Ethnobotanical study on medicinal plants used by the Rajapur Saraswat Community of Dakshina Kannada, the Western Ghats of India

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Research

Abstract

Background: The indigenous Rajapur Saraswat community in Dakshina Kannada district uses variety of herbal remedies to manage their primary healthcare needs. A large number of modern synthetic drugs are also available to serve the purpose, but they are often associated with severe side-effects. There are no previous reports on the documentation of ethno-medicinal information of this community.

Methods: An ethnobotanical survey of the Rajapur Saraswat community was conducted from 2023 to 2025 in the rural areas of Dakshina Kannada district, Karnataka state, India. A total of 29 traditional practitioners were interviewed through semi-structured, open-ended discussions using a questionnaire. The gathered data was analyzed using qualitative descriptive methods, and quantitative tools such as use value (UV), relative frequency of citation (RFC), and informant consensus factor (ICF).

Results: In total, 99 plant species belonging to 41 families were reported to have medicinal value and were used by the local community across the studied sites. The Fabaceae family was the most dominant family in terms of species diversity (7 species), followed by Lamiaceae (6 species), Apocyanaceae, Malvaceae, Phyllanthaceae and Rutaceae (5 species each), Euphorbiaceae, Myrtaceae, Poaceae and Rubiaceae (4 species each), Acanthaceae, Apiaceae and Combretaceae (3 species each). The plant species that have exhibited the highest RFC values are *Curcuma longa* (0.62), followed by *Tinospora cordifolia* and *Piper nigrum* (0.52 each), *Aristolochia indica* and *Leucas aspera* (0.48 each), *Cuminum cyminum*, *Ziziphus oenoplia* and *Hemidesmus indicus* (0.45 each), *Zingiber officinale*, *Coriandrum sativum*, *Jasminum grandiflorum*, *Ocimum tenuiflorum* and *Ventilago maderaspatana* (0.41 each), *Senegalia catechu* and *Plectranthus amboinicus* (0.38 each). Respiratory ailments had maximum agreement between informants (ICF=0.86) followed by digestive system (ICF=0.83), oral, dental, ear and nose category (ICF=0.82), dermatological (ICF=0.77), metabolic (ICF=0.75), fever (ICF=0.74), poisonous bites (ICF=0.73), urinary system (ICF=0.72), neurological and musculoskeletal (ICF=0.71), gynecological (ICF=0.58) and circulatory system (0.54). The plant species, *Cassia fistula* was reported to have the highest UV (1.00), followed by *Litsea wightiana* and *Breynia vitis-idaea* (0.67 each), and *Ficus racemosa* (0.57). The highest number of mentions was for *Curcuma longa* (seven), followed by *Cuminum cyminum* (six), *Aristolochia indica*, *Ixora coccinea*, *Piper nigrum*, and *Senegalia catechu* (five each). Considering the conservation status, *Syzygium travancoricum* is listed as Critically Endangered, *Syzygium caryophyllatum* as Endangered, *Aporosa cardiosperma* as Vulnerable, and *Aegle marmelos* as Near Threatened, as per the IUCN Red List.

Conclusions: The findings reveal a rich diversity of plant species used for various ailments, with notable emphasis on formulations such as decoctions and juices for oral administration. The high ICF values recorded in this study suggest strong

agreement on medicinal formulations among practitioners in the Rajapur Saraswat community. However, further interdisciplinary studies are needed to validate the therapeutic potential of medicinal plants to discover new drugs.

Keywords: Ethnobotany, Rajapur Saraswat, traditional knowledge, Dakshina Kannada

Background

India is very rich in its plant wealth. It is estimated that over 18,000 species of higher plants occur in different geographical regions of the country, of which about one-third are medicinally and economically important (Lingaraju *et al.* 2013). It is a well-established fact that medicinal plants play a vital role in rural healthcare due to their therapeutic potential (Omara, 2025). It is estimated that 80% of the population in developing countries depend on traditional medicine for their primary health care (Bhat *et al.* 2012). Documentation of medicinal species for further scientific validation and subsequent commercialization in India has gained momentum in recent decades (Ayyanar & Ignacimuthu 2011). Traditional medicine has greater cultural acceptability, affordability, effectiveness, and fewer side-effects than allopathic drugs (Lingaraju *et al.* 2013, Venkatachalapathi *et al.* 2018).

The World Health Organization (WHO) has devoted much effort towards documenting the use of medicinal plants by indigenous people from various regions of the world (Ashitha & Devi 2021). The United Nations established the Sustainable Development Goals (SDGs), as a reference to address severe collective problems such as climate change, poverty, and health issues, and give better lives for people in all areas of our planet. India's concerted efforts are crucial for achieving SDG-3, to ensure healthy lives and promote well-being for all age groups (Lnu *et al.* 2025). In Karnataka, several reports on ethnomedicinal documentation have been published from Kodagu, Shimoga, Uttara Kannada, Dakshina Kannada, Chikamagalur, Udupi, and Mysore districts. These studies have explored the traditional knowledge of some specific regions (Gireesha & Raju 2013, Lingaraju *et al.* 2013, Rajakumar & Shivanna 2009, Parinitha *et al.* 2004, Mahishi *et al.* 2005, Shiddamallayya *et al.* 2010), communities (Harsha *et al.* 2002, Bhat 2005, Achar *et al.* 2010, Hegde *et al.* 2019, Acharya *et al.* 2022), and diseases (Bhandary & Chandrashekar 2011, Upadhya *et al.* 2012, Yogeesha & Krishnakumar 2022, Yogeesha & Krishnakumar 2023, Anadka & Gulimane 2024). However, the ethnobotanical wealth of certain ethnic communities is still not fully explored in Dakshina Kannada district. The Rajapur Saraswat community is one such community that has sound knowledge of medicinal plants. The present study is aimed to document the traditional knowledge of the Rajapur Saraswat community in the Western Ghats of Dakshina Kannada, India. Therefore, documenting indigenous knowledge through ethnobotanical studies is important for the conservation of biological resources, and their sustainable use. Various quantitative indices were analyzed to determine consensus on the use of many plant species to treat wide range of ailments. This may help identify new drug formulations in future research.

Materials and Methods

Study area

Dakshina Kannada district lies in the Western Ghats region of Karnataka state, India with an area of 4866 km2. It lies between 12°23' - 13°49' North latitude and 74°37' - 75°41' East longitude. Dakshina Kannada has a humid tropical climate with annual rainfall ranging from 3900 mm to 4200 mm. The soil composition is primarily lateritic and acidic; approximately 95% of the soil is red, and while the remaining 5% is black alluvium (Bhat 2014). People of the Rajapur Saraswat community are settled in the district's remote rural areas. Majority of them are farmers who cultivate plantation crops such arecanut, cashew, cocoa, coconut, banana, pepper, paddy and rubber. The present ethnobotanical study covers taluks such as Puttur, Sullia, Kadaba, Belthangady, and Bantwal in the district (Figure 1).

Ethno-botanical survey

An ethnobotanical survey was conducted between 2023 and 2025 across the rural regions of the district. This survey was conducted in accordance with local norms for sharing the traditional knowledge. Prior consent was obtained from all 29 informants in the community; who were convinced that the study was designed for academic purposes focusing on the preservation of cultural heritage. Data were collected through open-ended discussions using a questionnaire (Martin 1995, Hoffman & Gallaher 2007). The questionnaires were designed in the English language. However, all the data were recorded in a local language, and then translated to English after the completion of the data collection (Figure 2). The demographic data of informants (age, educational qualification, gender, and experience), diseases treated, local plant names, habitat, parts used for medication, knowledge about present and past use, availability of plant, method of collection, the methods of preparation of formulation, and administration were documented. Only consistent information given on a particular species was considered. Photographs of each plant species were taken and herbaria prepared for authentic identification. Plant species were identified using standard floras such as Flora of South Kanara (Bhat 2014), Flora of Karnataka (Saldanha

1984) and Flora of Presidency of Madras (Gamble 1984). The valid names of the plant species were updated using databases such as World Flora Online (https://www.worldfloraonline.org), and Plants of the World Online (https://powo.science.kew.org). The voucher specimens were deposited in the Department of Applied Botany, Mangalore University, Karnataka state, India.

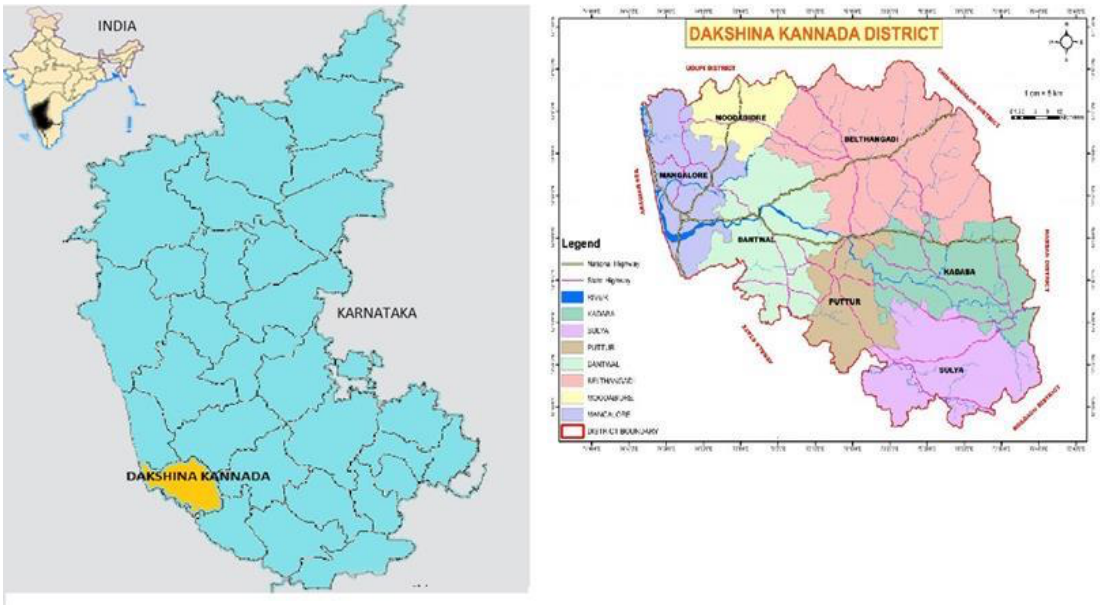

Figure 1. Map showing location of the survey in Dakshina Kannada district, Karnataka, India.

