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Evaluation of Physical Attributes and Efficacy of Lip Balm Formulated with Okra Fruit Extract (*Abelmoschus esculentus* (L.) Moench Fructus)

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ABSTRACT: The okra fruit (*A esculentus fructus*) is renowned for its significant antioxidant properties, attributed to its rich content of bioactive compounds. Despite its high antioxidant activity, which has been extensively documented, its potential as a component in cosmetic formulations particularly lip balm preparation remains underutilized. This study seeks to address this gap by incorporating okra fruit extract into lip balm formulations and evaluating the resulting physical and functional attributes. Lip balm formulations were developed with three varying concentrations of Ethanol okra fruit extract: F1 (1%), F2 (3%), and F3 (5%). A series of comprehensive evaluations were conducted to assess the physical stability and performance of the lip balms, including organoleptic properties, homogeneity, pH, melting point, spreadability, and overall stability. Stability was monitored over a 28-day period at room temperature to simulate typical storage conditions. The antioxidant efficacy of the okra extract was quantified using the DPPH (1,1-diphenyl-2-picrylhydrazyl) assay, which yielded an IC_{50} value of 10.06 $\mu g/ml$, reflecting its potent free radical scavenging capacity. In comparison, the lip balm formulations demonstrated higher IC_{50} values, with Formulation I (FI) at 46.35 $\mu g/ml$, Formulation II (FII) at 40 $\mu g/ml$, and Formulation III (FIII) at 30.23 $\mu g/ml$, indicating a reduction in antioxidant activity in the formulated products compared to the pure extract. The lip balm formulations exhibited a distinct okra aroma, smooth texture, and uniform color variations ranging from light brown (F1), brown (F2), to dark brown (F3). pH values ranged from 5.40 to 5.81, and melting points were between 49.6°C and 52.9°C, all within the acceptable range as per SNI 16-4769-1998 standards. ANOVA statistical analysis revealed no significant changes ($p > 0.05$) in melting point and spreadability over time. However, significant differences ($p < 0.05$) were noted in pH values, with further analysis indicating that formulations F2 and F3 differed significantly from F1 ($p < 0.05$). These results demonstrate that okra fruit extract not only enhances the antioxidant properties of lip balm but also maintains its stability and functionality, supporting its potential as a valuable ingredient in cosmetic formulations.

KEYWORDS: Cosmetic; Formulation; Lip balm; Okra fruit; Stability test

1. INTRODUCTION

Cosmetics are substances applied to external parts of the body, including skin, hair, nails, and genital areas, and have significantly evolved from their origins [1]. The global cosmetics industry represents a significant economic sector, with substantial growth and market opportunities. In 2023, the global cosmetics market was valued at approximately USD 600 billion, with projections indicating continued growth driven by rising consumer demand for innovative and high-quality cosmetic products. The industry encompasses a wide range of products, from skincare and haircare to makeup and personal care, reflecting its broad economic impact and potential [2]. The term "cosmetics" is derived from the Greek word "kosmein," meaning "to adorn" [3]. Modern cosmetics are not merely aesthetic enhancements but also offer functional benefits, addressing various dermatological needs. Further, cosmetics are broadly categorized into two main types based on their intended use: skincare cosmetics and decorative cosmetics [4]. Skincare cosmetics are designed to address and protect the skin from environmental damage and various skin conditions. In contrast, decorative cosmetics, also known as makeup, are utilized to improve appearance, conceal imperfections, and enhance self-esteem [5].

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Among the diverse range of cosmetic products, lip formulations are widely used. These include lipsticks, lip glosses, lip balms, lip creams, and lip tints. While lipsticks, lip creams, lip glosses, and lip tints are categorized as decorative cosmetics due to their aesthetic purposes, lip balms are classified as skincare cosmetics [6]. Their primary function is to moisturize and protect the lips from environmental factors, such as low humidity and extreme temperatures, which can lead to dehydration of the epithelial mucosa [7]. Lip balms are semi-solid preparations composed primarily of oils, waxes, and fats, which help in forming a protective barrier on the lips [8]. Moreover, to enhance the functionality of lip balms beyond basic moisturization, formulations can be modified to include antioxidants. Antioxidants play a crucial role in neutralizing free radicals, which are reactive molecules that contribute to oxidative stress and damage [9]. While the body naturally produces some antioxidants, additional synthetic and plant-derived antioxidants are often incorporated into cosmetic formulations. Okra fruit (*A esculentus* fructus) is a notable example of a plant with significant antioxidant properties [10].

