; Ganceviciene et al., 2012; Kang et al., 1995).

Along with the rapid growth of the beauty product industry, the community highly favors the use of plants as beauty ingredients and facial treatments. This is because natural beauty ingredients contain good ingredients and have fewer side effects (Michalak, 2022). Bakuchiol, a natural compound from the *Psoralea corylifolia* plant, is gaining popularity as a gentle alternative to the harsh retinol in anti-aging skin care (Bluemke et al., 2022). It offers similar benefits, such as reducing fine lines and wrinkles and improving skin texture without causing irritation. Bakuchiol also has anti-inflammatory properties, which can help reduce redness, irritation, and other signs of inflammation. Many skincare brands now incorporate bakuchiol into their products, appealing to the natural beauty community.

Bakuchiol is a lipid-soluble compound, typically found in oil-based products containing around 2.5% bakuchiol, and available in various products, such as cream, oil, serum, mask, gel, or emulsion. Lipid-soluble compounds have poor penetration power in penetrating the skin (Gugleva et al., 2021). To address this issue, a carrier substance that can penetrate the stratum corneum better and has an ideal release system is needed. A commonly employed delivery system in cosmeceuticals involves the use of liposomes through encapsulation technology (Liu et al., 2022).

Encapsulation technology in cosmetics offers numerous advantages, including improving the stability and effectiveness of active ingredients. The safeguarding against degradation ensures the potency of active ingredients. Several studies have investigated the efficacy of encapsulated active materials in cosmetics. It was reported that encapsulating vitamin C in liposomes improved product stability and enhanced skin penetration and, therefore, was more effective in increasing collagen synthesis and reducing wrinkles. Another study reported that encapsulating resveratrol in nanoparticles improved its antioxidant activity, improving skin texture and elasticity. These findings collectively underline the potential of encapsulation technology in cosmetics to elevate the efficacy and stability of active ingredients, ultimately enhancing skin benefits (Řepka et al., 2023; Yang et al., 2020).

Despite the growing interest in bakuchiol, there is limited research on the optimal formulation for topical use. Most studies have used bakuchiol in oil-based creams, raising concerns about the stability and skin bioavailability in these formulations. Encapsulation of bakuchiol in a delivery system could improve its stability and enhance its penetration into the skin (Lewińska et al., 2021).

This investigation aimed to assess the effectiveness of two formulations regarding their anti-aging properties by comparing the efficacy of 0.5% bakuchiol oil and encapsulated 0.5% bakuchiol cream formula on facial skin quality. The aging performance of the 0.5% bakuchiol oil cream and encapsulated 0.5% bakuchiol cream formulas was carried out using the A-One Tab

Skin Analyzer to observe moisture, pores, sebum levels, and wrinkles. The current research compared encapsulated bakuchiol cream and bakuchiol oil cream based on previous supporting data. The cream base was combined with 0.5% bakuchiol oil and encapsulated 0.5% bakuchiol. Bakuchiol oil is a phenolic monoterpene extracted from the fruit of *Psoralea corylifolia* L. in the form of unencapsulated oil and yellowish-brown in color. In contrast, bakuchiol is encapsulated with liposomes in the form of a thick paste and brown in color (Adhau and Pardeshi, 2020).

This study used a randomized, double-blind, split-face design to compare the efficacy of a 0.5% Bakuchiol oil cream formula to an encapsulated 0.5% bakuchiol cream formula on facial skin quality (moisture, pores, sebum levels, and wrinkles). The results of this study could provide valuable insights into the optimal formulation of bakuchiol for skincare products and help to inform clinical practice. The results may also have broader implications for developing natural alternatives to retinoids and other anti-aging compounds.

