Indigenous ecological knowledge and the usage of medicinal plants in Polavaram Mandal of Andhra Pradesh, India

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Research

Abstract

Background: This study was conducted in the Polavaram Mandal of Andhra Pradesh. Eighteen field visits were undertaken in the eight villages of Polavaram Mandal.

Methods: Information was collected from 126 informants using open-ended interviews and semi-structured questionnaires. The data was examined employing indices viz., Relative Frequency of Citation (RFC), Family Importance Value (FIV), and Informant Consensus Factor (ICF).

Results: The study reported 53 plant species used by people to treat several ailments. Herbs were the most commonly used plant species for treatment purposes (27 species). The most preferred plant parts used in herbal preparations were leaves (37%). Plant species with the highest RFC values were *Achyranthes aspera* L. (0.77), *Andrographis paniculata* (Burm.f.) Nees (0.74), *Eclipta alba* (L.) L. (0.61), *Hibiscus rosa-sinensis* L. (0.59). Based on ICF values, the highest degree of agreement among the informants was found for parasitic problems (0.98).

Conclusions: The research showed that the indigenous people of the Polavaram region of Andhra Pradesh had substantial knowledge and reliance on traditional healing methods. The present study reported new medicinal uses for some plant species such as *Amorphophallus paeoniifolius*, *Alpinia galanga*, *Azanza lampas*, *Borassus flabellifer*, *Calotropis procera*, *Pongamia pinnata*, *Pterocarpus marsupium*, *Pterocarpus santalinus*, *Solanum lasiocarpum*, *Tectona grandis*, and *Tinospora cordifolia*. We recommend further scientific studies on these plant species.

Keywords: Traditional knowledge, Medicinal plants, Informant Consensus Factor, Polavaram, Andhra Pradesh

Background

Plants maintain a significant part in the traditional medicinal systems, history, and cultural norms of the people residing in developing countries (Pan *et al*., 2014). They are employed for numerous reasons such as medicines, fiber, food, and shelter (Silva *et al*., 2014; Dutt *et al*., 2015). Different studies have observed that people in developing nations continue to rely on herbal remedies (Farnsworth, 1988; Bekalo *et al*., 2009; Srivastava *et al*., 2019). As per WHO, globally 21,000 medicinal plants are used for a variety of medical concerns (WHO, 2005). There are reports of traditional herbalists still using herbal therapy in remote areas. They use about 2500 plants to treat common ailments, which is one of the most effective means to treat illnesses in Indian medicine (Panmei *et al*., 2019; Akbar *et al*., 2020). An increasing body of scientific research indicates that the integration of traditional knowledge with cutting-edge scientific findings can yield environmentally sound and socially acceptable solutions that are fundamental for the development of local populations (Ayeni and Basiri, 2018). However, increasing demand and overuse have resulted in the over-exploitation and habitat degradation of medicinal plants (Lee *et al*., 2008). Oral transmission of ethnomedical knowledge has been common in rural areas (Bhatia *et al*., 2015; Batool *et al*., 2023). However, human migration and the restricted transmission of information have jeopardized it (Gurung and Pyakurel, 2017). Therefore, it is essential to record traditional knowledge gathered through ethnomedicinal surveys and observations to use newly discovered medicinal plants for disease prevention and treatment and the sustainable management and use of natural resources (Adhikari *et al*., 2018).

India has its own recognized conventional medicinal systems such as Ayurveda, Yoga, Unani, Siddha, and Homeopathy (AYUSH). India's healthcare structure is highly variable, serving both urban and rural populations that use both conventional and modern medical practices (Tikkanen *et al*., 2020). Although there is considerable development in contemporary medicine, the rural populace in India and the globe still entrust to herbal medicines for many health-related issues because of the scarcity of health services (Sen and Chakraborty, 2017). About 7,000 of the 17,000-18,000 flowering plant species in India are considered to have therapeutic qualities, according to the Indian Systems of Medicine (NMPB, 2021). It is a challenging task to record the ethnobotanical knowledge of the entire Indian subcontinent (Rupani and Chavez, 2018). However, many researchers have made efforts to document the traditional ethnobotanical knowledge in various parts of India (Tetali *et al*., 2009; Gairola *et al*., 2014, Vijayakumar *et al*., 2015; Seethapathy *et al*., 2018; Wagh and Jain, 2020; Singh *et al*., 2021; Dutta *et al*., 2021; Rana *et al*., 2021; Batool *et al*., 2023; Singh *et al*., 2022; Sharma *et al*., 2022; Sharma *et al*., 2023, Pradhan and Mondal 2023; Singh *et al*., 2024).

The present study is focused on the Polavaram region of West Godavari district of Andhra Pradesh. It is located in Andhra Pradesh and is also a rich source of biodiversity for the local people. The forest area (RFA) is 3,72,58,00 hectares, which is 22.86% of the land area (ISFR, 2019). The Polavaram Mandal is situated along the banks of river Godavari on the hills with enhanced forest cover and is a source of various species of plants (Naik *et al*., 2012). Polavaram is under the threat of habitat destruction because of the construction of the large-scale irrigation project Polavaram Dam (Mohan, 2020). It is not only a threat to biodiversity but also leads to rehabilitation or vanishing of tribal communities in the area. Hence, it is very important to record and report the diversity of medicinal plants and the knowledge related to ethnomedicine in the area, from the local people. Many ethnomedicinal surveys have been conducted in the districts of Andhra Pradesh (Vijayagiri and Mamidala 2012; Chandravathi *et al*., 2019; Padal *et al*., 2020; Savithramma *et al*., 2017; Rao *et al*., 2020) and Polavaram in particular (Kumar *et al*., 2012; Vijaya Kumar 2015; Naik *et al*., 2015; Kumari *et al*., 2017). Although previous papers provide valuable information on the use of medicinal plants in Polavaram, this article takes a different approach by conducting a quantitative ethnomedicinal investigation. The usage of plants in Polavaram could potentially be of substantial ethnobotanical significance, with the following objectives: (i) to gather information about medicinal flora and their usages in the region (ii) to assess the ethnomedicinal data by employing the ethnobotanical indicators such as Use Reports (UR) and Informant Consensus Factor (ICF) (iii) to assess the novelty of the current study, we compared our findings with other ethnobotanical research conducted in Andhra Pradesh and other parts of Southern India.

Materials and Methods

Study area

The study area 'Polavaram Mandal' falls within the West Godavari district of this state (Figure 1) and is one of the 48 Mandals in the district. It is administered by the Jangareddigudem revenue division, with its headquarters in Polavaram. A 'Mandal' is a local government area in India. The study villages in this area are situated along the hills near the banks of river Godavari which forms part of the Papikondalu hills. The total population of the study area constitutes 22,345 males and 23,047 females and the literacy rate stands at 23.12% (Census, 2011). Polavaram Mandal is divided into 4 panchayats with various tribal villages under it. Agriculture in the study area is seasonal with only one crop per year and also more than one crop in case of

favorable conditions which is the main source of living for the tribal living here. The irrigation mainly depended on water from the river Godavari, mostly hand-run motors. The climate of Polavaram is classified as tropical. The rainfall in this area ranges from 889 mm to 1016 mm (Amarnath and Thatikonda, 2020). The health care facilities are scarce with the primary health care center located in the Mandal headquarters. Agriculture, labor work, cattle rearing, fishing, and hunting are the main sources of income for the people living here. Polavaram Dam is a multipurpose irrigation project that is currently under construction in Andhra Pradesh (Mohan, 2020). The completion of this project submerges many tribal villages situated in this area losing huge biodiversity and disrupting culturally preserved traditional knowledge of medicinal plant use (Subramanyam and Veerabhadrudu, 2013; Mohan, 2020).