IUCN Conservation status

Documented plant species were checked for their conservation status by consulting the Red List of Threatened Species (https://www.iucnredlist.org/) database.

Disease categorization

Medical terminologies for various ailments and symptoms recorded during the survey were assigned by consulting allopathic medical practitioners. Finally, all the ailments, and symptoms were categorized according to the standard method (Cook 1995).

Data Analysis

The data were analyzed in MS Excel using conventional methods and quantitative tools. The information such as scientific name of the plant species, family name, local name, parts used in the formulation and their ethno-medicinal uses were attributed to each species. Various parameters such as Use-Value (UV), Relative Frequency of Citation (RFC), and the Informant Consensus Factor (ICF), were employed to analyze the data quantitatively.

Use-Value (UV)

The relative importance of a plant species known locally in herbal therapy is its use value. It was calculated using the following formula (Albuquerque *et al.* 2006):

$$UV=\sum Us/N$$

Where, 'UV' is Use-value for the species, '∑Us' is sum of the uses mentioned for a species and 'N' is the total number of informants.

Relative Frequency of Citation (RFC)

Relative frequency of citation is obtained by dividing the number of informants who mentioned the use of a particular species to the total number of informants participated in the study. Highest number of citations for a particular plant species suggests its wide use in a community. It is calculated by the following formula (Tardío & Pardo-de Santayana 2008):

$$RFC=FC/N$$

Where, 'RFC' is relative frequency of citation, 'FC' is number of informants who mentioned a particular species and 'N' is the total number of informants.

The RFC value ranges from 0 to 1. This value is close to zero when few informants mention a particular species, and it reaches the upper limit (1) when a larger number of informants quote it.

Figure 2. Data collection from traditional practitioners within the Rajapur Saraswat community.

Informant Consensus Factor (ICF)

The informant consensus factors determine the effectiveness of the medicinal plants in each ailment category. This value for an ailment category ranges from 0 to 1. ICF values are low (near 0), if plants are selected randomly or if there is no exchange of information among informants, and ICF values are high (near 1) if information is well exchanged among the informants in a community.

The ICF is calculated using the following formula (Heinrich *et al.* 1998):

$$\frac{(N_{ur} - N_t)}{(N_{ur} - 1)}$$

Where 'Nur' is the number of citations in each ailment category and 'Nt' is the number of taxa used for a particular ailment category.

Results and Discussion

Demographic data

Twenty-nine informants (19 females and 10 males) from the Rajapur Saraswat community participated in this study. There is higher participation by females than by males. This is because females are often responsible for their family's healthcare and have expertise in preparing herbal recipes (Omara 2025). The participant's ages ranged from 37 to 85 years. Age groups of 61 years and above are well represented (48.28%), followed by 51-60 years (27.59%), 41-50 years (17.24%), and below 40 years (6.89%). Sixteen informants (55.17%) had primary education, ten (34.48%) had secondary education, and three (10.35%) were graduates. All interviewed informants are farmers and the knowledge has been passed down by oral mode within families, without any written documents. Younger generations showed the least interest in practicing this system as they pursued modern academic qualifications and moved to cities in search of livelihoods. The survey revealed that knowledge of medicinal plants was significantly greater among practitioners of advanced age. But this knowledge has been diminishing as higher educational levels have risen among younger generations. Similar observations have also been noted in earlier surveys (El-Ghazouani *et al.* 2024, Muthukrishnan & Ramachandran 2025).

Enumeration of ethnomedicinal plants

Ninety-nine plant species belonging to 41 families used by the Rajapur Saraswats are summarized in Table 1 along with their botanical names, family name, local name, parts used, disease treated, use value, relative frequency of citation and the IUCN status.

The most important family in terms of number of species was Fabaceae (7 species), followed by Lamiaceae (6 species), Apocyanaceae, Malvaceae, Phyllanthaceae and Rutaceae (5 species each), Euphorbiaceae, Myrtaceae, Rubiaceae and Poaceae (4 species each), Acanthaceae, Apiaceae and Combretaceae (3 species each). The remaining 41 species belong to 28 different families. These findings are in line with earlier studies where Fabaceae, Lamiaceae, Apocyanaceae, Rutaceae, Phyllanthaceae, Euphorbiaceae, Rubiaceae, Acanthaceae, Malvaceae, Euphorbiaceae and Combretaceae to be the dominant families (Kantasrila *et al.* 2020, Singh *et al.* 2020, Acharya *et al.* 2022, Bhat 2005, Rajakumar & Shivanna 2009). Review of medicinal plants used by ethnic communities in South India revealed that among the reported species, family Fabaceae was dominant (192 species) followed by Asteraceae (104 species), Lamiaceae (89 species), Malvaceae (87 species), Apocynaceae (73 species), Acanthaceae (65 species), Rubiaceae (64 species), Poaceae (57 species) and Euphorbiaceae (56 species) (Santhoshkumar *et al.* 2019). The common use of species from these families may be due to their high therapeutic potential driven by the presence of a variety of bioactive compounds (Anju & Kumar 2024, Jenipher & Ayyanar 2024).

Among 99 plant species, trees were dominant (35 species) followed by herbs (30 species), shrubs (18 species) and climbers (16 species). The maximum utilization of trees and herbaceous species in the formulations is in line with previous investigations conducted in different regions (Rajakumar & Shivanna 2009, Syamala *et al.* 2014, Nibedita *et al.* 2015). Among the documented species, 71 were wild (71.72%) and 28 species are cultivated (28.28%). This data reveals the importance of wild species in traditional medicine which requires proper conservation strategies and sustainable utilization (Nibedita *et al.* 2015).

Table 1. List of ethnomedicinal plants used by Rajapur Saraswat community of the Western Ghats region of Dakshina Kannada to treat various ailments.

Botanical name and Family	Local Name	Parts Used	Disease treated	UV	RFC	IUCN Status
Abelmoschus esculentus (L.) Moench., Malvaceae, RAJ 045	Bende kayi	Root	Body pain	0.25	0.14	NE
Achyranthes aspera L., Amaranthaceae, RAJ 076	Uttarani	Leaf	Ringworm	0.33	0.10	LC
Acorus calamus L., Acoraceae, RAJ 034	Baje	Rhizome	Neuromuscular growth in children	0.20	0.17	LC
Aegle marmelos (L.) Correa., Rutaceae, RAJ 005	Bilva	Bark, Leaf	Ear pain	0.33	0.10	NT
Aerva lanata (L.) Juss., Amaranthaceae, RAJ 065	Pashana bedhi	Whole plant	Kidney stones	0.50	0.07	NE
Allium cepa L., Amaryllidaceae, RAJ 086	Neerulli	Leaf	Migraine	0.17	0.21	NE
Allium sativum L., Amaryllidaceae, RAJ 046	Belluli	Bulb	Postnatal care	0.33	0.10	NE
Aloe vera (L.) Burm.f., Xanthorrhoeaceae, RAJ 087	Lolerasa	Leaf	Burns, cuts and wounds, Eye pain, Insomnia	0.44	0.31	NE
Alstonia scholaris (L.) R. Br., Apocyanaceae, RAJ 089	Balindra pale	Bark	Fever	0.33	0.10	LC
Andrographis paniculata (Burm.f.) Nees., Acanthaceae, RAJ 020	Kirathakaddi	Leaf, Stem	Fever, Cough and Cold	0.20	0.34	NE
Aporosa cardiosperma (Gaertn.) Merr., Phyllanthaceae, RAJ 090	Sarali	Leaf, Root	Ringworm, Jaundice	0.25	0.28	VU
Aristolochia indica L., Aristolochiaceae, RAJ 030	Iswaraberu	Root	Poisonous bites, Skin rashes, Ringworm, Nail infections, Muscular pain	0.36	0.48	NE
Asparagus racemosus Willd., Asparagaceae, RAJ 066	Shathavari	Root	Neuromuscular growth in children	0.17	0.21	NE
Baringtonia racemosa (L.) Spreng., Lecythidaceae, RAJ 088	Samudra maphala	Seed	Tonsil infections	0.33	0.10	NE
Breynia vitis-idaea (Burm.f.) C.E.C.Fisch., Phyllanthaceae, RAJ 091	Palli soppu	Leaf	Chicken pox, Ringworm	0.67	0.10	LC
Calophyllum inophyllum L., Calophyllaceae, RAJ 048	Ponne mara	Seed, Leaf, Root	Postnatal care, Neuromuscular growth in children, Eye pain	0.30	0.34	LC
Calotropis gigantea (L.) Dryand., Apocyanaceae, RAJ 006	Ekka	Leaf, Root	Ear pain, Skin ulcers, Diabetes	0.50	0.21	NE
Capsicum annuum L., Solanaceae, RAJ 077	Menasu	Fruit	Postnatal care	0.33	0.10	LC
Careya arborea Roxb., Lecythidaceae, RAJ 064	Daddalu	Bark	Joint pain, Cuts and wounds	0.29	0.24	NE
Carica papaya L., Caricaceae, RAJ 052	Pappaya	Leaf, Bark	Poisonous bites	0.25	0.14	DD
Caryota urens L., Arecaceae, RAJ 047	Eendu	Bark	Postnatal care	0.33	0.10	LC

