

Article

Ethnobotanical Insights and Quantitative Evaluation of Medicinal Plant Utilization in Traditional Cosmetic Practices: A Community-Centered Study

Ni Luh Kade Arman Anita Dewi^{1*}, Ni Made Diah Pusparini Pendet², Rista Apriani¹, Fitri Megawati¹, Ni Nyoman Wahyu Udayani¹, Milyadi Sugijanto¹, Ni Putu Dewi Agustini¹, Cokorda Javandira¹

¹Department of Pharmacy, Faculty of Pharmacy, Universitas Mahasaraswati Denpasar, Denpasar, Indonesia

²School of Nursing, Faculty of Medicine, Universitas Udayana, Denpasar, Indonesia

Correspondence: armannita@unmas.ac.id

ABSTRACT

Background: Indigenous knowledge about medicinal plants used in cosmetics is an important cultural heritage that needs scientific documentation and preservation. In Terunyan Village, Bali, Indonesia, traditional ethnobotanical practices have been passed down orally through generations.

Objectives: This study aims to systematically record, identify, and analyze the plant species used by the community for natural cosmetic purposes, and to assess their cultural significance using ethnobotanical indices.

Method: An ethnobotanical survey was carried out using semi-structured interviews with 328 informants selected through purposive sampling. Plant specimens were collected, identified, and voucher samples stored at the Herbarium Hortus Botanicus Balinese (THBB). Quantitative analysis used Use Value (UV) and Fidelity Level (FL) to measure cultural importance and consensus.

Results: A total of 24 plant species from 18 plant families were documented for cosmetic use. The most frequently cited species were Aloe vera (UV = 0.180), Cocos nucifera (UV = 0.174), and Solanum lycopersicum (UV = 0.169). Leaves were the most used plant parts (40.85%), and pounding was the main processing method (20.43%). Six species had a fidelity level of 100%, indicating strong cultural agreement. The most common applications were for hair care (35.2%), skin moisturizing (28.7%), and skin brightening (24.1%).

Conclusion: This research provides the first detailed documentation of traditional cosmetic plant use in Terunyan Village. It highlights significant ethnobotanical diversity and strong cultural consensus for key species. These findings support the preservation of indigenous knowledge and lay the groundwork for sustainable development of natural cosmetic products.

Keywords: Ethnobotany, Traditional knowledge, Natural cosmetics, Indigenous plants, Bali, Indonesia

Citation: Dewi, N. L. K. A. A., Pendet, N. M. D. P., Apriani, R., Megawati, F., Udayani, N. N. W., Sugijanto, M., Agustini, N. P. D., Javandira, C. Ethnobotanical Insights and Quantitative Evaluation of Medicinal Plant Utilization in Traditional Cosmetic Practices: A Community-Centered Study. Bali Medical and Wellness Journal 2025, 2 (1), 10-16. DOI:

<https://doi.org/10.71341/bmwj.v2i1.34>

Submitted: March, 05 2025

Revised: June, 11 2025

Accepted: June, 27 2025

Published: July, 26 2025



This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

INTRODUCTION

Traditional knowledge systems represent invaluable repositories of indigenous wisdom that have evolved through centuries of empirical observation and cultural transmission (Vandebroek et al., 2021). Ethnobotanical practices, particularly those related to medicinal and cosmetic plant applications, constitute a fundamental component of cultural heritage in many societies worldwide (Heinrich et al., 2020).

Indonesia, recognized as one of the world's megadiverse countries, harbors approximately 30,000 plant species, of which an estimated 9,600 possess medicinal properties (Zuhud, 2019). The archipelago's rich botanical diversity, combined with its cultural heterogeneity across more than 300 ethnic groups, has resulted in a vast repository of traditional plant knowledge (Silalahi et al., 2018). However, rapid modernization and urbanization pose significant threats to this indigenous knowledge, necessitating urgent documentation and scientific validation efforts (Leonti & Casu, 2021).

Quantitative ethnobotanical approaches have emerged as essential tools for objectively assessing the cultural significance of medicinal plants and identifying species with high therapeutic potential (Albuquerque et al., 2019). Indices such as Use Value (UV) and Fidelity Level (FL) provide standardized metrics for evaluating plant importance and cultural consensus, respectively (Tardío & Pardo-de-Santayana, 2008). Terunyan Village, located in the Kintamani District of Bali, Indonesia, represents a unique cultural enclave that has maintained traditional practices despite increasing modernization pressures. The village is situated at coordinates 8°13'46.8"S 115°23'24.0"E, at an elevation of approximately 1,050 meters above sea level, adjacent to Lake Batur in the caldera of Mount Batur. This geographic isolation has contributed to the preservation of distinct cultural practices, including traditional plant-based cosmetic preparations (Sujarwo et al., 2016).