MATERIAL AND METHODS

Materials

Cream preparation and formula

Both 0.5% bakuchiol oil and encapsulated 0.5% bakuchiol were formulated into an oil-in-water-based cream. The materials used in the formulation are propanediol (Activonol-3), 1,2-pentanediol (Activonol-5), 1,2-hexanediol (Activonol-6), and phenoxyethanol/ethylhexyl-glycerin (Activonol PAF E-91) from Activon Co., LTD., Korea; xanthan gum (Keltrol CG) from CP Kelco., USA; hydroxyethyl cellulose (Natrosol), sodium EDTA from Ashland, USA; glyceryl behenate (Compritol 888 CG pellets MB), polyglyceryl-6 distearate/jojoba esters/polyglyceryl-3 beeswax/cetyl alcohol (Emulium Mellifera MB), jojoba esters/*Helianthus annuus* (sunflower) seed wax/*Acacia decurrens* flower wax, polyglycerine-3 (Acticire MB), octyldodecyl myristate (MOD) from Gattefossé, France; bakuchiol oil, and dimethicone, water/ glycerin/ capric triglyceride/bakuchiol/octyldodecanol/polyglyceryl-4 oleate/sucrose palmitate/1,2-hexanediol (CM-Bakuchiol 10) from CM Bridge, Korea. The exact concentration of each formula can be found in Table 1.

Freeze-thaw stability test of bakuchiol oil cream (A) and encapsulated bakuchiol cream (B)

Bakuchiol oil cream (0.5%) and encapsulated bakuchiol cream (0.5%) were stored at a temperature of ±4°C for 24 hours and a temperature of ±40°C for 24 hours. Testing was conducted over six cycles, with all parameters, including organoleptic properties, homogeneity, pH, spreadability, and emulsion type, being tested before and after the cycles.

Table 1. Formulation of bakuchiol oil cream (A) and formulation of encapsulated bakuchiol cream (B).

No.	International nomenclature of cosmetics ingredients	Function	A (%)	B (%)
A	Water	-	77.1	72.6
	Propanediol	Humectant	5	5
	1,2-Pentanediol	Humectant	3	3
	1,2-Hexanediol	Preservative	1	1
	Xanthan Gum	Gelling agent	0.15	0.15
	Hydroxyethylcellulose	Gelling agent	0.15	0.15
	Sodium EDTA	Chelating agent	0.1	0.1
B	Polyglyceryl-6 distearate, jojoba esters, polyglyceryl-3 beeswax, cetyl alcohol	Emulsifier	4	4
	Jojoba esters, Helianthus annus (sunflower) seed wax, Acacia decurrens flower wax, polyglyceryn-3	Texturing agent	2	2
	Octyldodecyl myristate	Emollient	2	2
	Glyceryl behenate	Texturing agent	1	1
	Phenoxyethanol, ethyhexylglycerin	Preservative	1	1
C	Bakuchiol oil	Active Ingredient	0.5	0
	Encapsulated bakuchiol *	Active Ingredient	0	5
	Dimethicone	Feel Modifier	3	3

* Encapsulated Bakuchiol consisting of water, glycerin and caprylic/capric triglyceride, octyldocecanol, polyglyceryl-4 oleate, sucrose palmitate and 1,2-hexandiol, and 0.5% bakuchiol (INCI name).