Cassia fistula L., Fabaceae, RAJ 067	Konde mara	Bark	Cuts and wounds, Skin infections	1.00	0.07	LC
Centella asiatica (L.) Urb., Apiaceae, RAJ 014	Ondelaga	Whole plant	Constipation, Neuromuscular growth in children, Insomnia	0.38	0.28	LC
Chrysopogon zizanioides (L.) Roberty., Poaceae, RAJ 085	Lavancha	Root	Fever, Hyperacidity, Prenatal care, Heart problems	0.50	0.28	NE
Citrus limon (L.) Osbeck., Rutaceae, RAJ 029	Nimbe	Fruit	Poisonous bites, Skin rashes	0.20	0.34	LC
Citrus medica L., Rutaceae, RAJ 015	Mahaphala	Leaf	Hyperacidity, Joint pain	0.50	0.14	LC
Clerodendrum infortunatum L., Lamiaceae, RAJ 063	Ittovu	Root	Nail infections, Ringworm	0.50	0.14	LC
Coccinia grandis (L.) Voigt., Cucurbitaceae, RAJ 039	Manoli	Root, Leaf	Skin boils, Body pain, Asthma	0.38	0.28	NE
Cocos nucifera L., Arecaceae, RAJ 051	Coconut	Fruit	Skin rashes, Poisonous bites, Prenatal care	0.25	0.41	NE
Coriandrum sativum L., Apiaceae, RAJ 013	Kothambari	Seed	Body pain, Cough and cold, Fever	0.25	0.41	NE
Croton persimilis Mull.Arg., Euphorbiaceae, RAJ 068	Somaraberu	Root	Poisonous bites	0.20	0.17	NE
Cucurbita moschata Duchesne., Cucurbitaceae, RAJ 049	Cheeni kai	Flower, Fruit stalk, Leaf	Poisonous bites	0.17	0.21	NE
Cuminum cyminum L., Apiaceae, RAJ 012	Jeerige	Seed	Vertigo, Jaundice, Body pain, Dysuria, Constipation, Muscular pain	0.46	0.45	NE
Curcuma longa L., Zingiberaceae, RAJ 018	Arashina	Rhizome	Poisonous bites, Nail infections, Tonsil infections, Herpes, Cuts and wounds, Fever, Cough and cold	0.39	0.62	DD
Cyclea peltata (Lam.) Hook.f. &Thomson., Menispermaceae, RAJ 031	Padli soppu	Leaf, Fruit, Whole plant	Diabetes, Prenatal care, Eye pain, Stomach pain	0.50	0.28	NE
Cymbopogon citratus (DC.) Stapf., Poaceae, RAJ 021	Majjige soppu	Leaf	Fever, Cough and cold	0.33	0.21	NE
Cynodon dactylon (L.) Pers., Poaceae, RAJ 041	Garike	Whole plant	Diabetes, Joint pain, Cuts and wounds	0.38	0.28	NE
Datura metel L., Solanaceae, RAJ 069	Ummatti	Leaf	Mumps	0.25	0.14	NE
Desmostachya bipinnata (L.) Stapf., Poaceae, RAJ 025	Darbhe	Root	Prenatal care	0.20	0.17	
Ficus racemosa L., Moraceae, RAJ 078	Atthi	Bark	Dysuria, Stomach pain, Ulcers, Insomnia	0.57	0.24	LC
Getonia floribunda Roxb., Combretaceae, RAJ 084	Enjir soppu	Leaf	Poisonous bites, Skin infections, Nail infections	0.43	0.24	NE
Grewia serrulata DC., Malvaceae, RAJ 016	Kadpadenji	Bark	Stomach pain during menstrual cycle	0.14	0.24	NE
Guilandina boduc L., Fabaceae, RAJ 070	Gajjuga	Leaf, Stem	Postnatal care, Fever	0.25	0.28	

Helicteres isora L., Malvaceae, RAJ 050	Kayyol, Kiranjal soppu	Leaf, Stem	Dysentery, Cough and cold	0.33	0.21	NE
Hemidesmus indicus (L.)R.Br.ex Schult., Apocyanaceae, RAJ 097	Namadari Sukurma	Root, Latex	Neuromuscular growth in children, Abnormal white discharge in females, Skin boils, Muscular pain	0.31	0.45	NE
Hibiscus rosa- sinensis L., Malvaceae, RAJ 062	Dasavala	Flower, Root	Abnormal white discharge in females, Muscular pain, Insomnia	0.33	0.31	NE
Holarrhena pubescens Wall. ex G.Don., Apocyanaceae, RAJ 083	Kodenchi	bark	Body pain, Dysentery	0.29	0.24	LC
Holigarna arnottiana Hook.f., Anacardiaceae, RAJ 075	Chere mara	Leaf	Postnatal care	0.25	0.14	NE
Indigofera tinctoria L., Fabaceae, RAJ 098	Neeli soppu	Leaf	Ringworm	0.33	0.10	NE
Ixora brachiata Roxb., Rubiaceae, RAJ 074	Kurejji	Leaf	Neuromuscular growth in children	0.33	0.10	NE
Ixora coccinea L., Rubiaceae, RAJ 061	Kepula	Root, Flower, Leaf	Stomach pain in children, Postnatal care, Herpes, Muscular pain, Joint pain	0.45	0.38	NE
Jasminum grandiflorum L., Oleaceae, RAJ 001	Jajimallige	Leaf	Tooth pain, Mouth ulcers, Skin infections, Ringworm	0.33	0.41	NE
Jasminum malabaricum Wight., Oleaceae, RAJ 026	Kadumallige Edroli soppu	Leaf, Root	Skin rashes, Poisonous bites, Cuts and wounds	0.50	0.21	NE
Jatropha curcas L., Euphorbiaceae, RAJ 011	Beli almuda	Root	Body pain	0.25	0.14	LC
Justicia adhatoda L., Acanthaceae, RAJ 002	Aadusoge	Leaf	Cough and cold, Fever	0.25	0.28	LC
Justicia gendarussa Burm.f., Acanthaceae, RAJ 053	Vathankolli	Leaf, Stem, Root	Body pain, Asthma	0.40	0.17	LC
Leucas aspera (Willd.) Link., Lamiaceae, RAJ 036	Thumbe	Leaf, Flower, Stem	Headache, Cough and cold, Fever	0.21	0.48	NE
Litsea glutinosa (Lour) C.B. Rob., Lauraceae, RAJ 054	Erachikutti	Bark, Leaf	Cuts and wounds, Fractures	0.40	0.17	LC
Litsea wightiana (Nees) Hook.f., Lauraceae, RAJ 079	Ellukutti	Bark, Leaf	Cuts and wounds, Fractures	0.67	0.10	NT
Loeseneriella arnottiana (Wight) A.C.Sm., Celastraceae, RAJ 060	Maderu balli	Leaf	Stomach pain in children	0.17	0.21	NE
Memecylon umbellatum Burm.f., Melastomataceae, RAJ 082	Ollekodi	Leaf, Root	Stomach pain during menstrual cycle, Muscular pain	0.33	0.21	NE
Mimosa pudica L., Fabaceae, RAJ 017	Muttidare muni	Whole plant, Leaf, Root	Cuts and wounds, Nail infections, Tooth pain, Postnatal care	0.40	0.34	LC
Morinda citrifolia L., Rubiaceae, RAJ 043	Noni	Bark	Body pain, Diabetes	0.29	0.24	NE

Moringa oleifera Lam., Moringaceae, RAJ 037	Nuggesoppu	Bark	Headache, Cough and cold	0.20	0.34	LC
Murraya koenigii (L.) Spreng., Rutaceae, RAJ 042	Karibevu	Leaf	Body pain, Diabetes	0.29	0.24	LC
Mussaenda laxa (Hook.f.) Hutch., Rubiaceae, RAJ 007	Bellotti gida	Stem, Leaf	Eye pain, Cough and cold, Insomnia	0.33	0.31	NE
Naravelia zeylanica (L.) DC., Ranunculaceae, RAJ 044	Umi Balli	Leaf	Migraine	0.17	0.21	NE
Ocimum basilicum L., Lamiaceae, RAJ 004	Kamakasturi	Leaf	Fever, Cough and cold	0.40	0.17	NE
Ocimum tenuiflorum L., Lamiaceae, RAJ 003	Tulasi	Leaf	Fever, Cough and cold	0.17	0.41	NE
Phyllanthus amarus Schumach. & Thonn., Phyllanthaceae, RAJ 059	Nela Nelli	Whole plant	Dysuria, Jaundice, Vertigo, Insomnia	0.40	0.34	NE
Phyllanthus emblica L., Phyllanthaceae, RAJ 080	Nellikai	Fruit, Leaf	Neuromuscular growth in children, Insomnia	0.22	0.31	LC
Phyllanthus urinaria L., Phyllanthaceae, RAJ 092	Kempu Nelanelli	Whole plant	Jaundice, Hyperacidity	0.50	0.14	NE
Piper betle L., Piperaceae, RAJ 023	Bacchire	Leaf	Varicose veins, Respiratory problem in children	0.33	0.21	NE
Piper nigrum L., Piperaceae, RAJ 022	Kari menasu	Seed, Root	Cough and cold, Varicose veins, Fever, Postnatal care, Tooth ache	0.33	0.52	NE
Plectranthus amboinicus (Lour.) Spreng., Lamiaceae, RAJ 019	Sambrani	Leaf	Varicose veins, Cough and cold	0.18	0.38	NE
Psidium guajava L., Myrtaceae, RAJ 24	Perala	Leaf	Diabetes, Heart problems, Neuromuscular growth in children	0.50	0.21	LC
Rauvolfia serpentina (L.) Benth.ex Kurz., Apocyanaceae, RAJ 028	Garuda pathala	Root	Poisonous bites, Skin rashes	0.25	0.28	NE
Rhaphidophora pertusa (Roxb.) Schott., Araceae, RAJ 081	Kandadi soppu	Leaf, Stem	Cuts and wounds	0.50	0.07	NE
Ricinus communis L., Euphorbiaceae, RAJ 073	Castor	Root, Seed	Skin boils, Body pain	0.25	0.28	NE
Salacia chinensis L., Celastraceae, RAJ 027	Ekanayaka	Root	Skin rashes, Poisonous bites	0.25	0.28	NE
Scleropyrum pentandrum (Dennst.) Mabb., Santalaceae, RAJ 058	Nayikuli	Seed	Dog bites	0.20	0.17	LC
Senegalia catechu (L.f.) P.J.H.Hurter & Mabb., Fabaceae, RAJ 009	Khadira	Root, Bark	Body pain, Heart problems, Dysentery, Insomnia, Muscular pain	0.45	0.38	LC
Senegalia rugata (Lam.) Britton & Rose., Fabaceae, RAJ 033	Seege Kai	Leaf	Maternal care	0.17	0.21	NE
Sesamum indicum L., Pedaliaceae, RAJ 032	Ellu	Seed	Prenatal care	0.33	0.10	NE