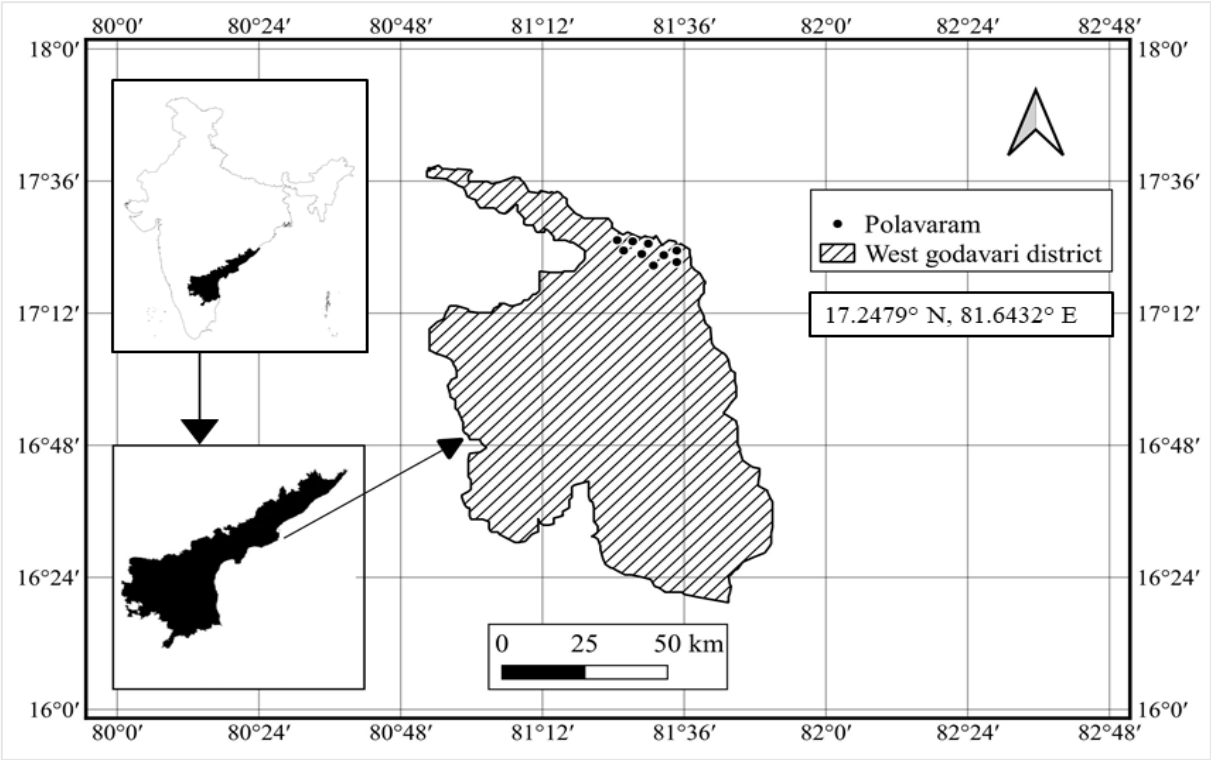

Figure 1. Map showing the study area.

Survey and data collection

Eighteen field visits were undertaken across eight villages in the Polavaram Mandal to collect comprehensive data, gain local trust, and ensure reliability and accuracy. The informants' prior informed consent was taken before interviews in compliance with CBD regulations (CBD, 1992). Interviews were conducted with 126 informants, ranging in age from 21 to 80 years (Table 1). Of them, 104 were selected by the snowball method, while 22 key informants were purposefully chosen based on suggestions from experienced elders. Emphasis was also given to the level of the explanation given by certain informants in an interview when determining the key informants. Local healers were naturally identified as key sources of information because they are traditional experts and custodians of this type of knowledge on medicinal plants. Field surveys, open-ended interviews, and semi-structured questionnaires were used to gather the data from the chosen participants. To validate and clarify the results, group discussions were also undertaken involving a total of 16 informants. The informants comprised a diverse group, including traditional healers and community elders. These individuals were selected for their extensive knowledge and experience with the ethnomedicinal practices under study. Interviews were executed in '*Telugu*' language and information on the vernacular name, plant part used, use method, and disease treated were recorded.

Identification of plant specimens was done using the regional floras (Pullaiah and Karuppusamy, 2008; Pullaiah *et al*., 2018) and eFloras (eFI 2023) The herbarium sheets were prepared following the standard method (Jain and Mudgal, 1990), and the authentic specimens have been submitted to RRLH (Regional Research Laboratory) for future reference. The botanical names of the documented plant species were validated by employing the database WFO (2023). Photographs of some of the plant species are shown in Figure 2. The details of the voucher specimens are shown in Table 2. To find out the novelty of the present study, primary ethnomedicinal data obtained in this study were compared with previously published

ethnomedicinal data. Databases such as Google Scholar, Scopus, Science Direct, and CAB International were employed to gather information on previous studies.

Table 1. Demographic profile of the informants.

		No. of informants	Percentage of informants
Gender	Male	74	58.7
	Female	52	41.3
Education level	Illiterate (never atended school)	40	31.7
	Primary level (upto 5th class)	36	28.6
	Middle level (6th to 8th class)	20	15.9
	Secondary level (9th-12th classes)	16	12.7
	Graduate (>12 classes)	14	11.1
Age groups	21-35 yrs. (Average= 29.80 yrs.)	37	29.4
	36-50 yrs. (Average= 43.50 yrs.)	49	38.9
	51-80 yrs. (Average=59.18 yrs.)	40	31.7
Occupation	Farmers	40	31.7
	Labors	55	43.7
	Local Healers	18	14.3
	Businessmen	13	10.3

Data analysis

The primary information was examined using Use Reports (UR). UR is the citation of a plant part by the individual informant. Further evaluation was done by adding the total citations for a species as frequency of citation (FC) (Khajuria *et al*., 2021).

Relative frequency of citation (RFC)

It is determined by dividing the frequency of citation (FC) by the total participant's number without considering the use categories;

$$RFC=FC/N$$

where 'FC' is the informant's number who cite the species use and 'N' is the informant's number who were interviewed in the study (Tardío and Santayana, 2008).

Family important value (FIV)

This index shows the relevance of a family and was calculated as follows (Mori *et al*. 1983).

$$FIV=FC_{family}/Ns$$

FC_{family} is the informant's number who cites family use and 'Ns' is the number of species in each family.

Informant consensus factor (ICF)

It indicates whether informants agree on the usage of specific species in certain disease categories and is calculated following Trotter and Logan (1986)

$$ICF=(n_{ur}-n_t)/(n_{ur}-1)$$

In this formula, N_t is the number of species utilized by informants for a certain illness category, and N_{ur} is the usage reports for that specific illness category. The index's range is 0 to 1, where a higher number (almost 1) indicates that a small percentage of people employ a given taxon (typically a species), and a low ICF signifies that informants are divided on which taxa should be used to treat a given illness category.

Ailment categories

All the diseases were clustered into 16 categories based on the International Classification of Primary Care (ICPC-2, 1995). These include: Antidote (ANT), Andrological/Gynecological/Birth problems (AND/GYN), Blood-related disorders (BRD), Cardiovascular disorders (CAR), Central Nervous system disorders (CNS), Dermatological disorders (DER), Ear, Nose and throat disorders (ENT), Fever (FVR), Gastrointestinal disorders (GAS), Inflammation and Pain (INF), Liver disorders (LIV), Parasitic problem (PAR), Respiratory disorders (RES), Skeleto-muscular disorders (SKE-L), Urological and rectal disorders (URO), and Endocrine/Metabolic and Nutritional (MET).

