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Etnopharmacy Study of Medical Plants in Sulawesi

Rafael Wellem Kauntu[1*)], Ade Zuhrotun[1)] , Yoppi Iskandar[1)]

[1)]Department of Biological Pharmacy, Faculty of Pharmacy, Padjadjaran University, Bandung, Indonesia

*Corresponding author: rafaelwellemkauntu@gmail.com

ABSTRACT

Sulawesi Island, Indonesia, is recognized for its high biodiversity and rich cultural diversity, both of which contribute to the extensive use of medicinal plants in traditional healthcare systems. The increasing global interest in plant-based medicine—driven by the rising prevalence of chronic diseases, antimicrobial resistance, and concerns regarding the adverse effects of synthetic drugs—highlights the importance of documenting regional ethnopharmaceutical knowledge. This study aims to synthesize available literature on medicinal plants traditionally used by communities in Sulawesi. A systematic literature review was conducted using electronic databases, including Google Scholar, PubMed, and Elsevier, covering publications from 2014 to 2025. Articles were screened based on predefined inclusion criteria, resulting in 20 eligible studies. The findings identified 17 plant species used across six provinces, with leaves as the most frequently utilized plant part (64.70%) and decoction as the predominant preparation method (47.05%). Five representative species—*Ficus septica*, *Lansium domesticum*, *Blumea balsamifera*, *Cymbopogon citratus*, and *Piper betle*—demonstrate pharmacological potential supported by phytochemical and experimental evidence. Although traditional use aligns with emerging scientific findings, clinical validation and standardization remain limited. These results emphasize the urgency of systematic documentation and rigorous scientific evaluation of medicinal plants in Sulawesi to support biodiversity conservation and future drug discovery initiatives.

Keywords: Biodiversity; herbal medicine; natural product research; pharmacological validation; traditional knowledge

Studi Etnofarmasi Tanaman Obat di Sulawesi

ABSTRAK

Pulau Sulawesi dikenal memiliki keanekaragaman hayati dan keragaman budaya yang tinggi, yang berkontribusi terhadap pemanfaatan tumbuhan obat dalam sistem pengobatan tradisional masyarakat. Meningkatnya minat global terhadap pengobatan berbasis tanaman, yang dipicu oleh prevalensi penyakit kronis, resistensi antimikroba, serta kekhawatiran terhadap efek samping obat sintetis, menegaskan pentingnya dokumentasi pengetahuan etnofarmasi di tingkat regional. Penelitian ini bertujuan untuk mensintesis literatur terkait tumbuhan obat yang digunakan secara tradisional oleh masyarakat di Sulawesi. Metode yang digunakan adalah tinjauan pustaka sistematis melalui basis data Google Scholar, PubMed, dan Elsevier untuk publikasi tahun 2014–2025. Artikel diseleksi berdasarkan kriteria inklusi yang telah ditetapkan dan diperoleh 20 artikel yang memenuhi syarat. Hasil kajian mengidentifikasi 17 spesies tumbuhan obat yang digunakan di enam provinsi di Sulawesi, dengan bagian daun sebagai bagian yang paling sering dimanfaatkan (64,70%) dan metode perebusan sebagai cara pengolahan yang dominan (47,05%). Lima spesies representatif, yaitu *Ficus septica*, *Lansium domesticum*, *Blumea balsamifera*, *Cymbopogon citratus*, dan *Piper betle*, menunjukkan potensi farmakologis yang didukung oleh bukti fitokimia dan

studi eksperimental. Meskipun penggunaan tradisional sejalan dengan temuan ilmiah awal, validasi klinis dan standardisasi metode masih terbatas. Temuan ini menegaskan urgensi dokumentasi dan evaluasi ilmiah tumbuhan obat di Sulawesi guna mendukung pelestarian keanekaragaman hayati serta pengembangan obat berbasis bahan alam secara berkelanjutan.
Kata Kunci: Keanekaragaman hayati; tumbuhan obat; penelitian bahan alam; validasi farmakologis; pengetahuan tradisional