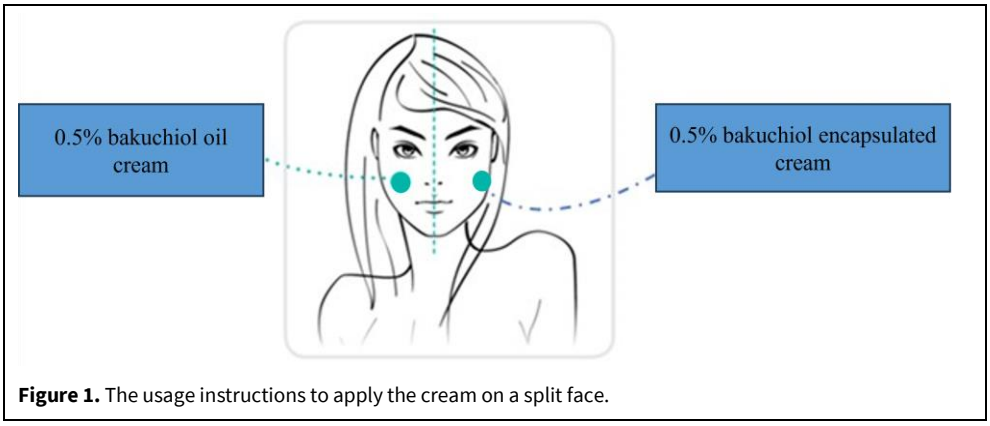

Figure 1. The usage instructions to apply the cream on a split face.

Anti-aging performance test

Study design

In this study, participants were randomly assigned to receive either treatment with bakuchiol oil (A) or treatment with encapsulated bakuchiol (B) on one half of their face. This study used a double-blind study design method in which participants and researchers were unaware of which treatment the participants used on their faces. This design helps reduce bias and increase the validity of study results by ensuring any differences in outcomes. In this design, each participant served as their control by having one-half of their face treated with one treatment and the other half of their face treated with a different treatment.

This study design allowed for a direct comparison of the two treatments, as the same person was exposed to both treatments under identical conditions. It also eliminated potential confounding factors such as age, gender, skin type, and other individual characteristics that could affect the outcomes of the study.

Subject of the study and sample size

The sample in this study consisted of 17 respondents, Indonesian, male and female, aged 25-45 years, with various skin types. Inclusion criteria in this study were male and female with signs of aging such as fine wrinkles, dry skin, big pores, and excess sebum. Exclusion criteria in this study were males and females allergic to the substance, aged under 17, and pregnant. This study was approved by the Ethics Committee of the University of Surabaya with ethical clearance number 80/KE/II/2023, and the patients in the figures had given written informed consent to publish their skin photographs.

Intervention

A 0.5% bakuchiol oil cream formula on one side of the face and encapsulated 0.5% bakuchiol cream formula on the other was applied, as illustrated in Fig. 1. The duration of the intervention was 28 days.

Skin aging performance test

The study assessed the anti-aging performance of bakuchiol oil cream and encapsulated bakuchiol cream by observing changes in skin quality, including moisture, pores, sebum, and wrinkles, using the A-One Tab Skin Analyzer on days 0, 14, and 28 of regular use of in the morning and evening. The protocol was designed to evaluate the cream's ability to address skin aging issues. The variables used and their operational parameters are presented in Table 2.

The study followed a randomized, double-blind, split-face design protocol. As Fig. 1, the participants were instructed to wash their hands before applying the cream and to use it at home on clean skin. The usage instructions were to apply 0.5% bakuchiol oil cream on the right side of the face and encapsulated 0.5% bakuchiol cream on the left side of the face. The creams were to be applied twice daily, in the morning and evening, for four weeks (28 days). Participants were instructed to apply the cream evenly and let it absorb into the skin.

Participants must refrain from using any skincare products recommended by a dermatologist. They should also avoid using similar anti-aging creams for two weeks prior to starting the observation. Routine skin care, such as cleansing/makeup for eyes and lips, compact, and loose powder, was permitted except for the foundation. Participants should not apply any makeup to their faces. They should have used a mild cleanser (without toner or makeup remover, among others) and rinse with water at least 2 hours before the visit for testing. On the day of testing (days 0, 14, and 28), anti-aging performance was assessed on the face.

No other skincare products should be used on the face except for the tested product during the test period. Self-tanning products should not be used on the

Table 2. The conceptual definition, operational definition, dimensions, indicators, and measuring scale of skin quality variables using the A-One Tab Skin Analyzer.