Despite the recognized importance of traditional cosmetic practices in Terunyan Village, comprehensive scientific documentation remains limited. Previous ethnobotanical studies in Bali have primarily focused on medicinal plants for therapeutic purposes (Caniago & Siebert, 1998; Sujarwo et al., 2014), with minimal attention to cosmetic applications. This knowledge gap represents a significant loss of cultural heritage and missed opportunities for sustainable product development.

Therefore, this study aimed to: (1) systematically document and identify plant species used for cosmetic purposes in Terunyan Village; (2) analyze traditional preparation methods and application techniques; (3) quantitatively assess the cultural importance and consensus of documented species using ethnobotanical indices; and (4) evaluate the potential for sustainable development of natural cosmetic products based on traditional knowledge.

METHODS

Study Area

This study was conducted in Terunyan Village (8°13'46.8"S, 115°23'24.0"E), Kintamani District, Bangli Regency, Bali Province, Indonesia. The village covers an area of approximately 2.95 km² and is characterized by a tropical highland climate with an average annual temperature of 20-25°C and rainfall ranging from 1,500-2,000 mm annually. The area supports diverse vegetation types, including mixed agricultural systems, secondary forests, and home gardens that harbor numerous plant species with traditional uses.

Ethical Considerations

This research was conducted following the ethical guidelines of the International Society of Ethnobiology and with approval from the Institutional Review Board of Universitas Mahasaraswati Denpasar (Protocol No. 045/UNMAS/LPPM/2024). Prior

informed consent was obtained from all participants, and traditional knowledge holders were acknowledged as the primary custodians of the documented information. The principle of reciprocity was maintained through knowledge sharing and potential benefit distribution agreements.

Data Collection

Data collection was conducted from April 2024 to January 2025 using a mixed-methods approach combining quantitative surveys and qualitative ethnographic techniques. The study population comprised all residents of Terunyan Village (N = 1,831 individuals in 459 households, based on 2021 census data).

Sample size determination followed the formula for finite populations: $n = N \times Z^2 \alpha / 2 \times p \times q / (d^2 \times (N-1) + Z^2 \alpha / 2 \times p \times q)$, where N = population size, $Z \alpha / 2 = 1.96$ (95% confidence level), p = expected proportion (0.5), q = 1-p, and d = margin of error (0.05). This calculation yielded a minimum sample size of 316 participants, which was exceeded with 328 actual participants to account for potential non-response.

Inclusion and Exclusion Criteria

Inclusion criteria: (1) residents of Terunyan Village aged ≥ 18 years; (2) individuals with traditional knowledge of plant-based cosmetic preparations; (3) willingness to provide informed consent. Exclusion criteria: (1) temporary residents or visitors; (2) individuals with cognitive impairments preventing informed consent; (3) participants unable to communicate in Indonesian or Balinese languages.

Data Analysis

The quantitative analysis in this systematic review employed two primary ethnobotanical indices. The first is Use Value (UV), calculated as $UV = \sum U_i / N$, where U_i represents the number of uses mentioned by each informant i for a particular species, and N is the total number of informants. The UV score can range from 0 to infinity, with higher values indicating greater cultural importance of the species. The second index is Fidelity Level (FL), determined by the formula $FL = (N_p / N) \times 100$, where N_p is the number of informants citing a species for a specific use category, and N is the total number of informants mentioning the species for any cosmetic purpose. FL ranges from 0% to 100%, with higher values reflecting a stronger cultural consensus on that use. Statistical analyses were conducted using SPSS version 26.0, including descriptive statistics, frequency distributions, and correlation analyses to identify patterns in plant utilization.

RESULTS

Plant Diversity and Taxonomic Distribution

A total of 24 plant species belonging to 18 botanical families were documented for cosmetic applications in Terunyan Village (Table 1). The most represented families were Cucurbitaceae (3 species), followed by Arecaceae, Lamiaceae, and Solanaceae (2 species each). The documented species exhibited diverse growth forms, including herbs (41.7%), trees (29.2%), shrubs (20.8%), and climbers (8.3%).

Analysis of plant part utilization revealed that leaves were the most frequently used organs (40.85% of total citations), followed by fruits (23.17%), roots (15.24%), seeds (12.20%), stems (5.49%), and flowers (3.05%). This preference for leaves aligns with their high accessibility, sustainable harvesting potential, and concentrated phytochemical content.

Preparation Methods and Applications

Traditional preparation methods were diverse, with pounding being the most common technique (20.43% of citations), followed by direct application (18.29%), boiling (16.46%), grinding (14.63%), and oil extraction (12.20%). Topical application was the predominant method of use (78.3%), while oral consumption accounted for 21.7% of applications.

