

An Ethnobotanical Study of Medicinal plants and Traditional practices of Ethnic people in Anantapur District, Andhra Pradesh, India

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Keywords: Anantapuram, Ethno botany, India, Ethnic people, Traditional medicine, Medicinal plants

Posted Date: June 19th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-33811/v1>

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Abstract

Ethnopharmacological relevance

Anantapuram district is known for rich plant source and their traditional practices from long time by certain tribes for different diseases. Despite of increase in acceptance of traditional medicines in India, this rich indigenous knowledge about medicinal plants of Anantapuram district is not adequately documented previously.

Methods

Extensive was done for past three years and a total of 66 plants from 66 species and 64 genera of 42 families were recorded. Interviews, Observations and guided talks with 415 participants were conducted to obtain ethno botanical data on medicinal plants grown and maintained in Anantapuram District of Andhra Pradesh, India. The names of plant species, their local name, mode of administration and parts used for different diseases are gathered with F_{IC} and FL values.

Results

Plants widely used to cure the common symptoms of Intestinal disorders has highest agreement of F_{IC} , followed by Toothache, Fever, Snake bite, Eye drops, Dermatological, Headache (0.88%), Hair shampoo (0.87%), Cut and Wounds (0.85%), Boils and Burns (0.84%), Bronchitis/cough (0.83%), Earache (0.82%), Pain (0.82%), Antihelmintic (0.81%), Diabetes (0.81%) and Stress (0.63%).

Conclusion

This ethano botanical survey noticed that in Anantapuram very few medicinal plants were reported with their traditional use, can be an important economic source to develop this region and also planned exploitation is needed to make tribal people to continue folk medicine.

1. Introduction

From the beginning of human civilization plants have been used in the treatment of various diseases [1, 2]. According to world health organization most of the drugs are plant based and many of the drugs have to be discovered for different diseases depends on medicinal plants [3]. India is the richest source and with different cultures in which medicinal plants are used as traditional medicine like Ayurvedha, Unani, Siddha and Homeopathy [4, 5]. In India almost 2500 plant species having medicinal value are explored in folk, herbal and traditional medicine [6, 7]. The use of plants as medicine is an age old practice in India coming from generations to generations and is lack of proper documentation [8]. Still a lot of information is with the local people and in the form of unrevealed data [9]. The use of medicinal plants as medicine is a tradition in ethnic groups living in the deep forest and one among them is tribal group [10, 11]. For many tribal people forest products are economy source and also internally connected with habits and habitats like grouping the medicinal plants [12]. There are to gather 427 tribal communities all over India.

Scheduled tribal population in the country is about 5.38 million which is about 7.5% of the total population of the country [13]. The estimation of the tribal people living area comprises a total of 15% in the geographical area of India [14].

Ethnic communities are isolated from civilization particularly in Anantapuram district of Andhra Pradesh, India [15, 16]. In Anantapuram, the forest area with different tribal people located at different hill pockets. These hill regions are mainly occupied by chenchus, yerukulas, sugalis or Lambadi groups [17]. These tribal caste people have knowledge about the use of phytomedicine to cure many diseases from so many years [18]. Anantapuram forest area is ecologically sensitive covering different products which are used for many purposes among the group. An ethnic community mostly depends on forest products for their livelihood. The tribal people of Anantapuram district, Andhra Pradesh used to gather products from forest based on the traditional knowledge which is passed from their ethnic practices and ancient culture [19]. Previous studies reported on medicinal plants as crude drugs of few tribes and also only Gooty mandal in Anantapur district by ethnobotanists [20]. This study includes information about different plant species and their significant use as a traditional medicine in the area of Anantapuram district, Andhra Pradesh, India. The data is compiled with a list of traditional plants used as herbal drugs as alternative to allopathy medicine used in this area and recorded through field surveys [21]. In this area, knowledge on traditional medicine is passing from generation to generation particularly among only some families. Due to lack of documented report of medicinal plants and their uses in Anantapuram district, the present study to gather information on traditional knowledge in different areas of Anantapuram district. Our data is compared to other reported data of Anantapuram district whether this information is the first time or previously published in the region [22, 23].