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INTRODUCTION

The global use of medicinal plants has increased significantly over the past decades and continues to play an essential role in primary healthcare systems worldwide. The World Health Organization (WHO) reports that a substantial proportion of the global population relies on traditional medicine, particularly herbal remedies, for preventive and curative health purposes (WHO, 2019). The growing prevalence of chronic diseases, antimicrobial resistance, and concerns regarding adverse effects associated with synthetic drugs have further stimulated interest in plant-based medicine as complementary and alternative therapeutic options (Atanasov *et al*., 2021)

Natural products have historically made major contributions to modern drug discovery. It is estimated that a considerable percentage of approved drugs are derived from, or inspired by, natural compounds, particularly plant secondary metabolites such as alkaloids, flavonoids, terpenoids, and phenolic compounds (Newman & Cragg, 2020). Ethnopharmacology, which integrates traditional medicinal knowledge with modern pharmaceutical sciences, plays a critical role in identifying bioactive compounds and validating traditional therapeutic claims (Heinrich *et al*., 2020).

Indonesia is recognized as one of the world's megabiodiversity countries, possessing extensive plant diversity distributed across its archipelagic regions. Traditional medicinal knowledge remains deeply embedded within local cultures and is transmitted across generations. National health reports indicate that Indonesian communities continue to utilize herbal medicine in daily healthcare practices (Depkes, 2014). Ethnopharmaceutical studies conducted in various ethnic communities—such as the Ammatoa Kajang tribe (Azis *et al*., 2020), and Kaili tribe (Dianto *et al*., 2015), and the Buton tribe (Indrayangingsih & Anam, 2015)—demonstrate the richness of plant-based therapeutic knowledge in Indonesia.

Sulawesi Island, located within the Wallacea biogeographical region, is characterized by high biodiversity and significant cultural heterogeneity. Several regional studies have documented the use of medicinal plants in different provinces of Sulawesi, including Gorontalo (Kandowangko *et al*., 2018), Southeast Sulawesi (Fachruddin *et al*., 2021), and South Sulawesi (Santi *et al.*, 2022). These studies indicate that medicinal plants are commonly used to treat dermatological disorders, gastrointestinal diseases, metabolic conditions, and infectious diseases. However, existing publications remain geographically fragmented and predominantly descriptive, limiting comprehensive understanding of plant utilization patterns and pharmacological validation across the island.

Modernization, urbanization, and sociocultural transformation may contribute to the gradual erosion of traditional medicinal knowledge if systematic documentation is not

conducted. Therefore, a structured synthesis of existing ethnopharmaceutical research in Sulawesi is necessary to identify dominant plant species, preparation methods, therapeutic trends, and supporting scientific evidence.

Based on these considerations, this study aims to systematically review published research on medicinal plants used in Sulawesi, analyze patterns of plant part utilization and preparation methods, and critically evaluate available pharmacological evidence. By consolidating fragmented data, this review contributes to the preservation of traditional knowledge and supports future evidence-based development of plant-derived therapeutic agents

RESEARCH METHOD

This study employed a systematic literature review approach following the general reporting principles of PRISMA 2020, including identification, screening, eligibility assessment, and inclusion stages. A comprehensive literature search was conducted using three electronic databases: Google Scholar, PubMed, and ScienceDirect. The search covered publications from January 2014 to March 2025. Keywords were combined using Boolean operators (AND, OR), including “Ethnopharmacy” AND “Medicinal Plants,” “Traditional medicine” AND “Sulawesi,” “Indonesia” AND “Medicinal plants,” and “Ethnobotany” AND “Sulawesi.”

The initial search identified 185 records (Google Scholar = 95; PubMed = 50; ScienceDirect = 40). After removing 25 duplicate records and excluding 20 records deemed irrelevant during preliminary filtering, 140 articles were screened based on titles and abstracts. Ninety-five records were excluded for not meeting the inclusion criteria, including studies not conducted in Sulawesi, not related to medicinal plants, or review articles. Forty-five full-text articles were assessed for eligibility, and 25 were excluded due to incomplete plant identification, lack of clear therapeutic information, or non–peer-reviewed status. Finally, 20 studies met all eligibility criteria and were included in the qualitative synthesis.