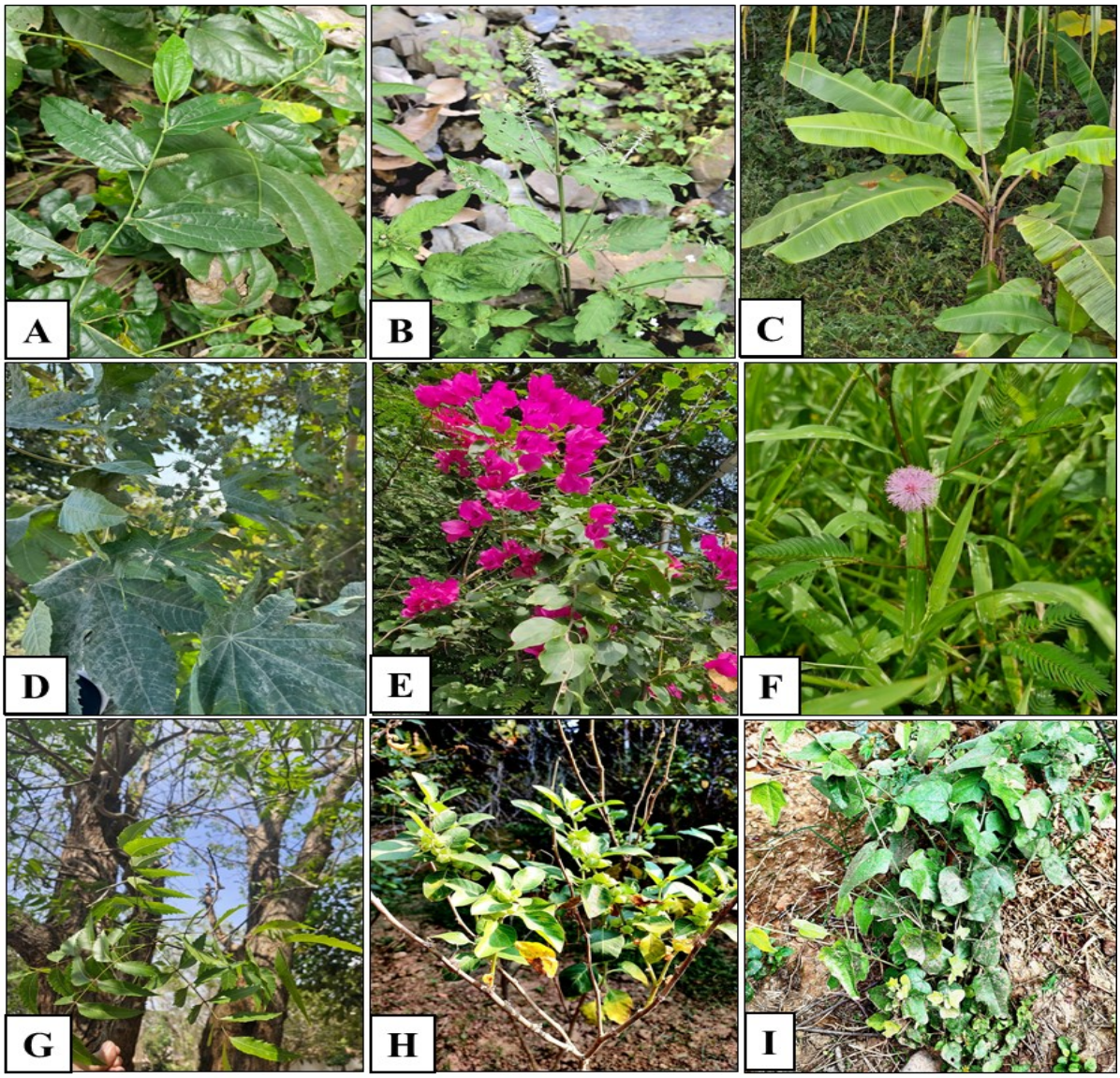

Figure 2. Some important medicinal plants found in their natural habitats in the study area (A) *Piper longum* L.; (B) *Achyranthes aspera* L.; (C) *Musa paradisiaca* L.; (D) *Ricinus communis* L.; (E) *Hibiscus rosa-sinensis* L.; (F) *Mimosa pudica* L.; (G) *Azadirachta indica* A.Juss.; (H) *Withania somnifera* (L.) Dunal; (I) *Cocculus hirsutus* (L.) W.Theob.

Results and Discussion

Ethnomedicinal diversity

The present study documented 53 plant species used by the local populace of Polavaram Mandal. The details of the plant species are summarized in Table 2. The important plant families were Fabaceae (6 species), Solanaceae (4 species) and Euphorbiaceae, Acanthaceae, Lamiaceae, Myrtaceae (3 species each) (Table 2). The dominance of Fabaceae has also been reported previously in several studies from Southern states of India (Padal *et al*., 2010; Prabhu *et al*., 2021; Sukumaran *et al*., 2021; Vidyullatha *et al*. 2022).

Habit

The medicinal plants were mostly herbs (27 species; 50.9%), followed by trees (14 species; 26.4%) and shrubs (12 species; 22.6%). This observation aligns with the pattern observed in earlier ethnomedical research conducted in other parts of India (Vijayakumar *et al*., 2015; Sharma *et al*., 2023; Batool *et al*., 2023). The highest dependency on herbaceous medicinal plants can be because of their higher availability than trees and shrubs. Just 17% of the plants were cultivated, while most (48 species, or 43%) were procured from the wild. The act of collecting wild plant species places substantial pressure on forest resources (Ganie *et al*., 2019). Consequently, conservation measures must be put into place to ensure the sustainable utilization of resources.

Part used, mode of preparation, and administration

The 53 plants reported in this study are used in treating several diseases in Polavaram Mandal. The most often used parts of plants were leaves (37%) followed by roots (18%), stems (9%), rhizomes (8%), fruits (7%), bark and seeds (6% each), flowers and whole plants (4% each), and gum (1%) (Figure 3). In India, several indigenous people make herbal medicines mostly from leaves (Bhat *et al*., 2014; Sivasankari *et al*., 2014; Prabhu *et al*., 2021; Srinivasan *et al*., 2021). Compared to underground portions, flowers, and fruits, leaves are easier to collect, which is one of the main reasons they are utilized. From a scientific perspective, the production of several secondary metabolites occurs in active areas found in leaves (Prabhu *et al*., 2014).

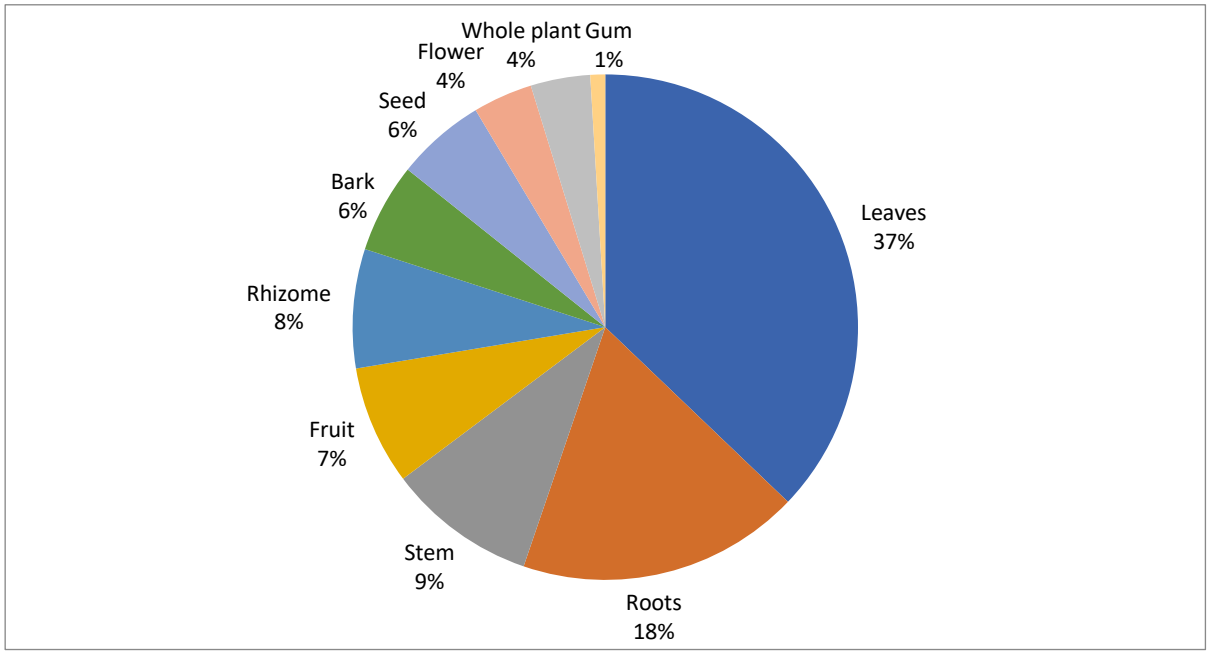

Figure 3. Plant parts used in herbal preparations in the study area.

The herbal preparations were mostly taken in the paste form (33%) followed by powder and decoction (23%), juice (8%), pills (5%) raw, and oil (4%) (Figure 4). This reflects a combination of practicality, effectiveness, and cultural significance in treating a wide range of ailments and promoting health and well-being. Several indigenous communities follow this common practice of using plant paste for treatments (Bhat *et al*., 2014; Vijayakumar *et al*., 2015; Xavier *et al*., 2014). The plant pieces, either fresh or dried, were ground with water to make the paste. The plant components were boiled in water to produce the decoction, or until the water's volume dropped to the desired level. Most of the informants prefer the oral application of the medicine (75%) and concur with earlier investigations (Srinivasan *et al*., 2021; Batool *et al*., 2023; Sharma *et al*., 2023).

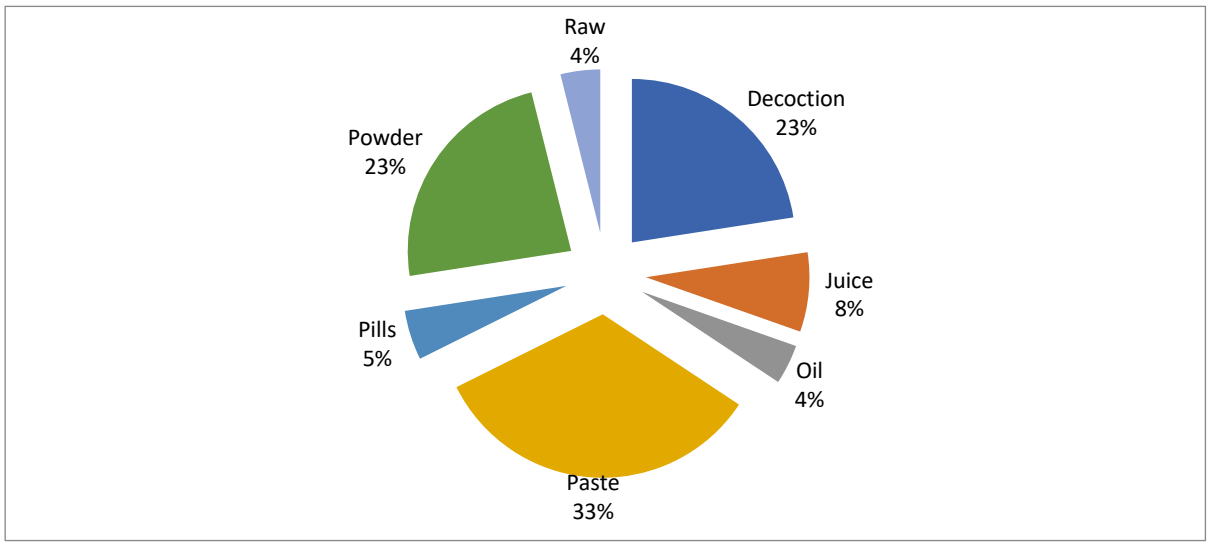

Figure 4. Mode of preparation of herbal medicine in the study area.

