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ANTIOXIDANT CREAM FORMULATION OF PORANG TUBER ETHANOL EXTRACT AS AN ANTI-AGING AGENT

Ain Naia[1], Roy Indrianto Bangar[2*], Hariyadi Dharmawan Syahputra[3]
[1]Bachelor of Clinical Pharmacy, Faculty of Health Sciences, Universitas Prima Indonesia, Medan, 20118, Indonesia
2Department of Clinical Pharmacy, Faculty of Health Sciences, Universitas Prima Indonesia, Medan, 20118, Indonesia
[3]PUI Phyto Degenerative & Lifestyle Medicine, Universitas Prima Indonesia
Email: ainnaia16@gmail.com

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Abstract
Irreversible skin aging begins in early adulthood due to intrinsic factors such as genetics and cellular metabolism and extrinsic factors such as ultraviolet exposure, smoking, pollution, and lifestyle, which trigger reactive oxygen species (ROS) and collagen damage, leading to wrinkles and reduced skin elasticity. This study aimed to formulate an optimal anti-aging cream from ethanol extract of porang tubers (Amorphophallus muelleri Blume) using variations in the HLB value of Span 60-Tween 80 emulsifiers. This quantitative experimental study used three cream formulas (F1: HLB 4.95; F2: HLB 5.7; F3: HLB 6.8) prepared from 3 kg of porang tubers obtained from Sirapit, Langkat. Evaluations included organoleptic properties, homogeneity, pH, viscosity, spreadability, adhesiveness, cycling-test stability, irritation, preference, and antioxidant activity using the DPPH method. The results showed that F2 was the optimal formula, with medium viscosity, spreadability of 6.2 cm², pH 5.8, stability for six cycles, and an IC_{50} value of approximately 114 µg/mL, indicating moderate antioxidant activity. Formula F2 therefore has potential as a topical antioxidant preparation for preventing premature skin aging based on locally sourced tropical material.

Keywords: Anti-Aging, Antioxidant, DPPH, HLB, Porang

INTRODUCTION

Skin aging is a complex and progressive biological process influenced by intrinsic factors, such as genetics and cellular metabolism, and extrinsic factors, such as ultraviolet exposure, pollution, smoking, and lifestyle. Extrinsic factors contribute significantly to premature aging because they increase the formation of free radicals in the form of reactive oxygen species (ROS). Excessive ROS causes oxidative stress that can damage cell membranes, proteins, DNA, and dermal collagen, resulting in reduced elasticity and wrinkle formation (Erwati, 2021; Shin et al., 2023; Wang et al., 2023).

Antioxidants are required to inhibit oxidation by scavenging free radicals and stabilizing reactive molecules. In cosmetic preparations, antioxidants are widely used as active ingredients in anti-aging products because they help protect the skin from oxidative damage (Masaki, 2010; Silva et al., 2024). One potential natural ingredient is porang tuber (Amorphophallus muelleri Blume). Porang tubers contain glucomannan and several bioactive compounds, including phenolics and flavonoids, which may contribute to antioxidant activity and provide a humectant or moisturizing effect (Istiqomah & Muhtadi, 2021; Marbun et al., 2023; Mukkun et al., 2022).

Cream was selected as the dosage form because it is comfortable to use, easy to spread, not too sticky, easy to wash off, and able to provide a moisturizing effect on the skin. A good cream preparation should meet physical quality requirements, including homogeneity, skin-compatible pH, appropriate viscosity and spreadability, adequate adhesiveness, storage stability, and topical safety (Anindhita & Arsanto, 2020; Pratasik et al., 2019; Widjaja et al., 2021). Based on these considerations, this study formulated ethanol extract of porang tubers into three cream formulas to obtain a stable and safe antioxidant preparation with potential as an anti-aging agent.

METHOD

Type, Time, and Place of Research

This research is an experimental study with a quantitative approach. The study was conducted from October to December 2025. The extraction of porang tubers and antioxidant activity testing were conducted in Research Laboratory 1, while the cream formulation was conducted in Research Laboratory 2 of the Pharmacy Study Program, Faculty of Medicine and Health Sciences, Universitas Prima Indonesia (Creswell & Creswell, 2022; Sugiyono, 2021).

Tools and materials

The tools used include glassware, glass jars, ovens, porcelain cups, pH indicator paper, mortars and stampers, analytical balances, grinding machines, filter paper, water baths, Brookfield viscometers, cream containers, water baths, adhesiveness testers, spreadability testers, and glass objects. The research materials consist of porang tubers (Amorphophallus muelleri Blume), 60% ethanol, NaCl, stearic acid, paraffin, vaseline album, sorbitan monostearate, triethanolamine, nipagin, and distilled water.

