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The Potential of Fragrant Pandan Leaves as Active Ingredients in Cosmetic Products: Phytochemical Analysis

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ABSTRACT
This study aimed to evaluate the phytochemical composition of *Pandanus amaryllifolius* (fragrant pandan) leaf extract as a preliminary assessment of its potential application in herbal cosmetic formulations. The extraction was performed using the maceration method with 95% ethanol as the solvent. Qualitative phytochemical screening was conducted to identify major classes of secondary metabolites. The results confirmed the presence of alkaloids, flavonoids, tannins, polyphenols, and saponins, while steroids and triterpenoids were not detected. Each identified compound group is known to contribute important biological activities, including antioxidant, anti-inflammatory, and antimicrobial effects, which are desirable in topical skincare products. These findings provide foundational evidence that *P. amaryllifolius* leaves are a promising natural source of multifunctional bioactive compounds for future cosmeceutical development.

Key words: *Pandanus amaryllifolius*, phytochemical screening, secondary metabolites, herbal cosmetics,

INTRODUCTION
Pandan leaves (*Pandanus amaryllifolius*) are tropical plants widely recognized across various countries, especially in Southeast Asia. This plant is commonly utilized in the culinary field as a natural additive to impart a distinctive fragrance, color, and unique flavor to a wide range of food and beverages. Moreover, pandan leaves hold significant value in traditional medicine due to their active compound content such as flavonoids, alkaloids, tannins, and saponins. These compounds are known to offer various health benefits, including antioxidant, antimicrobial, and anti-inflammatory properties, making them potential candidates for the development of herbal medicines and other health products. The combination of culinary and medicinal benefits

makes pandan leaves a valuable natural ingredient in both daily life and scientific research.

Fragrant pandan leaves are known to contain a variety of secondary metabolites, such as polyphenols, flavonoids, saponins, tannins, and alkaloids (Ridjal et al., 2019). These secondary metabolites present in fragrant pandan leaves—including polyphenols, flavonoids, saponins, kaolin tannins, and alkaloids—hold great potential as base ingredients in mask formulation. These compounds are renowned for their antioxidant, antimicrobial, and anti-inflammatory properties, which can help in skin care, acne treatment, and maintaining skin moisture and elasticity.

Determining the quality of herbal raw materials is a crucial step in ensuring their effectiveness and safety, particularly in health and cosmetic products. One of the primary methods employed is phytochemical screening, aimed at detecting the presence of bioactive compounds such as alkaloids, flavonoids, tannins, and saponins, which play a role in the biological activities of the material. In addition, moisture content analysis is also necessary to assess the humidity level of the material, as excessive moisture can increase the risk of microbial growth and reduce product stability. Ash content analysis is performed to determine the amount of mineral content and to ensure the raw material's purity from inorganic contamination. This combination of tests provides a comprehensive overview of the stability, quality, and suitability of herbal ingredients for further use in product formulations.

This study aims to identify the presence of secondary metabolites in fragrant pandan leaves (*Pandanus amaryllifolius*) through a series of phytochemical tests. This identification is important for determining bioactive compounds such as alkaloids, flavonoids, tannins, saponins, and polyphenols, which may offer health benefits. In addition, this research also measures the moisture content and ash content of pandan leaves as key indicators of herbal raw material quality. Moisture analysis is conducted to ensure the material’s stability against microbiological degradation, while ash content analysis determines the mineral content and purity from inorganic contaminants. The results of this study are expected to provide useful scientific data for the development of pandan-based products in both health and cosmetic applications.

MATERIAL AND METHODS

Material

All reagents and solvents used in this study were of analytical grade. The plant material utilized was *Pandanus amaryllifolius* (fragrant pandan) leaves,

collected from Lampung Selatan. The following reagents were employed for phytochemical screening and analytical testing: Dragendorff's reagent – for alkaloid detection, methanol for sample preparation and flavonoid testing, sodium hydroxide (NaOH) 50% for flavonoid confirmation, Ferric chloride ($FeCl_3$) 10% for tannin detection, Hydrochloric acid (HCl) 2N for saponin confirmation, Liebermann–Burchard reagent for steroid and triterpenoid identification and 95% Ethanol as the maceration solvent.

Methods

The extraction of bioactive constituents from Pandanus amaryllifolius leaves was carried out using the maceration technique. Dried and pulverized pandan leaves (5 g) were accurately weighed and transferred into a 150 mL glass beaker. The plant material was soaked in 95% ethanol at a ratio of 1:10 (w/v), ensuring complete immersion.

The mixture was covered and left to stand at room temperature (25–28 °C) for 72 hours with occasional stirring to facilitate solvent penetration and maximize diffusion of active constituents. Following the maceration period, the extract was filtered using Whatman No. 1 filter paper. The filtrate was then concentrated under reduced pressure using a rotary evaporator set at 40–50 °C to remove the ethanol solvent and obtain a thick viscous extract.

