



Plant biodiversity and ethnomedicinal practices for female reproductive health in Ganjam (Odisha) and Northern Andhra Pradesh, India

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Research

Abstract

Background: Traditional medicinal plants are central to female reproductive healthcare among rural and coastal communities of Ganjam (Odisha) and northern Andhra Pradesh, India. Indigenous knowledge integrates biodiversity with culturally embedded practices to manage infertility, menstrual irregularities, hormonal imbalance, uterine disorders, and menopausal symptoms.

Methods: An ethnobotanical survey (December 2024–October 2025) was conducted across Berhampur, Gopalpur, Rambha, Purushottampur, Digapahandi, Nuapada, and Ichchapuram. Data were gathered from 105 informants—including traditional healers, midwives, women SHG members, farmers, fisherfolk, and herbal vendors—using semi-structured interviews, participant observation, and guided field walks. Plant specimens were taxonomically authenticated and voucher samples deposited in a recognised herbarium. Quantitative indices (IP, IR, UR, UV, RFC, CI, FL, and FUV) were calculated to assess species importance and community consensus.

Results: Fifty medicinal plant species belonging to 34 families were recorded, with Fabaceae most represented. High-use species included *Cinnamomum verum* (UV = 0.990; RFC = 0.961), *Trigonella foenum-graecum* (UV = 0.980; RFC = 0.952), *Asparagus racemosus* (UV = 0.952; RFC = 0.923), *Hemidesmus indicus* (UV = 0.971), and *Withania somnifera* (UV = 0.961). Preparations comprised decoctions, powders, ghritas, lehyas, oils, and fermented formulations, often administered with milk, ghee, or honey. Reported activities included ovulation induction, insulin-sensitising effects (PCOS adjunct), anti-androgenic and antioxidant actions, uterine tonicity, anti-inflammatory effects, and endocrine modulation.

Conclusions: Quantitative ethnobotanical evidence supports the scientific plausibility of multi-targeted plant-based therapies for female reproductive health and highlights priority species for further phytochemical and clinical validation, alongside urgent biodiversity conservation efforts.

Keywords: Female reproductive health; ethnobotany; fertility; PCOS; coastal Odisha; phytotherapy; traditional medicine; biodiversity conservation.

Background

Ethnobotanical studies form the cornerstone of understanding the intimate and dynamic relationship between humans and their natural environment. Across generations, indigenous and rural communities have evolved a deep ecological consciousness, using local flora not merely for sustenance but also for healthcare and spiritual well-being (Khatiwara *et al.* 2025). In India, this knowledge forms an integral part of traditional medical systems such as Ayurveda, Siddha, Unani, and folk medicine, which continue to sustain community health in both inland and coastal regions. Among the many domains of traditional therapeutics, the use of plants to regulate female reproductive health and fertility occupies a pivotal place. The coastal stretch extending from southern Odisha's Ganjam district to northern Andhra Pradesh epitomizes this living heritage, where ecological abundance and cultural continuity have nurtured a rich corpus of ethnobotanical wisdom (Nayak *et al.* 2022).

The Ganjam-Andhra coastal belt is an ecological mosaic composed of mangrove swamps, saline estuaries, sandy dunes, and fertile plains—each hosting distinct plant communities with recognized medicinal potential. This biodiverse landscape sustains a wide range of herbs, shrubs, and trees that form the basis of local healthcare traditions. The inhabitants—fisherfolk, agrarian settlers, traditional healers, and women's self-help groups—share an enduring dependence on these natural resources for managing reproductive and general health disorders (Pandey *et al.* 2025). Women, in particular, serve as custodians of reproductive ethnomedicine, transmitting oral traditions that include decoctions, tonics, and ritual practices addressing menstrual irregularities, infertility, postpartum care, and menopausal ailments. These home-based formulations embody both empirical knowledge and cultural symbolism, reflecting a holistic worldview where fertility, health, and ecology are inseparable (Benkaddour *et al.* 2025).

Rising incidences of infertility, menstrual disorders, and hormonal imbalances due to stress, lifestyle changes, and environmental pollution have revived scientific and public interest in such indigenous herbal practices. The coastal communities of Ganjam and adjoining Andhra Pradesh rely on an intricate pharmacopeia of plants for managing reproductive health—an approach sustained through ecological familiarity, cultural faith, and intergenerational learning (Djerrou *et al.* 2022). Documenting this ethnomedicinal heritage is vital not only to safeguard disappearing traditional knowledge but also to identify promising bioactive species that could contribute to modern phytotherapeutic development for female fertility regulation (Nurudeen *et al.* 2022).

Ethnobotanical surveys serve as vital conduits linking traditional healers with modern scientific frameworks. They provide insights into how local populations perceive health, classify illnesses, and employ plants within socio-cultural and ecological contexts. In the Ganjam-Andhra coastal region, such surveys capture detailed information on medicinal plant diversity, seasonal availability, methods of preparation, and therapeutic applications (Agbodjento *et al.* 2021). The area encompasses coastal settlements like Berhampur, Gopalpur, Rambha, Purushottampur, Nuapada, and Ichchapuram—each representing a blend of agrarian and maritime lifestyles. Knowledge within these communities is maintained by Vaidyas (traditional healers), Dais (midwives), and elder women, whose practices integrate herbal treatments with dietary restrictions, ritual observances, and local belief systems associated with fertility and motherhood (Hamad, 2025).

Despite India's rich ethnobotanical heritage, earlier studies have concentrated on tribal or forested inland zones, leaving coastal ecosystems comparatively underexplored. The Ganjam coast, straddling the cultural boundary between Odisha and Andhra Pradesh, represents a unique ethnolinguistic corridor where Odia, Telugu, and Dravidian traditions intersect (Barik *et al.*, 2024). This cultural confluence has fostered the exchange and refinement of herbal knowledge, leading to distinctive formulations for women's health. Commonly employed species such as *Asparagus racemosus* (Shatavari), *Saraca asoca* (Ashoka), *Curcuma longa* (Turmeric), *Foeniculum vulgare* (Fennel), *Trigonella foenum-graecum* (Fenugreek), and *Withania somnifera* (Ashwagandha) exemplify this shared heritage, being used across both states for enhancing fertility, balancing hormones, and maintaining uterine health (Masjedi *et al.* 2024).

Within these traditions, fertility is viewed through a comprehensive lens—encompassing physiological, psychological, and spiritual dimensions. Herbal preparations are categorised according to their “heating” or “cooling” effects, echoing indigenous understandings of hormonal and metabolic balance (Eyango *et al.*, 2025). Plants are said to “nourish the womb,” “purify the blood,” or “open blocked channels,” metaphors that parallel modern interpretations of endocrine regulation and uterine tonicity. Rituals accompanying the use of plants, such as offering *Saraca asoca* flowers during fertility ceremonies or administering *Shatavari* tonics to newly married women, highlight the profound interlinkage between culture and therapy in maintaining reproductive well-being (Balkrishna *et al.*, 2025).

Moreover, the ethnobotanical landscape of this coastal belt underscores the ecological dependence of traditional healthcare systems. Medicinal plants thrive in farmlands, mangrove fringes, and village groves, ensuring year-round accessibility for community use. However, rapid urbanization, deforestation, and unregulated exploitation of wild resources have begun to threaten several key medicinal species, including *Saraca asoca*, *Curcuma caesia*, and *Rauvolfia serpentina* (Hyun *et al.*, 2024). Sustainable harvesting practices, habitat restoration, and community-based conservation initiatives are therefore essential to safeguard both biodiversity and traditional healthcare continuity. Empowering local women's groups, herbal practitioners, and youth through participatory conservation can enhance livelihood opportunities while preserving the ecological foundation of these healing traditions (Kadirova *et al.*, 2024).

The present ethnobotanical survey systematically documents and analyses traditional knowledge related to medicinal plants used to enhance female fertility in the coastal belt of Ganjam and northern Andhra Pradesh, encompassing the socio-demographic profiling of informants, authentication of plant species, identification of utilised parts, preparation methods, and therapeutic applications. Beyond mere documentation, it endeavours to validate these traditional claims through phytochemical and pharmacological insights, thereby bridging indigenous wisdom with modern reproductive medicine. This integrative approach not only deepens the scientific understanding of herbal fertility management but also reinforces the significance of culturally embedded and sustainable healthcare practices. Ultimately, the ethnobotanical exploration of this coastal region reveals a profound interconnection between biodiversity, traditional knowledge, and women's reproductive well-being, demonstrating how local communities have transformed their ecological surroundings into a living pharmacy that sustains both biological and cultural resilience. As contemporary science increasingly turns toward natural alternatives for managing complex reproductive disorders, the enduring traditions of the Ganjam-Andhra coast emerge as exemplary models of ecological intelligence, cultural continuity, and holistic reproductive health management.

Materials and Methods

Study Area

The ethnobotanical documentation was conducted along the coastal belt of Ganjam district (Odisha) and the northern coastal region of Andhra Pradesh, extending from Gopalpur and Rambha to Ichchapuram. This region, situated between 18°35'-19°10' N and 84°50'-85°15' E, forms part of the Eastern Ghats coastal corridor, characterized by sandy plains, mangrove fringes, estuarine wetlands, lateritic uplands, and fertile agricultural fields (Tripathy *et al.*, 2021). The climate is tropical humid-maritime, with temperatures ranging from 22-35 °C and an average annual rainfall of 1200-1400 mm, favoring luxuriant growth of both wild and cultivated medicinal plants. Major vegetation includes coconut and cashew plantations, paddy fields, home gardens, and sacred groves, which serve as repositories of rare ethnomedicinal species such as *Saraca asoca*, *Mucuna pruriens*, and *Symplocos racemosa* (Acharya *et al.*, 2025). The region's hydrological systems, including the Rushikulya and Bahuda rivers, sustain diverse microhabitats that nurture plant resources crucial to traditional healthcare. The population comprises Odia and Telugu-speaking communities, fisherfolk, cultivators, herbal traders, and women's self-help groups. These groups collectively maintain a dynamic folk medical system, where knowledge of medicinal flora is transmitted orally and applied mainly in treating female reproductive and fertility disorders (Priyadarsini *et al.*, 2025). Midwives (*Dais*) and traditional healers (*Vaidyas*) are central to this practice. Survey localities included Berhampur, Purushottampur, Kodala, Ranajhali, Digapahandi, Rambha, Gopalpur, Nuapada, and Ichchapuram, representing ecological and cultural gradients. The region thus embodies a biocultural interface where ecological richness and traditional knowledge intersect to sustain ethnomedicine focused on women's reproductive health (Nayak *et al.*, 2022). Figure 1 presents a picture of the study area.

