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Physicochemical analysis, antioxidant activity, and hedonic evaluation of facial serum containing roselle (*Hibiscus sabdariffa*) and pomegranate (*Punica granatum*) extracts

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ABSTRACT
The utilization of natural ingredients in cosmetic applications is increasing due to public awareness of their safety and minimal side effects. This study aims to evaluate and compare the antioxidant activity of facial serums containing Hibiscus sabdariffa (roselle) and Punica granatum (pomegranate) extracts. Physical quality tests were conducted, including organoleptic, homogeneity, pH, specific gravity, and viscosity evaluations. Organoleptic observations showed both formulations had stable characteristics, including brown color, typical herbal aroma, and thick consistency without changes during storage. Homogeneity testing indicated no phase separation or sedimentation. The specific gravity of both serums was 1.02 g/mL, meeting SNI standards. Viscosity values were 2840 cps for roselle serum and 2540 cps for pomegranate serum, indicating appropriate consistency for topical use. The pH values were 3.75 ± 0.006 and 3.94 ± 0.017, respectively. Antioxidant activity was analyzed using the DPPH method. IC_{50} values were 6000 ppm for roselle extract and 359.163 ± 0.437 ppm for pomegranate extract, indicating very weak antioxidant activity for anti-aging applications. This low activity may be influenced by extract concentration, degradation during formulation, storage conditions, and environmental exposure. While both serum formulations successfully met the SNI 19-4339-1996 physical quality requirements for topical use, their antioxidant efficacy was insufficient for potent anti-aging applications. This study contributes a critical baseline for natural serum formulation, identifying that physical stability does not guarantee antioxidant potency. These findings provide a necessary foundation for future research to focus on optimizing extract concentrations and stabilizing bioactive compounds against degradation during the formulation process.

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Antioxidant activity, DPPH assay, Facial serum, Pomegranate extract, Roselle extract.

INTRODUCTION

Comestics, according to the Regulation of the Head of the Indonesian Food and Drug Administration (BPOM) No. 23 of 2019, are defined as materials or preparations intended for use on the outside of the human body (Khodijah, 2021). Materials used in cosmetics must be safe, useful, of good quality, and not harmful to human health. However, along with the increasing number of cosmetic consumers in Indonesia, various instant products containing harmful chemicals have emerged (Fonseca et al., 2023). The use of natural ingredients for medical and cosmetic purposes is increasingly being

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used, because natural ingredients are safer and are also believed to be able to overcome skin problems better than chemicals that cause side effects. One of the natural ingredients that can be used is Roselle Flower (*Hibiscus sabdariffa L.)* and Pomegranate (*Punica granatum*) (Malinda & Syakdani, 2020).

Roselle (*Hibiscus sabdariffa L.)* is a type of plant that is widely recognized for its beautiful red flowers and rich nutrients. Roselle petals contain anthocyanins, vitamin C, and flavonoids that function as natural antioxidants (Wu et al., 2018). The red color in rosella flowers (*Hibiscus sabdariffa L.*) is caused by the anthocyanin content. Anthocyanins are antioxidants that have a conjugated double bond system, which makes anthocyanins an antioxidant with a radical capture mechanism. In the beauty world, roselle is used as a lip moisturizer, lotion, mask, and facial serum. Roselle extract has anti-inflammatory effects that can reduce redness and irritation on sensitive skin. Its antioxidant content also helps maintain healthy skin and fight signs of aging (Malinda & Syakdani, 2020; Sinuraya, 2024). Roselle flowers (*Hibiscus sabdariffa L.)* can also be processed into tea. Consuming Roselle tea regularly can make the skin healthier and more radiant due to its high content of glycolic acid, citric acid, and malic acid. Roselle flowers also protect the skin from free radicals and UV rays, and are rich in vitamin C, amino acids, and essential proteins that nourish the skin (Inggrid et al., 2018; Karmana, 2023).

Pomegranate (*Punica granatum*) has several active compounds, namely alkaloids, flavonoids, saponins, tannins, and triterpenoids (Apriliana & Mustofa, 2025; Roswiem, 2017). Pomegranate contains polyphenol and flavonoid compounds (anthocyanins) that function as strong antioxidants, which are higher than those in green tea or orange juice (Turrini et al., 2015). These antioxidants help ward off free radicals that can damage the skin, prevent premature aging, and maintain healthy skin. Pomegranate is also useful for improving skin elasticity, stimulating cell regeneration, and providing natural protection against damage from UV exposure (Khairudin & Saputro, 2022). Pomegranate extract has potential as an antibacterial because it has proven effective against various types of bacteria from both the fruit and the skin and seeds of the fruit (Halim et al., 2023). Punicalagin and ellagatanin are the main polyphenol contents in red pomegranate. These compounds have strong antioxidant properties that can be methanolized into asa ellagic and urolithin to fight free radicals. In addition, the antibacterial properties of these compounds help overcome P. Acnes bacteria, the main cause of acne (Mansur et al., 2022).