Articles were included if they were conducted in Sulawesi, reported specific medicinal plant species used by local communities, described plant parts and therapeutic indications, and were published in peer-reviewed journals in English or Indonesian. Data extracted from the selected studies included study location, plant species, plant parts used, preparation methods, and reported therapeutic functions. The analysis was conducted qualitatively to identify patterns in plant utilization, preparation methods, and therapeutic categories, and to evaluate the extent of available pharmacological evidence supporting traditional uses.

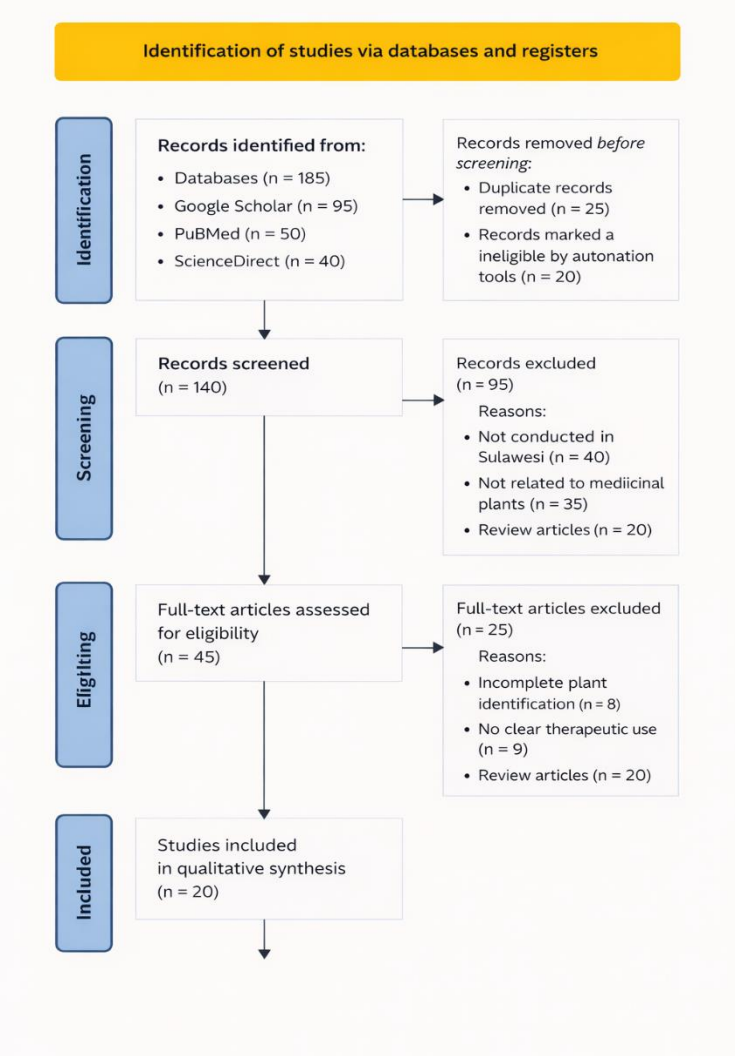


Figure 1. PRISMA Flow

RESULTS AND DISCUSSION

Based on the literature review that has been carried out, it was found that various types of plants are commonly used in medicine by the people of Sulawesi. These plants contain various kinds of secondary metabolites in abundance so it is not uncommon for one plant to have various benefits. The following list of plants used by the people of Sulawesi as an alternative to treat various diseases can be seen in Table 1.

The review identified 17 medicinal plant species distributed across six provinces in Sulawesi. These species are used to treat dermatological, gastrointestinal, metabolic, and infectious conditions. Their widespread use across multiple ethnic communities demonstrates that traditional medicine remains an essential component of local healthcare systems.

Leaves were the most frequently utilized plant part (64.70%), followed by stems and fruits (11.76%). This preference reflects both phytochemical and ecological considerations. Leaves are metabolically active organs rich in secondary metabolites such as flavonoids, alkaloids, and tannins. Moreover, harvesting leaves is generally more sustainable than harvesting roots or bark, suggesting that traditional practices may implicitly support conservation principles, although this aspect has not been systematically evaluated.