Ethnobotanical Data Collection

Fieldwork was conducted between December 2024 and October 2025, adhering to standardized ethnobotanical survey protocols (Fakchich *et al.*, 2023). Given that the study area spans the border of Odisha and Andhra Pradesh, the research team accounted for linguistic and cultural variations by engaging bilingual local guides and field assistants fluent in both Odia and Telugu. This ensured clear communication during interviews and accuracy in documenting vernacular nomenclature across the two states. Ethical guidelines were strictly followed, with Prior Informed Consent (PIC) obtained from all 105 participants. Data were gathered through semi-structured questionnaires, participant observation, and guided field walks (Rajput *et al.*, 2024). Informants provided details on vernacular names, plant parts used, seasonal availability, and specific therapeutic indications for female reproductive health, such as infertility and menstrual irregularities. The study cohort represented a comprehensive demographic spectrum, with ages ranging from younger practitioners (under 40)—who represent the current active workforce in herbal trade and self-help groups—to venerable elder custodians (over 80), who hold longitudinal traditional knowledge rarely found in younger generations. Plant specimens were collected, pressed, and dried following standard herbarium techniques. Taxonomic identification was performed using the authoritative "The Flora of Orissa" (Bharatpedia contributors) and cross-referenced with The Plant List (2023 revision) to ensure updated botanical

nomenclature. Voucher specimens were deposited in the Herbarium of the Department of Botany, Berhampur University, for permanent reference. Figure 2 represents the survey procedure during the documentation of information about the plant specimens.

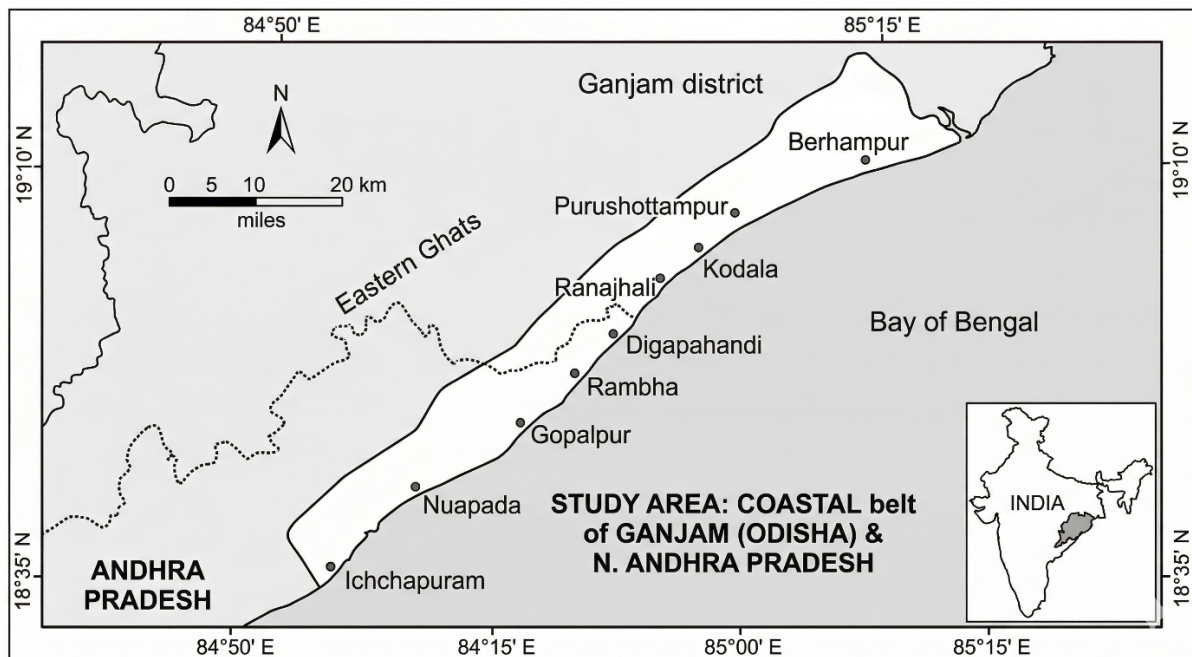


Figure 1. Map of the study area

Quantitative Ethnobotanical Analysis

In the present investigation, a quantitative ethnobotanical framework was employed to scientifically evaluate the cultural, therapeutic, and social importance of medicinal plants traditionally used for female fertility enhancement in Ganjam region of Odisha and other coastal region of Andhra Pradesh (Jistu *et al.*, 2025).

The calculation of **informant participation (IP)** and **informant response (IR)** was conducted using the following formula.

$$IP = \sum (\text{Total participants providing information on a specific plant})$$

$$IR = \sum (\text{Total responses for a specific plant})$$

We utilized the Use Value (UV) index to assess the relative significance of each plant species according to the frequency of use documented by the informants (Benhaya H *et al.*, 2023). We computed the UV as

$$UV = \frac{\sum U}{N}$$

Where $\sum U$ signifies the aggregate number of uses referenced for a species, and NN indicates the count of informants. This enabled us to recognise plants with considerable variety and importance in traditional practices. We recorded the Use Report (UR) as the aggregate number of occurrences in which informants referenced a particular plant species for any application. This enabled us to ascertain the prominence of specific plants throughout the community.

$$UR = \sum (\text{Total number of uses cited for a specific plant})$$



Figure 2. Collections of the photographs during the period of the survey at different location

Relative Frequency of Citation (RFC) to assess the agreement among informants concerning the utilisation of specific plant species (Ogwu MC *et al.*, 2025). We utilised the RFC formula.

$$RFC = \frac{FC}{N}$$

Where FC denotes the count of informants who identified a species, and N represents the total number of informants. This allowed us to assess the extensive acknowledgement and cultural significance of each plant. We employed the Cultural Importance Index (CI) to assess the overall relevance of plant species, considering the diversity of their applications across multiple domains. This method enabled us to understand the significant role specific plants played in the community's cultural activities (Ullah *et al.*, 2023). The confidence interval can be computed as follows:

$$CI = \sum_{j=1}^n \left(\frac{UR_{ij}}{N} \right)$$

Additionally, we computed the **Fidelity level (FL)** to evaluate the uniqueness of plant utilization for specified applications. We utilized the formula.

$$FL (\%) = \frac{Np}{N} \times 100$$

The **Family Use Value (FUV)** is an index used to assess the overall significance or utility of a specific plant family. The formula provided calculates this value by quantifying the combined use of all species within that family (Haq *et al.*, 2023).

$$FUV = \frac{\sum UV}{N}$$

In this formula, “ $\sum UV$ ” represents the sum of use values of all species included in a particular family, while “N” denotes the total number of species recorded from that family.

Results and Discussion

Socio-Demographic Profile of Respondents

The study surveyed 105 respondents from diverse localities across Ganjam and nearby coastal areas, with the highest participation from Berhampur (16.19%) and Gopalpur (12.38%), and the lowest from Nuapada (6.67%) and Ichchapuram (4.76%), reflecting a mix of urban, peri-urban, and rural populations. Gender distribution was almost equal, with males at 51.43% and females at 48.57%. Participants represented varied occupations linked to traditional knowledge and natural resources, including fisherfolk and fish traders (22.86%), women SHG members (20.95%), traditional herbal practitioners (19.05%), local herbal vendors (20%), and cashew/coconut cultivators or farmers (17.14%). The majority were aged between 60-80 years (32.38%) and 40-60 years (28.57%), while 21.90% were below 40 years and 17.14% above 80 years, indicating that older adults formed a significant portion of the knowledge holders. In terms of education, most respondents had primary (30.48%) or secondary/high school education (25.71%), 22.86% had no formal education, and 20.95% had vocational or college-level education. Overall, the sample reflects a balanced mix of gender, age, education, occupation, and locality, representing the diverse communities engaged in traditional practices and livelihoods. *Table 1* presents the locality, gender, occupation, age, and education distribution of the respondents involved in the study. The utilization of medicinal plants for female reproductive health represents a profound intersection of traditional knowledge, cultural practices, and biodiversity conservation. Indigenous and rural communities have historically relied on local flora to manage fertility, regulate menstrual cycles, support lactation, and address hormonal imbalances (Khadim S *et al.*, 2024). Such ethnomedicinal practices are not merely anecdotal but reflect centuries of empirical observation and experiential learning. In regions like Ganjam, the rich floristic diversity provides an abundant source of therapeutic plants, which have been carefully selected, categorized, and incorporated into specific formulations based on efficacy and cultural validation. Similar observations have been reported in other ethnobotanical surveys, where women’s health consistently emerges as a primary domain of plant-based interventions (Rehman *et al.*, 2022).

Table 1. Socio-demographic profile of informants participating in the ethnobotanical survey, including locality, gender, occupation, age group, and education level.