Antioxidants play an important role in counteracting free radicals caused by sun exposure, helping to prevent chronic diseases such as skin cancer, and reducing oxidation by binding to reactive molecules that can damage the skin. Free radicals can damage collagen and elastin in the skin, causing decreased elasticity, the appearance of wrinkles, and disruption of melanin pigment distribution, resulting in uneven pigmentation. In addition, free radicals can also damage macromolecules such as proteins, carbohydrates, fats, and DNA, risking skin cancer, but these effects can be prevented by the use of antioxidants (Khojah et al., 2024; Papaccio et al., 2022). Antioxidant compounds can be obtained from the skin of white pomegranate (*Punica granatum L.*), which contains ellagic acid and was shown to be effective in protecting and improving UV-induced skin pigmentation in guinea pig studies (Ikeda et al., 2025; Krishnakumar, 2024). In addition, roselle flowers are also rich in antioxidants that can protect cells from free radical damage. For the benefits to remain optimal, roselle needs to be processed with the right method to maintain its antioxidant content, where the more intense the color of the extract, the higher the antioxidant content (Kurnia et al., 2023; Rosalia et al., 2016).

Cosmetics with high concentrations of active ingredients attach active ingredients to the skin surface with low viscosity. Serums are formulated with low viscosity and are less clear (semitransparent), contain higher levels of active ingredients than common topical preparations, which deliver a thin film of active ingredients on the skin surface (Das & Wong, 2020). Facial serum is a type of pharmaceutical product designed to maintain skin health and can be applied to the skin to keep it healthy, clean, and well-groomed. Facial serum absorbs well and is easily applied to the skin. Serum absorption occurs in the stratum corneum, the outermost layer of the skin, which consists of many keratinocyte cells containing keratin protein (Rini et al., 2023; Setiawan, 2023).

This study aims to evaluate the effectiveness of antioxidants in an antiaging facial serum containing roselle flower (*Hibiscus sabdariffa*) and pomegranate (*Punica granatum*) extracts, analyze the comparative effects of the two extracts in serum formulation, and test its feasibility based on SNI

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16-4399-1996 standard. The results of this study are expected to provide scientific information on the potential of both extracts as active ingredients in safe and effective skin care products.

While the individual antioxidant properties of Roselle and Pomegranate have been documented in various food and medicinal contexts, there is limited comparative data regarding their efficacy when integrated into a low-viscosity facial serum delivery system. This study fills a critical gap in cosmetic formulation by determining the optimal synergy between Roselle's anthocyanins and Pomegranate's punicalagin to maximize radical scavenging activity. Furthermore, this research contributes to the standardization of natural serums by benchmarking the formulation against the SNI 16-4399-1996 national quality standards, providing a foundation for the commercial development of safe, plant-based anti-aging topicals.

RESEARCH METHOD

Materials

The tools used in the preparation of roselle and pomegranate extracts consist of various tools and materials. The tools used include a shaker, an Erlenmeyer flask, a water heater, an analytical balance, a three-neck flask, an electric heater, a magnetic stirrer, a static clamp, a condenser, a thermometer, a measuring cup, a heating mantle, a round-bottom flask, a holder, and UV-Vis spectrophotometry. Meanwhile, the materials used were methanol, ethanol, and Dimethylol-Dimethyl Hydantoin (DMDM) ($C_7H_{12}N_2O_4$), emollient Polyalkylene Glycol 46, cellulose gel, base serum, niacinamide, vitamin E, ascorbic acid (vitamin C), water, roselle flowers, and pomegranate. The primary botanical materials, roselle flowers and pomegranate extracts, were sourced from PT. Berkah Alam Nusantara, Garut, West Java.

Methods

As illustrated in Figure 1, this study was conducted through sequential stages, including sample preparation and extraction, serum formulation, physicochemical and organoleptic evaluation, stability testing, and antioxidant activity assessment using the DPPH method.