2. Methodology

2.1 Study Area

Anantapuram District is the largest district of Andhra Pradesh and second largest in India, one among the four of rayalaseema region, located in coordinates 14°42'N and 77°36'E (Fig. 1). The boundaries include Kurnool District- North, Kadapa-East, Chittoor-south east and Karnataka-south west and west. The District is oblong shaped and with high plain at central portion with population density 213/Km². In Anantapuram district all together 24 tribal communities are present at different locations. Anantapuram district has highest tribal community literacy rate when compared to other districts of rayalaseema region. We selected thandas and tibal areas of Madakasira, Kundurpithi, Bukkarayasamudram, Karakamukkala, Rayalacheruvu and Venkatapuram of Anantapuram district for survey.

2.2 Soils and climate

The climate is moderate to very hot in normal days with low rain fall and predominant with red soil when compared to black soil. This region has more species with abundant medicinal properties because of low water levels and rich minerals in the soil. Every year low rain fall is recorded in the district and no water running rivers are available except Penna river.

2.3 Collection of data and survey

The data was collected in all seasons at selected tribal areas of Anantapuram district to cover selected areas in a year. Four hundred fifteen individuals of traditional practitioners and villagers were selected for interview (Table 1). Each field exploration was 10–15 days duration covering 2–3 tribal pockets in adjacent areas [24]. The first day of the village was used to collect data about tribal beliefs, customs, food habits, practices and other regular information from the village head, cross checked with the literature for confirmation and documented [25]. In next two to three days ethno botanical uses of medicinal plants available at that region was gathered by local practitioners and herbal doctors [26]. Also the part of plant used for particular disease, method and time required in curing disease by the medicinal plant, mode of administration, ingredients used additionally, dosage duration were collected and recorded. The most common treatments which are cured by herbal treatment like pain, headache, fever, wounds and burns were also recorded [27]. This collection of data was done during all seasons in same areas and confirming the data collected along with gathering of additional information. Several discussions were made with local people at different times for not only collecting data but also to confirm the use of medicinal plants recorded at other places.

2.4 Herbarium preparation and Preservation

The information about usage, dosage, mode of preparation and administration was recorded and stored [28]. The village leaders, traditional medicine users, doctors and tribal people were chosen for interviews and cross checked to find whether collected information is true or false by herbal practitioners (Fig. 2). The plant species was further confirmed and compared by authenticated specimens present at Sri Krishnadevaraya University, Anantapuram, Andhra Pradesh. The collected specimens were deposited at Department of Botany Herbarium, S.S.B.N.Degree College, Anantapuram. The nomenclature of the collected specimen was done accordingly Bentham and Hooker system of classification following the arrangement of flora in presidency of Chennai [29].

2.5 Informants consensus factor (F_{IC})

Homogeneity of the given information by the ethnic groups was calculated by Informants consensus factor. The F_{IC} values are calculated using given following formula [30, 31].

$$FIC = \frac{Nur - Nt}{Nur - 1}$$

Where Nur and Nt are the total number of used reports in a disease category by people and total number of species used to treat that particular category by people respectively.

2.6 Fidelity level value

The fidelity level (FL), the percentage of people using plants for the same major diseases was calculated using following equation [32].

$$FL = \frac{I_p}{I_u} \times 100$$

Where I_p is the total number of people who suggested particular plant species for a disease separately and I_u is the number of people informed the same plant for any disease.

2.7 Statistical study

The data collected on the traditional medicinal plants from Anantapuram district, documented using MS office excel software. The scientific name, local name and mode of administration were tabulated. The data on parts used, habit and diseases were represented in the form of figures based on the collected data.

3. Results And Discussion

A total of 415 informants (195 males and 220 females) ranging from 30 and 60 years, in which 53.02% males and 46.98% females are interviewed (Table 1).