Socio-Demographic Variables	Parameters	Sample Number	Percentage (%)
Locality	Berhampur (urban slums & peri-urban)	17	16.19
	Purushottampur	12	11.43
	Kodala	11	10.48
	Ranjuali	9	8.57
	Ganjam (old port town & villages)	10	9.52
	Digapahandi	11	10.48
	Rambha	10	9.52
	Gopalpur	13	12.38
	Naupada (coastal belt, Ganjam-Andhra border)	7	6.67
	Ichchapuram (coastal belt, Ganjam-Andhra border)	5	4.76
Gender	Male	54	51.43
	Female	51	48.57
Occupation	Traditional herbal practitioners	20	19.05
	Fisherfolk & fish traders	24	22.86
	Cashew/coconut cultivators & farmers	18	17.14

	Women SHG members (selling herbs, dried fish, handicrafts)	22	20.95
	Local herbal vendors/plant sellers	21	20.00
Age Group	Below 40 years	23	21.90
	40-60 years	30	28.57
	60-80 years	34	32.38
	Above 80 years	18	17.14
Education Level	No formal education	24	22.86
	Primary education	32	30.48
	Secondary / High school	27	25.71
	Vocational / College-level	22	20.95

Ethnobotanical and Medicinal Plant Profile

The survey documented 50 medicinal plant species used by local communities, encompassing a wide range of botanical families, growth habits, and habitats. Trees were the most common habit, including species like *Saraca asoca*, *Terminalia arjuna*, *Phyllanthus emblica*, and *Azadirachta indica*, while herbs such as *Curcuma longa*, *Bacopa monnieri*, and *Withania somnifera* were also well represented. Creepers, climbers, and shrubs supplemented the diversity. Many plants were cultivated, such as *Asparagus racemosus*, *Curcuma longa*, and *Moringa oleifera*, while others like *Hemidesmus indicus*, *Symplocos racemosa*, and *Rauvolfia serpentina* were predominantly wild and sometimes rare or endangered. Availability varied seasonally, with some species present year-round (*Asparagus racemosus*, *Tinospora cordifolia*, *Ocimum tenuiflorum*), while others were seasonal. The plants serve a broad spectrum of ethnomedicinal uses, including galactagogues, adaptogens, anti-inflammatory agents, antioxidants, aphrodisiacs, and treatments for digestive, respiratory, cardiovascular, and gynaecological disorders. Conservation status ranged from Least Concern (*Phyllanthus emblica*, *Moringa oleifera*) to Critically Endangered (*Crocus sativus*, *Curcuma caesia*) and Endangered (*Rauvolfia serpentina*), reflecting both global and local pressures on certain species. Overall, the documented flora highlights the rich ethnobotanical knowledge of the region, demonstrating the importance of these plants in healthcare, nutrition, and cultural practices while underscoring the need for conservation of threatened taxa. *Table 2* shows the list of medicinal plants used in female reproductive disorders, along with the plant part used, preparation, and traditional therapeutic uses. *Figure 3* presents a few picture collections of the plants obtained from the survey. The documented diversity, spanning multiple botanical families, highlights the ecological and cultural importance of conserving local plant resources. Families such as Fabaceae, Zingiberaceae, and Apiaceae, which contribute significantly to reproductive healthcare, have been emphasized in earlier studies as reservoirs of bioactive secondary metabolites, including flavonoids, saponins, phenolic acids, and terpenoids (Latorre EC *et al.*, 2023). This supports the argument that ethnobotanical knowledge is closely linked with regional biodiversity, underscoring the need for sustainable harvesting, habitat preservation, and community-based conservation programs. Protecting these resources ensures the continued availability of species that are not only culturally significant but also pharmacologically valuable (Tsobou R *et al.*, 2016).

Table 2. Medicinal plants used for female reproductive disorders, their parts, preparation, and therapeutic uses.

Botanical name (with authority)	Family	Common name	Vernacular name (Odia)	Vernacular name (Telugu)	Voucher Specimen number	Habitat	Available season	Availability status	Crop status	Ethnomedicinal uses	Conservation status (IUCN/local)
<i>Trianthema portulacastrum</i> L.	Aizoaceae	Black pigweed	Rakta Puruni	Gali jiru / Tella galijeru	BU-BOT-6175	Herb	Rainy	Abundant	Wild	Anthelmintic, fever, oedema	Not Evaluated
<i>Achyranthes aspera</i> L.	Amaranthaceae	Apamarga	Apamargsa	Uttareni	BU-BOT-8335	Herb	Year-round	Abundant	Wild	Anthelmintic, cough, kidney stones	Least Concern
<i>Cuminum cyminum</i> L.	Apiaceae	Cumin	Jeera	Jeelakarra	BU-BOT-4456	Herb	Year-round	Abundant	Cultivated	Carminative, digestive	Least Concern
<i>Foeniculum vulgare</i> Mill.	Apiaceae	Fennel	Pan Mahuri	Sopu	BU-BOT-9912	Herb	Year-round	Abundant	Cultivated	Carminative, digestive, lactation aid	Least Concern
<i>Trachyspermum ammi</i> (L.) Sprague	Apiaceae	Ajwain	Ajwain	Vamu	BU-BOT-1087	Herb	Year-round	Abundant	Cultivated	Carminative, antimicrobial	Least Concern
<i>Alstonia scholaris</i> (L.) R.Br.	Apocynaceae	Devil's Tree	Saptaparna	Edukondala Paala / Eda-kula Ponna	BU-BOT-2619	Tree	Year-round	Abundant	Wild	Antipyretic, malaria, respiratory	Least Concern
<i>Hemidesmus indicus</i> (L.) R.Br. ex Schult.	Apocynaceae	Indian Sarsaparilla	Anantamul, Sugandhi	Sugandhapala	BU-BOT-3105	Shrub	Dec-Jan	Rare	Wild	Blood purifier, skin diseases, diuretic	Least Concern (declining locally)
<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz	Apocynaceae	Sarpagandha	Sarpagandha	Sarpagandhi / Patala Garudi	BU-BOT-1234	Shrub	Year-round	Rare	Wild	Antihypertensive, sedative	Endangered
<i>Asparagus racemosus</i> Willd.	Asparagaceae	Shatavari	Chatuari	Pilliteegalu / Shatavari	BU-BOT-7102	Creepers	Throughout year	Abundant	Cultivated	Galactagogue, female tonic, anti-ulcer, adaptogen	Least Concern
<i>Aloe barbadensis</i> Mill.	Asphodelaceae	Aloe vera	Ghritakumari	Kalabanda	BU-BOT-4406	Herb	Year-round	Abundant	Cultivated	Skin care, wound healing, digestive	Least Concern
<i>Stereospermum suaveolens</i> (Roxb.) DC.	Bignoniaceae	Patala	Patala	Kaligottu	BU-BOT-8712	Tree	Summer	Rare	Wild	Anti-inflammatory, analgesic	Vulnerable
<i>Mesua ferrea</i> L.	Calophyllaceae	Nagakesar	Nagesar	Naga Kesaramu	BU-BOT-8194	Tree	Feb-Sep	Rare	Wild	Hemostatic, anti-inflammatory	Vulnerable (local)
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Combretaceae	Arjuna	Arjuna	Tella Maddi	BU-BOT-2384	Tree	Autumn	Abundant	Wild	Cardioprotective, hypertension, wound healing	Least Concern

<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	Bahera	Bahada	Thanikkaya	BU-BOT-6625	Tree	Mar-Feb	Abundant	Wild	Respiratory disorders, Triphala	Least Concern
<i>Terminalia chebula</i> Retz.	Combretaceae	Haritaki	Harida	Karakkaya	BU-BOT-1349	Tree	Early Winter	Abundant	Wild	Digestive, laxative, Rasayana	Least Concern
<i>Ipomoea sepiaria</i> Koenig ex Roxb.	Convolvulaceae	Morning Glory	Alata lata	Lakshmana / Purusharatna	BU-BOT-9128	Climber	Rainy	Rare	Wild	Gynecological uses, tonic	Data Deficient
<i>Bryonopsis laciniosa</i> (L.) Naudin	Cucurbitaceae	Shivlinga	Shivlinga	Lingadonda	BU-BOT-4008	Herb	Year-round	Rare	Wild	Aphrodisiac, fertility enhancer	Data Deficient
<i>Caesalpinia crista</i> L.	Fabaceae	Kataka	Kataka rancha	Gachakaya	BU-BOT-9003	Climber	Summer	Abundant	Wild	Anthelmintic, liver tonic	Data Deficient
<i>Glycyrrhiza glabra</i> L.	Fabaceae	Liquorice	Mulethi	Atimadhuram	BU-BOT-7654	Herb	Year-round	Abundant	Cultivated	Expectorant, antiulcer, demulcent	Least Concern
<i>Mucuna pruriens</i> (L.) DC.	Fabaceae	Velvet bean	Kauchila	Dula gondi	BU-BOT-2119	Herb	Year-round	Abundant	Cultivated	Antiparkinson, aphrodisiac, nervine	Least Concern
<i>Saraca asoca</i> (Roxb.) Willd.	Fabaceae	Ashoka	Asoka	Ashoka vrukshamu	BU-BOT-4591	Tree	Feb-Jun	Abundant	Cultivated	Menstrual & uterine disorders, uterine tonic	Vulnerable
<i>Trigonella foenum-graecum</i> L.	Fabaceae	Fenugreek	Methi	Mentulu (Seeds) / Menthi kura (Leaves)	BU-BOT-2248	Herb	Year-round	Abundant	Cultivated	Digestive, lactation stimulant, diabetes	Least Concern
<i>Crocus sativus</i> L.	Iridaceae	Saffron	Kesar	Kumkuma puvvu	BU-BOT-8443	Herb	Winter	Rare	Cultivated	Antioxidant, aphrodisiac, CNS tonic	Critically Endangered
<i>Ocimum tenuiflorum</i> L.	Lamiaceae	Tulsi	Tulasi	Thulasi	BU-BOT-5502	Shrub	Year-round	Abundant	Wild	Antimicrobial, adaptogen, respiratory	Least Concern
<i>Cinnamomum tamala</i> (Buch.-Ham.) T.Nees & Eberm.	Lauraceae	Bay leaf	Tej Patra	Biryani Aku / Tejapatta	BU-BOT-7041	Tree	Year-round	Rare	Cultivated	Spice, carminative, digestive	Vulnerable
<i>Cinnamomum verum</i> J.Presl	Lauraceae	Cinnamon	Dalchini	Dalchina chekka	BU-BOT-9371	Tree	Year-round	Abundant	Cultivated	Carminative, antimicrobial	Vulnerable (local)
<i>Persea americana</i> Mill.	Lauraceae	Avocado	Butter fruit	Vennapandu (Avocado)	BU-BOT-1198	Tree	Jul-Oct	Abundant	Cultivated	Nutritional, cardiac tonic, digestive	Not Evaluated