Variables	Conceptual definition	Operational definition	Dimensions	Indicators	Score
Moisture	The water content in the skin's outermost layer is essential for maintaining its elasticity, softness, and vitality. Low moisture levels may decrease skin elasticity, roughness, and aging signs (Patel et al., 2018).	The amount of water in the skin's outermost layer is measured using a sensor that detects the capacitance changes in the skin's surface.	Moisture level Hydration index on skin	Low	<36
				Normal	36-37
				High	>37
Pores	A surface landmark of the mall openings or cavities in the skin's outermost layer that allow substances such as sweat, oil, and other secretions to pass through. The pores are essential for the skin's natural oil balance and the removal of impurities (Flament et al., 2015)	Skin pores are the visible openings of hair follicles and sebaceous glands on the skin's surface. The pore index is calculated by threshold values of pore size detected by a high-resolution camera and multi-sensor.	Size and visibility of pores and number of pores.	Small	0-2
				Normal	3-5
				Large	6-10
Sebum	The oily, waxy substance is produced naturally by the sebaceous glands that cover the skin to keep it hydrated and protected from external irritants. (Endly and Miller, 2017)	Sebum is a complex mixture of lipids, including triglycerides, free fatty acids, wax esters, squalene, and cholesterol. The production of sebum can be quantified by measuring the amount of sebum excreted per unit area of the skin.	Oiliness on skin	Low	0-500
				Medium	500-1000
				High	>1000
Wrinkles	The visible lines, creases, or folds that develop on the skin's surface over time are caused by a decrease in skin elasticity (Manríquez et al., 2014)	Visible lines, creases, or folds can be quantified by measuring the depth, length, and number of wrinkles using a high-resolution camera and image analysis software.	Number of deep wrinkles on crowfeet area near the eye	None	0
				Thin	1-5
				Thick (>5)	>5

face. Maintain hygiene and makeup routine only for eyes and lips. No makeup application on the face. Avoid exposure to intensive sunlight (natural or UVA). On the testing day, no makeup should be applied to the face. Instead, use a mild cleanser (without toner or makeup remover, among others) and rinse with water at least 2 hours before the visit. The testing was done using the A-One Tab device on days 0, 14, and 28.

The usage of A-One Tab instrument

In this study, the efficacy of bakuchiol oil cream and encapsulated bakuchiol cream in addressing skin aging problems was observed using the A-One Tab instrument (A-One Tab Skin and Hair Diagnosis System, Bomtech Electronics Co., Ltd., Seoul, Korea). The A-One Tab instrument is a device that scans the facial skin and measures several parameters such as moisture, pore size, sebum production, and wrinkles. The observations were taken on days 0, 14, and 28 of the study, and the results were displayed numerically.

Data analysis

This study compared numerical data using both parametric and non-parametric statistics. A skin analyzer was used to assess for moisture, pores, sebum, and wrinkles. The resulting data was analyzed using the SPSS system to conclude the efficacy of bakuchiol oil and encapsulated bakuchiol cream in addressing skin aging issues. The parametric data were expressed as means ± standard deviation (SD) with a p-value of 0.05.

RESULTS

Bakuchiol is becoming a popular anti-aging ingredient in skincare for its ability to provide benefits similar to retinol without the potential side effects. Bakuchiol is often formulated in skincare creams and serums to reduce the appearance of fine lines and wrinkles, improve skin texture, and promote a more even skin tone (Gugleva et al., 2021).

Freeze-thaw stability test results

Prior to performing the efficacy test, we observed the physical stability of bakuchiol creams. As shown in Table 3, the organoleptic test indicated that the bakuchiol oil cream had a semisolid form, beige color, and a characteristic fruity aroma. In contrast, the encapsulated 0.5% bakuchiol cream had a semisolid, white, and odorless form. The organoleptic test did

not reveal any phase separation, and both creams were homogeneous with an O/W emulsion type. There were no significant differences in pH or spreadability before and after six freeze-thaw cycles for the encapsulated bakuchiol creams. However, there were slight but significant changes in pH or spreadability for the bakuchiol oil creams.