Okra, an herbaceous vegetable originally from Africa and later introduced to the Americas, thrives in tropical climates and is characterized by its low water requirements, ease of cultivation, and extended shelf life [11, 12]. In Indonesia, okra is predominantly used as a food ingredient in various dishes, including soups and salads. The young fruit of the okra plant is rich in essential nutrients such as dietary fiber, vitamin A, calcium, and magnesium. It is also recognized for its potent antioxidant activity [13]. Research has demonstrated that okra fruit possesses robust antioxidant capabilities, with an IC_{50} values of 40.2 µg/ml [14], 27.15 µg/ml using the DPPH method, and 24.50 µg/ml using the ABTS method [15]. These findings highlight okra's potential applications as antioxidant agent that could be developed as lip balm. Despite its numerous benefits, the utilization of okra in pharmaceutical, particularly in cosmetic formulations remains underexplored in Indonesia. Given its potent antioxidant properties, there is a compelling rationale to incorporate okra fruit extract into lip balm formulations. This study aims to investigate the formulation of lip balm containing okra fruit extract at various concentrations and to evaluate the resulting product's physical attributes and efficacy.

2. MATERIALS AND METHODS

2.1. Extraction

The okra fruit was extracted using a maceration process with 70% ethanol, maintaining a 1:5 ratio of plant material to solvent. The okra used in this study was sourced from cultivated okra farms in Tangerang, Banten. The solvent employed in the extraction process was of technical grade, purchased from Brataco. First, 200 grams of dried okra fruit powder was accurately weighed. Subsequently, 1000 milliliters of 70% ethanol were prepared. The okra powder was soaked in ethanol solution and left to macerate for 5 days, with the solvent being replaced every 24 hours [16]. During this period, the mixture was stirred intermittently for 5 minutes each day and was kept in a dark, airtight container to protect it from light and potential degradation. After completing the maceration process, the mixture was filtered to remove solid residues from the liquid extract. The filtrate was then subjected to evaporation to obtain a concentrated, viscous extract.

2.2. Phytochemical Screening

Phytochemical screening is a methodological approach aimed at identifying and characterizing the diverse chemical compounds present in plant materials. In this study, the phytochemical screening focused on detecting several key classes of compounds, including alkaloids, flavonoids, saponins, tannins, phenolics, steroids, and triterpenoids. The screening procedures were adopted from the methodology outlined by Mugiyanto et al., which involves specific reagents and protocols to systematically test for the presence of these phytochemical groups [17].

2.3. Antioxidant Assay of Okra Ethanol Extract

The antioxidant activity of the okra ethanol extract was evaluated using the DPPH (1,1-diphenyl-2-picrylhydrazyl) method. A 100 µg/ml DPPH stock solution was prepared by dissolving 10 mg of DPPH powder in 100 ml of ethanol, and stored in a dark container. A working solution of 30 µg/ml DPPH was made by diluting this stock solution. To determine the maximum wavelength, 1 ml of the 30 µg/ml DPPH solution was diluted with ethanol in a 5 ml volumetric flask, and absorbance was measured using a UV-Vis spectrophotometer over 400-800 nm.

The test solutions were prepared from a 1000 µg/ml stock solution of the okra extract, which was diluted to final concentrations of 5, 7, 9, 11, and 13 µg/ml. One ml of each test solution was mixed with 2 ml of 30 µg/ml DPPH solution, and the mixture was allowed to react in the dark for 30 minutes. Absorbance was measured at 523 nm. Antioxidant activity was calculated as the percentage inhibition of DPPH radical absorption using:

$$\text{Inhibition} = [A-B] / [A] \times 100\% \text{ [18, 19]}$$

where (A) is the absorbance of the blank and (B) is the absorbance of the sample. The IC_{50} value, which reflects the concentration needed to inhibit 50% of DPPH activity, was determined from a plot of inhibition percentage versus concentration. This value was compared with that of ascorbic acid, prepared at concentrations of 2, 3, 4, 5, and 6 µg/ml using the same procedure.