<i>Punica granatum</i> L.	Lythraceae	Pomegranate	Dalimba	Danimma	BU-BOT-1823	Shrub	Sept-Jan	Abundant	Cultivated	Antioxidant, anthelmintic, diarrhea	Least Concern
<i>Abutilon indicum</i> (L.) Sweet	Malvaceae	Atibala	Kankei	Thuvva / Duvvena Kayalu	BU-BOT-1992	Shrub	Summer-Rainy	Abundant	Wild	Demulcent, urinary disorders	Least Concern
<i>Gossypium herbaceum</i> L.	Malvaceae	Cotton	Pata	Pratti	BU-BOT-4115	Shrub	Summer	Abundant	Cultivated	Emollient, textile use	Not Evaluated
<i>Azadirachta indica</i> A.Juss.	Meliaceae	Neem	Nimba	Vepa	BU-BOT-6331	Tree	Year-round	Abundant	Wild	Antimicrobial, insecticidal, blood purifier	Least Concern
<i>Tinospora cordifolia</i> (Willd.) Miers	Menispermaceae	Guduchi	Guluchi	Thippateega	BU-BOT-2847	Climber	Year-round	Abundant	Wild	Immunomodulator, febrifuge	Least Concern
<i>Morus alba</i> L.	Moraceae	Mulberry	Tut Koli	Reshma chattu	BU-BOT-7783	Tree	Spring-Summer	Abundant	Cultivated	Diabetes, liver tonic, anemia	Least Concern
<i>Moringa oleifera</i> Lam.	Moringaceae	Drumstick	Munika	Munaga	BU-BOT-5067	Tree	Year-round	Abundant	Cultivated	Nutritional, anti-inflammatory, galactagogue	Least Concern
<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	Myrtaceae	Clove	Labanga	Lavangalu	BU-BOT-5827	Tree	Year-round	Rare	Cultivated	Antiseptic, carminative, dental pain	Vulnerable
<i>Boerhavia diffusa</i> L.	Nyctaginaceae	Punarnava	Puruni Saga	Galijeru / Atika Mamidi	BU-BOT-3910	Herb	Rainy	Abundant	Wild	Diuretic, hepatoprotective	Least Concern
<i>Nyctanthes arbor-tristis</i> L.	Oleaceae	Night Jasmine	Gangaseuli	Parijatham	BU-BOT-9027	Tree	Aug-Dec	Abundant	Wild	Antipyretic, arthritis, skin diseases	Least Concern
<i>Olea europaea</i> L.	Oleaceae	Olive	Olive	Jaitun (Olive)	BU-BOT-5534	Tree	Winter	Abundant	Cultivated	Cardio-protective, antioxidant	Least Concern
<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Indian gooseberry	Amala	Usiri / Usirikaya	BU-BOT-8821	Tree	Nov-Feb	Abundant	Cultivated	Immunity booster, antioxidant, digestive	Least Concern
<i>Piper longum</i> L.	Piperaceae	Long Pepper	Pipali	Pippallu	BU-BOT-7329	Creeper	Dec-Feb	Abundant	Cultivated	Respiratory tonic, digestive stimulant	Vulnerable
<i>Billardiera scandens</i> Sm.	Pittosporaceae	Apple Berry	Barakoli	Buradi	BU-BOT-3301	Tree	Jan-Mar	Rare	Cultivated	Antioxidant, tonic	Not Evaluated
<i>Bacopa monnieri</i> (L.) Wettst.	Plantaginaceae	Brahmi	Brahmi	Brahmi / Sambrani Aku	BU-BOT-4216	Herb	Oct-Nov	Abundant	Wild	Memory enhancer, anxiolytic	Least Concern

<i>Eleusine coracana</i> (L.) Gaertn.	Poaceae	Ragi	Mandia	Ragulu / Chodi	BU-BOT-6721	Herb	Jun-Sep	Abundant	Cultivated	Nutritional, antidiabetic	Least Concern
<i>Aegle marmelos</i> (L.) Corrêa	Rutaceae	Bael	Kaitha/Bela	Maredu	BU-BOT-2561	Tree	Mar-May	Abundant	Cultivated	Digestive, diarrhea, diabetes	Least Concern
<i>Withania somnifera</i> (L.) Dunal	Solanaceae	Ashwagandha	Ashwagandha	Aswagandha / Penneru Gadda	BU-BOT-3456	Herb	Winter	Abundant	Cultivated	Adaptogen, nervine tonic, aphrodisiac	Least Concern
<i>Symplocos racemosa</i> Roxb.	Symplocaceae	Lodhra	Lodha	Lodduga	BU-BOT-8890	Tree	Summer-Rainy	Rare	Wild	Gynecological disorders, eye diseases	Vulnerable (local)
<i>Curcuma caesia</i> Roxb.	Zingiberaceae	Black turmeric	Kala haladi	Nalla Pasupu	BU-BOT-5098	Herb	Mar-Jun	Abundant	Cultivated	Antimicrobial, fertility enhancing	Critically Endangered
<i>Curcuma longa</i> L.	Zingiberaceae	Turmeric	Haladi	Pasupu	BU-BOT-6472	Herb	Throughout year	Abundant	Cultivated	Antimicrobial, wound healing, digestive	Least Concern
<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Ginger	Ada	Allam	BU-BOT-7982	Herb	Year-round	Abundant	Cultivated	Digestive, antiemetic, anti-inflammatory	Least Concern
<i>Tribulus terrestris</i> L.	Zygophyllaceae	Gokhru	Gokhura	Palleru	BU-BOT-3554	Herb	Summer-Autumn	Abundant	Wild	Aphrodisiac, diuretic	Least Concern



Figure 3. A few collections of the photographs of plant species obtained from the ethnobotanical survey

The families were analysed, and the Fabaceae family had the highest number of plant species used, with 5 species. Several other families, such as Apiaceae, Combretaceae, Apocynaceae, Zingiberaceae, and Lauraceae, have 3 species each, while many families have only 1 species used. This shows Fabaceae stands out significantly in terms of species usage among the families studied. Fabaceae is also known for its wide economic and medicinal importance worldwide. Figure 4 illustrates the most prevalent plant families abundantly represented among the documented species.

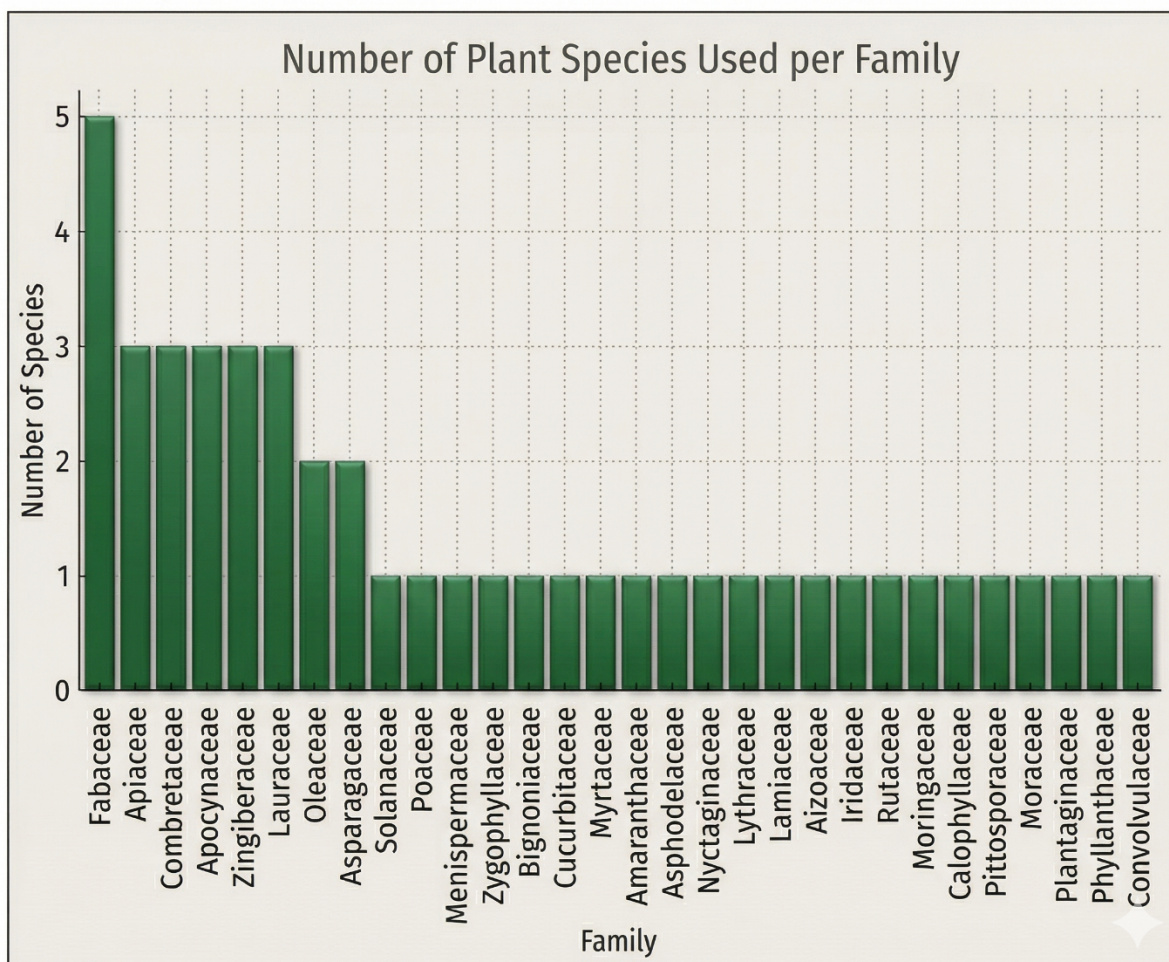


Figure 4. Most prevalent family abundantly distributed across the plant species.

Ethnomedicinal Preparations for Female Reproductive Health

The study documented 50 medicinal plant species used in female reproductive health, detailing parts used, collection methods, preparation forms, additional ingredients, Ayurvedic formulations, and therapeutic roles. Roots, rhizomes, bark, leaves, seeds, fruits, flowers, and whole plants were the most commonly utilized parts, collected through hand-picking, digging, cutting, or uprooting. Figure 5 represents Utilization of different plant parts for the treatment of gynaecological disorders as reported by the informants.

Preparations included shade-dried powders, decoctions, infusions, ghrilas, lehyas, pastes, oils, and syrups, often combined with supportive ingredients such as milk, ghee, honey, jaggery, or other herbs. These plants were integrated into classical Ayurvedic formulations like *Shatavari Ghrita*, *Ashokarishta*, *Chyawanprash*, *Triphala Churna*, *Punarnavadi Mandura*, *Kapikacchu Churna*, and others. Therapeutic applications spanned galactagogue activity, fertility enhancement, ovarian antioxidant support, menstrual regulation, dysmenorrhea relief, uterine tonic functions, hormonal balance, management of PCOS, amenorrhea, endometriosis, pelvic inflammatory conditions, and menopausal symptom alleviation. Plants such as *Asparagus racemosus*, *Saraca asoca*, *Moringa oleifera*, *Withania somnifera*, *Crocus sativus*, *Curcuma caesia*, and *Bryonopsis laciniosa* were highlighted for their specific roles in folliculogenesis, ovulation support, uterine health, and stress-related reproductive disorders. Overall, these ethnomedicinal practices reflect a sophisticated, integrative knowledge system combining plant-based therapies with classical Ayurvedic preparations to manage female reproductive health, while emphasizing dosage, preparation methods, and synergistic use of ingredients to optimize efficacy and safety. The detailed traditional uses, preparation methods, and therapeutic indications of the documented plants are summarized in *Table 3*.