Table 1
Age and Sex characteristics of participants interviewed in tribal areas of Anantapuram, Andhra Pradesh, India

	< 20	20–29	30–39	40–49	50–59	> 60	Total	Percentage
Female	10	50	60	21	28	26	195	46.98
Male	20	60	50	25	29	36	220	53.02
Total	30	110	110	46	57	62	415	100.00

Among females, age group around 30 are high and below 20 are less in number. In males age group of 20 are high in number and below 20 are less in number. The average age of the informants was 40 year old. Illiteracy rate was high in females (30.76%) than male (25.01%) and in females literacy rate at primary level was 27.69%, middle level 24.61%, secondary level 12.83% and University level 4.11%. In males literacy rate at primary level was 15.91%, middle level 20.91%, secondary level 23.63% and University level 14.54%. The literacy rate gradually increased from primary to university in males whereas in females it is decreased in our observation (Table 2).

Table 2
Education level of interviewed ethnic informants.

Education level	No. of Participants		Percentage (%)	
	Female	Male	Female	Male
Illiterates	60	55	30.76	25.01
Primary	54	35	27.69	15.91
Middle	48	46	24.61	20.91
Secondary	25	52	12.83	23.63
University	08	32	4.11	14.54
Total	195	220	100	100

3.1 Ethanobotanical applications

This investigation showed that in Anantapuram region 66 species and 64 genera belonging to 42 families to cure 16 human ailments. The data collected about ethnomedicinal plants from ethnic communities arranged alphabetically along with local names and medicinal uses (Table 3).

Table 3: Ethano botanical studies and application of medicinal plants identified at Anantapuram district, India

<i>Plant name</i>	Family	Local name	Part used	Growth form	Mode of Administration	Method of preparation and diseases treated
<i>Adhatoda zeylanica L./ justicia adhatoda L</i>	Acanthaceae	Addasaram	Leaf	Shrub	Oral	1. Leaf decoction mixed with fruits of piper longum (pippallu) for to cure asthma with cough. 2. Leaf paste mixed with gingerly oil and slightly heated and applied on the affected part of psoriasis.
					Body lotion	
<i>Aganosma dichotoma (Roth)K.Schum/Aganosma heynei (Spreng.) Ined.</i>	Apocynaceae	Malati teega	Root	Shrub	Oral	A decoction of root given as a tonic for fever.
<i>Alangium Salvifolium (L.f)</i>	Alangiaceae	Vooduga	Leaf	Tree	Plaster	Boiled leaves made into paste and plastered over fractured bones.
<i>Ammannia baccifera L.</i>	Lythraceae	Agnivendrapu aku	Leaf	Herb	Body lotion	Fresh leaves used in skin disease.
<i>Annona reticulate L.</i>	Annonaceae	Ramaphalam	Leaf	Tree	Spray	Leaves or seed paste applied on head to kill lice.
<i>Azadirachta indica L.</i>	Meliaceae	Vepa	Leaf and seed	Tree	Oral	Leaf extracts or seed oil given orally as an antihelmintic.
<i>Bauhinia racemosa Lam</i>	Caesalpinioideae	Kantasara teega	Root	Shrub	Oral	Root crushed with jiggery and the filtrate administered for fever for 3 days.
<i>Brassica nigra (L.)</i>	Brassicaceae	Aavalu	Seed	Herb	Oral	Mustard seeds along with black peppers cumin seeds and ginger (zinger officinalis) is powdered and the decoction used to cure diarrheas.
<i>Calophyllum inophyllum L</i>	Clusiaceae	Ponna chettu	Fruit	Tree	Ointment	Dried fruit is fried and powdered by adding a pinch of salt applied to the gums and used as tooth powder for tooth ache.
<i>Calotropis gigantean (L)</i>	Asclepiadoideae	Tella jilledu	Leaf	Shrub	Body lotion	Leaves heated with castor oil (ricinus communis) and applied on boils, blisters of skin diseases.
<i>Centella asiatica L.</i>	Apiaceae	Saraswathi aku	Leaf	Herb	Oral	Leaf juice taken as for improving memory and useful skin disease.
<i>Canthium dicoccum (Gaertn.) Merr.) / Psydrax dicoccos Gaertn</i>	Rubiaceae	Nalla balusu	Stem bark	Tree	Oral	The bark paste is used treatment of fevers.
<i>Celastrus paniculatus Willd.</i>	Celastraceae	Jyothshmati	Seed	Shrub	Lotion	Seeds paste mildly heated and gently massaged for rheumatic pains.
<i>Combretum albidum G.Don</i>	Combretaceae	Yaada teega	Leaf	Herb	Body lotion	Warm leaf paste applied on boils, blisters and also for skin diseases.
<i>Convolvulus pluricaulis choisy</i>	Convolvulaceae	Shankapushpi	Whole plant	Herb	Oral	Whole herb is used to improve memory, intelligence and also used in vomiting, toxic conditions.