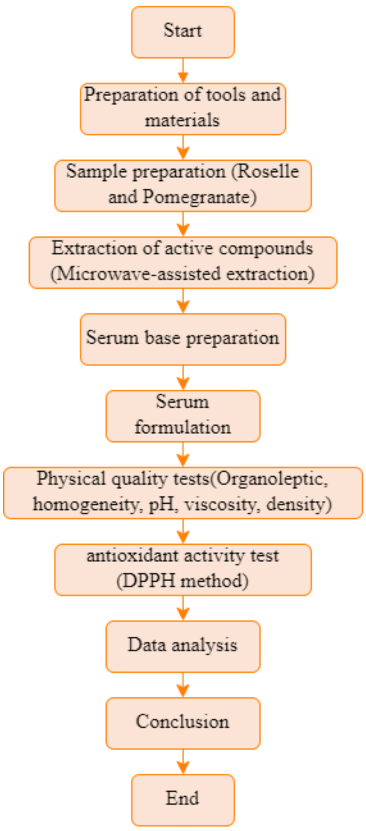

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Figure 1. The flowchart of the research methods.

1. Sample Preparation and Extraction

The rosella petal simplisia powder was pulverized again and sieved using a 40 mesh sieve. For the determination of drying shrinkage, as much as 1 gram of simplisia powder was weighed in a weighing bottle that had been heated and tared, then dried in an oven at 105 °C until it reached a fixed weight. The drying shrinkage value is expected to be less than 10% according to the standard set. Determination of ash content is done by putting 2 – 3 grams of samples into a silicate crucible, then heating in a furnace at 600 °C (± 25 °C) until the charcoal runs out and white ash remains, which is then cooled and weighed.

Determination of water-soluble essence content was carried out by the maceration method, where 5 grams of simplisia powder was macerated using 100 mL of solvent, namely chloroform, for 24 hours. During the first 6 hours, repeated shaking was carried out, then the solution was allowed to stand for 18 hours. After that, 20 mL of filtrate was evaporated to dryness, and the residue was heated at 105°C until the weight remained. Extraction of rosella petals was carried out by adding 25 grams of simplisia powder into a round-bottom flask containing 125 mL of aqueous solvent with various water-ethanol ratios (30%, 50%, 70%), 96% ethanol, and 1% Hydrochloric Acid. The extraction was carried out for five minutes using the Microwave-Assisted Extraction (MAE) method. The extraction results were filtered, evaporated using a rotary evaporator, and concentrated until a thick extract was obtained.

2. Antioxidant Facial Serum Preparation

Table 1. Serum Formulation.

No	Material Name	Weight
1	Base Serum	70 gr
2	Vitamin E	7.5 gr
3	Absorbic Acid	7.5 gr
4	Niacinamide	7.5 gr
5	Active Ingredient Extracts (roselle flower, pomegranate)	7.5 gr
	Total	100 gr

The serum formulation can be seen in Table 1, which consists of base serum, vitamin E, ascorbic acid, niacinamide, and active ingredient extracts. Base serum is made by mixing 70 grams of GPG emollient with 18.5 grams of DMDM in a plastic container, then adding 11.5 grams of cellulose gel and stirring until thickened. Serum was made by mixing 70 grams of base serum with 7.5 grams of rosella and pomegranate extracts in a plastic container, then stirring until homogeneous. Next, niacinamide, vitamin E, and ascorbic acid were added, then the mixture was stirred until evenly distributed and turned brownish in color.

3. Standard Test of Serum

The resulting serum was tested using several parameters. The viscosity test was conducted using an Ostwald viscometer by measuring the time for the test liquid to flow past a predetermined limit. Specific gravity test using a pycnometer by weighing an empty pycnometer, filling it with distilled water, then measuring the weight before and after filling it with serum. An organoleptic test was conducted by visually observing the color, aroma, and consistency of the serum. The homogeneity test aims to ensure the absence of clumping or precipitation in the serum at various temperature conditions and storage times (Andriyani et al., 2023).

4. Organoleptic Test

Organoleptic and Homogeneity Evaluation. Organoleptic evaluation was conducted to observe the physical characteristics of the formulation, including color, odor, and texture, using direct visual and sensory inspection by panelists. These observations were carried out

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periodically at intervals of 0, 3, 5, and 7 days to monitor the stability and physical consistency of the serum extracts during storage. Furthermore, homogeneity testing was performed by applying a small amount of sample onto a glass slide and spreading it evenly to visually examine the presence or absence of coarse particles or phase separation. Homogeneous preparation was indicated by a uniform appearance without visible aggregates, ensuring that the active ingredients and serum base were properly integrated.