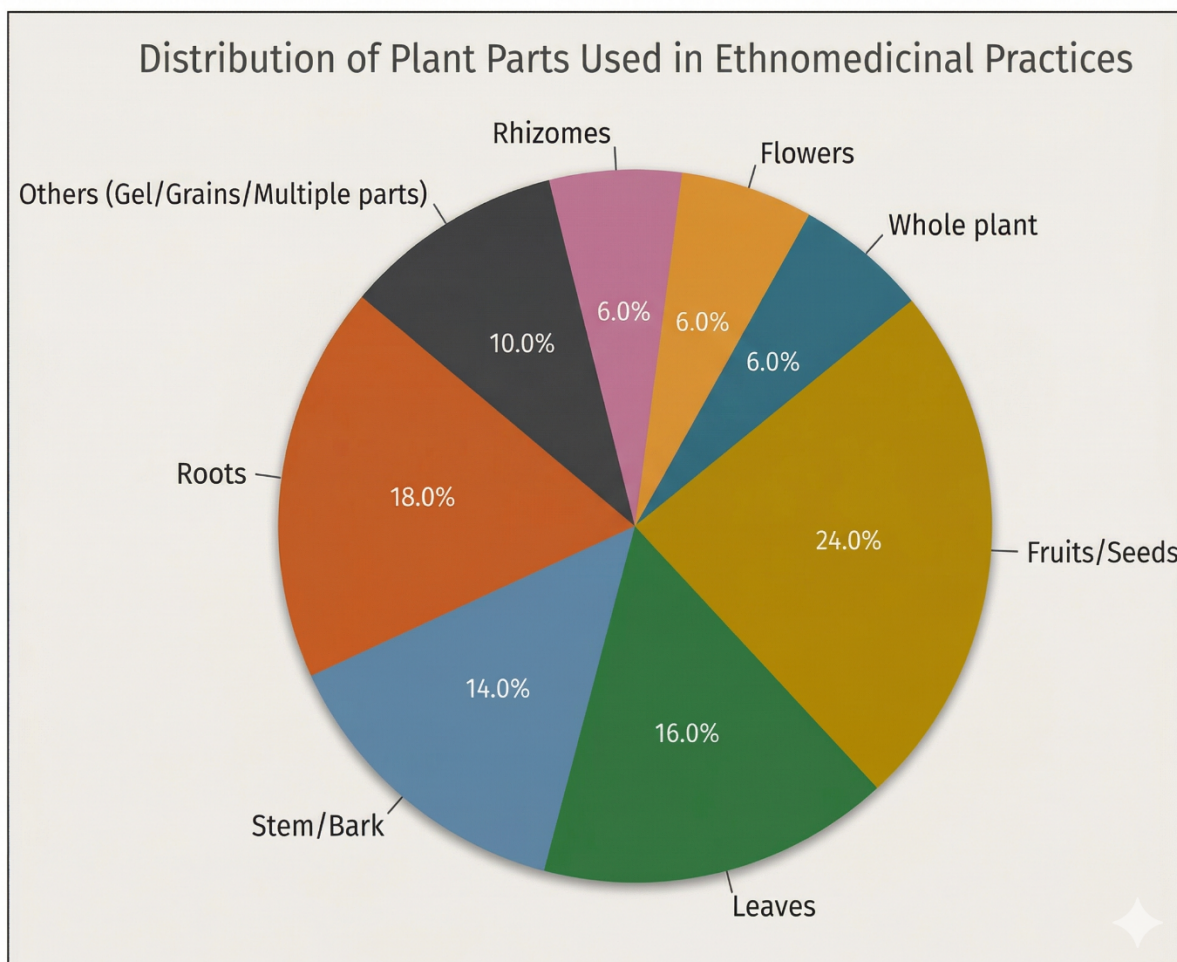


Figure 5. Utilization of plant parts for treating gynaecological disorders as reported by informants

Table 3. Traditional usage of medicinal plants in female reproductive health

Botanical name	Part used	Collection method	Preparation & dosage form	Additional ingredient	Available ayurvedic formulation	Therapeutic uses in female reproductive disorders
<i>Abutilon indicum</i> (L.) Sweet	Whole plant	Uprooted	Shade-dried, powdered; ethanol extraction	Honey, sugar	Atibala Kwath, Baladi formulation	Uterine tonic; dysmenorrhea relief; supports conception; uterine atony management
<i>Achyranthes aspera</i> L.	Whole plant	Uprooted	Shade-dried; powdered; decoction 20 g/400 ml water	Honey	Apamarga Kshara, Apamarga Churna	Emmenagogue; dysmenorrhea; uterine stimulant; aids in retained placenta (traditional obstetric uses)
<i>Aegle marmelos</i> (L.) Corrêa	Fruits, leaves, bark, roots	Hand-picking	Powder/decoction/paste; fruits mashed, leaves/roots decocted	Honey, ghee	Vilwadi Lehyam, Dasamoolarishta, Kutajavaleha, Bilwadi Churna	Menstrual regulation; dysmenorrhea; leucorrhoea management; supportive in endometritis

<i>Aloe barbadensis</i> Mill.	Inner leaf gel	Cutting leaves	Gel used fresh or lyophilized; decoction, syrup, juice	Milk, rose water, tea tree oil, cucumber juice	Kumaryasava (fermented tonic)	Anti-inflammatory for endometritis/endometriosis; wound healing post procedures; vaginal mucosa soothing; lactation support (topical/oral adjunct)
<i>Alstonia scholaris</i> (L.) R.Br.	Bark, leaves	Bark stripping	Shade-dried; powdered; decoction 20 g/400 ml water reduced to 100 ml	Honey, ghee	Saptaparna Kwath	Uterine tonic; dysmenorrhea; used traditionally for uterine disorders (use with care in pregnancy)
<i>Asparagus racemosus</i> Willd.	Fleshy roots	Dug & cleaned	Shade-dried, powdered; decoction 10-15 g in 150 ml water reduced to 40 ml; mixed with milk/ghee/honey	Milk, ghee, sugar, honey	Shatavari Ghrita, Shatavari Guda, Shatavari Lehya, Shatavari Churna, Shatavari Swarasa	Galactagogue; infertility; ovarian insufficiency; amenorrhea; luteal phase support; hormonal imbalance; menopausal symptoms
<i>Azadirachta indica</i> A.Juss.	Leaves, bark, seeds	Plucking, bark stripping	Shade-dried; powdered; decoction 10-20 g/200 ml water	Honey, ghee	Nimba Taila, Decoctions, Lehyas	Anti-androgenic and anti-inflammatory; PCOS adjunct; infection control (vaginitis); uterine tonic (traditional)
<i>Bacopa monnieri</i> (L.) Wettst.	Leaves, stems	Cutting	Shade-dried; decoction 20 g/400 ml water reduced to 100 ml; ghrita processed with ghee and milk	Ghee, milk, honey	Brahmi Ghrita, Brahmi Rasayana, Brahmi Vati, Saraswat Ghrita	Stress-related infertility; HPO axis modulation; support in menstrual irregularity due to stress; menopausal cognitive support
<i>Billardiera scandens</i> Sm.	Fruits	Collected ripe	Fresh paste or powdered; decoction simmered until soft, then filtered	Milk, honey	Digestive tonics, decoction/paste used in herbal lehyas	Folliculogenesis support; antioxidant for ovarian health; adjunct in ovarian dysfunction
<i>Boerhavia diffusa</i> L.	Leaves, roots	Hand-picking	Decoction or powder; roots washed & dried	Honey, ghee	Punarnavadi Mandura, Sukumara Ghrita, Punarnavasava, Punarnavastaka Kwath	Ovulation-inducing support; anti-inflammatory in pelvic conditions; ovarian cyst adjunct; edema associated with menstrual disorders
<i>Bryonopsis laciniosa</i> (L.) Naudin	Seeds, fruit	Hand-picking	Seeds dried, powdered; decoction 10-15 g/200 ml water	Honey, ghee	Strirativallabhubg pak, fertility tonics	Fertility tonic; ovulation support; traditional use in female reproductive weakness

<i>Caesalpinia crista</i> L.	Seeds, pods, flowers	Hand-picking	Shade-dried; decoction 10-20 g/200-400 ml water	Honey, ghee	Katakadi Kwath, Seed/fruit decoctions	Emmenagogue; fertility tonic; dysmenorrhea management (traditional uses)
<i>Cinnamomum tamala</i> (Buch.-Ham.) T.Nees & Eberm.	Leaves	Hand-picking	Shade-dried, powdered; extract prepared in water	Sugar, honey	Tejpatra Churna	Menstrual regulation; digestive support in menstrual/ pregnancy-related GI symptoms
<i>Cinnamomum verum</i> J.Presl	Bark	Hand-picking	Shade-dried; decoction or powder in lehyas/ghrita	Honey, ghee	Sitopaladi Churna, Chyawanprash, Lavan Bhaskar Churna, Dashamoola Kashayam	Insulin-sensitizing (PCOS adjunct); dysmenorrhea relief; regulates menstrual cycles
<i>Crocus sativus</i> L.	Stigmas	Hand-picking	Used fresh/dried in ghrita, pastes, oils	Milk, ghee	Kumkumadi Ghrita, Kumkumadi Tailam	Ovarian reserve support (antioxidant); mood regulation in PMS/menopausal women; improves menstrual regularity
<i>Cuminum cyminum</i> L.	Seeds	Hand-picking	Powdered; decoction/tea 5-10 g/200 ml water	Honey, ghee	Jeerakadyarista, Jeerakadi Modaka, Jeerakadi Churna	Ovulation support (antioxidant); menstrual discomfort relief; digestive support during pregnancy/postpartum (traditional)
<i>Curcuma caesia</i> Roxb.	Rhizomes	Dug	Shade-dried or fresh; powdered; decoction/ghrita	Milk, ghee, honey	Kala Haladi Ghrita, Lehyas, Poultices	Anti-inflammatory; dysmenorrhea relief; uterine cramp relief; adjunct in pelvic pain syndromes
<i>Curcuma longa</i> L.	Rhizomes	Dug	Fresh or shade-dried; powdered; decoction/ghrita	Milk, ghee, honey, jaggery	Chandraprabha Vati, Mahatikta Ghrita	Anti-inflammatory; anti-androgenic (PCOS); endometriosis adjunct; dysmenorrhea; reduction of pelvic inflammation and adhesions
<i>Eleusine coracana</i> (L.) Gaertn.	Grains	Harvested & dried	Flour prepared; porridge or decoction	Milk, jaggery	Mandia Porridge, Flour-based decoctions	Ovarian antioxidant; nutritional support in infertility; amenorrhea due to malnutrition
<i>Foeniculum vulgare</i> Mill.	Bulb, foliage, seeds	Hand-picking	Powder, decoction, or infusion; seeds roasted/boiled as needed	Honey, ghee	Avipattikar Churna, Sitopaladi Churna, Shatapushpadi Churna	Estrogenic effects; amenorrhea; dysmenorrhea relief; galactagogue; menstrual cramps