Preparation methods were nearly evenly divided between decoction (47.05%) and topical application (52.94%). Decoction was primarily used for systemic conditions such as

diarrhea and metabolic disorders, whereas topical application was predominantly applied to dermatological problems. This pattern indicates a logical correspondence between the route of administration and the targeted physiological system.

Dermatological complaints, particularly itching and dermatitis, were among the most frequently treated conditions. Ten species were reported for managing skin disorders. Tropical environmental conditions in Sulawesi—characterized by high humidity and temperature—may contribute to the prevalence of fungal and bacterial skin infections (Nengsih *et al.*, 2019). Based on Basic Health Research by the Department of Health in 2014, the national prevalence of dermatitis was 6.8% (based on respondent complaints). A total of 13 provinces exceed the national figure and 3 of them are on the island of Sulawesi, namely Gorontalo, Central Sulawesi, and South Sulawesi (Depkes, 2014). The reliance on herbal topical treatments likely reflects accessibility, affordability, and long-standing cultural trust in traditional remedies. Although phytochemical studies indicate that many of these plants contain antimicrobial and anti-inflammatory compounds, standardized microbiological testing and safety evaluations remain limited.

Gastrointestinal disorders, especially diarrhea, were also commonly treated using medicinal plants. Based on Basic Health Research in 2018, the prevalence of diarrhea in Indonesia for all age groups was 8% and the prevalence rate for toddlers was 12.3%, while for babies, the prevalence of diarrhea was 10.6% (Depkes, 2018). Several species demonstrated antibacterial and anti-inflammatory activities in experimental studies, suggesting consistency between traditional use and pharmacological mechanisms. However, most investigations were conducted in vitro or in animal models, and clinical validation in human populations remains scarce.

Table 1. Medical Plants in Sulawesi

Name/ *English Name*	Local Name	Family	Scientific Name	Therapeutic Function	*Plant Parts	Application	People	Source
Awar-awar/ *Wild fig*	Kuciat	*Moraceae*	*Ficus septica* Burm. f	Itcy	FOL	The leaves are crushed and applied to the skin	Southeast Sulawesi/ West Muna/ Maginti/ Bangko	(Fachruddin et al., 2021)
Bangko minyak/ *tall-stilt mangrove*	Bangko	*Rhizophoracea e*	*Rhizophora apiculata*	Itcy	CAU	Smoothed and applied to the skin	Southeast Sulawesi/ West Muna/ Maginti/ Bangko	(Fachruddin et al., 2021)
Belimbing/ *Starfruit*	Balimbi	*Oxalidaceae*	*Averrhoa carambola* L.	Itcy	FO	Smoothed and applied to the skin	Gorontalo/ North Gorontalo/ Atinggola	(Kandowangko et al., 2018)
Belimbing Sayur / *Cucumber tree*	Lembetue	*Oxalidaceae*	*Averrhoa bilimbi* L.	Itcy	FOL	Smoothed and applied to the skin	Gorontalo/ North Gorontalo/ Atinggola	(Kandowangko et al., 2018)
Duku/ *Duku fruit*	Duku	*Mahogany*	*Lansium domesticum*	Dengue fever, antimalarial, diarrhea and dysentery	SEM , FRU	Boiled and eat as usual	Central Sulawesi/South Lore/Badangkaja	(Hanum & Rina, 2013)
Jarak Pagar/ *Physic nut*	Balacae	*Euphorbiaceae*	*Jathropa curcas* L.	Itchy	FOL	The leaves are crushed and applied to the skin	Gorontalo/ North Gorontalo/ Atinggola	(Kandowangko et al., 2018)
Kasumba / *Achiote*	Kesumba	*Asteraceae*	*Carthamus tinctorius*	Measles	FLO	Boiled	North Sulawesi/ West Modayag/ Bangunan Wuwuk	(Noena et al., 2021)