2.4. Formulation Design of Lip Balm

The basic formulation for lip balm was adapted from Rieger (2009) and includes a blend of various components. The formula demonstrated in Table 1.

Table 1. Okra's lip balm formula and its amount based on previous study.

Ingredients	Formula (%)			Contribution
	F1	F2	F3	
Okra's extract	1	3	5	Active ingredient
Cera Alba	15	15	15	Base
Shea Butter	20	20	20	Base
Vaselin album	30	30	30	Emolien
Tween 80	5	5	5	Emulgator
Castor Oil	12.5	12.5	12.5	Emolien
Nipagin	0.3	0.3	0.3	Preservative
Propilen Glikol	Ad 100	Ad 100	Ad 100	Solvent

The paraffin wax and beeswax contribute to the solid structure of the balm, while petrolatum and mineral oil enhance its moisturizing and protective qualities [19]. These modifications are designed to enhance the properties of the lip balm, including its stability and effectiveness. The proportions are based on the standards and recommendations found in the literature [20].

2.5. Preparation of Okra Fruit Extract Lip Balm

The processed begin by melting Cera Alba, Castor Oil, and Shea Butter using a water bath. Once these components have melted, add Vaselin album and Propylene Glycol to the mixture, stirring continuously until the mixture is homogeneous (Mixture A). In a separate container, dissolve the Okra Fruit Extract and Tween 80, then incorporate Nipagin and mix until homogeneous (Mixture B). Slowly add Mixture B to Mixture A while stirring continuously. Pour the combined mixture into molds while it is still warm and allow it to cool and solidify.

2.6. Evaluation of Okra Fruit Extract Lip Balm

The evaluation of the okra fruit extract lip balm following previous study that involves several key tests to ensure its quality and performance [21]. Organoleptic testing assesses the physical attributes of the lip balm using the senses of sight, touch, and taste. This includes evaluating the color, flavor, shape, texture, and aroma of the product to ensure it meets the desired sensory standards. Additionally, homogeneity testing is conducted to confirm that the formulation is evenly mixed. This is done by applying a sample of the lip balm onto a glass slide, covering it with another slide, and checking for any lumps or inconsistencies that would indicate poor mixing. pH testing is performed to measure the acidity or alkalinity of the lip balm using a pH meter or pH indicator paper. The pH paper is used to observe color changes, which are then compared to a standard color scale to determine the pH value. Melting point testing is also carried out by heating a 1-gram sample of the lip balm in a water bath until it fully melts, with the temperature recorded using a thermometer to ascertain the melting point. Spreadability testing evaluates how easily the lip balm can be applied and spread on the skin. The product is placed on a glass slide, covered with another slide, and weighted to measure

the distance it spreads, with a desirable range being 5-7 cm for topical formulations. Finally, stability testing monitors the changes in organoleptic properties, pH, and homogeneity of the lip balm during storage at room temperature over 28 days, with observations made on 0, 7, 14, 21, and 28th days. This ensures that the lip balm maintains its quality and effectiveness throughout its intended shelf life.

2.7. Stability Test Data Analysis

The stability test data were analyzed statistically using the Kolmogorov-Smirnov test to determine if the data were normally distributed. For data exhibiting normal distribution, further analysis was conducted using one-way ANOVA (Analysis of Variance) with a confidence level of $\alpha = 0.05$. If significant differences were detected, the data were subsequently subjected to LSD (Least Significant Difference) post-hoc testing. This methodology was employed to assess the impact of different concentrations of okra extract on the stability of the lip balm during storage at room temperature over a specified period, as indicated by significant values in the output.

3. RESULTS

3.1. Okra Extract

The concentrated okra extract appeared as a dark brown substance with a distinct okra odor and a bitter taste. After concentration using a vacuum rotary evaporator, 47 grams of thick okra fruit extract was obtained. The extract rendemen was demonstrated in Table 2.

Table 2. Okra Extraction Results.

Result	Number
Okra powder	406 g
Concentrated okra extract	47 g
Extract yield	11.6%

The yield of the okra extract was calculated to be 11.6%, reflecting the efficiency of the extraction and concentration process.