Table 2. Medicinal plants used by the local people to treat health problems in the study area.

Botanical name/Family/Voucher No.	Common name Telugu/ English	Habit	Plant part used in the medicine	Preparation mode	Administration mode	Uses (No. of citations)	Disease category	FC	RFC	Threat status	Similar use reports in previous studies
Abrus precatorius L./ Fabaceae/ RRLH-30023	Erra guruvindha (ఎర్రగురువింద)/ *Rosary pea*	Herb	Leaves	Decoction	Oral	Cough and cold (8)	RES	12	0.09	NE	Genesan & Xu (2017)
			Root	Paste	Topical	White patches of skin (4)	DER				Buragohain & Konwar (2007)
Acalypha indica L./ Euphorbiaceae/ RRLH-24375	Murakonda (మురకొండ)/ *Indian Copper leaf*	Herb	Leaves	Paste	Topical	Scorpion sting (23)	ANT	23	0.17	NE	Naturu *et al*. (2013), Yabesh *et al*. (2014), Venkaiah *et al*. (2020)
Achyranthes aspera L./ Amaranthaceae/ RRLH-24369	Vadapalli /Kukkapalli Uttareni	Herb	Leaves	Powder	Oral	Cough (38)	RES	110	0.83	NE	Ganesan & Xu (2017), Venkaiah *et al*. (2020)
			Root	Powder	Oral	Epilepsy (19)	CNS				Dey *et al*. (2017)
			Leaves	Powder	Oral	Dysentery (29)	GAS				Alagesaboopathi (2009), Venkaiah *et al*. (2020)
			Root	Paste	Topical	Boils (24)	DER				Ignacimuthu *et al*. (2008), Yabesh *et al*. (2014), Venkaiah *et al*. (2020)
Aegle marmelos (L.) Correa/ Rutaceae/ RRLH-24382	Maredu (మారేడు)/ *Stone apple*	Tree	Leaves	Powder	Oral	Diarrhea (7)	GAS	24	0.18	NT	Alagesaboopathi (2009), Silja *et al*. (2008), Sureshkumar *et al*. (2017)
			Root	Decoction	Oral	Insomnia (3)	CNS				Tiwari *et al*. (2018)

			Stem	Decoction	Oral	Cough (10)	RES				Venkaiah *et al*. (2020)
			Root	Paste	Topical	Scorpion sting (4)	ANT				Samy *et al*. (2008)
Aerva lanata (L.) Juss./ Amaranthaceae/ RRLH-24356	Konda pindi aaku (కొండపిండిఆకు)/ *Mountain knotgrass*	Herb	Leaves	Juice	Oral	Kidney stones (32)	URO	32	0.24	NE	Ganesan & Xu (2017), Venkaiah *et al*. (2020), Rao *et al*. (2015), Jeyaprakash *et al*. (2011), Loganathan & Selvum (2018)
Alangium salviifolium (L.f.) Wangerin/ Cornaceae/ RRLH-24381	Nalla udiga (నల్లఉడుగ)/ *Sage-leaved alangium*	Herb	Bark	Paste	Oral	Skin problems (3)	DER	8	0.06	NE	Raju *et al*. (2014), Loganathan & Selvum (2018)
			Bark	Paste	Topical	Snake bite (5)	ANT				Naturu *et al*. (2013), Loganathan & Selvum (2018)
Alpinia galanga (L.) Willd./ Zingiberaceae/ RRLH-30019	Dumpa rashtram (దుంపరాష్ట్రం)/ *Siamese ginger*	Herb	Rhizome	Powder	Oral	Cold (12)	RES	27	0.20	NE	Vijay Shalini & Abirami (2018)
			Rhizome	Paste	Oral	Sore throats (7)	ENT				Vijay Shalini & Abirami (2018)
			Rhizome	Powder	Oral	Malarial fever (8)	FEV				NA
Amorphophallus paeoniifolius (Dennst.) Nicolson/ Araceae/ RRLH-30017	Kondala dumpa (కందదుంప)/ *Elephant foot yam*	Herb	Rhizome	Powder	Oral	Stomach pain (40)	GAS	40	0.30	LC	NA
Andrographis paniculata (Burm.f.) Nees/ Acanthaceae/ RRLH-25022	Nelavemu (నేలవేము)/ *Bitter weed*	Herb	Leaves	Decoction	Oral	Deworming (41)	PAR	105	0.80	NE	Alagesaboopathi (2009), Ganesan & Xu (2017), Venkaiah *et al*. (2020)
			Whole plant	Paste	Topical	Snakebite (29)	ANT				Samy *et al*. (2008)

			Whole plant	Decoction	Oral	Bronchitis (13)	RES				Sivasankari *et al*. (2014)
			Leaves	Decoction	Oral	Fever (22)	FEV				Sukumaran *et al*. (2021)
Azadirachta indica A.Juss./Meliaceae/ RRLH-30029	Vepa (వేప)/ *Neem*	Tree	Seed	Oil	Topical	Skin diseases (23), Hair tonic (37)	DER	76	0.58	LC	Alagesaboopathi (2009)
			Seed	Oil	Oral	Blood detoxification (16)	BRD				Nayak *et al*. (1998), Venkaiah *et al*. (2020), Reddy *et al*. (1988)
			Seed	Oil	Oral	Diabetes (10)	MET				Venkaiah *et al*. (2020), Reddy *et al*. (1988)
Azanza lampas Alef/ Malvaceae/ RRLH-30012	Adavi benda (అడవిబెండ)/ *Common mallow*	Shrub	Root	Powder	Oral	Gonorrhea (7)	AND/GYN	20	0.15	NE	Ghosh *et al*. (2018)
			Root	Paste	Topical	Skin rashes (13)	DER				NA
Boerhavia diffusa L./ Nyctaginaceae/ RRLH-30013	Gudlamalli (గుడ్లమల్లి)/ *Red spiderling*	Herb	Leaves	Decoction	Oral	Leucorrhea (8)	AND/GYN	8	0.06	NE	Rao *et al*. (2015)
Borassus flabellifer L./Arecaceae/ RRLH-30018	Taati chettu (తాటిచెట్టు)/ *Toddy palm*	Tree	Stem	Paste	Oral	Jaundice (14)	LIV	14	0.11	NE	NA
Butea monosperma Lam. Kuntze/ Fabaceae/ CUKH-00123	Moduga Chettu (మోదుగచెట్టు)/ Flame-of-the-forest	Tree	Gum	Paste	Oral	Postnatal Care (23)	AND/GYN	23	0.17	LC	Venkaiah *et al*. (2020)
Guilandina bonduc (L.)/ Fabaceae/ RRLH-30020	Gaccha pappu kayalu	Shrub	Fruits and seeds	Paste	Topical	Swellings (5)	INF	5	0.04	LC	Ganesan & Xu (2017), Dash & Mishra (1999)

	(గచ్చపప్పుకాయలు)/ *Grey nicker*										
Calotropis procera (Aiton) Dryend./ Asclepiadaceae/ RRLH-30027	Tella jilledu (తెల్లజిల్లేడు)/ *Rooster tree*	Herb	Leaves	Pills	Oral	Reduce menstrual pain (9)	AND/GYN	9	0.07	LC	NA
Citrus medica L./ Rutaceae/ RRLH-24387	Maadhi phalam (మాదిఫలం)/ *Citron*	Shrub	Fruits	Juice	Oral	Gastric (2)	GAS	6	0.05	LC	NA
				Juice	Oral	Vomiting sensations (4)	CNS				NA
Coccinia grandis (L.) Voigt/ Cucurbitaceae/ RRLH-24366	Kaki Donda, Tiyya donda (కాకిదొండ, తియ్యదొండ)/ Scarlet-fruited gourd	Herb	Root	Powder	Oral	Joint pains (3)	SKEL	18	0.14	NE	Mohan (2008)
			Leaves	Paste	Topical	Scabies (15)	DER				NA
Cocculus hirsutus (L.) W.Theob./Menispermaceae / RRLH-24374	Chilahinta (చీపురుతీగ)/ *broom creeper*	Shrub	Roots	Decoction	Oral	Arthritis (31)	SKEL	42	0.32	NE	Venkaiah *et al*. (2020), Rao *et al*. (2015)
			Leaves	Decoction	Oral	Leucorrhea (11)	AND/GYN				Sharma *et al*. (2023)
Curcuma longa L./ Zingiberaceae/ RRLH-30026	Pasup (పసుపు)/ *Turmeric*	Herb	Rhizome	Powder	Oral	Antiinflammatory (23)	INF	28	0.21	DD	Jeeva & Femila (2012)
			Rhizome	Powder	Oral	Fever (5)	FEV				NA
Datura stramonium L./ Solanaceae/ RRLH-30022	Nalla ummettha (నల్లఉమ్మెత్త)/ *Jimsonweed*	Herb	Leaves	Paste	Topical	Dermatic problems (15)	DER	15	0.11	NE	Policepatel & Manikrao (2013)
Dichrostachys cinerea (L.) Wight & Arn./Mimosaceae/ RRLH-30014	Veluturu Chettu (వెలుతురుచెట్టు)/ Sickle bush	Shrub	Leaves	Paste	Topical	Headache (17)	INF	60	0.45	LC	NA
			Bark	Decoction	Oral	Elephantiasis (14)	PAR				Sivasankari *et al*. (2014)