Physicochemical and Stability Testing Physicochemical properties were assessed through pH, viscosity, and specific gravity measurements to ensure compliance with topical application standards. The pH measurement was carried out using a calibrated pH meter at room temperature. Viscosity testing was performed using an Ostwald viscometer to determine the flow properties and consistency of the formulation, ensuring it remains easy to apply without being overly fluid. Additionally, a specific gravity test was conducted using a pycnometer to determine the influence of the formulation on the density of the serum preparations. Stability evaluations were also maintained through storage at different temperature conditions, followed by periodic observation of physical changes to guarantee the product's shelf life and effectiveness.

5. Antioxidant Activity Testing

Antioxidant activity testing was conducted using the DPPH method. DPPH 0.15 mM solution was made by dissolving 20 mg DPPH in 10 mL ethanol p.a., then diluted to 50 mL using a volumetric flask. Determination of the maximum wavelength was done by measuring the absorbance of DPPH solution in the range of 450 – 600 nm against the blank ethanol p.a. To determine the negative control, 1 mL of 0.15 mM DPPH solution was mixed with 1 mL of ethanol p.a., then homogenized and measured at the maximum wavelength obtained.

The sample mother solution was prepared by weighing and dissolving the sample in 5 mL of ethanol p.a., then sonicated for 15 minutes and filtered. A certain volume of the sample mother solution was diluted to 5 mL, then 1 mL of the solution was mixed with 1 mL of DPPH solution, and the absorbance was measured within 0 – 60 minutes at 516 nm. The antioxidant activity curve was constructed using six variations of sample concentrations, each reacted with DPPH, homogenized, incubated at room temperature within the optimal time range, and measured at the maximum wavelength.

RESULT AND DISCUSSION

Rosella flower and pomegranate extract preparations can be seen in Figure 2. Rosella flowers and pomegranates have functions as antioxidants or anti-aging properties. The use of rosella flowers and pomegranates is widely used as active and main ingredients of cosmetic products.

Figure 2. Extracts of roselle and pomegranate.

This experiment aims to determine the antioxidant effectiveness of rosella flower (*Hibiscus sabdariffa*) and pomegranate (*Punica granatum*) based serum and determine the antioxidant activity with DPPH (2,2-diphenyl-1-picrylhydrazyl) testing method and its qualification based on SNI 16-4399-1996.

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Homogeneity Test

The homogeneity test is a statistical test procedure that aims to show that two or more groups of data samples are taken from populations that have the same variance (Sianturi, 2022). The homogeneity test was conducted to test whether there were clumps or precipitates formed to determine the quality of the serum formula. This homogeneity test was conducted through direct observation for 1 month with variables of 3, 7, 14, and 30 days. The results obtained from the homogeneity test can be seen in Table 2.

Table 2. Homogeneity observation result.

Active Ingredient	Result 1		Result 2 (put in refrigerator)		Observation
	Day	Temperature	Day	Temperature	
Roselle Flower	3	24	10	24	Homogeneous
Pomegranate					Homogeneous
Roselle Flower	7	25	15	21	Homogeneous
Pomegranate					Homogeneous
Roselle Flower	14	24	20	18	Homogeneous
Pomegranate					Homogeneous
Roselle Flower	30	26	25	14	Homogeneous
Pomegranate					Homogeneous

In addition, homogeneity testing was also carried out based on a decrease in temperature, which can be seen in Table 2, this is to see if there is clumping or precipitation in the serum under different temperature conditions. In the test, the sample was put in the refrigerator at intervals of 10, 15, 20, and 25 minutes, and then the temperature and condition of serum homogeneity were measured. The result can be seen in Table 2.

The homogeneity test results presented in Table 1 show that the serum formulation with active ingredients of rosella flowers and pomegranate extract has a good level of homogeneity. This is indicated by the absence of phase separation in the form of lumps or deposits in the serum preparation. This finding is in line with research conducted by Cahya & Fitri (2020), which states that optimal homogeneity is characterized by the absence of oil phase separation or the formation of sediment in serum formulations.

Organoleptic Test

Table 3. Organoleptic test observation results.

Active Ingredient	Parameter	Observation Result			Description
		Day 0	**Day 3**	**Day 7**	
Roselle Flower	Aroma	Typical of herbal medicine	Typical of herbal medicine	Typical of herbal medicine	No Changes
	Color	Solid brown	Solid brown	Solid brown	
	Consistency	Thick	Thick	Thick	
Pomegranate	Aroma	Typical of herbal medicine	Typical of herbal medicine	Typical of herbal medicine	No Changes
	Color	Faint Brown	Faint Brown	Faint Brown	
	Consistency	Thick	Thick	Thick	

Organoleptic test or sensory test is a testing method using human senses as the main tool for measuring the acceptance of the product (Suryono et al., 2018). The organoleptic test was carried out to observe the aroma, color, and consistency of the serum extract preparation, which was carried out by direct observation or visual test at the intervals of days 0, 3, 5, and 7, and the results are presented in Table 3.