Sida cordata (Burm.f.) Borss.Waalk., Malvaceae, RAJ 099	Perathane	Stem, Leaf	Stomach pain, Dysentery	0.25	0.28	NE
Syzygium aromaticum (L.) Merr. & L.M.Perry., Myrtaceae, RAJ 057	Lavanga	Bark	Varicose veins	0.25	0.14	NE
Syzygium caryophyllatum (L.) Alston., Myrtaceae, RAJ 093	Kunta nerale	Bark, Leaf	Diabetes, Stomach pain in children, Neuromuscular growth in children, Body pain	0.50	0.28	EN
Syzygium travancoricum Gamble., Myrtaceae, RAJ 035	Vathankolli	Leaf, Bark	Body pain	0.25	0.14	CR
Terminalia bellirica (Gaertn.) Roxb., Combretaceae, RAJ 094	Shanthikai	Seed	Ringworm, Insomnia	0.40	0.17	LC
Terminalia chebula Retz., Combretaceae, RAJ 072	Anilekayee	Fruit	Skin rashes, Ringworm, Dysentery, Insomnia	0.44	0.31	LC
Tetrameles nudiflora R. Br., Tetramelaceae, RAJ 095	Kaadbende	Root	Ringworm, Nail infections	0.50	0.14	LC
Tinospora cordifolia (Willd.) Miers., Menispermaceae, RAJ 010	Amritha balli	Leaf, Stem	Body pain, Fever	0.13	0.52	NE
Tragia involucrata L., Euphorbiaceae, RAJ 056	Aakire	Leaf	Nail infections	0.25	0.14	NE
Trigonella foenum-graecum L., Fabaceae, RAJ 040	Menthe	Leaf	Diabetes, Joint pain	0.40	0.17	NE
Ventilago maderaspatana Gaertn., Rhamnaceae, RAJ 055	Aithala balli	Root	Hair loss, Neuromuscular growth in children, Insomnia	0.25	0.41	NE
Vitex negundo L., Lamiaceae, RAJ 096	Nekki	Leaf	Migraine, Fever	0.29	0.24	LC
Zanthoxylum rhetsa (Roxb) DC., Rutaceae, RAJ 071	Kaavate	Bark	Mumps	0.10	0.34	LC
Zingiber officinale Roscoe., Zingiberaceae, RAJ 008	Ginger	Rhizome	Cough and cold, Fever, Indigestion	0.25	0.41	DD
Ziziphus oenoplia (L.) Mill., Rhamnaceae, RAJ 038	Choori mullu	Root, Leaf, Bark	Poisonous bites, Postnatal care, Diarrhea, Indigestion	0.31	0.45	NE

Parts used, method of preparation and application of herbal drugs

It was noticed that various plant parts of different species are used in the preparation of herbal drugs (Figure 3). Leaves (37.23%) were the most useful part followed by root (18.98%), bark (13.88%), stem and seeds (6.57% each), whole plant (5.12%), fruits (4.38%), flowers (2.92%), rhizome (2.19%), bulb, fruit stalk and latex (0.72% each).

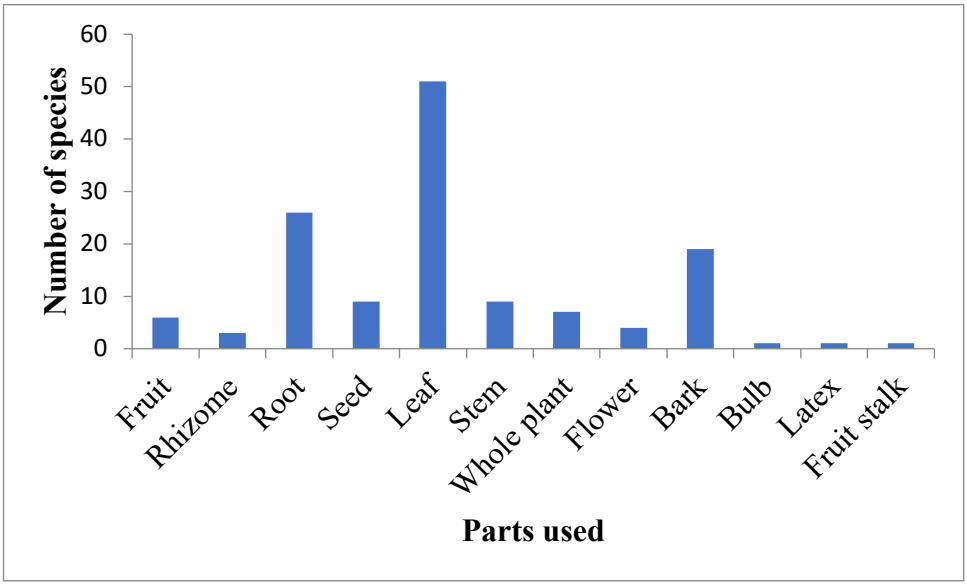

Figure 3. Parts used versus number of species for the preparation of formulation

Predominant use of leaves suggests the presence of more bioactive ingredients in leaves as it is the major photosynthetic organ. In a way, this minimizes the threat to the plant's long-term survival. This is in consistent with previous reports (Yogeesha & Krishnakumar 2023, Abba & Dogara 2021, Singh *et al.* 2023, Dery *et al.* 2023, Dessie & Amsalu 2024).

Among 116 total formulations, 78 are single herb remedies and 38 are polyherbal preparations. These are used to treat 49 different ailments (Table 2). Herbal preparations include decoction (32.76%), juice (29.31%), paste (18.97%), oil (11.21%), medicated food (6.03%), latex and raw form (0.86% each). Earlier reports on the Naika tribes suggest that paste was the mostly preferred formulation, followed by decoction, juice, oil, medicated food, and the powdered plant part, for treating various ailments in the same region (Bhat 2005). The practitioners frequently use ingredients such as rock sugar, rice water, honey, ghee, cow's milk or palm jaggery to improve the acceptability and medicinal property of the formulations. The oils of castor, coconut, mustard, neem, and sesame were commonly used in the preparation of pastes and medicated oils administered as topical applications. The use of rock sugar, honey, ghee, and palm jiggery will mask the bitterness of the preparations. The use of similar adjuvants was reported in earlier studies (Senthilkumar *et al.* 2013, Muthukrishnan & Ramachandran 2025). Fresh plant parts are preferred in preparations because they are more effective than dried parts. This is because fresh plant parts possess elevated levels of active compounds, including alkaloids, flavonoids and essential oils (Senthilkumar *et al.* 2013, Chashike *et al.* 2025). Water was the primary solvent in most preparations, particularly decoctions because most plant metabolites are soluble in it (Singh *et al.* 2023).

Single plant remedies are dominant in this survey, which is in line with earlier studies on the Paniya tribes in Kerala (Malappurathattil & Pillai 2021) and tribal communities of Kodagu district, Karnataka (Lingaraju *et al.* 2013). Dosages were recommended based on age, gender, patient's physical fitness, and symptom severity. The formulations are administered by oral (49.57%), dermal (47.86%), and internal (2.57%) routes. Oral intake of decoction, which was predominant in this study, was well reflected in the ethno-medicinal practices of tribals of Kodagu district, Karnataka (Lingaraju *et al.* 2013), the Eastern Ghats of Tamilnadu (Muthukrishnan & Ramachandran 2025), and the Western Ghats in Tamilnadu (Jenipher & Ayyanar 2024); South Ethiopia (Chashike *et al.* 2025), and Ghana (Dery *et al.* 2023). The most common administration is in the form of drinks. This could be because of its quicker action and effectiveness for internal health issues such as indigestion, stomach ache, dysentery, cough and cold, constipation, fever, and diarrhea. This is in line with earlier surveys (Dessie & Amsalu 2024, Muthukrishnan & Ramachandran 2025). In contrast to these results, earlier surveys of this region on other communities revealed that external application of various preparations were predominant compared to oral administration of decoction (Acharya *et al.* 2022, Shiddamallayya *et al.* 2010, Bhat 2005). Practitioners of this community have some

monoherbal formulations, such as the whole-plant decoction of *Phyllanthus amarus* for vertigo and jaundice; leaf and fruit decoction of *Cyclea peltata* for diabetes and prenatal care; root decoction of *Chrysopogon zizanioides* for fever and hyperacidity; leaf and stem juice of *Mussaenda laxa* for eye pain, cough, and cold.