			Root	Paste	Topical	Scabies (20)	DER				NA
			Leaves	Paste	Oral	Toothache (9)	INF				NA
Eclipta prostrata (L.) L./ Asteraceae/ RRLH-25023	Guntakalaga Ra (గుంటకలగర)/ False daisy	Herb	Whole plant	Powder	Oral	Liver complaints (32)	LIV	86	0.65	LC	Dash & Mishra (1999), Ganesan & Xu (2017)
			Leaves	Decoction	Topical	Hair tonic (29)	DER				Yabesh *et al*. (2014), Prabhu *et al*. (2020), Venkaiah *et al*. (2020)
			Whole plant	Paste	Oral	Anaemia (25)	BRD				Jeyaprakash *et al*. (2011), Prabhu *et al*. (2020)
Eucalyptus obliqua L'Hér./ Myrtaceae/ RRLH-24370	Jamoil (జుమోలి)/ *Gum tree*	Tree	Leaves	Paste	Topical	Skin infection (4)	DER	10	0.08	NT	Rekha (2013)
Ficus religiosa L./ Moraceae/ RRLH-24391	Raagi chettu (రావిచెట్టు)/ *Sacred fig*	Tree	Fruit	Paste	Oral	Infertility (6)	AND/GYN	12	0.09	LC	Samy *et al*. (2008)
			Bark	Powder	Oral	Leucorrhea (4)	AND/GYN				
			Bark	Decoction	Oral	Diabetes (2)	MET				Kirana *et al*. (2009)
Hemidesmus indicus (L.) R. Br. ex Schult./ Apocynaceae/ RRLH-24392	Palasugandhi or sugandhi pala (పాలసుగంధి / సుగంధిపాల)/ *Indian sarsaparilla*	Shrub	Leaves	Paste	Oral	Blood purification (5)	BRD	5	0.04	NE	Reddy *et al*. (1988)
Hibiscus rosa-sinensis L./ Malvaceae/ RRLH-24380	Mandara (మందార)/ *China rose*	Shrub	Fresh leaves, flowers	Paste	Topical	Boils (28)	DER	84	0.64	NE	Ganesan & Xu (2017), Nayak *et al*. (1998)
			Flower, leaves	Decoction	Oral	Bronchitis (19)	RES				NA

			Leaves	Paste	Topical	Dandruff (24)	DER			Ganesan & Xu (2017), Yabesh *et al*. (2014), Jeeva and Femila (2012)
			Stem	Powder	Oral	Epilepsy (13)	CNS			Santhosh Kumar *et al*. (2019)
Hygrophila auriculata (Schumach.) Heine/ Acanthaceae/ RRLH-24355	Mullagorimi (ముల్లగొరిమి)/ *Marsh barbel*	Herb	Root, Flowers	Powder	Topical	Skin irritation (5)	DER	7	0.05	LC	Sethiya *et al*. (2018)
			Root	Decoction	Oral	Urinary problems (2)	URO				Jeyaprakash *et al*. (2011)
Justicia adhatoda L./ Acanthaceae/ RRLH-30025	Addasaram (అడ్డసరం)/ *malabar nutleaf*	Herb	Leaves	Juice	Oral	Cough (28), breathlessness (16)	RES	44	0.33	LC	Alagesaboopathi (2009), Ganesan & Xu (2017), Yabesh *et al*. (2014)
Marsilea minuta L./ Marsileaceae/ RRLH-24388	Neeti chenchili Kura (నీటిచెంచలికూర)/ Dwarf waterclover	Herb	Leaves	Powder	Oral	Sleeplessness (10)	CNS	10	0.08	LC	Satapathy & Brahmam, 1996
Mimosa pudica L./ Mimosaceae/ RRLH-24368	Athipathi (అత్తిపత్తి)/ *Sensitive plant*	Herb	Leaves	Pills	Oral	Leucorrhea (13)	AND/GYN	22	0.17	LC	Sharma *et al*. (2023)
			Leaves	Juice	Oral	Malaria fever (9)	FEV				Sukumaran *et al*. (2014)
Musa paradisiaca L./ Musaceae/ RRLH-25025	Arati (అరటి)/ *Banana*	Herb	Leaf	Powder	Oral	Cold and cough (16)	RES	48	0.36	NE	Ganesan and Xu (2017), Raju *et al*. (2014)
			Fruit	Decoction	Oral	Diarrhea (21)	GAS				NA
			Rhizome	Decoction	Oral	Impotency (11)	AND/GYN				NA

Nyctanthes arbor-tristis L./ Oleaceae/ RRLH-24357	Paarijatham (పారిజాతం)/ *Coral jasmine*	Shrub	Leaves	Decoction	Oral	Diabetes (8)	MET	8	0.06	LC	Sharma *et al*. (2021)
Ocimum tenuiflorum L./ Lamiaceae/ RRLH-24365	Tulasi (తులసి)/ *Holi basil*	Herb	Leaves	Raw	Oral	Gastric problems (54)	GAS	54	0.41	NE	Yabesh *et al*. (2014) Nayak *et al*. (1998)
Phyllanthus reticulatus Poir./Euphorbiaceae/ RRLH-24394	Nalla puli (నల్లపూలి)/ *Black honey shrub*	Shrub	Leaves	Paste	Topical	Hernia (14)	URO	14	0.11	LC	NA
Piper betle L./ Piperaceae/	Adavi tamalapaku (అడవితమలపాకు) / *Peter pepper*	Shrub	Leaves	Paste	Oral	Stomach purification (5)	GAS	5	0.04	NE	Sureshkumar *et al*. (2017)
Piper longum L./ Piperaceae/ RRLH-24358	Pippallu (పిప్పళ్లు)/ *Indian long pepper*	Herb	Fruit	Paste	Topical	Headache (18)	INF	18	0.14	NE	Yabesh *et al*. (2014)
Plumbago indica L./ Plumbaginaceae/ RRLH-30028	Erra chitramulam (ఎర్రచిత్రమూలం)/ *Whorled plantian*	Herb	Root	Paste	Oral	Indigestion (9)	GAS	24	0.18	NE	Reddy *et al*. (1988)
			Root	Powder	Oral	Blood purification (5)	BRD				Reddy *et al*. (1988)
			Root	Paste	Oral	Improve menstrual flow (4), abortifacient (6)	AND/GYN				Jayaprakash *et al*. (2011)
Plumbago zeylanica L./Plumbaginaceae/ RRLH-24389	Chitrammool Um (చిత్రమూలం)/ Ceylon leadwort	Herb	Roots	Pills	Oral	Abortion (7)	AND/GYN	19	0.14	NE	Venkaiah *et al*. (2020)
			Roots	Paste	Oral	Epilepsy (12)	CNS				Venkaiah *et al*. (2020)
		Tree	Seed	Oil	Topical	Skin pimples (11)	DER	25	0.19	LC	Anitha *et al*. (2008)