3.2. Phytochemical Content

Phytochemical screening was performed on both okra fruit powder and the concentrated okra extract using the same procedures. The results of the phytochemical screening for both okra fruit powder and concentrated okra extract are presented in Table 3.

Table 3. Phytochemical Content Results.

Phytochemical group	Result	
	Powder	Extract
Alkaloid (Meyer)	+	-
Alkaloid (Dragenderoff)	+	+
Flavonoid	+	+
Saponin	+	+
Tanin	+	+
Phenolic	+	+
Terpenoid	+	+

(+) Indicates the presence of secondary metabolites
(-) Indicates the absence of secondary metabolites

3.3. Antioxidant Activity Results of Okra Extract

The antioxidant activity of okra fruit extract was evaluated using the DPPH method. This method was chosen due to its accuracy, efficiency, and quantitative nature in determining free radical scavenging activities [22]. The results indicate that the okra extract exhibited a strong antioxidant activity with an IC_{50} value of 10.06 µg/ml, confirming its potential as a highly effective antioxidant agent. However, when formulated into lip balms, the antioxidant activity decreased across all formulations. FI showed an IC_{50} value of 46.35 µg/ml, FII had an IC_{50} value of 40 µg/ml, and FIII demonstrated the highest antioxidant activity among the formulations with an IC_{50} value of 30.23 µg/ml. The trend suggests that the antioxidant activity of the okra extract

diminishes upon incorporation into the lip balm matrix, but all formulations still retain moderate antioxidant properties. This finding emphasizes the impact of formulation components on the overall antioxidant effectiveness, highlighting the importance of optimizing formulation parameters to preserve the extract's potent antioxidant activity in the final cosmetic product (**Figure 1**). Moreover the antioxidant activity tests for vitamin C revealed an IC_{50} values 3.3 µg/ml. Based on these results, the IC_{50} value of okra extract indicates very strong antioxidant activity. Notably, the IC_{50} value obtained in this study is significantly lower than previous findings [14, 15].

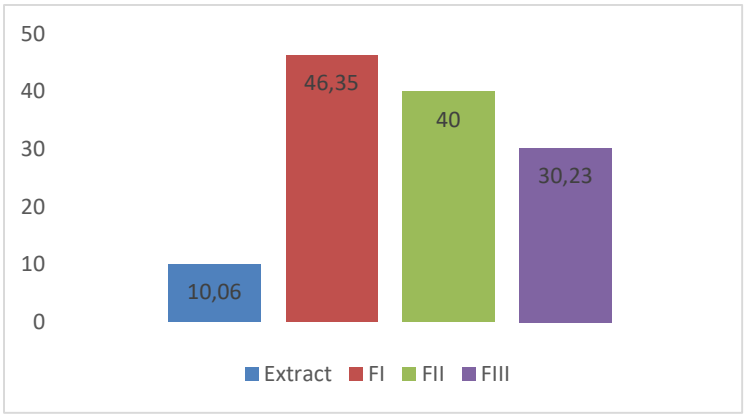

Figure 1. Antioxidant Activity (IC_{50} Values) of Okra Extract and Lip Balm Formulations (FI, FII, FIII)

Since a lower IC_{50} value signifies higher antioxidant activity, these results suggest that the okra fruit used in this study possesses strong antioxidant properties compared to prior research.

3.4. Physical Evaluation Result

3.4.1. Organoleptic

The organoleptic evaluation of the okra fruit extract lip balm formulations assessed color, texture, and aroma over a 28-day period at room temperature. All three formulations maintained stable organoleptic characteristics throughout the study. Formulation F1 exhibited a whitish-brown color, semi-solid texture, and a distinct aroma from day 0 to day 28. Formulation F2 showed a consistent light brown color, semi-solid texture, and the same distinct aroma throughout the observation period. Similarly, formulation F3 retained a brown color, semi-solid texture, and a distinct aroma across all time points. No significant changes in the organoleptic properties were observed during the storage period.