Anti-aging performance test results

The efficacy of bakuchiol oil and encapsulated bakuchiol creams on anti-aging performance was observed by measuring the facial skin quality (moisture, pores, sebum, and wrinkles). Fig. 2a presents data on the effect of two different cream formulations on the moisture level of the skin over a period of 28 days. The faces were scanned on Day 0, Day 14, and Day 28. The 0,5% bakuchiol oil cream increased skin moisture level from 34.47 ± 3.20 (D-0) to 35.59 ± 2.83 (D-28), while the encapsulated 0.5% bakuchiol cream increased skin moisture from 33.65 ± 2.69 (D-0) to 37.12 ± 2.47 (D-28). The p-values for both comparisons are less than 0.05. The results show that both cream formulations significantly improved skin moisture after 28 days of application. However, when the two creams were compared for their ability to increase skin hydration, the bakuchiol oil cream improved skin hydration by only 4%, while the encapsulated 0.5% bakuchiol cream improved skin hydration by 11%, although the difference was not statistically significant (see Table 4).

Fig. 2b presents data on the effect of two cream formulations on the pore level of the skin after the application for 28 days. The results show that both cream formulations significantly reduced the visibility of pores. The bakuchiol oil cream resulted in a decrease from 4.47 ± 2.55 to 3.65 ± 1.66, while the encapsulated bakuchiol cream reduced pore visibility from 3.47 ± 2.10 to 2.18 ± 1.13. The p-values for both comparisons are less than 0.05, which means that the results are significantly different. Both creams were able to reduce the visibility of pores after 28 days of application. However, the cream containing encapsulated bakuchiol showed a 33% reduction in visible pores. This ability was significantly greater than the 10% reduction observed with the bakuchiol oil cream (see Table 4).

Fig. 2c presents data on the effect of two different creams on the sebum level of the skin after 28 days of application. The results show that both cream formulations significantly reduced the amount of sebum produced by the skin at D-28 compared to D-0. The 0.5% bakuchiol oil cream resulted in a decrease from 791.47 ± 847.98 to 516.88 ± 571.64, while the encapsulated 0.5% bakuchiol cream reduced sebum production from 718.00 ± 695.21 to 357.82 ± 341.67. The p-values for both comparisons were less than 0.05, meaning the differences were statistically significant.

Table 3. Observed stability parameters before and after six cycles of freeze-thawing.

Parameter	Bakuchiol oil cream (A)		Encapsulated bakuchiol cream (B)	
	Before cycling test	After cycling test	Before cycling test	After cycling test
Organoleptic	Beige cream, distinctive fruity aroma	Beige cream, distinctive fruity aroma	White cream, odorless	White cream, odorless
Homogeneity	Homogeneous	Homogeneous	Homogeneous	Homogeneous
Emulsion type	O/W	O/W	O/W	O/W
Spreadability (cm)*	5.90 ± 0.17	5.23 ± 0.21	5.23 ± 0.06	5.23 ± 0.06
pH	7.53 ± 0.06	7.76 ± 0.01	7.61 ± 0.01	7.64 ± 0.02

Table 4. Summary of the changes (in percentage) in the parameters of the skin quality observed at D-28 in comparison with the initial condition at D-0.

Parameter (%)	Bakuchiol oil	Encapsulated bakuchiol	P-value	Significance
Moisture increment (%)	4.0 ± 6.0	11.0 ± 7.0	1.000	Insignificant
Pore reduction (%)	10.1 ± 26.0	32.9 ± 30.0	0.005	Significant
Sebum reduction (%)	32.8 ± 24.0	41.5 ± 27.0	0.003	Significant
Wrinkle reduction (%)	54.0 ± 23.4	76.1 ± 22.0	0.001	Significant