Pongamia pinnata (L.) Pierre/ Fabaceae/ RRLH-24384	Kanuga (కానుగు)/ *Indian beech*		Root	Juice	Oral	Sinus ulcers (6)	ENT				NA
			Flower	Powder	Oral	Diabetes (8)	MET				NA
Psidium guajava L./ Myrtaceae/ RRLH-24397	Jaama (జామ)/ *Guava*	Tree	Leaves	Decoction	Oral	Diabetes (6)	MET	6	0.05	LC	Ganesan & Xu (2017), Jeeva & Femila (2012)
Pterocarpus marsupium Roxb/ Fabaceae/ RRLH-24379	Yegisa (ఏగిస)/ *Andaman redwood*	Tree	Root bark	Juice	Oral	Dysentery (14)	GAS	24	0.18	NT	Ignacimuthu *et al*. (2008)
			Stem bark and rhizome	Juice	Oral	Piles (10)	URO				NA
Pterocarpus santalinus L.f./ Fabaceae/ RRLH-24376	Erra chandanum (ఎర్రచందనం)/ *Red sandal wood*	Tree	Stem	Decoction	Oral	Analgesic (9)	INF	12	0.09	EN	NA
			Stem	Decoction	Oral	Anti inflammatory (3)	INF				NA
Ricinus communis L./ Euphorbiaceae/ RRLH-24361	Amudham (ఆముదం)/ *Castor oil*	Herb	Leaves	Raw	Topical	Headache (21)	GEN	48	0.36	NE	NA
			Leaves	Powder	Oral	Menstrual disorders (27)	AND/GYN				Sharma *et al*. (2023)
Solanum lasiocarpum Dunal/ Solanaceae/ RRLH-24403	Poyyadakki (పొయ్యదక్కి)/ *African eggplant*	Herb	Bark	Decoction	Oral	Epilepsy (13)	CNS	13	0.10	NE	NA
Solanum virginianum L. Syn *Solanum surattense* Burm. f./Solanaceae/ RRLH-24363	Peda Poyyadakki (పేద్దపొయ్యదక్కి)/ Yellow fruit nightshade	Herb	Leaves	Pills	Oral	Jaundice (23)	LIV	23	0.17	NE	Venkaiah *et al*. (2020), Rao *et al*. (2015)
Syzygium cumini (L.) Skeels./ Myrtaceae/ RRLH-24383	Neredu (నేరేడు)/ *Java plum*	Tree	Fruits	Raw	Oral	Stomachache (15)	GAS	25	0.19	LC	Ganesan & Xu (2017), Venkaiah *et al*. (2020)

			Fruits	Raw	Oral	Reduces blood sugar level (10)	MET				Alagesaboopathi (2009), Yabesh *et al*. (2014), Venkaiah *et al*. (2020)
Tamarindus indica L./ Fabaceae/ RRLH-24378	Chintha chettu (చింతచెట్టు)/ *Tamarind*	Tree	Stem	Pills	Oral	Bone fractures (15)	SKEL	15	0.11	LC	Sureshkumar *et al*. (2017), Sukumaran *et al*. (2014), Jeeva & Femila (2012)
Tectona grandis L.f./ Lamiaceae/ RRLH-30016	Teku (టేకు)/ *Teak*	Tree	Stem	Paste	Topical	Muscle pains (15)	SKEL	15	0.11	EN	NA
Terminalia arjuna (Roxb. ex DC.) Wight & Arn./ Combretaceae/ RRLH-30015	Tellamaddi (తెల్లమద్ది)/ *Arjun nut*	Tree	Seeds	Powder	Oral	Asthma (6)	RES	11	0.08	NE	NA
			Leaves	Paste	Topical	Earache (2)	ENT				NA
			Stem	Decoction	Oral	Heart problems (3)	CAR				Silambarasan & Ayyanar (2015)
Tinospora cordifolia (Willd.) Miers ex Hook.f. & Thomson/ Menispermaceae/ RRLH-25024	Tippa teega (తిప్పతీగ)/ *Moonseed*		Leaves	Paste	Oral	Diarrhoea (24)	GAS	52	0.39	NE	NA
			Leaves	Powder	Oral	Jaundice (11)	LIV				NA
			Stem	Decoction	Oral	Joint pains (17)	SKEL				Bhattacharjya *et al*. (2023)
Vitex negundo L./ Lamiaceae/ RRLH-30021	Nalla vavili (నల్లవావిలి)/ *Horse shoe*	Shrub	Leaves	Paste	Topical	Joint pains (4)	SKEL	4	0.03	LC	Ganesan & Xu (2017), Yabesh *et al*. (2014)
Withania somnifera (L.) Dunal/ Solanaceae/ RRLH-30024	Ashwa gandha (అశ్వగంధ)/ *Winter cherry*	Herb	Leaves	Powder	Oral	Cardiac problems (22)	CAR	35	0.27	NE	Raju *et al*. (2014), Esakkimuthu *et al*. (2016)
			Leaves	Powder	Oral	Nerve weakness (13)	CNS				Singh *et al*. (2020)

Family importance value (FIV)

The culturally most important botanical families according to their FIVs were Acanthaceae (126.6) followed by Amaranthaceae (126), Fabaceae (96.3), and Asteraceae (86) (Figure 5). The lowest FIV index was recorded for Oleaceae (8) followed by Apocyanaceae (5). The high FIV values may be attributed to the widespread distribution of these families in Andhra Pradesh. The dominance of these families has also been previously reported in Andhra Pradesh (Pullaiah *et al*., 2016). Several previous studies have reported high Family Importance Values (FIV) for these plant families, indicating their significant role in traditional medicinal practices (Thakur 2018; Benkhnigue *et al*., 2020; Zareef *et al*., 2023; Sehgal *et al*., 2024).

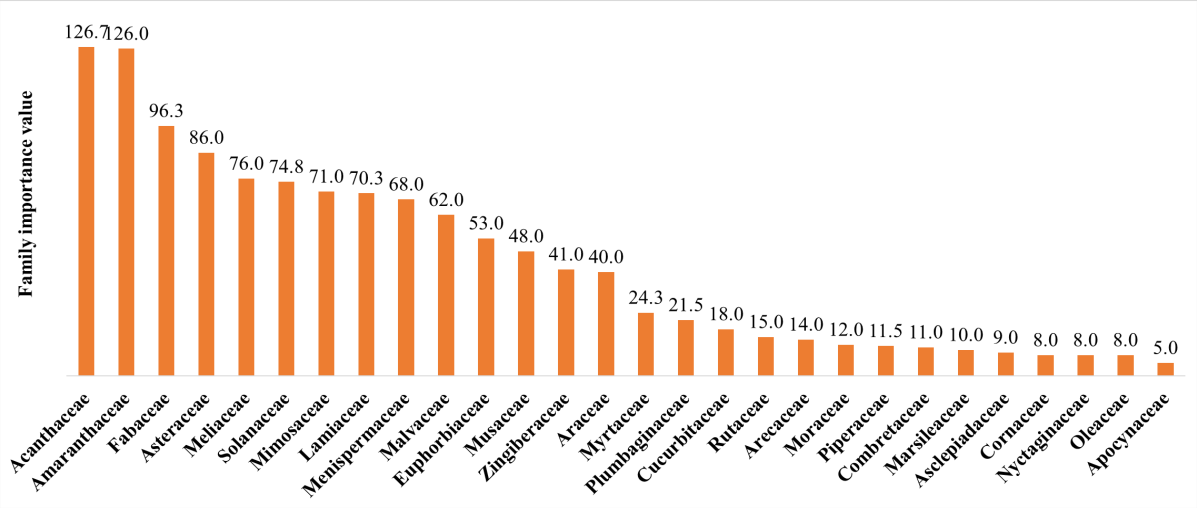

Figure 5. Family importance values (FIVs) of the medicinal plants employed in the health care practices in the study area.

Relative frequency of citation (RFC)

The RFCs reported for the documented species were in the range of 0.03-0.77. The highest RFC value was obtained for *Achyranthes aspera* L. (0.77), followed by *Andrographis paniculata* (Burm.f.) Nees (0.74), *Eclipta alba* (L.) L. (0.61), *Hibiscus rosa-sinensis* L. (0.59), *Azadirachta indica* A.Juss. (0.54) (Table 2). RFC values are used to find out the most commonly mentioned taxa for treating diseases (Vitalini *et al*., 2013). The plant species' easy availability, vast distribution, and long-standing cultural practices in the region may be the cause of the high RFC value (Kayani *et al*., 2015). These kinds of plants could be helpful for future drug discovery as well as phytochemical and pharmacological targeting in the future. In addition to the aforementioned, conservation should be prioritized because overharvesting might jeopardize their population.

Achyranthes aspera, an annual herb, is used in Ayurveda as a laxative, pungent, carminative, and stomachic (Pandey *et al*., 2013). It is also known traditionally to treat health problems like malaria, dysentery, fever, asthma, diabetes, and hypertension (Mankilik *et al*., 2021). People in Northern Pakistan consume the plant decoction to treat asthma and cough (Kayani *et al*., 2014). In Bangladesh, it is widely used for rheumatism, indigestion, fever, painful micturition, easy labor, abdominal pain, scurvy, canker sore, and as an abortifacient (Kadir *et al*., 2014). It is used by Hoklos people in China to get relief from tonsillitis, dysmenorrhoea, dieresis, and premature menopause (Li *et al*., 2016). Triterpenoids, polypeptides polysaccharides, ketosteroids, and saponins are the main bioactive components of *Achyranthes aspera* (He *et al*., 2017). *A. paniculata* commonly known as 'Kalmegh' in India is used in folk medicines in India, China, Pakistan, Bangladesh, Philippines, and Malaysia to treat respiratory infections, common cold, pharyngitis, encephalitis B, pneumonia, urinary tract infections, hepatic problems, indigestion, and dermatic problems (Jayakumar *et al*., 2013; Hossain *et al*., 2014). *A. paniculata* is rich in diterpenoid lactones, especially 14-Deoxy-11,12-dehydroandrographolide, andrographolide, and 14-deoxy andrographolide (Rafi *et al*., 2020).