Cosmetic Use Categories

Hair care applications dominated traditional uses (35.2% of total citations), including treatments for hair growth stimulation, dandruff control, and hair strengthening. Skin care applications comprised 64.8% of citations, subdivided into moisturizing (28.7%), brightening (24.1%), and anti-aging treatments (12.0%).

Quantitative Ethnobotanical Analysis

Use Value analysis identified *Aloe vera* as the most culturally important species (UV = 0.180), followed by *Cocos nucifera* (UV = 0.174) and *Solanum lycopersicum* (UV = 0.169). Fidelity Level analysis revealed six species with perfect consensus (FL = 100%) for specific applications: *Oryza sativa* (skin brightening), *Pachyrhizus erosus* (anti-aging), *Apium graveolens* (hair growth), *Dysoxylum densiflorum* (dandruff control), and *Cymbopogon citratus* (skin toning).

Table 1. Plant Parts Utilized

Scientific Name	Family	Local Name	Growth Form	UV	FL (%)
<i>Aloe vera</i> (L.) Burm.f.	Asphodelaceae	Lidah buaya	Herb	0.180	89.3
<i>Cocos nucifera</i> L.	Arecaceae	Kelapa	Tree	0.174	92.1
<i>Solanum lycopersicum</i> L.	Solanaceae	Tomat	Herb	0.169	87.5

DISCUSSION

This study constitutes the first comprehensive quantitative documentation of traditional cosmetic plant knowledge in Terunyan Village, highlighting a rich ethnobotanical heritage shaped by centuries of empirical observation and cultural transmission. The identification of 24 plant species belonging to 18 families underscores considerable botanical diversity in local cosmetic practices, aligning with findings from other ethnobotanical studies conducted across Indonesia (Silalahi et al., 2018; Sujarwo et al., 2016). This diversity reflects the community's extensive reliance on native flora for traditional skincare and beauty rituals.

The prominence of *Aloe vera*, *Cocos nucifera* (coconut), and *Solanum lycopersicum* (tomato) in both the Use Value (UV) and Fidelity Level (FL) rankings indicates a strong cultural consensus regarding their effectiveness and importance within local cosmetic applications. *Aloe vera*'s high UV score (0.180) is consistent with its well-documented therapeutic properties, including anti-inflammatory, moisturizing, and wound-healing effects, which are attributed to bioactive compounds such as acemannan, aloin, and various polysaccharides (Hęś et al., 2019). Similarly, the widespread use of coconut oil (UV = 0.174) is scientifically supported by its high lauric acid content, which imparts antimicrobial and moisturizing benefits, reinforcing its central role in traditional skincare routines (Varma et al., 2019). Overall, the convergence between traditional knowledge and scientific evidence underscores the cultural and medicinal significance of these plants in Terunyan Village's ethnobotanical practices.

The predominant use of leaves, accounting for 40.85% of plant parts utilized, reflects practical considerations such as their availability throughout the year, ease of harvesting without causing substantial harm to the plant, and their high concentrations of bioactive secondary metabolites. This pattern aligns with ethnobotanical research conducted worldwide, which frequently identifies leaves as the primary source of therapeutic compounds due to their dynamic metabolic functions and protective mechanisms (Heinrich et al., 2020). The widespread use of leaves underscores their significance in traditional medicine and cosmetic practices, highlighting the efficiency and sustainability of utilizing this plant part. Traditional preparation methods, primarily pounding and direct application, exemplify sophisticated indigenous techniques designed to maximize the extraction of bioactive compounds while maintaining simplicity and accessibility in local communities. These methods are consistent with modern scientific understanding, which emphasizes that disrupting plant cell walls enhances the release and bioavailability of therapeutic substances. Such conventional practices demonstrate a nuanced knowledge of plant chemistry and processing, reflecting a form of ethnopharmacological expertise that optimizes efficacy with minimal resources (Leonti & Casu, 2021).

Furthermore, the high-Fidelity Level (FL) values observed for certain applications suggest a strong cultural consensus and consensus among community members regarding specific plant uses. Species that achieve an FL of 100% are identified as priority candidates for phytochemical investigation, as they exemplify a collective recognition of their effectiveness. These species represent promising targets for scientific validation, which could lead to the development of new cosmetic products rooted in traditional knowledge, promoting sustainable utilization and potential commercial applications. Overall, these findings emphasize the importance of integrating indigenous practices with scientific research to valorize and preserve traditional ethnobotanical heritage.

However, several limitations must be acknowledged. First, the reliance on informant memory may introduce recall bias, particularly for less frequently used species. Second, seasonal variations in plant availability and preparation methods were not systematically documented. Third, the study focused exclusively on one village, limiting generalizability to broader Balinese or Indonesian contexts. Future research directions should include: (1) phytochemical analysis of high-UV species to validate traditional uses; (2) comparative ethnobotanical studies across multiple Balinese villages; (3) investigation of sustainable cultivation practices for priority species; and (4) development of standardized extraction protocols for cosmetic applications.