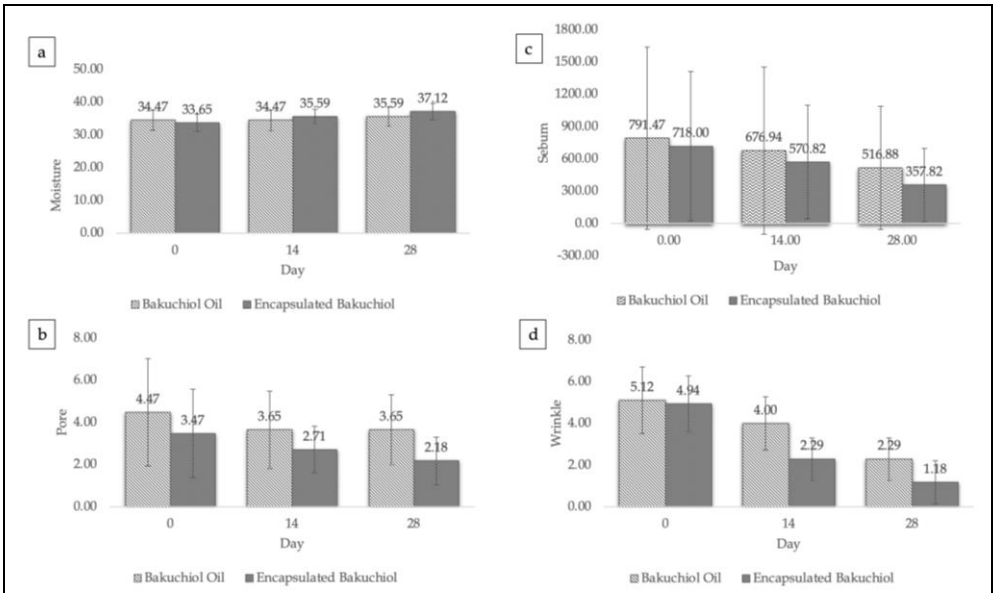

Figure 2. The result of skin moistures (a), pores (b), sebum (c), and wrinkles (d) of 0.5% bakuchiol oil cream and encapsulated 0.5% bakuchiol cream during application on days 0, 14, and 28, measured by A-One Tab Skin Analyzer.

The bar chart displays the mean ± SD (n = 17) with a significance level (p-value) below 0.05.

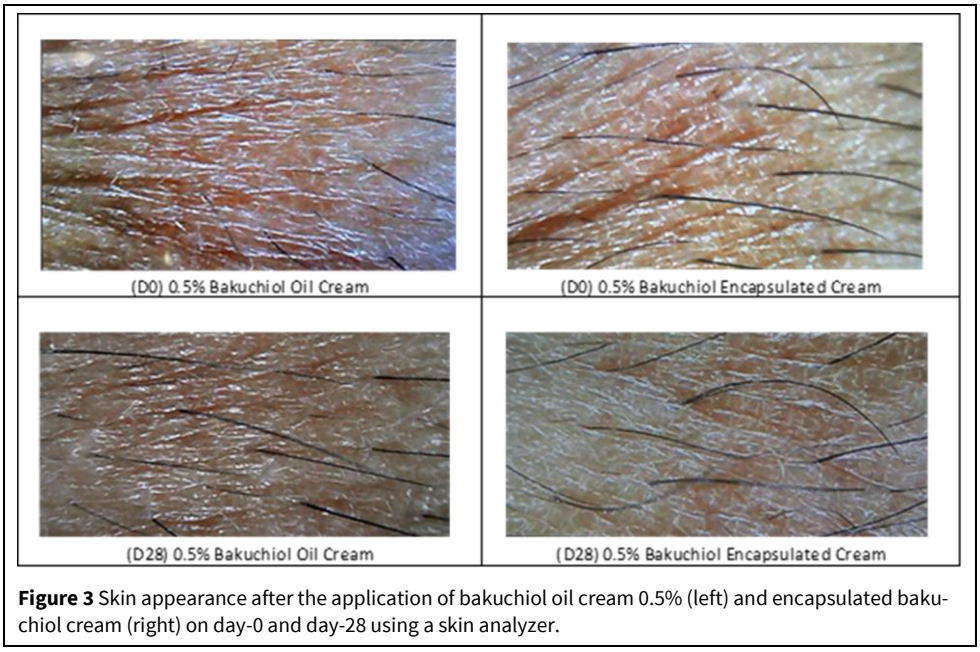

Figure 3 Skin appearance after the application of bakuchiol oil cream 0.5% (left) and encapsulated bakuchiol cream (right) on day-0 and day-28 using a skin analyzer.