Eclipta prostrata is another important plant species utilized by the local inhabitants in treating liver problems. It is utilized in Ayurveda for its anti-aging and rejuvenating properties (Puri 2002). It is also used in treating chicken pox by the Oraon and Gor tribal groups of Bangladesh (Azam *et al*., 2013). *E. prostrata* is commonly used in Brazilian folk medicine to treat syphilis, leprosy, snakebites, and filariasis (Morel *et al*., 2017). People in Pakistan use its leaf paste to treat ringworm, allergy, and athlete's foot (Arshad *et al*., 2011). *E. prostrata* contain several chemical constituents like cardiac glycosides, alkaloids, steroids, alkenynes, flavonoids, lipids, saponins, steroidal alkaloids, phytosterol, and triterpenes (Puri 2002; Timalsina and Devkota 2021).

The roots and flower buds of *Hibiscus-rosa-sinensis* are employed in treating skin diseases, burning sensation, fatigue, and blood dysentery by the people in the Eastern Himalaya (Pala *et al*., 2019). Gujjar tribe use leaf powder of this plant in treating menstrual disorders in Uttarakhand (Sharma *et al*., 2023). People in Kuwait use flowers as an aphrodisiac and as a remedy for boils in the Philippines, whereas the whole plant is used in treating chicken pox and the roots to heal coughs in Nepal and South Africa respectively (Kapoor *et al*., 2021). Phytochemicals reported in this plant include tannins, saponins, glycosides, riboflavin, fats, apigenidine, thiamine, oxalic acid, quercetin, citric acid, ascorbic acid niacin, pelargonidine, sitosterol, cyclic teraxeryl acetate, phytosterols, flavonoids, malvalic and sterculic acids (Amtaghri *et al*., 2024).

Azadirachta indica, an evergreen tree of family Meliaceae is used in Bangladesh for the treatment of gastritis, high blood pressure, jaundice and flatulence (Uddin *et al*., 2013). Local people in Dindigul district, Tamilnadu use the bark, seed, flower and oil of this plant against eczema, hyperdipsia, leukoderma, fever and as spermicidal (Sivasankari *et al*., 2014). Some biologically active phytochemicals obtained from different parts of *A. indica* includes Nimbin (antifeedent), nimbolide (anti-inflammatory), sugiol (microbial), azadiradione (antifungal), gedunin (antimalarial), lupeopl (anticancerous), nimbiol (anti-acne), mahmoodin (antibacterial), nimbothalin (insecticidal) (Saleem *et al*., 2018).

Informant consensus factor (ICF)

The current study collected 1493 use-reports for 59 ailments that were grouped into 16 categories. According to Weckerle *et al*. (2018), the homogeneity in the information among informants regarding the medicinal value of plants may assist in directing future research investigations that seek to assess their toxicity and efficacy. Consequently, we employed two significant quantitative indicators in addition to the conventional uses for plants for analyzing the data. The ICF values of the present study ranged between 0.88-0.98 (Table 3).

Table 3. Informant Consensus Factor (ICF) for disease categories.

Disease categories	Names of the ailments	Number of taxa used (N_t)	Number of use reports (N_{ur})	Informant consensus factor (ICF)
Antidote	Scorpion sting, snake bite	4	61	0.95
Andrological/gynaecological/birth problems	Gonorrhoea, leucorrhoea, postnatal care, infertility, abortion, impotence, menstrual problem	12	136	0.92
Blood-related disorders	Anaemia, blood purification, blood detoxification	4	51	0.94
Cardiovascular disorders	Heart problems	2	25	0.96
Central Nervous system disorders	Sleeplessness, epilepsy, insomnia, vomiting sensation, nerve weakness	8	87	0.92
Dermatological disorders	Boils, skin rashes, scabies, hair tonic, dandruff, skin irritation, skin pimples, skin infection, white patches of skin	14	255	0.95
Ear, Nose, and throat disorders	Sinus ulcers, earache, sore throat	3	15	0.86
Fever	Fever, malaria fever	4	44	0.93
Gastrointestinal disorders	Dysentery, diarrhea, stomach pain, gastric problems, stomach purification, indigestion	11	220	0.95
Inflammation and pain	Headache, toothache, analgesic,	9	111	0.93
Liver disorders	Liver complaints, jaundice	4	80	0.96
Parasitic problem	Elephantiasis, deworming	2	55	0.98
Respiratory disorders	Cold, cough, bronchitis, asthma, breathlessness	8	166	0.96
Skeleto-muscular disorders	Joint pain, muscle pain, arthritis, bone fracture	6	85	0.94
Urological and rectal disorders	Urinary problems, kidney stones, hernia, piles	4	58	0.95
Endocrine/Metabolic and Nutritional disorders	Diabetes	6	44	0.88

The highest consensus was found for parasitic disorders (ICF=0.98), and *A. paniculata* was the most accepted medicinal plant. The other disease categories having high ICF values were respiratory disorders (166 UR and 8 species), liver disorders (80 UR

and 4 species), and cardiovascular disorders (25 UR and 2 species) which have similar ICF values of 0.96. The high ICF values may be ascribed due to the lack of alternative resources for these problems or the small number of species used to treat these ailments. A high ICF score for a certain illness category may also depict how effective the plants are in curing specific categories of illnesses (Cakilcioglu *et al*. 2011). Previous ethno-medicinal studies in different Southern states of India have also reported a high consensus for most of the ailment categories (Xavier *et al*., 2014; Krupa *et al*., 2019; Srinivasan *et al*., 2021). However, with an ICF value of 0.88, the respondents' agreement was the lowest for the disease category namely Endocrine/Metabolic and Nutritional disorders. The possible reason for this could be the cultural diversity and diversity in the usage of plant species among the informants over the treatment of this particular disease category.

Threats and conservation of medicinal plants

The 53 medicinal plant species reported in the present study include endangered species viz., *Pterocarpus santalinus* L.f., *Tectona grandis* L.f., and near threatened species viz., *Aegle marmelos* L. Correa, *Eucalyptus obliqua* L'Hér., *Pterocarpus marsupium* Roxb. as per IUCN (IUCN, 2023). In the current study, the main threats to plant diversity loss were habitat degradation caused by deforestation, and urbanization. The construction of this Polavaram Dam also has the potential to significantly reduce plant species diversity in the future by flooding natural habitats, altering ecosystems, and fragmenting populations. Given the importance of medicinal plant species such as *P. santalinus*, *T. grandis*, *A. marmelos*, *E. obliqua*, and *P. marsupium*, in situ and ex-situ conservation efforts are critical. During this study, researchers highlighted the need of sustainable harvesting methods with locals, such as nondestructive sampling, selective harvesting, safeguarding critical ecosystems, and farming threatened species. To ensure the sustainable use of the region's plant resources, the relevant authorities must provide adequate training and education to both locals and herbal healers.

Comparative assessment with previous studies in Polavaram Mandal of Andhra Pradesh

The literature review revealed (Table 2) similarities in the uses of plant species from other parts, underscoring the perception of human societies in leveraging the resources available to them for healthcare purposes. A comparative assessment of the present study with those conducted in the same region has disclosed additional medicinal properties in addition to those reported in the present study. The additional use of *Aerva lanata* (L.) Juss. (leaves), *Hemidesmus indicus* (L.) R. Br. ex Schult. (roots), *Nyctanthes arbor-tristis* L. (stem and leaves), *Ocimum tenuiflorum* L. (leaves), *Piper betle* L. (leaves) for asthma problems was found in the study of Kumar (2012).

Likewise, additional uses were found in the study of Kumar (2015) and include *Abrus precatorius* L. (root; jaundice and ulcers), *Achyranthes aspera* (whole plant; pneumonia, renal dropsy, opthalmia and dysentery), *Alangium salviifolium* (L.f.) (stem; arthritis), *Amorphophallus paeoniifolius* (Dennst.) Nicolson (Corms; dysentery, piles, throat infections, and bleeding piles), *Andrographis paniculata* (leaves; diabetes), *Azadirachta indica* (leaves and bark; jaundice and stomach ache, diarrhea respectively), *Boerhavia diffusa* L. (roots and leaves; colic stomachache and increase in sperm count), *Borassus flabellifer* L. (fruits; intestinal worms and skin diseases), *Butea monosperma* Lam. Kuntze (root; bone fracture, seed paste; kill intestinal worms and root; dental problems, *Calotropis procera* (Aiton) Dryend. (stem bark; snakebite, root; diabetes), *Coccinia grandis* (L.) Voigt (root tubers; asthma, leaf; gastric problem), *Cocculus hirsutus* (L.) W.Theob. (leaf; cooling agent), *Curcuma longa* L. (rhizome; indigestion, headache and skin problems), *Dichrostachys cinerea* (L.) Wight & Arn. (roots; rheumatic pains, paralysis, bone fracture), *Ficus religiosa* L. (root or stem: paralysis and dysentery), *Hemidesmus indicus* (root: dysentery), *Musa paradisiaca* L. (rhizome; cooling agent, stem: abortifacient), *Nyctanthes arbor-tristis* (leaves: intestinal worm and allergies, flowers and leaves: rheumatism and fever), *Plumbago zeylanica* L. (roots: rheumatic pains and skin diseases), *Psidium guajava* L. (bark; dysentery, leaves; wounds, indigestion problems, cholera, fever, rheumatic pains and epilepsy), *Pterocarpus santalinus* (leaves; skin diseases, gum; diarrhoea and dysentery, stem bark; cough and dysentery), *Ricinus communis* L. (leaf; cough, throat infection, seed; purgative and culinary), *Syzygium cumini* (L.) Skeels (roots; skin disease, stem; rheumatic pains, fruits; digestion, seed; diabetes), *Tamarindus indica* L. (seeds; dysentery, burning sensation, giddiness and ulcers), *Tectona grandis* (bark; bronchitis, burning sensation), *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn (root; wounds, leaf; asthma, stem bark; rheumatic pains). However, several new uses are also reported in the present study.