Table 2. Medicinal preparations of Rajapur Saraswat community of Dakshina Kannada to treat various ailments

Botanical name and parts used	**Mode of preparation**	**Ailment category**	**Mode of administration**
Phyllanthus amarus (whole plant) + *Cuminum cyminum* (seeds)	Decoction	Dysuria, Vertigo, Jaundice	Oral
Plectranthus amboinicus (leaf) + *Piper betle* (leaf) + *Piper nigrum* (seeds) + *Syzygium aromaticum* (bark)	Decoction	Varicose veins	Oral
Ocimum tenuiflorum (leaf)	Juice	Cough and cold	Oral
Ocimum basilicum (leaf)	Juice	Cough and cold, Fever	Oral
Andrographis paniculata (leaf, stem) + *Cymbopogon citratus* (leaf)	Decoction	Fever, Cough and cold	Oral
Aegle marmelos (leaf) + *Calotropis gigantea* (leaf)	Juice	Ear pain	Internal
Mussaenda laxa (leaf, stem)	Juice	Eye pain, Cough and cold	External
Alstonia scholaris (bark)	Decoction	Fever	Oral
Chrysopogon zizanioides (root)	Decoction	Fever, Hyperacidity	Oral
Grewia serrulata (bark)	Juice	Stomach pain	Oral
Citrus medica (leaf)	Decoction	Hyperacidity	Oral
Zingiber officinale (rhizome)	Juice	Cough and cold, Indigestion, Fever	Oral
Mimosa pudica (whole plant) + *Curcuma longa* (rhizome) + Coconut oil	Paste	Nail infections, Cuts and wounds	External
Senegalia catechu (root) + *Tinospora cordifolia* (leaf, stem) + *Jatropha curcas* (root) + *Cuminum cyminum* (seeds) + *Coriandrum sativum* (seeds)	Decoction	Body pain	Oral
Cuminum cyminum (seeds) + *Centella asiatica* (whole plant)	Juice	Constipation	Oral
Andrographis paniculata (leaf, stem) + *Tinospora cordifolia* (leaf, stem)	Decoction	Fever	Oral
Curcuma longa (rhizome) + *Ocimum tenuiflorum* (leaf) + *Piper nigrum* (seeds) + *Coriandrum sativum* (seeds)	Decoction	Fever, Cough and cold	Oral
Aporosa cardiosperma (leaf)	Juice	Ringworm	External
Mimosa pudica (whole plant)	Decoction	Tooth pain	External
Chrysopogon zizanioides (root) + *Desmostachya bipinnata* (root)	Decoction	Prenatal care	Oral
Jasminum grandiflorum (leaf)	Decoction	Mouth ulcers, Tooth ache	External
Jasminum malabaricum (root) + *Salacia chinensis* (root) + *Rauvolfia serpentina* (root) + *Aristolochia indica* (root) + *Citrus limon* (fruit juice) + *Cocos nucifera* (tender coconut mesocarp)	Paste	Skin rashes	External
Cyclea peltata (whole plant) + *Cocos nucifera* (tender coconut water) + *Sesamum indicum* (seeds)	Juice	Prenatal care	Oral

Senegalia rugata (leaf)	Decoction	Maternal care	Oral
Acorus calamus (rhizome) + *Centella asiatica* (whole plant)	Paste	Neuromuscular growth in children	Oral
Syzygium travancoricum (bark, leaf)	Decoction	Body pain	External
Leucas aspera (leaf) + *Moringa oleifera* (bark)	Juice	Headache, Cough and cold	External
Aporosa cardiosperma (root)	Decoction	Jaundice	Oral
Plectranthus amboinicus (leaf)	Juice	Cough and cold	Oral
Ziziphus oenoplia (Leaf) + *Curcuma longa* (rhizome)	Paste	Poisonous bites	External
Rauvolfia serpentina (root) + *Aristolochia indica* (root) + *Citrus limon* (fruit juice) + *Curcuma longa* (rhizome) + *Salacia chinensis* (root) + *Cocos nucifera* (tender coconut mesocarp)	Paste	Poisonous bites	External
Coccinia grandis (leaf)	Juice	Skin boils, Asthma	External, Oral
Trigonella foenum-graecum (leaf) + *Cynodon dactylon* (whole plant)	Decoction	Diabetes, Joint pain	Oral
Murraya koenigii (leaf) + *Morinda citrifolia* (bark) + *Syzygium caryophyllatum* (bark)	Decoction	Diabetes, Body pain	Oral
Allium cepa (leaf) + *Vitex negundo* (leaf)	Juice	Migraine	Internal
Terminalia chebula (fruit)	Paste	Skin rashes, Ringworm	External
Hemidesmus indicus (root)	Medicated food	Neuromuscular growth in children	Oral
Jasminum grandiflorum (leaf) + Coconut oil	Oil	Skin infections, Ringworm	External
Cynodon dactylon (whole plant ash) + Coconut oil	Paste	Cuts and wounds	External
Breynia vitis-idaea (leaf)	Paste	Chicken pox, Ringworm	External
Piper nigrum (root)	Paste	Tooth ache	External
Phyllanthus urinaria (whole plant)	Decoction	Jaundice, Hyperacidity	Oral
Getonia floribunda (tender leaf)	Juice	Poisonous bites	Oral
Aporosa cardiosperma (root)	Decoction	Jaundice	Oral
Calophyllum inophyllum (seeds)	Oil	Postnatal care	External
Scleropyrum pentandrum (seed oil)	Oil	Dog bites	External
Leucas aspera (flower, leaf) + Coconut oil	Oil	Cough and cold, Headache	External
Cyclea peltata (leaf, fruit)	Decoction	Diabetes, Stomach pain	Oral
Croton persimilis (root)	Paste	Poisonous bites	External
Loeseneriella arnottiana (leaf) + *Syzygium caryophyllatum* (leaf) + *Ixora coccinea* (flower)	Juice	Stomach pain in children	Oral
Careya arborea (Bark)	Decoction	Cuts and wounds	External
Guilandina boduc (leaf)	Juice	Postnatal care	Oral
Guilandina boduc (leaf, stem)	Decoction	Fever	Oral
Getonia floribunda (Tender leaf)	Juice	Skin infections, Nail infections	External
Zanthoxylum rhetsa (bark)	Juice	Mumps	External
Tragia involucrata (leaf)	Juice	Nail infections	External

Calotropis gigantea (leaf)	Raw	Diabetes	External
Sida cordata (stem, leaf)	Juice	Stomach pain, Dysentery	Oral
Asparagus racemosus (root) + *Hemidesmus indicus* (root)	Medicated food	Neuromuscular growth in children	Oral
Memecylon umbellatum (leaf)	Juice	Stomach pain during menstruation	Oral
Justicia adhatoda (leaf)	Juice	Cough and cold, Fever	Oral
Holigarna arnottiana (leaf) + *Ixora coccinea* (leaf) + *Ziziphus oenoplia* (leaf)	Medicated food	Postnatal care	Oral
Carica papaya (bark, leaf*)*	Juice	Poisonous bites	External
Mussaenda laxa (leaf)	Paste (Mucilage)	Insomnia	External
Hemidesmus indicus (root) + *Hibiscus rosa- sinensis* (flower)	Medicated food	Abnormal white discharge	Oral
Hibiscus rosa- sinensis (root)	Medicated food	Abnormal white discharge	Oral
Ventilago maderaspatana (root) + Coconut oil	Paste	Neuromuscular growth in children	Oral
Ventilago maderaspatana (root) + *Calophyllum inophyllum* (root) + Coconut oil	Oil	Neuromuscular growth in children	External
Helicteres isora (stem)	Decoction	Dysentery	Oral
Cyclea peltata (leaf)	Paste	Eye pain	External
Calophyllum inophyllum (leaf)	Juice	Eye pain	External
Phyllanthus amarus (whole plant) + *Phyllanthus emblica* (fruit) + *Terminalia chebula* (fruit)	Oil	Insomnia	External
Ventilago maderaspatana (root) + *Hibiscus rosa- sinensis* (root) + *Ficus racemosa* (bark) + Coconut oil	Oil	Insomnia	External
Leucas aspera (leaf, stem)	Decoction	Fever, Cough and cold	Oral
Ricinus communis (seed oil)	Oil	Skin boils	External
Abelmoschus esculentus (root) + *Ricinus communis* (root) + *Coccinia grandis* (root) + *Tinospora cordifolia* (stem, leaf)	Decoction	Body pain	Oral
Ixora coccinea (root) + *Curcuma longa* (rhizome)	Paste	Herpes	External
Rhaphidophora pertusa (leaf, stem)	Juice	Cuts and wounds	External
Indigofera tinctoria (leaf)	Paste	Ringworm	External
Aerva lanata (whole plant)	Decoction	Kidney stones	Oral
Ventilago maderaspatana (root) + Coconut oil	Oil	Hair loss	External
Hemidesmus indicus (latex)	Latex	Skin boils	External
Careya arborea (bark) + *Ixora coccinea* (leaf) + *Citrus medica* (leaf)	Decoction	Joint pain	External
Psidium guajava (leaf)	Decoction	Diabetes, Heart problems	Oral
Baringtonia racemosa (seed) + *Curcuma longa* (rhizome)	Decoction	Tonsil infections	External
Aristolochia indica (root) + *Hemidesmus indicus* (root) + *Ixora coccinea* (root) + *Hibiscus rosa-sinensis* (root)	Oil	Muscular pain	External