Population and Sample

The study population consisted of all antioxidant cream formulas based on ethanol extract of porang tubers as an anti-aging preparation. The research sample consisted of three purposively selected cream formulas: F1, F2, and F3, with varying concentrations of porang tuber extract. The main ingredient, 3 kg of fresh porang tubers, was obtained from Tanjung Keriahan Village, Sirapit District, Langkat Regency.

Preparation, Extraction, and Cream Making

Porang tubers were prepared by peeling, washing, slicing to a thickness of 0.5-1 cm, soaking in warm water at 40°C for 3 hours, soaking in 15% NaCl solution for 1 hour, rinsing, drying in an oven at 60°C for 10 hours, and grinding to obtain simplicia powder (Depkes RI, 1978; Mukkun et al., 2022). A total of 200 g of simplicia powder was extracted by maceration using 3 L of 60% ethanol for 3 days with 30 minutes of daily stirring. The filtrate was then filtered, evaporated using a water bath at 60°C until a thick extract was obtained, and dried in an oven at 60°C for 12 hours to obtain a dry extract (Depkes RI, 1978; Marbun et al., 2023).

The cream was prepared by separating the oil phase, consisting of stearic acid, paraffin, vaseline album, and sorbitan monostearate, from the water phase, consisting of triethanolamine, nipagin, and distilled water. Both phases were heated at 60-70°C until melted, after which the water phase was gradually added to the oil phase while stirring until homogeneous and cooled to room temperature. Porang tuber extract was then added gradually according to the concentration of each formula (Anindhita & Arsanto, 2020; Depkes RI, 1978; Widjaja et al., 2021).

Determination of Simplicia Water Content

Toluene saturation was performed by adding 200 mL of toluene to a round-bottom flask and then adding 2 mL of distilled water. The apparatus was installed and distillation was carried out for 2 hours. The distillation was stopped and allowed to cool for approximately 30 minutes; then, the water volume in the receiving tube was read to the nearest 0.1 mL (Depkes RI, 1978).

A total of 5 g of accurately weighed porang tuber powder was placed in a flask containing saturated toluene and heated gently for 15 minutes. After the toluene boiled, the drip rate was adjusted to 2 drops per second until most of the water had distilled, then increased to 4 drops per second. After all the water had distilled, the inside of the condenser was rinsed with toluene and distillation was continued for 5 minutes. The receiving tube was allowed to cool to room temperature. After the water and toluene had completely separated, the water volume was read to the nearest 0.1 mL. The difference between the final and initial water volumes indicated the water content in the sample. The water content was calculated as a percentage using the following formula (Depkes RI, 1978).

Water content formula:

Determination of Water-Soluble Extractive Content

A total of 5 g of porang tuber powder was placed in a stoppered flask and macerated with 100 mL of water-chloroform P for 24 hours. The mixture was shaken occasionally for the first 6 hours and then left for 18 hours. After that, the mixture was filtered and 20 mL of the filtrate was evaporated to dryness in a shallow, flat-bottomed, tared dish. The residue was heated at 105°C until a constant weight was reached. The water-soluble extractive content was calculated for the dried material (Depkes RI, 1978).

Water-soluble extractive content formula:

Determination of Ethanol-Soluble Extractive Content

A total of 5 g of porang tuber powder was placed in a stoppered flask and macerated with 100 mL of 96% ethanol for 24 hours. The mixture was shaken occasionally for the first 6 hours and then left for 18 hours. The mixture was filtered, and 20 mL of the filtrate was evaporated to dryness in a shallow, flat-bottomed, tared dish. The residue was heated at 105°C until a constant weight was reached. The ethanol-soluble extractive content was calculated for the dried material (Depkes RI, 1978).

Ethanol-soluble extractive content formula:

Determination of Total Ash Content

A total of 2 g of accurately weighed powdered porang tuber simplicia was placed into a previously heated and tared porcelain crucible, then leveled. The crucible was heated until a constant weight was obtained, then cooled and weighed. The total ash content was calculated for the dried material (Depkes RI, 1978).

Total ash content formula:

Determination of Acid Insoluble Ash Content

The ash obtained from the total ash content determination was boiled with 25 mL of 2 N hydrochloric acid for 5 minutes. The acid-insoluble portion was collected, filtered using ash-free filter paper, and washed with hot water. The residue and filter paper were heated to a constant weight, then

cooled and weighed. The acid-insoluble ash content was calculated for the dried material (Depkes RI, 1978).