<i>Glycyrrhiza glabra</i> L.	Roots, rhizomes	Dug	Shade-dried; decoction 10 g/200 ml water reduced; powder used in churnas	Sugar, honey, ghee	Yashtimadhu Churna, Mulethi Ghrita	Anti-androgenic (useful in PCOS); amenorrhea; luteal phase support; estrogenic modulation; dysmenorrhea relief
<i>Gossypium herbaceum</i> L.	Leaves, seeds	Hand-picking	Shade-dried leaves/powder; seeds pressed for oil	Ghee, honey	Pata Taila, Leaf decoction, Poulitices	Uterine tonic; traditional use for menstrual regulation and uterine weakness
<i>Hemidesmus indicus</i> (L.) R.Br. ex Schult.	Roots	Dug & washed	Shade-dried; decoction 10 g/200 ml water reduced to 50 ml; syrup concentrated with jaggery	Sugar, jaggery, honey	Anantamul Churna, Anantamul Juice, Anantamul Ghan Vati	Anti-inflammatory in pelvic disorders; PCOS adjunct; ovarian cyst support; amenorrhea; leucorrhea
<i>Ipomoea sepiaria</i> Koenig ex Roxb.	Roots, leaves, fruits	Uprooting	Shade-dried; decoction/paste prepared by boiling/crushing fresh parts	Milk, honey, rice water, jaggery	Lakshmanarishta (liquid), Loudh (tablet)	Uterine tonic; emmenagogue; aids in menstrual regulation; used traditionally for pelvic pain and sterility
<i>Mesua ferrea</i> L.	Flowers, stamens	Collected fresh	Shade-dried; decoction 20 g/300 ml water reduced to 100 ml; ghrita by maceration	Ghee, milk	Pumsavana, Garbhasrava, Püga, Gulgulwasavam	Follicle maturation support; anti-fibrotic (adhesion prevention); management of uterine fibroids; dysmenorrhea relief
<i>Moringa oleifera</i> Lam.	Leaves, fruits, flowers, roots, bark	Harvest tender leaves	Leaves shade-dried; decoction 20 g/400 ml water reduced to 100 ml; seeds crushed for oil; pods used fresh; roots decoction 10 g/200 ml water	Ghee, honey, milk	Sobhanjanadi Lepa, Sigru Kwath, Sudarsana Choornam, Moringa oil-based lehyas	Ovarian antioxidant; improves menstrual regularity; supports lactation/nutrition in postpartum women
<i>Morus alba</i> L.	Leaves, fruits, root bark, stems	Hand-picking	Leaves/roots shade-dried; decoction 15 g/300 ml water reduced to 75 ml; fresh fruit used directly	Milk, ghee, jaggery, honey	Leaf/root/bark decoctions, syrups, pastes, fermented Asava	Hormone modulation; amenorrhea; dysmenorrhea; galactagogue support (traditional use)
<i>Mucuna pruriens</i> (L.) DC.	Seeds, pods	Hand-picking	Seeds roasted/boiled to remove toxins, powdered; decoction prepared	Milk, ghee, honey	Kapikacchu Churna, Vati, Decoctions	Folliculogenesis stimulant; improves sperm/ovarian function; enhances gonadotropin release (L-DOPA mediated)
<i>Nyctanthes arbor-tristis</i> L.	Leaves, flowers	Cutting	Decoction: 20 g/400 ml water reduced to 100	Jaggery, honey	Leaf decoction, flower teas,	Irregular menstruation; dysmenorrhea;

	, stem, seeds		ml; paste prepared from fresh leaves/flowers		infused oils, topical pastes	hormonal modulation; mild uterotonic/tonic effects
<i>Ocimum tenuiflorum</i> L.	Leaves, flowers, stems, roots, seeds	Hand-picking	Decoction: 10-20 g/200-400 ml water reduced; paste prepared	Honey, ghee	Tribhuvan Kirti Ras, Tulsi Kwath	PCOS adjunct (anti-androgenic/antioxidant); stress-related menstrual irregularities; dysmenorrhea relief
<i>Olea europaea</i> L.	Fruits, leaves	Hand-picking	Fruits cold-pressed for oil; leaves shade-dried; decoction 10 g/200 ml water reduced to 50 ml	Lemon, honey	Jaitun Tel, herbal teas, infused oils	Anti-inflammatory (endometriosis); uterine tonic; antioxidant support for ovarian health; menstrual pain relief
<i>Persea americana</i> Mill.	Fruit, leaves, seeds	Hand-picking	Fruits mashed; seeds crushed for oil; leaves decoction 10 g/200 ml water reduced to 50 ml	Honey, ghee	Avocado oil decoction, pulp-based lehyas and pastes	Hormone-regulating support; menstrual irregularities; ovarian dysfunction; nutritive support in infertility; topical uterine massage oils
<i>Phyllanthus emblica</i> L.	Fruits, seeds, leaves, bark, roots, flowers	Hand-picking	Shade-dried; decoction 30 g/500 ml water reduced to 100 ml; powder used in chyawanprash	Jaggery, ghee, honey, other herbs	Chyawanprash, Brahmyarasyana	Ovarian antioxidant; improves ovarian reserve; infertility; premature ovarian insufficiency; menstrual irregularities
<i>Piper longum</i> L.	Dried fruits, roots	Hand-picking	Powdered; decoction/ghrita prepared	Honey, ghee	Trikatu, Chyawanprash, Pippalyadi Ghrita	Ovulation-inducing adjunct; improves absorption of formulations; supports menopausal symptoms; libido support
<i>Punica granatum</i> L.	Fruits, seeds, leaves, flowers, bark	Hand-picking	Powdered; decoction: 10-20 g/200-400 ml water	Honey, ghee	Dadimadighrita, Dadimavaleha, Dadimashtaka Churna	Folliculogenesis and estrogenic support; uterine tonic; management of menorrhagia and dysmenorrhea
<i>Rauwolfia serpentina</i> (L.) Benth. ex Kurz	Roots	Dug	Shade-dried; decoction/powder 5-10 g	Honey, ghee	Sarpagandha Churna, Vati, Decoctions for hypertension	Adjunct in hypertensive pregnant patients (with caution); anti-inflammatory; may help in stress-related menstrual disorders (use with medical oversight)

<i>Saraca asoca</i> (Roxb.) Willd.	Stem bark, flowers, seeds	Bark stripping & hand-picking	Bark dried; decoction: 1 part bark in 16 parts water reduced to ¼; flowers/seeds used fresh	Jaggery, water, other herbs	Ashokarishta, Ashokaghrita, Ashokavalehya, Ashokadi Churna	Dysmenorrhea; menorrhagia; dysfunctional uterine bleeding; uterine fibroids; uterine tonic; infertility support
<i>Stereospermum suaveolens</i> (Roxb.) DC.	Bark	Bark stripping	Dried, pulverized; macerated in ethanol, filtered, solvent evaporated	Honey	Patala Kwath, Dashamoola Kwath	Uterine tonic; anti-inflammatory for pelvic pain; adjunct in menstrual disorders
<i>Symplocos racemosa</i> Roxb.	Bark	Bark stripping	Shade-dried; powdered; decoction 10-20 g/200-400 ml water	Honey, ghee	Lodhra Kwath, Lodhra Churna	Uterine tonic; anti-fibrotic (adhesion prevention); menstrual regulation; infertility support
<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	Flower buds	Hand-picking	Dried, powdered; decoction/boiled for extracts	Honey, ghee	Lavanga Vati, Lavanga Taila	Dysmenorrhea relief; emmenagogue; supports uterine cramping and pelvic pain
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Bark, leaves, fruits, roots	Bark stripping	Shade-dried; decoction 10-15 g/150 ml water reduced to 40 ml; ghrita prepared	Milk, sugar, honey	Arjunarishta, Arjuna Kwath	Supports ovarian function (antioxidant); PCOS adjunct; irregular menses; uterine tonic; management of oxidative stress in infertility
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Fruits	Hand-picking	Dried, powdered; decoction 20-30 g/500 ml water reduced to 100 ml	Milk, jaggery	Bahera Churna, Triphala powder	Menstrual regulation; uterine tonic; antioxidant support; adjunct in infertility protocols
<i>Terminalia chebula</i> Retz.	Fruits, leaves, bark	Scraping/cutting	Shade-dried; decoction 20-30 g/500 ml water reduced to 100 ml	Milk, ghee, jaggery, honey	Abhayarishta, Agastya Rasayana, Brahma Rasayana, Dashamoola Haritaki	Menstrual regulation; antioxidant support for ovarian function; aids in infertility and menstrual disorders
<i>Tinospora cordifolia</i> (Willd.) Miers	Stem	Cutting	Decoction 10-20 g/200-400 ml water; powdered stem	Ghee, honey	Guduchi Churna, Guduchi Kwath	Ovarian reserve support (antioxidant); immunomodulatory in endometritis/ PID; supports menstrual regularity
<i>Trachyspermum ammi</i> (L.) Sprague	Seeds	Hand-picking	Powdered; decoction/tea or added to ghrita	Honey, ghee	Yavanyadi Churna, Yavanikadi Kwath, Yavanikadi Ghrita	Ovulation support; dysmenorrhea relief; uterine cramp relief; supportive in menstrual irregularities