The study indicates that the 0.5% bakuchiol oil cream and the encapsulated 0.5% bakuchiol cream reduced sebum production. However, the encapsulated 0.5% bakuchiol cream was more effective, reducing sebum production by 41% after 28 days of application, while the bakuchiol oil cream reduced sebum production by only 33% (see Table 4).

Fig. 2d presents data on the effect of two different creams on the appearance of wrinkles on the skin for 28 days. The results show that both cream formulations had a significant effect on reducing the appearance of wrinkles on the skin at D-28 compared to D-0. The 0.5% bakuchiol oil cream resulted in a decrease in wrinkle appearance from 5.12 ± 1.60 to 2.29 ± 1.02, while the encapsulated 0.5% bakuchiol cream reduced wrinkle appearance from 4.94 ± 1.35 to 1.18 ± 1.04. The p-values for both comparisons were less than 0.05, meaning the differences were statistically significant. The study showed that both 0.5% bakuchiol oil cream and encapsulated 0.5% bakuchiol cream reduced the appearance of wrinkles after 28 days of application. However, as summarized in Table 4, the

encapsulated bakuchiol cream had a greater effect on reducing wrinkles, with a 76% reduction compared to 54% for the bakuchiol oil cream.

Fig. 3 displays the improvement in skin quality after using 0.5% bakuchiol oil cream and encapsulated 0.5% bakuchiol cream from day 0 to day 28. The changes observed were a reduction in pore size and visibility of wrinkles.

DISCUSSION

Bakuchiol, a lipid-soluble derived plant ingredient, is commonly found in the market as an oil-based skincare product. Cosmetic formulators often choose creams as a vehicle to deliver lipid-soluble substances, because they are semisolid emulsions that can incorporate both water-soluble and lipid-soluble ingredients. Two formulas of bakuchiol-containing creams were chosen based on the preliminary study (unpublished results). The first formulation contained bakuchiol oil, while the second contained encapsulated bakuchiol using liposome technology. Through characterization and physical stability tests, we have found that liposome encapsulation can mask the color and odor of bakuchiol and improve its stability in cream (Casanova and Santos, 2016).

The study aimed to compare the effectiveness of bakuchiol oil and encapsulated bakuchiol cream in improving facial skin quality. This provides insight into the advantage of an advanced delivery of plant-derived actives into the skin. The results showed that encapsulation technology improved the efficacy of bakuchiol.

Encapsulated 0.5% bakuchiol cream showed a more significant increase in skin hydration than 0.5% bakuchiol oil cream. Lewińska et al. (2021) investigated the formulation of polymeric nanoparticles loaded with bakuchiol for enhanced skin moisturizing effect. The results showed that the encapsulated bakuchiol had a more significant moisturizing effect than free bakuchiol. The nanoparticles could serve as a promising carrier for the delivery of bakuchiol in cosmetic and dermatological applications.

Encapsulated 0.5% bakuchiol cream demonstrated a more significant reduction in pore visibility than 0.5% bakuchiol oil cream. Reducing pore size can be essential to an anti-aging skincare routine. In addition to bakuchiol, several ingredients have been reported to help reduce pore size, including retinoids, alpha-hydroxy acids (AHAs), beta-hydroxy acids (BHAs), and niacinamide (Adhau and Pardeshi, 2020). These ingredients have been reported to accelerate cell turnover and improve skin elasticity, resulting in smaller pores. Liposome encapsulation has been reported to modulate the release of glycolic acid and salicylic acid into the skin (Bastos and Santos, 2015).