Acid insoluble ash content formula:

Table 1. Formulation of cream preparation of ethanol extract of porang tubers

Material	F1	F2	F3
Porang tuber extract	1.5%	3%	6%
Stearic acid	10%	10%	10%
Paraffin	8%	8%	8%
Vaseline album	6%	6%	6%
Triethanolamine	1%	1%	1%
Sorbitan monostearate	2%	2%	2%
Nipagin	0.2%	0.2%	0.2%
Aquadest	ad 100%	ad 100%	ad 100%

RESULTS AND DISCUSSION

Material Characterization and Screening

1. Characterization of Simplisia

Characterization of simplicia is a crucial initial stage in natural product research because it determines the quality and suitability of raw materials before extraction. The porang tuber simplicia used in this study was obtained through peeling, washing, soaking, drying, and grinding, followed by quality parameter testing. The observed parameters included water content, water-soluble extractive content, ethanol-soluble extractive content, total ash content, and acid-insoluble ash content. Low water content indicates good storage stability and reduces the risk of microbial growth and degradation of active compounds (Depkes RI, 1978; Istiqomah & Muhtadi, 2021; Mukkun et al., 2022).

Table 2. Characterization of porang tuber simplicia

Characterization	Results
Water content	7.85%
Water-soluble extractive content	28.46%
Ethanol-soluble extractive content	12.13%
Total ash content	8.94%
Acid insoluble ash content	0.82%

The characterization results indicate that porang tuber simplicia met the initial quality requirements for extract raw materials. The relatively high water- and ethanol-soluble extractive contents indicate the presence of polar and semi-polar compounds that could be extracted and may contribute to the antioxidant activity of the preparation (Istiqomah & Muhtadi, 2021; Marbun et al., 2023).

2. Phytochemical Screening

Phytochemical screening was conducted to identify secondary metabolite compounds that could contribute to the biological activity of the ethanol extract of porang tubers. Qualitative testing showed positive results for alkaloids, flavonoids, saponins, and tannins, while triterpenoids/steroids were not

detected. The presence of flavonoids and tannins supports antioxidant potential because these compounds can donate electrons or hydrogen atoms to stabilize free radicals (Marbun et al., 2023; Winarsi, 2007).

Table 3. Phytochemical screening of ethanol extract of porang tubers

Phytochemical Screening	Results
Alkaloid	(+)
Flavonoid	(+)
Saponin	(+)
Tannin	(+)
Triterpenoids/Steroids	(+)

Description: (+) = detected; (-) = not detected.

3. IC_{50} Analysis with DPPH Method

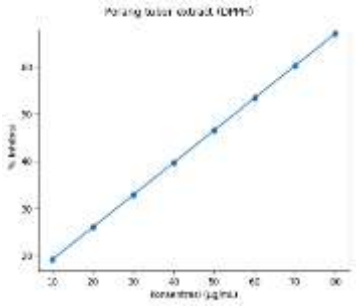

Figure 1. Calibration curve of porang tuber ethanol extract using the DPPH method

Testing of the antioxidant activity of porang tuber ethanol extract was carried out using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method.

This method measures the ability of a compound to donate hydrogen atoms or electrons to stabilize DPPH free radicals, which is characterized by a color change from purple to pale yellow and a decrease in absorbance at a wavelength of 517 nm (Marbun et al., 2023; Winarsi, 2007).

Based on the regression analysis, the IC_{50} value of the porang tuber ethanol extract was 74.21 µg/mL, which is categorized as strong antioxidant activity.

This value indicates that porang tuber ethanol extract is capable of reducing 50% of DPPH free radicals at a relatively low concentration. The concentration-response relationship showed a linear trend based on absorbance measurements at several concentrations.

The coefficient of determination (R^2) value approaching 1 indicates that the concentration of the extract is strongly related to the percentage of DPPH inhibition.

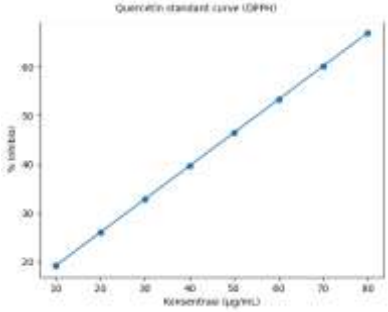

Figure 2. Quercetin standard curve using the DPPH method

Quercetin was used as a comparison standard because it is a flavonoid compound with strong antioxidant activity.

The IC_{50} value of quercetin was 8.45 µg/mL, indicating very strong antioxidant activity. Compared with quercetin and vitamin C, the porang tuber ethanol extract had lower activity but still demonstrated antioxidant potential suitable for development as a topical cosmetic active ingredient (Masaki, 2010; Winarsi, 2007).