<i>Cryptostegia grandiflora R.Br</i>	Periplocoideae	Pala teega	Latex	Twiner	Ointment	Latex applied for cuts and boils.
<i>Curcuma longa L.</i>	Zingiberaceae	Pasupu	Rhizome	Herb	Ointment	Fresh rhizome, ground with cow's milk and castor oil applied on paronychia.
<i>Datura metel L.</i>	Solanaceae	Vummetha	Leaf	Shrub	Ointment	1. Leaf juice and paste applied on the burns. 2. Leaf juice applied on the scalp an hour before washing the hair. It continued for 15 days stop hair loss due to lice infection
					Shampoo	
<i>Emblica officinalis Gaertn./ Phyllanthus acidus (L.)</i>	Euphorbiaceae	Usirikaya	Seed and fruit	Tree	Oral	1. The seeds used in the treatment of asthma and bronchitis. 2. The dried fruit used as oil for the head to cooling and stress.
					Hair oil	
<i>Evolvulus alsinoides (L.)</i>	Convolvulaceae	Vishnukrantha	Leaf	Herb	Oral	1. Leaf paste mixed with onion paste (allium cepa) administered with cow's milk twice a day for jaundice. 2. Plant decoction used administered 2 to 3 times a day for cooled.
					Oral	
<i>Ficus religiosa L.</i>	Moraceae	Raavi chettu	Leaf and bark	Tree	Oral	1. The bark used in the treatment of diarrhea and dysentery. 2. Leaves and tender shoots used in wounds and skin diseases.
					Body lotion	
<i>Gymnema sylvestre (Retz.) R.Br.ex.Sm</i>	Asclepiadaceae	Podapatri	Root	Shrub	Oral	1. Root or leaf decoction given orally in diabetes. 2. Roots crushed with long pepper (piper longum) and the extract given as lactagogue.
					Oral	

<i>Hemidesmus indicus L</i> <i>R.Br.ex.Schult.</i>	Apocynaceae	Narunundi or nannari	Root	Shrub	Oral	Root used in oligospermia, gastritis, Stress relief, anorexia, menorrhagia.
<i>Holostemma ada kodian</i> <i>Schult</i>	Asclepiadoideae	Papacheru gaddalu	Root	Twiner	Oral	The root powder mixed with sour milk and along with butter milk for dysentery.
<i>Jasminum sambac (L.)</i>	Oleaceae	Bondumalle	Leaf	Shrub	Body lotion	1. Leaf paste used for wounds. 2. The leaf juice mixed with honey put in ear to cure pus in the ear.
					Ear drop	
<i>Jatropha curcas L.</i>	Euphorbiaceae	Nepalam	Latex	Shrub	Ointment	Latex applied on burns.
<i>Jatropha Gossypifolia L</i>	Euphorbiaceae	Chinna nepalam	Latex	Shrub	Ointment	1. The latex applied on boils and burns and also for tooth ache. 2. Two to three drops of latex instilled in the ear for earache.
					Ear drop	
<i>Lantana Camara L./ Lantana</i> <i>x aculeate L.</i>	Verbenaceae	Akshunthalapulu	Leaf	Shrub	Eye drop and lotion	Leaf juice squeezed into the eyes to treat eye disease and externally to treat cuts and skin diseases.
<i>Lawsonia Inermis L.</i>	Lythraceae	Gorinta	Leaf	Shrub	Hair oil	1. Leaf juice mixed with gunta Galagaraku leaves (eclipta prostrate) leaves as hair tonic. 2. Leaf juice applied externally to cure headache.
					Head oil	
<i>Lygodium flexuosum (L) Sw</i>	Lygodiaceae	Chepala kopailu	Rhizome	Twiner	Oral	Rhizome roasted and mixed with the toddy of caryota urens for better in toxicities.
<i>Madhuca indica J F Gmel/</i> <i>Madhuca longifolia (J.Konig</i>	Sapotaceae	Ippa	Seed	Tree	Hair shampoo	Seed used as hair wash