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In Table 3, it can be seen that the serum extract formulation of the three types of active ingredients tends to be consistent and has no change in aroma, color, and consistency during observation on days 0, 3, and 7. The product investigated in this study was a facial serum formulation containing herbal active ingredients. The facial serum exhibited a turbid yellow appearance, supporting the organoleptic test results presented in the table 3. This indicates that the serum extract formulation has good quality and physical stability that is maintained within a certain time span. This stability indicates that the ingredients in the serum mix well without any significant degradation. In addition, the absence of physical changes in the preparation also reflects the compatibility of the active ingredients with the serum base used, thus ensuring the effectiveness and shelf life of the product within a certain period of time.

Specific Gravity Test

The specific gravity test is a test with a treatment that aims to determine the effect of the formulation used in the composition of facial serum extract on the specific gravity of the serum extract preparation produced (Hasrawati et al., 2020). In this specific gravity test, a pycnometer was used. This specific gravity test was carried out on day 0, when the preparation was finished, and carried out on each serum extract, namely Rosella Flower and Pomegranate. The results obtained show the same specific gravity value of 1.02 g/mL. This shows that from the two facial serum extract preparations that meet the requirements of the specific gravity standard of facial serum extract preparations, SNI 16-4399-1996 states that the specific gravity standard is 0.95 – 1.05 g/mL.

Viscosity Test

The purpose of the viscosity test is to determine the consistency of the product, which affects the spreadability of the product, such as being easy to remove from the packaging, but not easy to just flow from the hand (Tungadi et al., 2023). This viscosity test uses an Ostwald viscometer. The results of viscosity observations can be seen in Table 4.

Table 4. Viscosity observation results of extract preparations.

Preparation	Viscosity (N/m^2)	Viscosity (cps)	Standard SNI 16-4399-1995 (cps)
Roselle Flower	2.84	2840	2000 – 50000
Pomegranate	2.54	2540	2000 – 50000

Based on the observations presented in Table 4, the viscosity of ingredients for facial serum rosella flowers and pomegranate is at 2840 cps and 2540 cps, respectively. This value is in accordance with the SNI 16-4399-1996 standard, which sets the serum viscosity range between 2000 and 50000 cps. This indicates that both serum formulas have a suitable consistency for topical application, where sufficient viscosity ensures that the product can be easily removed from the packaging without being too runny so that it does not easily flow from the hands when used. Thus, these test results confirm that the tested serum formulations have physical characteristics that meet the established quality standards.

Antioxidant Test

Quantitative antioxidant activity test with DPPH method is expressed in IC50 (inhibition concentration) value, which describes the sample concentration required to inhibit 50% of DPPH free radicals. The smaller the IC_{50} value, the higher the antioxidant activity of a compound (Ikram et al., 2017). The results of the DPPH antioxidant test for extraction made from rosella flower extract with ethanol solvent have antioxidant activity, with the IC_{50} value obtained being 6981 ± 17 with ppm units, while the IC_{50} value of the extract preparation made from pomegranate extract is 359.163 ± 0.437 ppm. The DPPH antioxidant test results for serum made from rosella flower extract with ethanol solvent have antioxidant activity, with the IC_{50} value obtained being 5623 ± 23 ppm units, while the IC_{50} value for serum made from pomegranate extract is 4546 ± 4 ppm. Table 5 describes some test parameters of the serum.

Table 5. Assay results of pomegranate and roselle flower extracts in serum.

Test Parameters	Roselle Flower Extract Serum	Pomegranate Extract Serum
SPF Test	10.029 ± 0.026	8.280 ± 0.008
Specific Gravity Test	1.3199	1.3201
pH Test	3.75 ± 0.006	3.94 ± 0.017
Viscosity Test (centipoise)	100.28 ± 1.70	123.73 ± 2.11

Based on the results of laboratory tests in Table 5 on two types of serum, namely pomegranate extract serum and roselle flower extract serum, several test parameters were obtained that showed differences in the characteristics of the two serums. In the Sun Protection Factor (SPF) test, pomegranate extract serum has an SPF value of 8.280 ± 0.008, while roselle flower extract serum has a higher SPF value of 10.029 ± 0.026. This indicates that roselle flower extract serum has greater UV protection potential than pomegranate extract serum. Furthermore, in the specific gravity test, the pomegranate extract serum had a specific gravity of 1.3201, while the roselle flower extract serum had a very similar specific gravity of 1.3199, indicating that the density of the two serums was almost the same, with no significant difference in this aspect.