The resulting crude extract was stored in an amber glass container at 4 °C until further analysis.

A series of qualitative phytochemical assays was conducted to preliminarily assess the presence of major classes of secondary metabolites in the extract of *Pandanus amaryllifolius* leaves. The procedures applied were adapted from standardized pharmacognostic methods and are detailed as follows:

Alkaloid Detection (Dragendorff's Test)

An aliquot of 0.5 mL of the sample was diluted with 5 mL of distilled water, followed by the addition of five drops of Dragendorff's reagent. The appearance of an orange to reddish-brown precipitate was interpreted as indicative of alkaloid presence.

Flavonoid Detection (Alkaline Reagent Test)

One milliliter of the sample was mixed with 9 mL of methanol, followed by the addition of three drops of 50% sodium hydroxide solution. A transient yellow coloration that disappeared upon acidification confirmed the presence of flavonoid compounds.

Tannin Detection (Ferric Chloride Test)
Two milliliters of the sample were gently heated in a water bath. Subsequently, three drops of 10% ferric chloride solution were added. The formation of a greenish-black or blue-black color was taken as evidence for the presence of tannins.

Saponin Detection (Foam Test)
The sample (0.5 mL) was mixed with 5 mL of distilled water and shaken vigorously for 30 seconds. Two drops of 2N hydrochloric acid were then added. The formation of a stable froth layer indicated the presence of saponins.

Steroid and Triterpenoid Detection (Liebermann–Burchard Reaction)
One milliliter of the extract was treated with five drops of Liebermann–Burchard reagent. A color change to greenish-blue suggested the presence of steroids, whereas the emergence of a pink to reddish color signified triterpenoids.

RESULT AND DISCUSSION

The qualitative phytochemical screening conducted in this study confirmed the presence of several key secondary metabolites in the ethanolic extract of *Pandanus amaryllifolius* leaves, namely alkaloids, flavonoids, tannins, polyphenols, and saponins (Table 1). These bioactive compounds are well recognized for their therapeutic potential and are commonly utilized in herbal cosmetic formulations due to their multifunctional biological activities.

Table 1. Phytochemical Constituents Detected in Pandanus amaryllifolius Leaf Extract

Phytochemical Test	Test Method	Result
Alkaloids	Dragendorff's reagent test	+
Flavonoids	Alkaline reagent test (NaOH)	+
Tannins	Ferric chloride test ($FeCl_3$)	+
Polyphenols	General phenolic screening	+
Saponins	Foam test with HCl	+
Steroids	Liebermann–Burchard reaction	-

Phytochemical Test	Test Method	Result
Triterpenoids	Liebermann–Burchard reaction	-

The presence of alkaloids, as indicated by a positive Dragendorff's test, suggests potential pharmacological effects including anti-inflammatory and antimicrobial properties. Alkaloids are known to modulate enzyme activity and cellular responses, making them valuable in cosmeceutical applications aimed at reducing skin inflammation and microbial infections [Kumar et al., 2017].

Flavonoids, detected through the alkaline reagent test, are potent antioxidants capable of neutralizing free radicals that contribute to oxidative stress and skin aging. Their photoprotective and anti-inflammatory functions support their frequent use in formulations targeting UV-induced skin damage and erythema [Panche et al., 2016].

Tannins, confirmed via ferric chloride test, are astringent phenolic compounds that aid in skin tightening and sebum control. Their antimicrobial effect also contributes to acne prevention and wound healing, further enhancing their suitability for facial care products such as clay masks [Scalbert, 1991].

The presence of saponins, observed through frothing, indicates surfactant-like behavior which can aid in emulsification and foaming properties in topical applications. Beyond their functional roles, saponins also contribute to skin barrier enhancement and exhibit antimicrobial properties beneficial for maintaining skin hygiene [Sahu et al., 2014].

Although steroids and triterpenoids were tested using the Liebermann–Burchard reagent, their absence in the extract may be attributed to either their negligible concentration or insufficient solubility in ethanol. Nonetheless, their exclusion does not diminish the overall efficacy of the extract, as the detected constituents already provide a wide spectrum of skin-beneficial properties.

The abundance of polyphenolic and flavonoid content aligns with previous literature on the antioxidant-rich profile of *Pandanus amaryllifolius*, further validating its traditional use in skin-soothing and anti-aging treatments. This phytochemical composition suggests that the extract possesses a synergistic

potential when incorporated into cosmetic formulations, especially for products aimed at soothing, protecting, and revitalizing the skin.

CONCLUSION

The findings of this study demonstrate that *Pandanus amaryllifolius* (fragrant pandan) leaf extract contains a diverse array of secondary metabolites, including alkaloids, flavonoids, tannins, saponins, and polyphenols. These bioactive compounds contribute significant antioxidant, anti-inflammatory, and antimicrobial properties that support the plant's potential application as a natural active ingredient in cosmetic formulations.

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