Kelapa / *Coconut*	Saloka	*Arecaceae*	*Cocos nucifera*	Itchy, scabies	FRU	Fruit is grilled and spread	Southeast Sulawesi/ West Muna/ Maginti/ Bangko	(Fachruddin et al., 2021)
Kemangi / *Basil*	Surawung	*Lamiaceae*	*Ocimum basilicum* L.	Itchy	FOL	The leaves are crushed and applied to the skin	Southeast Sulawesi/ West Muna/ Maginti/ Bangko	(Fachruddin et al., 2021)
Pohon Kuda/ *Indian ash tree*	Kayu Jawa	*Anacardiaceae*	*Lannea coromandelica*	Diabetes	COR	Boiled	Central Sulawesi/ Kaili Ledo	(Dianto et al., 2015)
Sambiloto/ *King of bitters*	Sambiloto	*Acanthaceae*	*Andrographis paniculate*	Diabetes	FOL	Boiled	North Sulawesi/ Lolak/ Baturapa Main	(Noena et al., 2021)
Sambung / *Longevity spinach*	Sambung Nyawa	*Asteraceae*	*Gynura procumbens*	Itchy	FOL	Crushed it and put it in a bucket filled with water for bathing	South Sulawesi/ Ammatoa Tribe	(Azis et al., 2020)
Seleguri / *Arrowleaf sida*	A'llupang	*Malvaceae*	*Sida rhombifolia*	Itching due to insect bites	FOL	The leaves are crushed and applied to the skin	Sulawesi Selatan/ Suku Ammatoa	(Azis et al., 2020)
Sembung / *Sambong*	Sembung	*Astereceae*	*Blumea balsamifera*	Treats influenza, diarrhea, flatulence, asthma, bronchitis, rheumatism,	FOL	4 leaves boiled in 110 ml water.	North Sulawesi/ Southeast Minahasa/ Tombatu	(Dalimartha, 2008)

				menstrual pain and diabetes				
Serai / *Lemongrass*	Serai Wangi	*Gramineae*	*Cymbopogon citratus*	Mengobati diare, mempunyai aktivitas antidiare	CAU	Boiled	West Sulawesi/ West Tapalang/ Lebani	(Magota et al., 2021)
Sirih / *Betel leaf*	Sirih	*Piperaceace*	*Pipper betle* Linn.	Itchy	FOL	Boiled	South Sulawesi/ Gowa/ Bantonompo/ Barembeng	(Noena et al., 2021)
Sukun /	Baka	*Moraceae*	*Artocarpus atilis*	Hypertension	FOL	1-2 leaves boiled with 3 glasses of water, 1 x a day	South Sulawesi/ Bone	(Santi et al., 2022)

* Plant Part = CAU: caulis (stem); COR: cortex (bark); FOL: folium (leaf); FLO: flos (flower, inflorescence); FRU: fructus (fruit), SEM: semen (seed).

Although 17 medicinal plant species were identified across the reviewed studies, a more in-depth discussion was limited to five representative species—*Ficus septica*, *Lansium domesticum*, *Blumea balsamifera*, *Cymbopogon citratus*, and *Piper betle*. The selection was based on several methodological and scientific considerations. First, these species were among the most frequently reported across multiple study locations, suggesting broader cultural acceptance and consistent therapeutic application among different communities in Sulawesi. Second, they are primarily used to treat prevalent and clinically relevant health conditions, particularly dermatological and gastrointestinal disorders, which emerged as the dominant therapeutic categories in this review. Third, compared to the remaining identified species, these five plants have relatively more comprehensive phytochemical characterization and experimental pharmacological investigations, enabling a more rigorous assessment of the consistency between traditional claims and scientific evidence.

It is important to emphasize that the exclusion of the other twelve species from detailed discussion does not imply lesser therapeutic value. Rather, it reflects the current limitations of available scientific data, as many of these plants have not yet undergone sufficient phytochemical profiling or pharmacological validation. This gap highlights the need for future interdisciplinary research to explore under-investigated species and expand the evidence base for traditional medicinal plants in Sulawesi.

Awar-awar (*Ficus septica* Burm F.)

The awar-awar plant contains several important components that are useful for use in medicine, one of which is the flavonoid genistin. Flavonoid compounds are specifically able to stop the formation and release of substances that cause inflammation due to allergic reactions (Herbie, 2015). Another research conducted by (Dewi, 2016) stated that awar- awar leaf extract macerated with 96% ethanol contained secondary metabolite compounds as below when tested phytochemically and analyzed using UV-vis spectrophotometry.