3.4.2. Homogenity

The homogenity results showed that the okra fruit extract lip balm formulations met the required standards for homogeneity. In the tests conducted, none of the three formulations exhibited any coarse particles when applied to a transparent glass surface, indicating that the lip balms were uniformly mixed. A homogeneous lip balm ensures that all ingredients are evenly dispersed throughout the base, leading to effective application. The stability of the lip balm formulations also met the criteria, as no changes in homogeneity were observed over the 28-day storage period at room temperature.

3.4.3. pH

The pH testing of the okra extract lip balm formulations was conducted to determine the acidity level of the product, using a pH meter. According to the Indonesian National Standard (SNI) 16-4769-1998, an ideal lip balm should have a pH range between 4.5 and 7.5. The results of the pH evaluation are summarized in the Figure 2.

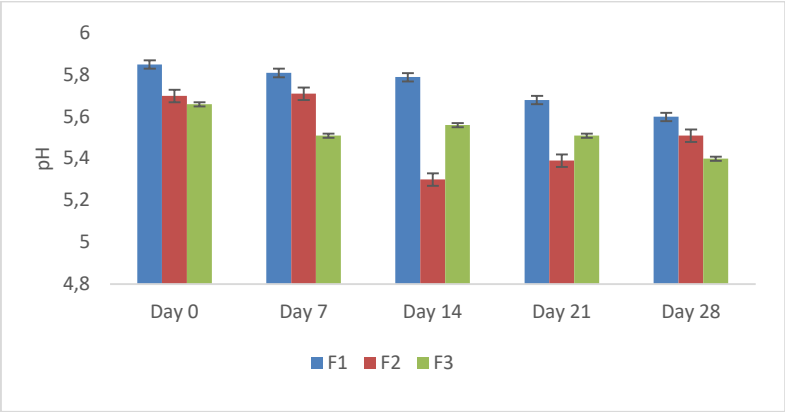

Figure 2. pH Evaluation Results. All formulations remain within the acceptable pH range of 4.5-7.5 for lip balm products.

Further, in the stability testing of the lip balm pH, the significance level was 0.147, allowing further analysis with one-way ANOVA. The one-way ANOVA results yielded a significance level of 0.3, indicating that there were significant differences among the pH levels of the three formulations stored at room temperature for 28 days. To further investigate these differences, the LSD test was conducted. The results revealed that Formulations F2 and F3 exhibited significant differences compared to Formulation F1 ($p < 0.05$), while no significant difference was observed between F2 and F3 ($p > 0.05$).

3.4.4. Melting Point

Melting point testing was conducted to evaluate the stability of each lip balm formulation containing okra fruit extract. The melting point is a crucial parameter for determining the storage and usability of the lip balm, ensuring it retains its shape and consistency during use. The results of the melting point measurements for the lip balm formulations with various concentrations are presented in Figure 3.

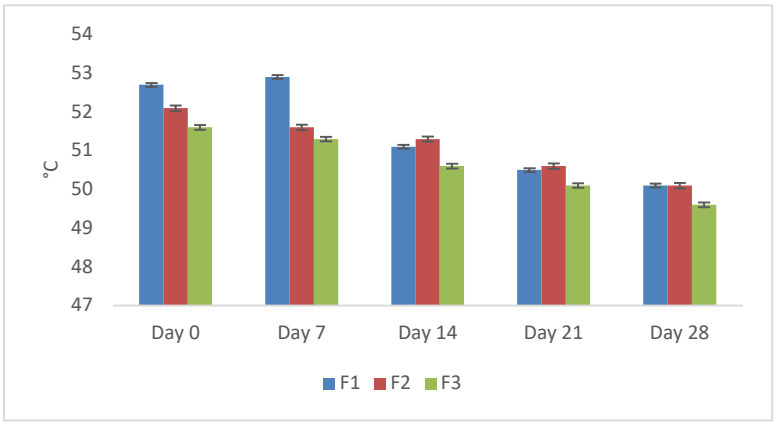

Figure 3. The melting points of lip balm formulations containing okra fruit extract.

Based on the data, a one-way ANOVA was performed, revealing a significance value of 0.444 ($p > 0.05$). This indicates that there are no significant differences among the formulations over the storage period.