Terminalia bellirica (seeds) + coconut oil	Paste	Ringworm	External
Aristolochia indica (root) + *Clerodendrum infortunatum* (root) + *Tetrameles nudiflora* (root) + Coconut oil	Paste	Ringworm, Nail infections	External
Cucurbita moschata (fruit stalk, leaf, flower)	Paste	Poisonous bites	External
Mimosa pudica (leaf, root)	Medicated food	Postnatal care	Oral
Ficus racemosa (bark)	Decoction	Dysuria, Stomach pain	Oral
Senegalia catechu (root) + *Chrysopogon zizanioides* (root)	Decoction	Heart problems	Oral
Syzygium caryophyllatum (leaf) + *Psidium guajava* (leaf) + *Ixora brachiata* (leaf) + *Phyllanthus emblica* (fruit, leaf) + *Sesame* oil + Coconut oil	Oil	Neuromuscular growth in children	External
Cassia fistula (bark)	Juice	Cuts and wounds, Skin infections	External
Datura metel (leaf)	Juice	Mumps	External
Holarrhena pubescens (bark) + *Senegalia catechu* (bark)	Decoction	Body pain	Oral
Justicia gendarussa (leaf, stem)	Decoction	Body pain	External
Litsea glutinosa (leaf, bark)	Paste	Cuts and wounds, Fractures	External
Litsea wightiana (bark, leaf)	Paste	Cuts and wounds, Fractures	External
Naravelia zeylanica (leaf)	Juice	Migraine	Internal
Achyranthes aspera (leaf)	Juice	Ringworm	External
Terminalia bellirica (seeds) + *Centella asiatica* + *Senegalia catechu* (root) + *Aloe vera* (leaf) + *Phyllanthus emblica* (fruit) + Sesame oil	Oil	Insomnia	External
Ficus racemosa (bark) + Sesame oil	Paste	Ulcers	External
Calotropis gigantea (root) + Coconut oil	Paste	Skin ulcers	External
Jasminum malabaricum (leaf) + Coconut oil	Oil	Cuts and wounds, Poisonous bites	External
Terminalia chebula (Fruit)	Decoction	Dysentery	Oral
Senegalia catechu (bark)	Decoction	Dysentery	Oral
Piper betle (leaf)	Juice	Respiratory problems in children	Oral
Vitex negundo (leaf)	Juice	Fever	Oral
Ziziphus oenoplia (bark)	Decoction	Diarrhea, Indigestion	Oral
Justicia gendarussa (root)	Juice	Asthma	Oral
Memecylon umbellatum (root) + *Senegalia catechu* (root) + *Cuminum cyminum* (seeds)	Decoction	Muscular pain	Oral
Helicteres isora (leaf)	Juice	Cough and cold	Oral
Holarrhena pubescens (bark)	Medicated food	Dysentery	Oral
Aloe vera (leaf)	Juice	Burns, Cuts and wounds, Eye pain	External

Caryota urens (bark) + *Allium sativum* (bulb) + *Piper nigrum* (seeds) + *Capsicum annuum* (fruit)	Decoction	Postnatal care	Oral

Comparative analysis of formulations of this community with earlier reports of other communities revealed that there is some uniqueness in the use of a plant species in the drug formulation. For example, leaf juice of *Coccinia grandis* for treating asthma and skin boils in our study. The Khare-Vokkaliga community prefers the stem decoction of the same species for a pregnant woman to facilitate an easy delivery. External application of bark juice of *Cassia fistula* suggested for skin infections, cuts and wounds in our study, whereas dermal application of leaf paste of the same species is suggested for ringworm by the Khare-Vokkaliga community; leaf juice of *Achyranthes aspera* is suggested for ringworm in our study whereas warm leaf juice of same species is given for treating asthma; bark decoction of *Holarrhena pubescens* and *Senegalia catechu* is suggested for body pain in our study whereas root paste of *Holarrhena pubescens* with *Citrus limon* fruit juice recommended for dysentery by the Khare-Vokkaliga community in Uttara Kannada (Achar *et al.* 2010). Medicated food prepared from the tuberous roots of *Asparagus racemosus* and the roots of *Hemidesmus indicus* is suggested for neuromuscular growth in children in our study, whereas the lehya prepared from the tuberous roots of *Asparagus racemosus* is recommended for maternal care by the Havyak community in Uttara Kannada (Hegde *et al.* 2019).

Similarly, leaf juice of *Justicia adhatoda* suggested for fever, cough and cold in our study was suggested for cough; root paste of *Calotropis gigantea* presecribed for skin ulcers in our study whereas root juice of same species is suggested for pregnant women to reduce labour pain during child birth; root paste of *Croton persimilis* is utilized for treating poisonous bites in our study whereas root bark juice of the same species prescribed for inflammations; droplets of leaf juice *Naravelia zeylanica* is administered into nose for migraine in our study whereas inhalation of pungent odour of crushed vines of same plant is suggested for all kinds of colds and migraine by the Siddis tribes of Uttara Kannada (Bhandary *et al.* 1995). Leaf mucilage of *Mussaenda laxa* is suggested for insomnia in our study but prescribed for hair fall by the Paniyeravas (Kshirsagar & Singh 2001); leaf oil of *Jasminum malabaricum* is suggested for poisonous bites, cuts and wounds in this study whereas stem juice of same plant is used for eye complaints by bettakurubas (Kshirsagar & Singh 2001). Herbal preparations made from *Ixora coccinea* are recommended for stomach pain in children, postnatal care, herpes, muscular pain, and joint pain in our study, whereas the fresh juice of the flowers is used to treat eye complaints, insomnia, and vertigo by the Naika tribe of the same region (Bhat 2005). Oral intake of bark decoction of *Ficus racemosa* is suggested for stomach pain and dysuria in this study. The dermal application of a paste prepared from the bark of *Ficus racemosa* is used to treat skin diseases, and the fruit juice of the same species is taken orally for urinary complaints by the Mullu Kuruma tribes of Kerala (Silja *et al.* 2008). Dermal application of fruit paste of *Terminalia chebula* is suggested for treating ringworm and skin rashes in our study, whereas the Malayali tribes of the Eastern Ghats recommend oral intake of the fruit powder of the same species for asthma (Senthilkumar *et al.* 2013).

Some of the noteworthy observations not documented earlier in the ethno-medicinal literature are, medicated food prepared from tender leaves of *Holigarna arnottiana*, *Ixora coccinia* and *Ziziphus oenoplia* for post-natal care; decoction prepared from the seeds of *Baringtonia racemosa* and *Curcuma longa* rhizome for tonsil infections; decoction prepared from *Senegalia catechu* and roots of *Chrysopogon zizanioides* for heart problems; oil prepared from roots of *Ventilago maderaspatana* and *Calophyllum inophyllum* for neuromuscular growth in children; juice prepared from the flowers of *Ixora coccinea*, tender leaves of *Loeseneriella arnottiana* and *Syzygium caryophyllatum* for treating stomach pain; paste prepared from roots of *Salacia chinensis*, *Rauvolfia serpentina*, *Jasminum malabaricum* and *Aristolochia indica* for treating skin rashes; topical application of leaf and stem decoction prepared from *Justicia gendarussa* and *Syzygium travancoricum* for relieving body pain. Furthermore, the research identifies 19 specific formulations for maternal, child, and adolescent health, essential for the attainment of United Nations SDG-3 (Table 2).

Quantitative analysis

Use value

Use value (UV) evaluates the relative importance of a medicinal plant based on informants' citations. In this study, the use value for recorded species ranged from 0.10 to 1 (Table 1). The plant species *Cassia fistula* has exhibited the highest use value (UV=1, with 2 use reports), and the lowest UV was shown by *Zanthoxylum rhetsa* (UV=0.10, with 1 use report).

Some notable species in the present study with high use value are *Litsea wightiana* and *Breynia vitis-idaea* (UV=0.67 with two use reports); *Ficus racemosa* (UV=0.57 with four use reports); *Chrysopogon zizanioides*, *Cyclea peltata* and *Syzygium caryophyllatum* (UV=0.50 with four use reports); *Calotropis gigantea*, *Jasminum malabaricum* and *Psidium guajava* (UV=0.50

with three use reports); *Citrus medica*, *Clerodendrum infortunatum*, *Phyllanthus urinaria* and *Tetrameles nudiflora* (UV=0.50 with two use reports); *Aerva lanata* and *Rhaphidophora pertusa* (UV=0.50 with single use reports).

Similarly, *Curcuma longa* (UV=0.39 with seven use reports); *Cuminum cyminum* (UV=0.46 with six use reports); *Ixora coccinea* (UV=0.45 with five use reports); *Senegalia catechu* (UV=0.45 with five use reports); *Aristolochia indica* (UV=0.36 with five use reports); *Piper nigrum* (UV=0.33 with five use reports); *Aloe vera* (UV=0.44 with four use reports); *Terminalia chebula* (UV=0.44 with four use reports); *Jasminum grandiflorum* (UV=0.33 with four use reports); *Ziziphus oenoplia* (UV=0.31 with four use reports); *Mimosa pudica* (UV=0.40 with four use reports); *Hemidesmus indicus* (UV=0.31 with four use reports) and *Phyllanthus amarus* (UV=0.40 with four use reports) have emerged as important species in this study.

Previous reports revealed that *Calotropis gigantea* ranks top with its use value of 1.33 followed by *Terminalia chebula* (UV=1), *Cuminum cyminum* (UV=0.75), *Curcuma longa* (UV= 0.67), *Cassia fistula*, *Ixora coccinea*, *Ficus racemosa* and *Piper nigrum* (UV=0.50 each), *Clerodendrum infortunatum* (UV=0.33), *Aristolochia indica* (UV=0.17), *Mimosa pudica* (UV=0.14), *Citrus medica* (UV=0.13) and *Jasminum malabaricum* with least use value (UV=0.08) among the ethnic communities of Uttara Kannada district of the Western Ghats (Bhat *et al.* 2012). An earlier report suggests that bark juice of *Cassia fistula* was used to treat inflammations; leaf juice of *Calotropis gigantea* for scabies and skin infections; *Jasminum malabaricum* for asthma and diarrhea; *Clerodendrum infortunatum* for fever; *Mimosa pudica* for wounds and dysentery by the Siddis of Uttara Kannada (Bhandary *et al.* 1995). Previous surveys on Malayali tribes of the Eastern Ghats of Kerala reported the use of *Cassia fistula* for snake bites, *Aerva lanata* for menstrual problems, *Terminalia chebula* for asthma, *Psidium guajava* for diabetes and earache, *Citrus medica* for inflammations, and *Mimosa pudica* for cuts and wounds (Senthikumar *et al.* 2013).