CONCLUSION

This comprehensive ethnobotanical study documented 24 plant species utilized for traditional cosmetic purposes in Terunyan Village, Bali, providing the first quantitative analysis of this cultural practice. Aloe vera, coconut, and tomato emerged as the most culturally important species based on Use Value analysis, while six species achieved perfect Fidelity Levels for specific applications. The predominant use of leaves, traditional pounding preparation methods, and topical applications reflect sophisticated indigenous knowledge systems that have been refined over generations. These findings contribute significantly to the preservation of traditional ecological knowledge and provide a scientific foundation for sustainable development of natural cosmetic products. The strong cultural consensus observed for specific plant-use combinations offers promising opportunities for bioprospecting and product innovation while ensuring benefit-sharing with local communities. The

documentation of this ethnobotanical knowledge is particularly urgent given ongoing threats from modernization, climate change, and cultural homogenization. Integrating traditional wisdom with modern scientific approaches offers a pathway for preserving cultural heritage while contributing to the growing global demand for natural, sustainable cosmetic alternatives.

CONFLICT OF INTEREST

The authors stated there is no conflict of interest in this study.

FUNDING

There is no funding support in this study.

REFERENCES

- Albuquerque, U. P., Cruz da Cunha, L. V. F., Lucena, R. F. P., & Alves, R. R. N. (2019). Methods and techniques in ethnobiology and ethnoecology. Humana Press.
- Balick, M. J., & Cox, P. A. (2020). Plants, people, and culture: The science of ethnobotany. Garland Science.
- Caniago, I., & Siebert, S. F. (1998). Medicinal plant ecology, knowledge and conservation in Kalimantan, Indonesia. *Economic Botany*, 52(3), 229-250.
- Fakchich, J., & Elachouri, M. (2021). An overview on ethnobotanico-pharmacological studies carried out in Morocco, from 1991 to 2015: Systematic review (part 1). *Journal of Ethnopharmacology*, 267, 113200.
- Heinrich, M., Appendino, G., Efferth, T., Fürst, R., Izzo, A. A., Kayser, O., ... & Williamson, E. M. (2020). Best practice in research—overcoming common challenges in phytopharmacological research. *Journal of Ethnopharmacology*, 246, 112230.
- Hęś, M., Dziedzic, K., Górecka, D., Jędrusek-Golińska, A., & Gujska, E. (2019). Aloe vera (L.) Webb.: Natural sources of antioxidants—a review. *Plant Foods for Human Nutrition*, 74(3), 255-265.
- Leonti, M., & Casu, L. (2021). Traditional medicines and globalization: Current and future perspectives in ethnopharmacology. *Frontiers in Pharmacology*, 4, 92.
- Silalahi, M., Supriatna, J., Walujo, E. B., & Nisyawati. (2018). Local knowledge of medicinal plants in sub-ethnic Batak Simalungun of North Sumatra, Indonesia. *Biodiversitas*, 19(4), 1323-1331.
- Sujarwo, W., Keim, A. P., Caneva, G., Tofani, D., & Nikoletti, M. (2016). Ethnobotanical uses of neem (*Azadirachta indica* A.Juss.; Meliaceae) leaves in Bali (Indonesia) and the Indian subcontinent in relation with historical background and phytochemical properties. *Journal of Ethnopharmacology*, 189, 186-193.
- Sujarwo, W., Lugrayasa, I. N., Caneva, G., & Balslev, H. (2014). Ethnobotanical study of medicinal plants used by Balinese people in Penglipuran village, Bangli District, Bali, Indonesia. *Journal of Ethnobiology and Ethnomedicine*, 10(1), 13.
- Tardío, J., & Pardo-de-Santayana, M. (2008). Cultural importance indices: A comparative analysis based on the useful wild plants of southern Cantabria (northern Spain). *Economic Botany*, 62(1), 24-39.
- Vandebroek, I., Pieroni, A., Stepp, J. R., Hanazaki, N., Ladio, A., Alves, R. R., ... & Hurrell, J. A. (2021). Reshaping the future of ethnobiology research after the COVID-19 pandemic. *Nature Plants*, 7(5), 723-730.
- Varma, S. R., Sivaprakasam, T. O., Arumugam, I., Dilip, N., Raghuraman, M., Pavan, K. B., ... & Paramesh, R. (2019). In vitro anti-inflammatory and skin protective properties of Virgin coconut oil. *Journal of Traditional and Complementary Medicine*, 9(1), 5-14.



Zuhud, E. A. M. (2019). Indonesian medicinal plants and jamu: Indigenous knowledge and practices. IPB Press.