In the pH test, pomegranate extract serum had a pH value of 3.94 ± 0.017, while roselle flower extract serum had a slightly lower pH of 3.75 ± 0.006, indicating that both serums were acidic, with roselle flower extract serum being more acidic than pomegranate extract serum. This difference is likely attributed to the higher content of organic acids present in roselle extract, such as hibiscus acid, citric acid, and ascorbic acid, as well as its rich anthocyanin compounds, which contribute to increased acidity. In contrast, pomegranate extract contains polyphenols and tannins that exhibit antioxidant properties but contribute less to overall acidity, resulting in a relatively higher pH value (Wulansari et al., 2020). In the viscosity test, the pomegranate extract serum had a viscosity of 123.73 ± 2.11 centipoise, while the roselle flower extract serum had a lower viscosity of 100.28 ± 1.70 centipoise, indicating that the pomegranate extract serum had a thicker texture. From these test results, it can be concluded that roselle flower extract serum has a higher SPF, a more acidic pH, and a lower viscosity than pomegranate extract serum. These differences may affect the characteristics and effectiveness of serum use in skin care applications.

Based on the antioxidant activity results, the facial serum formulated with pomegranate (*Punica granatum*) extract demonstrated better performance than the roselle (*Hibiscus sabdariffa*) extract serum, as indicated by its lower IC_{50} value. Although the roselle serum exhibited a slightly higher SPF value, antioxidant activity remains the primary parameter for evaluating anti-aging potential. Therefore, the pomegranate-based formulation can be considered more effective in this study. However, both formulations showed relatively low antioxidant activity, indicating that further optimization of extract concentration, formulation strategy, and storage conditions is required to enhance their efficacy as anti-aging cosmetic products.

In a study conducted by Farlina et al. (2023), the comparison of active ingredient concentrations in serum showed that formulas with higher active ingredient levels had greater antioxidant activity. Of the three formulas tested, namely with 5%, 7.5%, and 10% active ingredient extract content, it was found that the formula with the highest concentration (F3) had an IC_{50} value of 80.63 ppm, indicating stronger antioxidant activity than the other formulas (Farlina et al., 2023). Similar findings were also reported by Ernawati et al. (2021), where the formula with the largest active ingredient content had a higher antioxidant value. In the study, formulas with 0%, 0.76%, and 1.53% extract content showed that the formula with the highest content (F2) had an IC50 value of 326.717 ppm.

CONCLUSION

This study successfully formulated a facial serum containing Roselle and pomegranate extracts that meets the SNI 16-4399-1996 standards for physical quality, including organoleptic properties, homogeneity, pH, viscosity, and specific gravity. Although comparative analysis indicates that Roselle flower extract has higher antioxidant activity than pomegranate in this formulation, the overall antioxidant activity remains relatively low, indicating it does not yet function as an effective anti-aging agent. This limited potency is likely influenced by the extract concentration, storage duration, and

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degradation of active compounds during preparation; therefore, future research should focus on optimizing the concentration and extraction methods to enhance the serum's effectiveness as a functional skincare product.

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REFERENCES

Andriyani, A., Trisina, J., Naitasi, G. S., & Munthe, S. W. N. (2023). Formulation of 96% ethanol extract serum preparation of tekelan leaves (Chromolaena odorata (L) R.M. King & H. Rob) and antioxidant test. *FaST: Jurnal Sains Dan Teknologi*, *7*(2), 148. https://doi.org/10.19166/jstfast.v7i2.6917

Apriliana, S., & Mustofa, U. (2025). Awareness of halal certification ownership among micro, small, and medium enterprises (MSMEs) in Iringmulyo, East Metro. *Halal Science*, *1*(1), 18–24. https://doi.org/10.58920/halal0101363

Cahya, A. P., & Fitri, N. (2020). Formulasi dan uji antioksidan serum wajah berbasis minyak jintan hitam (Nigella sativa L.) menggunakan metode DPPH. *AJIE: Asian Journal of Innovation and Entrepreneurship*, *5*(3), 44–53.