Ayurvedic literature of India reports that *Cassia fistula* is in use for treating fever, abdominal diseases, skin diseases, diabetes, epilepsy and cough; *Terminalia chebula* for fever, ulcers, eye diseases, digestive disorders, piles, diabetes, skin diseases and arthritis; *Piper nigrum* for cough, asthma, tooth ache, skin diseases and arthritis; *Cuminum cyminum* for poisonous bites, fever, acidity, cough, wounds, skin diseases, kidney problems and digestive disorders; *Aristolochia indica* for snake bites, fever, wounds, worm infestation and arthritis; *Senegalia catechu* for skin diseases, wound cleaning, oral cavity diseases, tonsil infections, cough, ulcers and wounds; *Jasminum grandiflorum* against wounds, joint diseases, skin diseases, eye diseases and toothache; *Phyllanthus amarus* in asthma, diabetes, fever, jaundice, urinary problems and cough; *Aloe vera* for burns, inflammations, jaundice, wounds, eye infections, constipation and asthma; *Hemidesmus indicus* for fever, poisoning, wounds, asthma, cough and loss of appetite; *Mimosa pudica* for fractures, diarrhea, asthma, skin diseases and wounds; *Curcuma longa* for diabetes, skin diseases, wounds, burns, asthma, jaundice and cough; *Cyclea peltata* for dysentery, jaundice, fever, asthma, wounds and stomach ache (Sharma & Sahu 2020, Nabiar *et al.* 1985).

High use values for a species suggest its effectiveness in treating the ailment. However, most medicinal plant species appear to have lower use values in the study area, which may not imply that they are less effective for treating ailments; rather, they were mentioned by more informants (Dessie & Amsalu 2024). Those medicinal plant species with high use value and have been cited for multiple ailments must be further assessed to identify their active constituents for drug development (Jisthu *et al.* 2025).

Relative frequency of citation (RFC)

The RFC values in this study ranged from 0.07 to 0.62 (Table 1). Analysis of RFC has shown that, for 43 species RFC values range between 0.16 and 0.30; for 24 species, between 0.31 and 0.45; for four species, between 0.46 and 0.60 and for 27 species, the values lie in the lower range (0 and 0.15). Maximum RFC value of 0.62 was recorded for *Curcuma longa* followed by *Tinospora cordifolia* and *Piper nigrum* (0.52 each); *Aristolochia indica* and *Leucas aspera* (0.48 each); *Cuminum cyminum*, *Hemidesmus indicus* and *Ziziphus oenoplia* (0.45 each); *Coriandrum sativum*, *Jasminum grandiflorum*, *Ocimum tenuiflorum*, *Zingiber officinale* and *Ventilago maderaspatana* (0.41 each); *Plectranthus amboinicus*, *Senegalia catechu* and *Ixora coccinea* (0.38 each); *Andrographis paniculata*, *Calophyllum inophyllum*, *Mimosa pudica*, *Phyllanthus amarus*, *Citrus limon*, *Moringa oleifera* and *Zanthoxylum rhetsa* (0.34 each).

The plants with high RFC values, such as *Curcuma longa*, have been cited by the Siddi tribes for diarrhea (Bhandary *et al.* 1995); cuts and wounds (Bhat *et al.* 2012), and urinary tract infections and fever by the Kunabi tribes (Harsha *et al.* 2002). *Tinospora cordifolia* was cited for paralysis, children health care and pregnancy stomach pain; *Aristolochia indica* for paralysis, poisonous bites, herpes, red lumps and skin itching; *Cuminum cyminum* for paralysis, joint pain, cheek pain, jaundice, white discharge and labour pain; *Hemidesmus indicus* for infertility, paralysis and kidney stone; *Phyllanthus amarus* for jaundice, kidney stone and paralysis; *Mimosa pudica* for kidney failure; *Senegalia catechu* for herpes, mumps and

paralysis; *Terminalia chebula* for paralysis, asthma, piles, uterus problems, excessive bleeding during menses, skin allergy, herpes and mumps by the Nalike tribal community (Acharya *et al.* 2022). *Hibiscus rosa- sinensis* was cited for urinary tract infections and burning sensation in stomach; *Leucas aspera* for jaundice; *Justicia adhatoda* for fever, cough and cold by the Kunabi tribes of Uttara Kannada (Harsha *et al.* 2002). *Ziziphus oenoplia* cited for mouth ulcers; *Terminalia chebula* for hyperacidity; *Andrographis paniculata* for itching; *Cyclea peltata* for dysentery; *Holarrhena pubescens* for ringworm; *Memecylon umbellatum* for herpes and Psidium *guajava* for indigestion by the people of the Western Ghats of Shimoga (Rajakumar & Shivanna 2009). *Justicia adhatoda* was cited for cough; *Calotropis gigantea* for scabies and maternity care; *Zingiber officinale* for fever; *Getonia floribunda* for indigestion; *Careya arborea* for dysentery; Sida *cordata* for bowel disorders in babies; *Jasminum malabaricum* for diarrhea; *Murraya koenigii* for scabies; *Vitex negundo* for migraine by the Siddis of Uttara Kannada (Bhandary *et al.* 1995).

Wider medicinal uses of plant species are due to their effective healing properties. Studies have confirmed that pharmacological activity of plants directly corresponds to their ethnomedicinal uses (Agidew 2022, Sharma & Sahu 2020, Rajakumar & Shivanna 2009) The plants with higher RFC values are widely used in the system and hence, harvested very frequently from the habitat whereas the low RFC value indicates a comparatively less use pressure (Pradhan & Mondal 2023).

Informant Consensus factor (ICF)

As indicated in Table 3, the healers employed medicinal plants to treat 49 distinct medical conditions that were divided into 11 major categories. Given that a single plant may be used to treat multiple disease categories, the ICF was examined by disease category. This value for 11 disease categories ranged from 0.54 to 0.86. The maximum ICF value of 0.86 was for respiratory system ailments, followed by digestive system ailments (0.83); Oral, dental, ear and nose problems (0.82); dermatological ailments (0.77); metabolic disorders (0.75); fever (0.74); poisonous bites (0.73); urinary system complications (0.72); neurological and musculoskeletal ailments (0.71), and gynecological ailments (0.58). The moderate ICF value of 0.54 was reported for circulatory system ailments.

A high ICF value (close to 1) suggests that the informants rely mostly on the same taxa to treat a specific disease, while lower value (close to 0) indicates that there is no consensus among the informants in treating a given disease (Rajakumar & Shivanna 2009, El-Ghazouani *et al.* 2024, Singh *et al.* 2025). ICF scores in our investigation were often high, indicating that informants agreed on the plants used to cure ailments. The availability of plant species in the study area directly influences ICF value. Another factor to be considered is that, as this study involved a single ethnic group (the Rajapur Saraswat), the exchange of information between informants was greater, leading to greater homogeneity in their knowledge. The high ICF values reported in this study are in line with earlier surveys on Lois community of Manipur (Singh *et al.* 2025), Kani tribes of Tamilnadu (Sukumaran *et al.* 2021) and Kerala (Xavier *et al.* 2014). In contrast, lower ICF values have been recorded in a previous survey conducted in the same region for neurological disorders (Yogeesha & Krishnakumar 2023) and in Shimoga district of the Western Ghats for various ailments (Rajakumar & Shivanna 2009). This is because of the inclusion of many communities and also the limited interactions between them.

Table 3. Informant Consensus Factors for disease categories

Ailment Categories	Use Citations (NUR)	Number of Taxa (Nt)	ICF
Dermatological ailments: nail infections, ringworm, cuts and wounds, skin infections, chicken pox, mumps, herpes, skin rashes, ulcers, skin boils, hair loss, burns	151	36	0.77
Neurological and Musculoskeletal ailments: vertigo, neuromuscular growth in children, insomnia, migraine, fractures, headache, joint pain, muscular pain	110	33	0.71
Digestive system ailments: stomach pain, indigestion, constipation, dysentery, diarrhea	77	14	0.83
Respiratory system ailments: cough and cold, respiratory problem in children, asthma, tonsil infections	106	16	0.86
Urinary system ailments: dysuria, kidney stones	12	4	0.72

Gynecological ailments: prenatal care, postnatal care, maternal care, stomach pain during menstruation, abnormal white discharge	46	20	0.58
Poisonous bites: dog bites, poisonous bites	46	13	0.73
Metabolic ailments: jaundice, diabetes, hyperacidity	52	14	0.75
Circulatory system ailments: varicose veins, heart problems	14	7	0.54
Fever: fever, body pain	100	27	0.74
Oral, dental, ear and eye problems: mouth ulcers, tooth pain, ear pain, eye pain	46	9	0.82

Relationship between cultural rituals and plant species among the Rajapur Saraswat community