<i>Trianthema portulacastrum</i> L.	Leaves, stems, roots, seeds	Hand-picking	Shade-dried; decoction 10-20 g/200-400 ml water	Honey, ghee	Punamavarista, Poultices, Leaf decoctions	Folliculogenesis support; antioxidant; amenorrhoea; wound healing post gynecologic procedures
<i>Tribulus terrestris</i> L.	Whole plant	Hand-picking fruits	Powdered aerial parts; ethanol extraction using soxhlet, dried extract	Milk, sugar	Gokshuradi Guggulu, Gokshur Kwath	Fertility tonic; supports ovarian function; hormonal balance; luteal support in infertility
<i>Trigonella foenum-graecum</i> L.	Seeds, leaves	Mature seeds collected & dried	Powdered; decoction/tea 5-10 g/200 ml water boiled 10-15 min	Honey, ghee	Mustakarishtha, Mritasanjivani Sura	Ovulation-inducing; galactagogue; supports amenorrhoea; improves menstrual regularity; PCOS adjunct (insulin-sensitizing effects)
<i>Withania somnifera</i> (L.) Dunal	Roots	Dug	Shade-dried; powdered; decoction 10-20 g/200 ml water	Milk, ghee, honey	Ashwagandha Ghrita, Churna, Rasayana	Ovarian reserve enhancer; stress-related infertility; improves menstrual regularity; supports menopausal symptoms
<i>Zingiber officinale</i> Roscoe	Rhizomes	Dug	Fresh or dried; powdered; decoction or ghrita	Honey, ghee, milk	Ardra Kwath, Churna, Chyawanprash	Dysmenorrhoea relief; anti-inflammatory in endometriosis; improves pelvic circulation; nausea control in pregnancy (small doses)

Quantitative Ethnobotanical Analysis of Medicinal Plants

The ethnobotanical survey of 50 plant species revealed high levels of traditional knowledge and use in female reproductive health, as measured by indices such as IP, IR, UR, UV, RFC, and CI. Species like *Asparagus racemosus*, *Trigonella foenum-graecum*, *Cinnamomum verum*, *Hemidesmus indicus*, *Ocimum tenuiflorum*, and *Withania somnifera* recorded the highest UV values (0.952-0.990), reflecting frequent citation and broad therapeutic applications. High RFC values (>0.9) for *Asparagus racemosus*, *Hemidesmus indicus*, *Trigonella foenum-graecum*, and *Cinnamomum verum* indicate strong consensus among informants regarding their efficacy. CI values for key species such as *Asparagus racemosus* (0.971) and *Trigonella foenum-graecum* (0.990) suggest cultural prominence and integrative use in traditional formulations. Plants like *Persea americana*, *Morus alba*, *Azadirachta indica*, and *Alstonia scholaris* showed relatively lower indices, highlighting less frequent use or regional specificity. Overall, the high concordance between IC, RFC, and UV across the majority of species demonstrates both the reliability of traditional knowledge and the central role of these plants in managing female reproductive disorders, while also identifying priority species for further pharmacological validation and conservation efforts. Table 4 summarizes ethnobotanical indices such as informant consensus and use value for each species.

Table 4. Ethnobotanical indices of documented medicinal plants

BOTANICAL NAME	IP	IR	UR	CI	RFC	UV
<i>Abutilon indicum</i> (L.) Sweet	101	95	102	0.961	0.904	0.971
<i>Achyranthes aspera</i> L.	98	94	100	0.933	0.895	0.952
<i>Aegle marmelos</i> (L.) Corrêa	95	91	98	0.904	0.866	0.933
<i>Aloe barbadensis</i> Mill.	100	96	102	0.952	0.914	0.971
<i>Alstonia scholaris</i> (L.) R.Br.	74	72	85	0.704	0.685	0.809
<i>Asparagus racemosus</i> Willd.	102	97	100	0.971	0.923	0.952
<i>Azadirachta indica</i> A.Juss.	78	72	83	0.742	0.685	0.790

<i>Bacopa monnieri</i> (L.) Wettst.	99	95	100	0.942	0.904	0.952
<i>Billardiera scandens</i> Sm.	75	70	82	0.714	0.666	0.780
<i>Boerhavia diffusa</i> L.	85	79	87	0.809	0.752	0.828
<i>Bryonopsis laciniosa</i> (L.) Naudin	94	89	85	0.895	0.809	0.809
<i>Caesalpinia crista</i> L.	75	70	81	0.714	0.666	0.771
<i>Cinnamomum tamala</i> (Buch.-Ham.) T.Nees & Eberm.	99	95	100	0.942	0.904	0.952
<i>Cinnamomum verum</i> J.Presl	103	101	104	0.980	0.961	0.990
<i>Crocus sativus</i> L.	91	87	96	0.866	0.828	0.914
<i>Cuminum cyminum</i> L.	97	92	98	0.923	0.876	0.933
<i>Curcuma caesia</i> Roxb.	85	80	91	0.809	0.761	0.866
<i>Curcuma longa</i> L.	95	93	101	0.904	0.885	0.961
<i>Eleusine coracana</i> (L.) Gaertn.	97	92	99	0.923	0.876	0.942
<i>Foeniculum vulgare</i> Mill.	98	94	99	0.933	0.895	0.942
<i>Glycyrrhiza glabra</i> L.	97	90	99	0.923	0.857	0.942
<i>Gossypium herbaceum</i> L.	86	80	89	0.819	0.761	0.847
<i>Hemidesmus indicus</i> (L.) R.Br. ex Schult.	99	95	102	0.942	0.904	0.971
<i>Ipomoea sepiaria</i> Koenig ex Roxb.	81	74	85	0.771	0.704	0.809
<i>Mesua ferrea</i> L.	85	80	91	0.809	0.761	0.866
<i>Moringa oleifera</i> Lam.	97	93	100	0.923	0.885	0.952
<i>Morus alba</i> L.	75	72	80	0.714	0.685	0.761
<i>Mucuna pruriens</i> (L.) DC.	94	90	96	0.895	0.857	0.914
<i>Nyctanthes arbor-tristis</i> L.	97	90	99	0.923	0.857	0.942
<i>Ocimum tenuiflorum</i> L.	98	97	100	0.933	0.923	0.952
<i>Olea europaea</i> L.	85	79	89	0.809	0.752	0.847
<i>Persea americana</i> Mill.	78	73	82	0.742	0.695	0.780
<i>Phyllanthus emblica</i> L.	97	93	99	0.923	0.885	0.942
<i>Piper longum</i> L.	90	85	97	0.857	0.809	0.923
<i>Punica granatum</i> L.	99	94	101	0.942	0.895	0.961
<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz	94	90	97	0.895	0.857	0.923
<i>Saraca asoca</i> (Roxb.) Willd.	98	93	88	0.933	0.885	0.838
<i>Stereospermum suaveolens</i> (Roxb.) DC.	79	73	85	0.752	0.695	0.809
<i>Symplocos racemosa</i> Roxb.	95	93	98	0.904	0.885	0.933
<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	100	94	102	0.952	0.895	0.971
<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	96	90	98	0.914	0.857	0.933
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	91	87	95	0.866	0.828	0.904
<i>Terminalia chebula</i> Retz.	95	80	99	0.904	0.761	0.942
<i>Tinospora cordifolia</i> (Willd.) Miers	90	85	94	0.857	0.809	0.895
<i>Trachyspermum ammi</i> (L.) Sprague	99	94	101	0.942	0.895	0.961
<i>Trianthema portulacastrum</i> L.	86	77	88	0.819	0.733	0.838
<i>Tribulus terrestris</i> L.	96	93	99	0.914	0.885	0.942
<i>Trigonella foenum-graecum</i> L.	104	100	103	0.990	0.952	0.980
<i>Withania somnifera</i> (L.) Dunal	99	95	101	0.942	0.904	0.961
<i>Zingiber officinale</i> Roscoe	100	95	102	0.952	0.904	0.971

Family-Level Analysis of Ethnomedicinal Plant Use

The ethnobotanical assessment revealed 34 plant families encompassing 50 species, with the average use value (UV) highlighting the cultural and therapeutic significance of each family in female reproductive health. Families such as Asparagaceae, Phyllanthaceae, Moringaceae, Lamiaceae, and Amaranthaceae exhibited high average UVs (0.952), indicating strong consensus and frequent utilization of their species. Apiaceae also showed a notable average UV of 0.945 across three species, reflecting their prominent role in traditional formulations. Zingiberaceae and Combretaceae averaged 0.933 and 0.926 respectively, suggesting substantial integration of these families in medicinal practices. Fabaceae, with five species, showed a slightly lower average UV of 0.883, while Lauraceae and Oleaceae averaged 0.876 and 0.895, respectively, highlighting moderate but consistent use. Several single-species families, including Myrtaceae and Asphodelaceae, had the

highest recorded UVs (0.971), underlining their exceptional cultural and therapeutic relevance. Conversely, families such as Moraceae, Pittosporaceae, Cucurbitaceae, Bignoniaceae, and Convolvulaceae had comparatively lower UVs (0.780-0.809), indicating limited but targeted usage. Overall, the family-level analysis underscores both the diversity and specificity of plant usage, with multiple high-UV families serving as primary sources for formulations addressing menstrual regulation, fertility enhancement, ovarian support, and other female reproductive health concerns. *Table 5* presents the family-wise distribution of plants and the average use value for each family.

Table 5. Family-wise distribution of medicinal plants with species count and average use value.