Das, S., & Wong, A. B. H. (2020). Stabilization of ferulic acid in topical gel formulation via nanoencapsulation and pH optimization. *Scientific Reports*, *10*(1), 12288. https://doi.org/10.1038/s41598-020-68732-6

Ernawati, E. E., Farida, Y., & Taurhesia, S. (2021). Formulasi serum antioksidan kombinasi ekstrak buah ceremai dan kulit buah semangka. *Majalah Farmasetika*, *6*(5), 398. https://doi.org/10.24198/mfarmasetika.v6i5.36080

Farlina, N., Saputri, R. K., & Basith, A. (2023). Karakterisasi dan uji aktivitas antioksidan serum nanopartikel ekstrak daun binahong merah (Anredera cordifolia). *Indonesian Journal of Health Science*, *3*(2a), 446–454. https://doi.org/10.54957/ijhs.v3i2a.604

Fonseca, S., Amaral, M. N., Reis, C. P., & Custódio, L. (2023). Marine natural products as innovative cosmetic ingredients. *Marine Drugs*, *21*(3), 170. https://doi.org/10.3390/md21030170

Halim, S., Florenly, F., & Anggriani, S. (2023). Uji efektivitas antibakteri ekstrak kulit buah delima merah (Punica granatum L.) terhadap pertumbuhan Lactobacillus acidophilus secara in vitro. *E-GiGi*, *11*(2), 318–325. https://doi.org/10.35790/eg.v11i2.46515

Hasrawati, A., Hardianti, H., Qama, A., & Wais, M. (2020). Pengembangan ekstrak etanol limbah biji pepaya (Carica papaya L.) sebagai serum antijerawat. *Jurnal Fitofarmaka Indonesia*, *7*(1), 1–8. https://doi.org/10.33096/jffi.v7i1.458

Ikeda, Y., Nasu, M., Bruxer, J., Díaz-Puertas, R., Martínez-Godfrey, J., Bulbiankova, D., Herranz-López, M., Micol, V., & Álvarez-Martínez, F. J. (2025). Photoprotective, antioxidant and anti-Inflammatory effects of aged Punica granatum extract: In vitro and in vivo insights. *Food Science & Nutrition*, *13*(8), e70631. https://doi.org/10.1002/fsn3.70631

Ikram, K. D., Jayali, A. M., Umar, S., & Sasmita, I. (2017). Penentuan total fenolik dan aktivitas antioksidan ekstrak etanolik daun samama (Anthocephalus macrophylus) asal Ternate, Maluku Utara. *Jurnal Kimia Mulawarman*, *15*(1), 11. https://doi.org/10.30872/jkm.v15i1.495

Inggrid, M., Hartanto, Y., & Widjaja, J. F. (2018). Karakteristik antioksidan pada kelopak bunga rosella (Hibiscus sabdariffa Linn.). *Jurnal Rekayasa Hijau*, *2*(3), 283–289. https://doi.org/10.26760/jrh.v2i3.2517

Karmana, I. W. (2023). Artikel review: Bioaktivitas bunga rosella (Hibiscus sabdariffa L.) beserta pemanfaatannya. *Educatoria: Jurnal Ilmiah Ilmu Pendidikan*, *3*(3), 208–216. https://doi.org/10.36312/educatoria.v3i3.200

Khairudin, N. A., & Saputro, W. (2022). Klasifikasi kualitas mutu buah delima dengan menggunakan ekstraksi gray level co-occurrence matrix (GLCM) dan k-nearest neighbor (KNN). *Jurnal Informatika Teknologi Dan Sains*, *4*(3), 273–278. https://doi.org/10.51401/jinteks.v4i3.1990

Khodijah, S. (2021). The role of BPOM in the circulation of cosmetics with fake distribution permission. *Estudiante Law Journal*, *3*(1), 114–128. https://doi.org/10.33756/eslaj.v0i0.15685

Khojah, H., Ahmed, S. R., Alharbi, S. Y., AlSabeelah, K. K., Alrayyes, H. Y., Almusayyab, K. B., Alrawiliy, S. R., Alshammari, R. M., & Qasim, S. (2024). Skin anti-aging potential of Launaea procumbens extract: Antioxidant and enzyme inhibition activities supported by ADMET and molecular docking studies. *Saudi Pharmaceutical Journal*, *32*(7), 102107. https://doi.org/10.1016/j.jsps.2024.102107

Krishnakumar, A. (2024). Efficacy and safety of a proprietary Punica granatum extract in skin health - a randomized, placebo-controlled clinical study in healthy volunteers. *American Journal of Translational Research*, *16*(12), 8043–8053. https://doi.org/10.62347/SRIC1154

Kurnia, A., Chasanah, U., & Rahmasari, D. (2023). Uji karakteristik serum dari ekstrak kulit buah delima putih (Punica granatum L) pada konsentrasi 0,5%, 0,75%, dan 1% dengan sistem niosom. *Jurnal Ilmiah Farmasi Attamru*, *4*(1), 60–71. https://doi.org/10.31102/attamru.2023.4.1.60-71

Malinda, O., & Syakdani, A. (2020). Potential of antioxidant in flower classroom rosella (Hibiscus sabdariffa L.) as anti-aging. *Jurnal Kinetika*, *11*(3), 60–65.