The Rajapur Saraswat is a Brahmin community also known as Balavalikar Gaud Saraswat Brahmins. The community members mainly reside in the districts of Dakshina Kannada, Udupi, and Kodagu in Karnataka and Kasaragod in Kerala. They are strongly bound to their own cultural rituals in addition to local traditions. This community uses various plant species in their traditional rituals (Table 4). Leaves of *Piper betel*, fruits of *Areca catechu* and *Cocos nucifera* are used in all cultural ceremonies. Special dishes are made using *Curcuma longa* leaves during Nagara Panchami (a local worship of Indian cobra snake). Turmeric, the powder from the rhizome of *Curcuma longa*, is used in all rituals on various occasions. Mature shoot with inflorescence (battha tene) of *Oryza sativa* wrapped by leaves of *Artocarpus heterophyllus*, *Ficus racemosa*, *Ficus benghalensis*, *Ficus religiosa, Lygodium flexuosum*, *Mangifera indica*, *Clerodendrum infortunatum* and then tied around the house using a thread made from the bark of *Careya arborea*. Vegetarian dishes such as Pathrode and special curries are prepared using leaves of *Colocasia esculenta*. Special preparations were made during *Ugadi*, using the seeds of *Piper nigrum*, ripe fruits of *Musa* × *paradisiaca* and the seeds of *Vigna radiata*. Species such as *Achyranthes aspera*, *Aegle marmelos*, *Cynodon dactylon*, *Eclipta prostrata*, *Chrysopogon zizanioides*, *Myristica malabarica*, *Butea monosperma*, *Desmostachya bipinnata*, *Senegalia catechu*, *Sesamum indicum*, *Prosopis cineraria*, *Calotropis gigantea* and *Smilax zeylanica* are commonly used during religious ceremonies. Leaves of *Plectranthus amboinicus*, fruits of *Phyllanthus emblica*, whole plant of *Centella asiatica*, and rhizome of *Curcuma amada* are used to make chutney during special occasions which also have medicinal value. Tender leaves of *Holigarna arnottiana*, *Syzygium caryophyllatum*, *Loeseneriella arnottiana*, *Ixora coccinea*, *Senegalia rugata* and *Melastoma malabathricum* are used together to prepare nutritious chutney. Tender shoots of *Bambusa bambos* are used in the preparation of special dishes and pickles. Tuberous roots of *Asparagus racemosus* and starch rich flour obtained from pith of the trunk of *Caryota urens* are used in the preparation of nutritious food for infants. Leaves of *Curcuma longa* and *Ocimum tenuiflorum* are used in the final stage of ghee preparation to infuse it with a distinct aroma and flavor. Importance of *Aegle marmelos*, *Areca catechu*, *Asparagus racemosus, Butea monosperma*, *Curcuma longa*, *Cynodon dactylon*, *Ficus racemosa*, *Ficus benghalensis*, *Ficus religiosa, Mangifera indica*, *Ocimum sanctum*, and *Tinospora cordifolia* in the human cultural tradition have been discussed in the earlier study conducted in Kerala (Abraham 2015).

Table 4. Plant species used by Rajapur Saraswat community in cultural rituals

Plant Name	Family	Local name	Parts used
Achyranthes aspera L.	Amaranthaceae	Uttarane	Whole plant
Aegle marmelos (L.) Correa	Rutaceae	Bilva	Leaves
Areca catechu L.	Arecaceae	Adike	Fruit
Artocarpus heterophyllus Lam.	Moraceae	Halasu	Leaves
Asparagus racemosus Willd.	Asparagaceae	Shathavari	Roots
Bambusa bambos (L.) Voss	Poaceae	Bamboo	Tender shoot
Butea monosperma (Lam.) Taub.	Fabaceae	Palasha	Stem
Calotropis gigantea (L.) Dryand.	Apocyanaceae	Ekka	Stem
Careya arborea Roxb.	Lecythidaceae	Daddalu	Bark
Caryota urens L.	Arecaceae	Eendu	Stem
Centella asiatica (L.) Urb.	Apiaceae	Ondelaga	Whole plant
Chrysopogon zizanioides (L.) Roberty	Poaceae	Lavancha	Roots
Clerodendrum infortunatum L.	Lamiaceae	Ittovu	Leaves
Cocos nucifera L.	Arecaceae	Coconut	Fruit
Colocasia esculenta (l.) Schott	Araceae	Chevu	Leaves
Curcuma amada Roxb.	Zingiberaceae	Mango ginger	Rhizome

Curcuma longa L.	Zingiberaceae	Arashina	Rhizome
Cynodon dactylon (L.) Pers.	Poaceae	Garike	Whole plant
Desmostachya bipinnata (L.) Stapf	Poaceae	Darbhe	Leaves
Eclipta prostrata (L.) L.	Asteraceae	Brangaraja	Stem, Leaves
Ficus benghalensis L.	Moraceae	Goli mara	Stem, Leaves
Ficus racemosa L.	Moraceae	Atthi	Stem, Leaves
Ficus religiosa L.	Moraceae	Ashwatha	Stem, Leaves
Holigarna arnottiana Hook.f.	Anacardiaceae	Chere mara	Sprouting leaves
Ixora coccinea L.	Rubiaceae	Kepula	Sprouting leaves
Loeseneriella arnottiana (Wight) A.C.Sm.	Celastraceae	Maderu balli	Sprouting leaves
Lygodium flexuosum (L.) Sw.	Lygodiaceae	Poli balli	Stem, Leaves
Mangifera indica L.	Anacardiaceae	Mavu	Leaves
Melastoma malabathricum L.	Melastomataceae	Nekkare gida	Sprouting leaves
Musa × *paradisiaca* L.	Musaceae	Baale	Ripe fruits
Myristica malabarica Lam.	Myristicaceae	Ramapatre	Fruit
Ocimum tenuiflorum L.	Lamiaceae	Tulasi	Leaves
Oryza sativa L.	Poaceae	Battha	Paddy panicle
Phyllanthus emblica L.	Phyllanthaceae	Nellikai	Fruit
Piper betel L.	Piperaceae	Bacchire	Leaves
Piper nigrum L.	Piperaceae	Kari menasu	Fruit
Plectranthus amboinicus (Lour.) Spreng.	Lamiaceae	Sambrani	Leaves
Prosopis cineraria (L.) Druce.	Fabaceae	Shami	Stem, Leaves
Senegalia catechu (L.f.) P.J.H.Hurter & Mabb	Fabaceae	Khadira	Stem, Leaves
Senegalia rugata (Lam.) Britton & Rose	Fabaceae	Seege	Sprouting leaves
Sesamum indicum L.	Pedaliaceae	Ellu	Seeds
Smilax zeylanica L.	Smilacaceae	Chennara balli	Stem, Leaves
Syzygium caryophyllatum (L.) Alston	Myrtaceae	Kuntanerale	Sprouting leaves
Vigna radiata (L.) R.Wilczek	Fabaceae	Moong	Seeds

Endemism and IUCN conservation status of medicinal plants

It is noteworthy that six species recorded here, namely *Cyclea peltata*, *Ixora brachiata*, *Jasminum malabaricum*, *Litsea wightiana*, *Mussaenda laxa*, and *Syzygium travancoricum* are endemic to the Western Ghats and Peninsular India (Sasidharan 2004). The conservation status of the medicinal plants reported here is presented in Table 1. Based on this, *Syzygium travancoricum* is Critically Endangered (CR), *Syzygium caryophyllatum* is Endangered (EN), *Aegle marmelos* and *Litsea wightiana* are in Near Threatened (NT) and *Aporosa cardiosperma* is in Vulnerable (VU) category, 30 species recorded here, are in Least Concern (LC) category, 3 species in Data Deficient (DD), and the status is Not Evaluated for 61 species (NE). Hence, it is likely that 61 species (NE category) are readily available in the localities and are currently not under any serious threat. However, plant species fall under the CR, EN, NT, and VU categories require special attention, and measures for sustainable use should be adopted.

The continued increase in demand for medicinal plants leads to their overexploitation, which would subsequently result in the extinction of many valuable plants. This creates the need for conservation through efficient biotechnological processes, such as *in-vitro* amplification of bioactive compounds of interest (Gusain *et al.* 2021). Reintroduction of threatened species in large numbers into an area suitable for their growth or into their natural habitat is the ideal approach for their population recovery. Developing durable strategies that are both sustainable and easily accessible is essential for the conservation of the plants (Gowthami *et al.* 2021). This approach has been successfully applied in India as part of conservation efforts for threatened species such as *Vanda coerulea* (Seeni & Latha 2000), *Syzygium travancorium* (Anand 2003), *Calophyllum apetalum*, and *Blepharistemma serratum* (Krishnan *et al.* 2011).

Conclusions

This study has explored the use of 99 plant species belonging to 41 families to treat 49 ailments by the practitioners of the Rajapur Saraswat community. Plants such as *Curcuma longa*, *Cuminum cyminum, Aristolochia indica, Ixora coccinea, Piper nigrum*, *Senegalia catechu*, *Aloe vera*, *Chrysopogon zizanioides*, *Cyclea peltata*, *Ficus racemosa*, *Hemidesmus indicus*,

Jasminum grandiflorum, *Mimosa pudica*, *Phyllanthus amarus*, *Syzygium caryophyllatum*, *Terminalia chebula*, and *Ziziphus oenoplia* showed multiple use mentions. High ICF values reported in this study suggest strong agreement among the informants in the community on plant species for treating an ailment. This study has also recorded 43 plant species used by this community in cultural rituals. These findings highlight the rich cultural heritage of medicinal plants used by the Rajapur Saraswat people of Dakshina Kannada. Indigenous medicinal practices are becoming more susceptible as allopathic medicine seeps into remote areas. Traditional medical practices are steadily vanishing due to a lack of interest among the younger generation and the wide availability of non-prescription medications. It is important to appropriately document the experiences of senior citizens, whose empirical knowledge of the use of medicinal plants in ethnomedicine is both acknowledged and treasured. This documentation has produced new insights and expanded the range of treatments available for various illnesses. Further validation of the medicinal uses can be achieved through analytical scientific investigations for the development of new drugs.

Declarations

List of abbreviations: WHO (World Health Organization), SDGs (Sustainable Development Goals), IUCN (International Union for Conservation of Nature & Natural Resources), POWO (Plant of the World Online), WFO (World Flora Online), UV (Use Value), ∑Us (Sum of Uses), N (Total Number of Informants), ICF (Informants' Consensus Factor), Nur (Number of Use Citations), Nt (Number of Taxa), RFC (Relative Frequency of Citation), FC (Frequency of Citation), CR (Critically Endangered), VU (Vulnerable), NT (Near Threatened), EN (Endangered), LC (Least Concern), NE (Not Evaluated), DD (Data Deficient).

Ethics approval and consent to participate: Verbal and written consent was obtained from all participants for the survey.

Consent for publication: People who participated in this study gave prior informed consent for the publication of the article. All people shown in images gave their consent to have the image published.

Availability of data and materials: The raw data without names of participants are available from the authors.

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