Table 4. IC_{50} Results

Sample	IC_{50} (µg/mL)
Porang tuber ethanol extract	74.21
Vitamin C	6.12
Quercetin	8.45

DISCUSSION

Relationship between Characterization of Simplicia and Cream Quality

Characterization of porang tuber simplicia showed a water content of 7.85%, water-soluble extractive content of 28.46%, ethanol-soluble extractive content of 12.13%, total ash content of 8.94%, and acid-insoluble ash content of 0.82%. Low water content is important for simplicia stability because it minimizes the risk of microbial growth and degradation of active compounds during storage (Depkes RI, 1978; Bangar et al., 2024).

The total ash and acid-insoluble ash values indicate the mineral content and possible inorganic contamination of the material. Meanwhile, the relatively high water- and ethanol-soluble extractive values support the presence of soluble bioactive compounds in the extract. These findings are consistent with studies reporting that porang contains glucomannan and phenolic compounds that may contribute to antioxidant activity (Istiqomah & Muhtadi, 2021; Marbun et al., 2023; Mukkun et al., 2022).

The quality of the raw material is therefore an important factor in supporting the physical stability and biological effectiveness of the resulting cream preparation (Siregar et al., 2025; Widjaja et al., 2021).

Evaluation of Cream Preparations and Their Relationship to Physical Properties

Evaluation of the cream preparation showed that Formula F2 had moderate viscosity (8,900 cP), optimal spreadability (6.2 cm^2), and high adhesiveness (0.57 g/cm^2). Balanced viscosity is important for ease of removal from the container and application to the skin, while spreadability and adhesiveness influence comfort, retention, and effectiveness of topical use (Anindhita & Arsanto, 2020; Pratasik et al., 2019; Voigt, 1994).

The cream stability was also maintained at room and elevated temperatures, with minimal pH change (5.8 to 5.7) and stable color. This indicates that Formula F2 maintained its physical quality during storage, in accordance with the principles of stable emulsion formulation (Pratasik et al., 2019; Widjaja et al., 2021).

This finding is consistent with previous topical cream formulation studies showing that appropriate emulsifier composition, controlled mixing, and stable raw material quality are important determinants of cream stability (Anindhita & Arsanto, 2020; Widjaja et al., 2021).

Antioxidant Activity of Cream

The DPPH test showed that F2 cream maintained antioxidant activity, with an inhibition percentage reaching 81.2% at a concentration of 100 µg/mL. This activity may be related to the flavonoid and tannin

content detected during phytochemical screening. Although the antioxidant activity in the formulation may be lower than that of the pure extract due to processing and matrix effects, the preparation still demonstrated antioxidant potential (Marbun et al., 2023; Masaki, 2010; Winarsi, 2007).

The dose-response relationship indicated that increasing cream concentration increased antioxidant activity. Therefore, the cream may provide a protective effect against free-radical-induced skin damage (Masaki, 2010; Shin et al., 2023; Wang et al., 2023).

In addition, the stability of the active compounds in the cream supports the potential use of the preparation as a functional cosmetic product with antioxidant benefits, as also reported in studies of antioxidant-based skin care formulations (Silva et al., 2024).

Likability and Irritation Test

The preference test showed an average panelist score of 4.225 on a scale of 1-5, indicating that the cream was organoleptically acceptable, particularly in terms of aroma and ease of application. Organoleptic acceptability is an important quality parameter for topical products because it influences user comfort and compliance (Cahyani & Erwiyani, 2022; Hidayati et al., 2023).

Irritation tests showed no signs of redness or itching among all panelists. The cream pH, which was close to the physiological skin pH (5.8 ± 0.1), and the use of common topical excipients support the absence of irritation. Thus, F2 cream can be considered safe for topical use within the scope of this preliminary test (Pratasik et al., 2019; Widjaja et al., 2021).

CONCLUSION

The optimal anti-aging cream formula from ethanol extract of porang tubers (Amorphophallus muelleri Blume) was obtained using variations in the HLB value of Span 60 and Tween 80 emulsifiers, namely F1 (HLB 4.95), F2 (HLB 5.7), and F3 (HLB 6.8). Formula F2 showed the best physical characteristics, including moderate viscosity, optimal spreadability, high adhesiveness, skin-compatible pH, good homogeneity, and maintained stability after six cycles of the cycling test. The antioxidant activity of F2 using the DPPH method showed an IC_{50} value of approximately 114 µg/mL, indicating moderate activity and supporting the potential of porang tuber extract as a natural antioxidant for preventing premature skin aging.

While the results are promising, limitations include a limited sample size of three formulas without in vivo clinical trials and long-term testing of more than six cycles, which may affect generalizability to Indonesian climate variations. Suggestions for further research include in vitro release evaluation, animal irritation testing, and comparison with synthetic antioxidants for clinical validation. Practically, F2 cream has implications for the development of sustainable local industrial cosmetic products, supporting the prevention of premature aging in young populations, and empowering porang farmers in North Sumatra.

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