3.4.5. Spreadability

The spreadability test was conducted to evaluate how easily the lip balm spreads on the skin. This was measured by determining the spread diameter of the lip balm under different weights: 50 g, 100 g, and 150 g. Each test was repeated three times to ensure accuracy. The results of these measurements are presented below.

Table 4. Results of Spreadability Test for Okra Fruit Extract Lip Balm.

Weight (g)	Formula	Days				
		0	7	14	21	28
50	F1	4.10	4.10	4.12	4.11	4.14
	F2	4.12	4.12	4.13	4.15	4.17
	F3	3.90	4.00	4.14	4.15	4.17
100	F1	4.15	4.17	4.18	4.20	4.20
	F2	4.13	4.15	4.14	4.15	4.15
	F3	4.19	4.20	4.21	4.21	4.22
150	F1	4.18	4.18	4.20	4.20	2.21
	F2	4.19	4.20	4.20	4.21	4.22
	F3	4.20	4.20	4.19	4.20	4.20

Statistical analysis yielded a significance value of 0.949 ($p > 0.05$), indicating no significant differences in spreadability among the different formulations throughout the storage period.

4. DISCUSSION

The results of the study provide a comprehensive evaluation of the okra fruit extract lip balm, assessing both its antioxidant potential and its physical characteristics over a 28-day period. The antioxidant activity of the okra fruit extract, measured using the DPPH method, yielded an IC_{50} value of 10.06 µg/ml, demonstrating a potent antioxidant capacity. In comparison, the formulated lip balms showed IC50 values of 46.35 µg/ml for F I, 40 µg/ml for FII, and 30.23 µg/ml for F III, reflecting reduced but still notable antioxidant effects. These results surpass previous findings by Astutiningsih (2023) and Faisal (2019), who reported IC50 values of 27.15 µg/ml and 40.23 µg/ml, respectively, highlighting the strong antioxidant potential of the okra extract, even when incorporated into cosmetic formulations. [14, 15]. The lower IC_{50} value suggests that the okra extract is highly effective at scavenging free radicals, which is beneficial for formulating antioxidant-rich cosmetic products. This strong antioxidant activity underlines the potential of okra extract as an active ingredient in skincare products, contributing to the protection of the skin from oxidative stress and environmental damage. In the broader context of the cosmetic industry, antioxidants are crucial as they help combat the effects of aging and environmental pollutants [23]. As consumers increasingly seek products that offer skin protection and promote skin health, incorporating potent antioxidants like okra extract can enhance the efficacy and appeal of cosmetic formulations. This aligns with current trends in the cosmetic industry, where there is a growing emphasis on using natural and effective ingredients to address skin concerns and improve overall skin health [24].

The physical evaluation of the lip balm formulations, which included the organoleptic properties, homogeneity, pH, melting point, and spreadability, provided insights into the quality and usability of the product. The organoleptic testing showed that the formulations maintained consistent characteristics throughout the storage period. Specifically, Formulation F1 exhibited a color range from light brown to brown, a semi-solid texture, and a characteristic aroma. Formulations F2 and F3 also displayed stable texture and aroma, with gradual changes in color. These sensory attributes are crucial as they significantly impact consumer acceptability and satisfaction with the product. A visually appealing, pleasant-smelling, and comfortable-to-use lip balm enhances user experience and marketability. The result inline with SNI 16-4769-1998 standards, a well-formulated lip balm should have a desirable appearance, a pleasant scent, and a smooth texture to ensure user satisfaction [25].

Homogeneity tests confirmed that all lip balm formulations were well-mixed, with no visible lumps or inconsistencies observed. This uniformity ensures that the active ingredients are evenly distributed throughout the base, which is essential for the efficacy of the product. According to international standards such as those set by the International Organization for Standardization (ISO) and the European Pharmacopeia, homogeneity is a critical quality attribute for cosmetic products [26]. These standards emphasize that a homogeneous formulation ensures consistent performance, contributes to a smooth and effective application, and maintains the product's stability over its intended shelf life. Further, a homogeneous formulation not only ensures consistent performance but also contributes to a smooth and effective application, which is vital for consumer satisfaction. This is crucial for cosmetic products, as uneven application can lead to varying effectiveness and user experience [27]. The ability to deliver an even layer of the product ensures that the

benefits of the active ingredients, such as antioxidants and moisturizers, are uniformly applied to the lips, thereby optimizing their efficacy and providing a reliable cosmetic benefit. Compliance with these international standards helps in ensuring that the product meets high-quality benchmarks and aligns with global expectations for cosmetic safety and performance.