Table 2. Phytochemical Test Results of *Ficus septica* Burm F.

Parameters	Result
Total Alkaloid Equivalents *Quinin*	0,16 (%b/b)
Total Flavonoid Equivalents *Quinin*	6,33 (%b/b)
Total Tannin Equivalents *Tanic Acid*	68,76 (%b/b)
Saponin *From Quailaja* bark	8,21 (%b/b)

The results in Table 2 were compared with those reported for various other plants, such as avocado and soursop, and the results obtained in this study were superior to those reported for the comparison plants. So it can be said that awar-awar leaf extract contains alkaloids, flavonoids, tannins, and saponins that are abundant compared to others.

The research on awar-awar as an anti-inflammatory drug conducted by (Arief *et al.*, 2021) on mice proved that after using awar-awar leaf extract ointment with a concentration of 2% it had anti-inflammatory activity with a fold reduction in thickness. The back skin of mice was 38.79% after 6 hours of use which was not significantly different from the positive control Betamethasone.

Duku (*Lansium domesticum* Correa.)

Duku is a plant that is often used by the people of Central Sulawesi as a medicine for dengue fever. The content of secondary metabolite compounds found in duku fruit skin includes tannins, flavonoids, saponins, alkaloids, and triterpenoids (Mayanti, 2009). Several compounds in duku have benefits in treating malaria, such as alkaloids, flavonoids, and saponins. Alkaloids have an important role in inhibiting the *acetylcholinesterase* enzyme which plays an important role in the nervous system of larvae that cause malaria. Flavonoids have a larvicidal effect because they inhibit nucleic acid synthesis and Saponins have activity to inhibit the planting of *Aedes aegypti* mosquito larvae (Ni`mah *et al*., 2014).

The *Lansium domesticum* Correa plant has antioxidant properties by donating hydrogen. Triterpenoid compounds have roles as antibacterial, antibiotic, and antifungal. Triterpenoids will form polymer bonds that damage purines in bacterial cell walls resulting in reduced cell wall permeability and bacteria losing important nutrients. Tannin compounds interfere with bacterial cell wall polypeptides which ultimately cause the bacterial cell walls to stiffen and then the bacteria lyse. Saponin compounds work by reducing surface tension which results in cell leakage and intracellular compounds coming out (Nuria, 2021).

Sembung (*Blumea balsamifera*)

Blumea balsamifera is one of the plants used by people in North Sulawesi as an antidiarrheal. The main content in sembung leaves is flavonoids. This is proven by research conducted by (Ruhardi & Sahumena, 2021) on the Identification of Sembung Leaf Flavonoid Compounds. In this research, the results obtained were that the total flavonoid content was 0.175%. Flavonoids themselves are useful as antibacterials by denaturing bacterial cell proteins and damaging cell membranes beyond repair.

(Larasati *et al*., 2015) tested the antidiarrheal effect of sembung leaf extract in vivo on white mice (*Mus muculus*) by observing the frequency of diarrhea. Sembung leaf extraction is obtained through the maceration extraction method which is then evaporated using a rotary evaporator and obtains a thick extract that still contains solvent. The solvent was evaporated again in a water bath until a dry extract was obtained. From these tests, it was found that at a dose of 250 mg/kg bw, sembung leaf ethyl acetate extract was effective as an antidiarrheal drug.

Apart from that, (Ruhimat, 2015) also tested the efficacy of sembung leaves to see the inhibitory power of sembung leaf infusion against gastrointestinal bacteria, *Escherichia coli*. Testing was carried out in vitro using the disc diffusion method. Through this test, it was found that sembung leaf infusion at a concentration of 90% was effective in suppressing the growth of Escherichia coli bacteria.

Serai (*Cymbopogon citratus)*

Serai contains metabolite compounds, namely citronellal, citronelo, limonene, and linalool (Magota *et al*., 2021). These compounds are the main compounds in citronella oil. Serai wangi is also known as sehai, sorae (Sumatra), Bubu (Halmahera), Garamakusu (Ternate), Sulawesi, and Kedaungwitu (Sumba).