Family	Species Count	Sum of UV	FUV
Aizoaceae	1	0.838	0.838
Amaranthaceae	1	0.952	0.952
Apiaceae	3	2.836	0.945
Apocynaceae	3	2.675	0.892
Asparagaceae	1	0.952	0.952
Asphodelaceae	1	0.971	0.971
Bignoniaceae	1	0.809	0.809
Calophyllaceae	1	0.866	0.866
Combretaceae	3	2.779	0.926
Convolvulaceae	1	0.809	0.809
Cucurbitaceae	1	0.809	0.809
Fabaceae	5	4.416	0.883
Iridaceae	1	0.914	0.914
Lamiaceae	1	0.952	0.952
Lauraceae	3	2.627	0.876
Lythraceae	1	0.961	0.961
Malvaceae	2	1.818	0.909
Meliaceae	1	0.790	0.790
Menispermaceae	1	0.895	0.895
Moraceae	1	0.761	0.761
Moringaceae	1	0.952	0.952
Myrtaceae	1	0.971	0.971
Nyctaginaceae	1	0.828	0.828
Oleaceae	2	1.789	0.895
Phyllanthaceae	1	0.942	0.942
Piperaceae	1	0.923	0.923
Pittosporaceae	1	0.780	0.780
Plantaginaceae	1	0.952	0.952
Poaceae	1	0.942	0.942
Rutaceae	1	0.933	0.933
Solanaceae	1	0.961	0.961
Symplocaceae	1	0.933	0.933
Zingiberaceae	3	2.798	0.933
Zygophyllaceae	1	0.942	0.942

Pharmacological Insights into Medicinal Plants for Female Reproductive Health

The ethnopharmacological evaluation revealed diverse bioactivities of 50 medicinal plants targeting female reproductive disorders, quantified using fidelity level (FL %) values. Ovulation-inducing activity was prominently reported in *Trigonella foenum-graecum* (FL 99.05%), *Trachyspermum ammi* (94.29%), *Cuminum cyminum* (92.38%), and *Glycyrrhiza glabra* (92.38%), primarily mediated via antioxidant protection of ovarian tissue, modulation of gonadotropins, steroidogenic enzymes, and HPO axis regulation. Hormone-regulating activity, including estrogenic, progestogenic, and gonadotropin-modulating effects, was observed in *Asparagus racemosus* (97.14%), *Saraca asoca* (93.33%), *Bacopa monnieri* (94.29%), and *Phyllanthus emblica* (92.38%), largely through ER/PR binding, steroidogenesis modulation, and neuroendocrine signaling. Folliculogenesis stimulation was notable in *Ocimum tenuiflorum* (93.33%), *Punica granatum* (94.29%), and *Mucuna pruriens*

(89.52%), mediated via ROS reduction, granulosa cell proliferation, and gonadotropin enhancement. Ovarian reserve enhancement was demonstrated by *Withania somnifera* (94.29%), *Phyllanthus emblica* (92.38%), and *Tinospora cordifolia* (85.71%) through HPA axis modulation, antioxidant protection, and primordial follicle preservation. Anti-androgenic effects relevant to PCOS were reported for *Curcuma longa* (90.48%), *Glycyrrhiza glabra* (92.38%), and *Ocimum tenuiflorum* (93.33%), via CYP17 inhibition, 5 α -reductase suppression, and androgen receptor modulation. Uterine tonic activity was observed in *Saraca asoca* (93.33%) and *Abutilon indicum* (96.19%), enhancing uterine contractility through estrogenic modulation. Anti-inflammatory actions were prominent in *Aloe barbadensis* (95.24%), *Zingiber officinale* (95.24%), and *Hemidesmus indicus* (94.29%), mediated via NF- κ B, COX-2, and cytokine modulation. Anti-fibrotic/anti-adhesion effects were notable in *Mesua ferrea* (80.95%) and *Symplocos racemosa* (90.48%) through TGF- β pathway inhibition and fibroblast suppression. Ovarian antioxidant activity, crucial for oocyte protection, was recorded in *Phyllanthus emblica*, *Eleusine coracana*, and *Moringa oleifera* (all 92.38%), while galactagogue and prolactin-modulating activity was strongly evidenced in *Trigonella foenum-graecum* (99.05%) and *Asparagus racemosus* (97.14%) via dopaminergic antagonism and ER/PR signaling. Overall, these data highlight the molecular basis of traditional plant use in fertility support, hormonal regulation, ovulation enhancement, and management of reproductive disorders. *Table S1* outlines the pharmacological activities, major chemical constituents, and proposed mechanisms of action for the documented plants.

Traditional knowledge also reflects a sophisticated understanding of synergistic plant use. Polyherbal formulations combining ovulation-inducing, hormone-regulating, antioxidant and anti-inflammatory species have been employed to achieve multi-targeted effects (Shafi *et al.*, 2021). For instance, *Asparagus racemosus* and *Trigonella foenum-graecum* are traditionally used for fertility and lactation; preclinical studies demonstrate that steroidal saponins and phytoestrogens from these plants modulate the hypothalamic-pituitary-ovarian axis, stimulate gonadotropin release, and improve follicular development (Huy *et al.*, 2018). Similarly, antioxidant-rich species such as *Phyllanthus emblica* and *Withania somnifera* protect ovarian follicles from oxidative stress, which aligns with experimental evidence showing decreased reactive oxygen species, enhanced mitochondrial integrity, and improved ovarian reserve (Usatiuc *et al.*, 2025). Hormone-regulating plants, including *Saraca asoca*, *Curcuma longa*, and *Foeniculum vulgare*, illustrate the interplay between ethnomedicine and molecular pharmacology. Flavonoids, phenolics, and curcuminoids present in these species interact with estrogen and progesterone receptors, modulate steroidogenic enzymes, and influence gonadotropin secretion (Nair *et al.*, 2024). Preclinical models have demonstrated estrogenic, progestogenic, and uterotonic activities consistent with traditional use, supporting the rationale for their employment in menstrual regulation and dysmenorrhea management (Karmakar *et al.*, 2025). Anti-androgenic species, such as *Glycyrrhiza glabra* and *Ocimum tenuiflorum*, further validate the ethnomedicinal approach for conditions like polycystic ovary syndrome. Experimental studies indicate downregulation of CYP17 and 5 α -reductase enzymes, along with modulation of androgen receptor signalling, providing a mechanistic basis for traditional claims (Shehab *et al.*, 2023). Plants supporting folliculogenesis and ovulation, including *Mucuna pruriens*, *Punica granatum*, and *Ocimum tenuiflorum*, demonstrate neuroendocrine modulation, antioxidative protection, and granulosa cell proliferation in preclinical models (Yuan J *et al.*, 2025). L-DOPA from *Mucuna* enhances GnRH release, stimulating LH/FSH secretion and promoting follicle maturation, as observed in animal studies and clinical pilot trials. Phytoestrogenic compounds in *Punica granatum* and *Ocimum* support ovarian microenvironment and granulosa cell proliferation, corroborating reports that these species improve fertility parameters and oocyte quality (Jozkowiak *et al.*, 2022).

The ethnomedicinal focus on uterine tonics, anti-inflammatory, and anti-fibrotic plants, such as *Saraca asoca*, *Abutilon indicum*, *Mesua ferrea*, and *Symplocos racemosa*, reflects an understanding of reproductive physiology and pathological processes like uterine atony, endometriosis, and post-surgical adhesions (Hennes *et al.*, 2021). Preclinical studies demonstrate that these species modulate prostaglandin synthesis, inhibit NF- κ B signalling, and attenuate TGF- β -mediated fibrosis, validating their traditional application in maintaining uterine health and reducing complications (Nie *et al.*, 2025).

Future directions

The findings of this study open multiple avenues for future research and application. First, preclinical and clinical validation of the documented species is essential to confirm efficacy, dosage, safety, and pharmacokinetics in managing female reproductive disorders. Standardization of extracts and bioactive constituents, such as flavonoids, steroidal saponins, and polyphenols, would enable reproducible therapeutic outcomes (Sepehrfar *et al.*, 2023). Further studies could focus on multi-herb synergistic formulations to explore potential additive or synergistic effects on ovulation, hormone balance, and ovarian reserve. Conservation strategies are crucial to preserve wild plant populations and promote sustainable harvesting, particularly for high-demand species like *Asparagus racemosus*, *Saraca asoca*, and *Trigonella foenum-graecum* (Rescia *et al.*, 2021). Ethnopharmacological studies should also expand to under-documented communities to capture a broader spectrum of indigenous knowledge. Integrating molecular and mechanistic studies, such as gene expression profiling and pathway

analysis, can elucidate the precise interactions of plant compounds with hormonal and oxidative pathways. Additionally, the incorporation of modern technologies like nanocarrier-based delivery systems could enhance bioavailability and therapeutic targeting (Adia *et al.*, 2025). Awareness programs and collaboration with local communities can ensure knowledge preservation and ethical sharing. Ultimately, translating this ethnobotanical knowledge into evidence-based phytotherapeutics could provide affordable, culturally acceptable, and multi-targeted interventions for reproductive health challenges, including infertility, PCOS, and menstrual disorders, thereby bridging traditional medicine and modern clinical practice (Kumar *et al.*, 2021).

Conclusion

This study highlights the rich ethnobotanical heritage of Ganjam and adjoining coastal regions, emphasizing the crucial role of medicinal plants in supporting female reproductive health. The documented species demonstrate a wide range of pharmacological activities, including ovulation induction, hormone regulation, folliculogenesis stimulation, ovarian reserve enhancement, anti-androgenic effects, uterine tonicity, anti-inflammatory action, antioxidant protection, and anti-fibrotic properties. Traditional knowledge regarding plant selection, preparation, and dosage remains highly consistent across communities, reflecting centuries of empirical observation and experience. The convergence of ethnobotanical evidence with preclinical and mechanistic studies reinforces the scientific credibility of these practices, illustrating that bioactive compounds act on multiple molecular pathways, including steroidogenesis, gonadotropin signalling, oxidative stress mitigation, and uterotonic modulation. Furthermore, the study underscores the interdependence of biodiversity conservation and knowledge preservation, highlighting that sustainable utilisation of medicinal flora is essential for maintaining community health resources. By documenting species, preparation methods, and therapeutic uses, this work provides a foundation for future pharmacological and clinical investigations, aiming to develop standardised, multi-targeted phytotherapeutics. The findings advocate for a synergistic approach that integrates indigenous wisdom, biodiversity conservation, and modern scientific validation to address reproductive health challenges such as infertility, menstrual irregularities, PCOS, and ovarian insufficiency. Overall, this study demonstrates that traditional medicinal plants offer both cultural and biomedical value, and their systematic exploration can contribute to accessible, safe, and effective interventions for women's reproductive health.

Declarations

Ethics statement: All participants provided oral prior informed consent.

Data Availability: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Consent for Publication: Prior informed consent was obtained from all participants before their inclusion in the study, and they voluntarily agreed to the publication of their images in online scientific publications.

Conflict of Interest: The authors declare no competing interests.

Research Involving Humans and Animals: None.

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