The pH of the lip balm formulations was measured to ensure they fell within the acceptable range of 4.5 to 7.5, as specified by SNI 16-4769-1998. The pH values remained stable throughout the 28-day storage period, with no significant differences detected among the formulations ($p > 0.05$). This stability in pH is crucial for maintaining the safety and effectiveness of the lip balm, as deviations in pH can affect skin compatibility and product stability. A consistent pH within this range is essential for minimizing the risk of skin irritation and adverse reactions [28]. Products with a pH significantly outside this range can disrupt the natural acid mantle of the skin, leading to potential irritation, dryness, or allergic reactions. The lip balm formulations in this study, maintaining a stable pH, indicate that they are less likely to cause irritation or discomfort, enhancing user safety. Moreover, a stable pH contributes to the preservation of the product's active ingredients and overall effectiveness [29]. For instance, extreme pH levels can cause the breakdown of certain compounds, reducing their efficacy and potentially altering the product's performance [30]. By adhering to the specified pH range, the lip balm not only ensures safety but also maintains its intended benefits over time, providing reliable performance throughout its shelf life. This adherence to pH standards aligns with best practices in cosmetic formulation, as outlined by international guidelines such as those from the International Organization for Standardization (ISO) and the European Pharmacopeia. These standards emphasize the importance of pH stability in ensuring product safety, effectiveness, and consumer satisfaction. Thus, the consistent pH observed in these formulations supports their suitability for long-term use and their compliance with global safety standards.

Lastly, the melting point and spreadability tests provided valuable insights into the physical stability and usability of the lip balm formulations. The melting point measurements indicated that there were no significant differences among the formulations ($p > 0.05$), suggesting that all formulations maintained their structural integrity under typical storage conditions. This stability is crucial because it ensures that the lip balm does not lose its form or become compromised under normal temperature variations, which could otherwise affect its performance and user experience. The spreadability tests further supported the quality of the formulations by demonstrating consistent performance across different weights and formulations, with no significant differences observed ($p > 0.05$). This result indicates that the lip balm spreads evenly and comfortably on the skin, which is essential for a pleasant user experience [31]. Even application is key in cosmetic products, as it ensures that the active ingredients are distributed uniformly, maximizing their effectiveness and providing a smooth, enjoyable application. From a cosmetic effectiveness perspective, these physical attributes are integral to the overall efficacy and user satisfaction of the product. A well-formulated lip balm that maintains its structure and spreads easily can deliver consistent results and ensure that the benefits of the active ingredients are fully realized. In this case, the okra fruit extract provides antioxidant benefits that are enhanced by the stable and well-spread formulation, contributing to skin protection and hydration.

The alignment of these findings with the goals of cosmetic products, such as ensuring efficacy, safety, and user comfort—highlights the potential of the okra fruit extract lip balm as a promising option in the skincare market. The formulation's ability to maintain physical integrity, provide even application, and deliver antioxidant protection supports its effectiveness and attractiveness to consumers seeking high-quality, reliable cosmetic products. This not only underscores the product's utility in protecting and improving skin health but also aligns with the broader objectives of cosmetic efficacy and consumer satisfaction.

5. CONCLUSION

This research successfully formulated and evaluated lip balm preparations containing okra fruit extract with strong antioxidant properties. The IC_{50} value of 10.06 µg/ml demonstrated that the okra extract exhibited very potent antioxidant activity, making it a promising ingredient for skincare formulations aimed at protecting against oxidative stress. The physical evaluations, including organoleptic, homogeneity, pH, melting point, and spreadability, met the standards set by SNI 16-4769-1998, indicating that the formulations are safe, stable, and effective for cosmetic use. The stable pH values and absence of significant changes in physical characteristics during storage ensure both the product's efficacy and user safety. Overall, the okra-

based lip balm formulation is a viable option for antioxidant-rich cosmetic products that provide both protective and aesthetic benefits.

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