The additional uses found in Kumari and Vishnuvardhan (2017) include *Acalypha indica* L. (leaves; jaundice), *Achyranthes aspera* (leaf; chicken pox, jaundice), *Aegle marmelos* (roots; diabetes), *Andrographis paniculata* (leaves; diabetes), *Azanza lampas* flowers; syphilis), *Butea monosperma* (stem bark; infertility), *Coccinia grandis* (leaf; scabies), *Dichrostachys cinerea* (root; leprosy and syphilis), *Eclipta prostrata* (whole plant; anaemia and diarrhea), *Hemidesmus indicus* (root; diarrhoea and menstrual disorders), *Hibiscus rosa-sinensis* (leaves; leucorrhoea), *Marsilea minuta* (leaves; ringworms), *Musa paradisiaca* (roots and leaves; epilepsy and jaundice respectively), *Piper longum* L. (leaves and seeds; cold and cough and asthma), *Plumbago zeylanica* (whole plant; viral infections, roots; ringworm), *Pterocarpus marsupium* (stem; conception), *Terminalia*

arjuna (seed; diabetes), *Tinospora cordifolia* (Willd.) Miers ex Hook.f. & Thomson (leaves; foot and mouth disease, whole plant; viral infections).

New reports for medicinal plants

A comparison of previous ethnomedicinal studies from a neighboring region revealed 28 new medicinal uses for southern states of India viz., Andhra Pradesh, Tamil Nadu, Kerala, and Karnataka (Table 2). These include *Alpinia galanga* (rhizome) to treat malarial fever; *Amorphophallus paeoniifolius* (rhizome) to treat stomach pain; *Azanza lampas* (roots) to treat skin rashes; *Borassus flabellifer* (stem) to treat jaundice; *Calotropis procera* (leaves) to treat menstrual problems, *Citrus medica* (fruits) to treat gastric problem and vomiting sensations; *Coccinia grandis* (leaves) to treat scabies; *Curcuma longa* (rhizome) to treat fever; *Dichrostachys cinerea* (leaves, root) to treat headache, toothache and scabies; *Hibiscus rosa-sinensis* (leaves, flower) to treat bronchitis; *Musa paradisiaca* (fruit, rhizome) to treat diarrhoea and impotency; *Phyllanthus reticula*tus (leaves) to treat hernia; *Pongamia pinnata* (roots, flower) to treat diabetes and sinus ulcers; *Pterocarpus marsupium* (stem bark, rhizome) to treat piles; *P. santalinus* (stem) as analgesic; *R. communis* (leaves) to treat headache; *S. lasiocarpum* (bark) to treat epilepsy; *T. grandis* (stem) to treat muscle pains; *T. arjuna* (seeds, leaves) to treat asthma and earache; *T. cordifolia* (leaves) to treat diarrhea and jaundice. The uses indicate the richness of the ethnomedicinal knowledge of the villagers.

Harmful effects of medicinal plants

The informants caution against overdosing on herbs like *Ricinus communis* and *Abrus precatorius* because it can be dangerous. The informants provided general information about the consequences of using these plants on humans during the study, however, they were unfamiliar with the precise hazardous element(s), and their rate of action. The toxicity of abrin is linked to its capacity to inhibit the cellular expression of the protein, which is linked to the toxicity of *A. precatorius*. Human health is said to be negatively impacted by a bisphenol concentration of 0.1 to 1 mg/kg bw (Dickers *et al*., 2003). The toxic substance ricin, which has a fatal dose (LD50) of 3-5 g/kg for inhalation and 20 mg/kg for oral administration, is present in *R. communis* (Moshiri *et al*., 2016). Tropane alkaloids are primarily responsible for *D. stramonium's* toxicity (Gaire and Subedi 2013).

Perspectives on School Education

The findings of this study hold significance for school education, particularly in creating an awareness and appreciation for local biodiversity and indigenous knowledge systems (IKS). The NEP 2020 in India emphasizes the need of enhancing students' comprehension of their global social responsibilities by promoting cultural rootedness and incorporating indigenous knowledge systems into modern education. Similarly, to promote ecologically accountable behavior and biodiversity conservation, NCF 2023 supports place-based learning and the integration of Indigenous Knowledge into the curriculum. This ethnobotanical research sheds light on the cultural, ecological, and economic significance of plants while offering important insights into their traditional use in medicine. Documenting the presence of families like Fabaceae, Solanaceae, and Acanthaceae, as well as the use of herbs for medicinal purposes, highlights the potential of this study to teach students about local biodiversity and sustainable practices. Furthermore, the findings about the widespread use of naturally occurring plants like *Achyranthes aspera* and *Andrographis paniculata* demonstrate how much the community depends on these resources, which is consistent with NEP's objectives of promoting local knowledge and safeguarding the environment. The inclusion of such disciplines in the school curriculum aligns with the interdisciplinary methods suggested by NEP 2020 and NCF 2023. Lessons on the preparation of herbal remedies, the sustainable use of resources, and the preservation of endangered species like *Tectona grandis* and *Pterocarpus santalinus* can motivate students to find links between what they learn in the classroom and the real world. The study's focus on sustainable harvesting practices and medicinal plant preservation concurs with NCF 2023's goal of promoting ecological literacy among students. Furthermore, to improve their teaching strategies, STEM education modules might include quantitative ethnobotanical indicators such as Informant Consensus Factor (ICF), Relative Frequency of Citations (RFC), and Family Importance Value (FIV). Students who comprehend these concepts acquire a greater understanding of the importance of data collection, analysis, and interpretation in understanding and preserving biodiversity. By integrating the results of this research into the science curriculum, educators may create culturally responsive learning environments that respect indigenous knowledge and promote scientific inquiry and critical thinking. This approach not only fulfills the NEP 2020's vision of an all-encompassing, multidisciplinary education system, but it also ensures that the next generation will be equipped with the knowledge and values necessary for safeguarding their local and cultural heritage.

Conclusion

The present study is the first quantitative assessment of indigenous medicine in Polavaram. The study reported 53 plant species used in basic healthcare services by the local people in the area. The current study documents new medicinal claims

for 20 plant species, demonstrating that herbal therapies based on traditional knowledge are practiced in Polavaram. The most preferred plant parts used in herbal preparations were leaves. Plant species with the highest RFC values were *Achyranthes aspera*, *Andrographis paniculata*, *Eclipta alba*, and *Hibiscus rosa-sinensis*. Based on ICF values, high agreement amongst the informants was found for the plants used to treat parasitic problems, respiratory disorders, liver disorders, and cardiovascular disorders. The high ICF values obtained in the present study indicate that the gathered data can be employed as a reliable source for further ethnopharmacological studies in the future. New medicinal uses were reported for *C. grandis*, *D. cinerea*, *F. religiosa*, *H. rosa sinensis*, *H. auriculata*, *M. minuta*, *M. pinnata*, *M. pudica*, *P. reticulatus*, *S. indicum*, *S. anacardium*, *S. anacardium*, *T. arjuna*, *T. grandis*, *A. paeoniifolius*, *R. communis* and *C. bonducella*. These species may offer novel bioresources for the study of several bioactive principles and the discovery of potential treatment targets for a multitude of diseases. It is envisaged that the findings of this study would serve as a foundation for chemical, pharmacological, and agronomic bioprospecting research targeted at ensuring the long-term sustainability of plant germplasm resources in this region. Moreover, integrating local medicinal plant knowledge into educational curricula might enhance cultural awareness and respect for indigenous heritage among students, hence encouraging sustainable and contextually relevant learning in scientific education.

Declarations

List of abbreviations: EN-Endangered; NT-Near threatened; LC-Least concern; DD-Data deficient; NE-Not evaluated.
Ethics approval and consent to participate: Verbal prior informal consent was obtained before the survey.
Availability of data and material: All the supporting data available in the article.
Declaration of competing interest: The author declared no competing interest.
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Author's Contribution: AK and KS conceptualized the study. KDC conducted the field study. KS and AT wrote the manuscript. KS, VSG, and SG, AK revised and edited the manuscript.

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