Encapsulated 0.5% bakuchiol cream showed a more significant reduction in sebum production compared to 0.5% bakuchiol oil cream. Chaudhuri and Bojanowski (2014) reported a decrease in sebum production in individuals with oily skin who used a topical cream containing bakuchiol and salicylic acid. Encapsulating salicylic acid in lecithin and cholesterol was reported as a promising delivery system for salicylic acid, due to its ability to provide controlled release and improved stability (Bhalerao and Harshal, 2003).

The study found that the cream with encapsulated 0.5% bakuchiol resulted in a more significant decrease in wrinkle level compared to the cream with 0.5% bakuchiol oil. Dhaliwal et al. (2019) reported that a cream containing 0.5% bakuchiol had anti-aging effects, including a reduction in the appearance of wrinkles and improved skin texture and pigmentation. This study suggests that bakuchiol may be a promising alternative to retinol for individuals with sensitive skin or those who cannot tolerate retinoids. Kim et al. (2006) reported that the encapsulation of retinol in chitosan nanoparticles helped minimize the side effects of free retinol and improved the delivery and efficacy of retinol in topical applications.

Overall, the use of encapsulated 0.5% bakuchiol cream gave better results than 0.5% bakuchiol oil cream. This is because encapsulation can improve aspects such as delivery, skin irritation avoidance, and product stability. Encapsulation offers additional features such as controlled release, effective delivery systems, and safer cosmetics for skin types (Casanova and Santos et al., 2016). There were no adverse reactions or side effects of using both formulations. With faster technological developments and the growing demand for unique products, customers will likely prefer encapsulated bakuchiol over bakuchiol oil, as it offers more significant advantages (Wadhwa et al., 2019).

The study suggests that using encapsulated 0.5% bakuchiol cream can be a promising approach to help reduce signs of aging by improving skin moisture, reducing pore visibility, decreasing sebum production, and reducing wrinkles. These findings have significant implications for the skincare industry and dermatological practice. Manufacturers can use bakuchiol in their formulations to enhance product efficacy, while healthcare professionals can recommend this ingredient to their patients as part of their skincare routine. Encapsulation has improved aspects such as delivery, skin irritation avoidance, and product stability, making it a valuable technique for cos-

metic and dermatological applications. Encapsulation provides benefits such as controlled release, effective delivery systems, and safer cosmetics for various skin types (Bastos and Santos, 2015). However, further research is needed to elucidate the long-term effects and optimal concentrations of encapsulated bakuchiol cream in various skin types and its potential combination with other active ingredients to improve its efficacy. Additionally, more studies are required to comprehend the underlying mechanisms of action of bakuchiol on the skin, which can inform the development of novel skincare products for various skin issues.

CONCLUSION

The efficacy of the anti-aging properties of bakuchiol oil cream and encapsulated bakuchiol cream was tested based on the results of anti-aging performance tests. The results showed that the encapsulated 0.5% bakuchiol cream had a more significant effect than the 0.5% bakuchiol oil cream in three aspects (pores, sebum, and wrinkles). These findings have substantial implications for the skincare industry and dermatological practice. Encapsulation technology can be utilized to improve product efficacy, delivery, and stability while avoiding skin irritation. The use of encapsulated bakuchiol cream can be recommended to patients as part of their skincare routine to reduce signs of aging.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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Contribution	Hadiwidjaja M	Romadhona E	Yulianto	Chauwito NA	Sidauruk MGE	Kardiono R	Avanti C
Concepts or ideas	x						x
Design	x	x					x
Definition of intellectual content	x						x
Literature search	x	x		x		x	x
Clinical trial		x		x	x	x	
Experimental studies			x	x	x		
Data acquisition		x	x			x	
Data analysis		x	x			x	x
Statistical analysis			x	x	x		x
Manuscript preparation	x	x		x		x	x
Manuscript editing	x				x	x	x
Manuscript review	x	x	x	x	x	x	x

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