Mansur, S. A., Deroyeen, A. F., Indriyanti, M. N., Annisak, A. K., Fajriati, D. R., & Amiruddin, M. (2022). Kandungan buah delima (Punica granatum L.) dalam perspektif Al-Qur'an, Sunnah, dan Sains. *Proceedings of International Pharmacy Ulul Albab Conference and Seminar (PLANAR)*, *2*, 69. https://doi.org/10.18860/planar.v2i0.2128

Papaccio, F., D′Arino, A., Caputo, S., & Bellei, B. (2022). Focus on the contribution of oxidative stress in skin aging. *Antioxidants*, *11*(6), 1121. https://doi.org/10.3390/antiox11061121

Rini, I. W., Budi, S., & Tumanggor, A. H. U. (2023). Formulation and evaluation of serum gel from sengkubak leaf extract (Pycnarrhena cauliflora Diels). *Journal Pharmaceutical Care and Sciences*, *4*(1), 99–108. https://doi.org/10.33859/jpcs.v4i1.459

Rosalia, L., Mustofa, A., & Kurniawati, L. (2016). Aktivitas antioksidan nata de rosela (Hibiscus sabdariffa L.) dengan variasi lama ekstraksi dan berat bunga rosela. *JITIPARI: Jurnal Ilmiah Teknologi Dan Industri Pangan UNISRI*, *1*(2), 107–115.

Roswiem, A. P. (2017). Aktivitas jus buah delima (Punica granatum L.) terhadap peroksidasi lipid darah tikus yang diinduksi parasetamol. *Jurnal Kedokteran YARSI*, *22*(2), 114–124. https://doi.org/10.33476/jky.v22i2.307

Setiawan, P. (2023). Formulasi dan uji antioksidan sediaan serum wajah ekstrak etanol daun miana (Coleus scuatellariodes L. Benth). *Jurnal Ilmiah Fitomedika Indonesia*, *2*(1), 50.

Sianturi, R. (2022). Uji homogenitas sebagai syarat pengujian analisis. *Jurnal Pendidikan, Sains Sosial, Dan Agama*, *8*(1), 386–397. https://doi.org/10.53565/pssa.v8i1.507

Sinuraya, T. M. (2024). Pengaruh konsentrasi ekstrak rosela (Hibiscus sabdariffa L.) terhadap karakteristik mutu masker clay. *Prosiding Seminar Nasional Pembangunan Dan Pendidikan Vokasi Pertanian*, *5*(1), 991–996. https://doi.org/10.47687/snppvp.v5i1.1175

Suryono, C., Ningrum, L., & Dewi, T. R. (2018). Uji kesukaan dan organoleptik terhadap 5 kemasan dan produk Kepulauan Seribu secara deskriptif. *Jurnal Pariwisata*, *5*(2).

Tungadi, R., Pakaya, M. Sy., & As'ali, P. D. (2023). Formulasi dan evaluasi stabilitas fisik sediaan krim senyawa astaxanthin. *Indonesian Journal of Pharmaceutical Education*, *3*(1), 117–124. https://doi.org/10.37311/ijpe.v3i1.14612

Turrini, E., Ferruzzi, L., & Fimognari, C. (2015). Potential effects of pomegranate polyphenols in cancer prevention and therapy. *Oxidative Medicine and Cellular Longevity*, *2015*, 1–19. https://doi.org/10.1155/2015/938475

Wu, H.-Y., Yang, K.-M., & Chiang, P.-Y. (2018). Roselle anthocyanins: Antioxidant properties and stability to heat and pH. *Molecules*, *23*(6), 1357. https://doi.org/10.3390/molecules23061357

Wulansari, I. D., Admadi, B., & Mulyani, S. (2020). Pengaruh suhu penyimpanan terhadap kerusakan antioksidan ekstrak daun asam (Tamarindus indica L). *Jurnal Rekayasa Dan Manajemen Agroindustri*, *8*(4), 544–550. https://doi.org/10.24843/JRMA.2020.v08.i04.p07