Most antibacterials come from plants that are known to contain secondary metabolites identified as phenolics and terpenoids in essential oils. (Magota *et al*., 2021) Serai is known to have antibacterial activity because its main content is citral essential oil. Citral itself is a combination of two acylic monoterpene isomeraldehydes. This citral compound forms other derivatives, namely citronella, citronellol, and geraniol. This is proven by research conducted by (Ishak *et al*., 2021), namely obtaining citronellal levels of 85.05%, citronellal levels including E-Citral and Z-Citral. Geraniol levels were obtained at 7.16% and citronellol levels were at 5.06%.

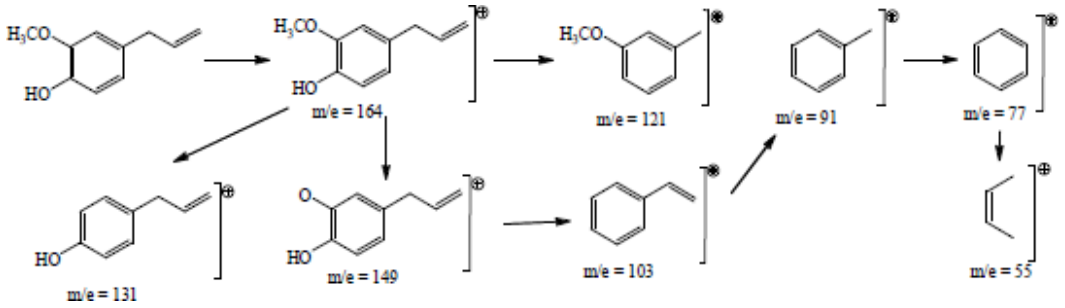
The research on the antimicrobial activity of Serai was carried out by (Poeloengan, 2009) proved that citronella essential oil at concentrations of 50%, 25%, 12.5% , and 6.25% could

inhibit the growth of *Streptococcus agalactiae* and *Staphylococcus epidermidis* bacteria, whereas, at a concentration of 12.5%, it only inhibited E. coli bacteria, the greater the concentration, the greater the zone of inhibition of bacterial growth.

Sirih (*Piper betle* L.)

Sirih (*Piper betle*) is a tropical plant that has various health benefits. One of its benefits is to treat skin diseases such as eczema because it is antimicrobial and antifungal (Saising *et al*., 2022). Another example is the use of Sirih by the people of Barembeng Village in South Sulawesi as a medicine to treat itching caused by fungus (Noena *et al*., 2021). Sirih leaves contain flavonoid secondary metabolites, polyphenolic compounds, tannins, essential oils, steroids, saponins, and phytosterols (Pratiwi *et al*., 2016). According to (Pratiwi *et al*., 2016) sirih leaf extract contains a compound in the form of eugenol, as evidenced by the abundance of peaks for the extract compound at numbers 39, 55, 77, 92, 103, 121, and 131. Eugenol is known to be a phenolic compound that has antibacterial activity (Nazzaro *et al*., 2013).

Figure 2. Eugenol Spectrum



Several studies have proven the benefits of sirih for treating skin problems. Sirih preparations in lotion form can reduce redness and itching on the skin caused by wearing diapers because they contain antimicrobial compounds (Debora & Kartikasari, 2019). Antimicrobial effects were also found in cream preparations from sirih which were able to inhibit the growth of the Propionibacterium acnes microbe that causes acne (Meinisasti *et al*., 2020).

CONCLUSION

This review identified 17 medicinal plant species used across six provinces in Sulawesi, primarily for the treatment of dermatological and gastrointestinal disorders. Leaves were the most commonly utilized plant part, and decoction and topical application were the predominant preparation methods. Five representative species demonstrate promising pharmacological potential supported by phytochemical and experimental evidence. Despite the alignment between traditional knowledge and emerging scientific findings, most available studies remain preliminary and lack clinical validation and methodological standardization. Comprehensive scientific evaluation, including toxicity assessment and controlled clinical trials, is necessary to strengthen evidence-based applications. Systematic documentation and rigorous research on medicinal plants in Sulawesi are essential not only to preserve traditional knowledge but also to support biodiversity conservation and sustainable drug discovery efforts.

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