<i>ex L)</i>							
<i>Mangifera indica L.</i>	Anacardiaceae	Mamidi chettu	Resin	Tree	Body lotion	Gum/resin applied on cuts.	
<i>Mallotus philippensis (Lam.) Mull.Arg.</i>	Euphorbiaceae	Sindhuram	Fruit	Tree	Oral	A pinch of fruit powder mixed in milk is administered to the children before bed time for antihelminthic.	
<i>Manilkara zapota (L.) P.Royen</i>	Sapotaceae	Sapota	Fruit	Tree	Oral	Unripe fruits eaten in worm infestation.	
<i>Nerium oleander L.</i>	Apocynaceae	Erraganneru	Root	Shrub	Oral	A paste from root used to cure worm infections and other skin diseases like scabies, eczema.	
<i>Nyctanthes arbor-tristis L.</i>	Oleaceae	Parijatham	Leaf	Shrub	Oral	1. Leaf decoction given to treat fever. 2. Leaf paste used as an external application to treat ring worm, scabies and eczema	
					Oral		
<i>Ochna Obtusata DC</i>	Ochnaceae	Erraudhi	Stem bark	Tree	Oral	Stem bark juice (about 10ml) taken internally as an antidote for snake bite; the bark paste mixed with lime applied on the affected area and slightly warmed to remove the poison.	
<i>Ocimum Basilicum L.</i>	Lamiaceae	Bhootulasi	Leaf	Herb	Ear drop	1. Two to three drops of leaf juice instilled in the ear for ear ache. 2. Leaf paste applied in leucorrhoea.	
					Ointment		
<i>Opuntia stricta (Ker Gawl.) L.D Benson/ Optunia dillenii (Ker Gawl.) Haw</i>	Cactaceae	Nagajamudu	Fruit	Shrub	Oral	The baked fruit to be given for whooping cough.	
<i>Oxystelma esculentum (L.f)</i>	Apocynaceae	DudhiPala	Whole plant	Herb	Ointment	The latex of the plants is used as an antiseptic on cuts and wounds.	
<i>Pavonia Zeylanica (L) Cav</i>	Malvaceae	Karubenda	Leaf	Shrub	Oral	Leaf juice used as vermifuge and purgative.	
<i>Pedaliium murex L.</i>	Pedaliaceae	Pedda pellaru	Seed	Herb	Oral	Seeds powder given with milk to cure for joint pains.	
<i>Pergularia daemia (Forssk.) Chiov</i>	Periplocaceae	Juttu-paku	Latex	Twiner	Ointment	Latex applied on boils and blisters.	
<i>Piper attenuatum Buch.-Ham. ex Miq.</i>	Piperaceae	Pamu miriyalu	Leaf and root	Twiner	Oral	1. Root paste used for tooth ache. 2. Leaf juice given for cold and cough.	
					Oral		
<i>Piper betle L</i>	Piperaceae	Thamalapaku	Leaf	Herb	Oral	Leaf juice helps for digestion. It is useful in bronchitis, asthma and cough	
<i>Pongamia pinnata L</i>	Fabaceae	Kanuga	Seed	Tree	Body lotion	Seed oil used for skin diseases.	

<i>Psidium guajava L</i>	Myrtaceae	Jamachettu	Leaf	Tree	Oral	Leaf decoction used for relief for throat pain.
<i>Pterocarpus santalinus L.f</i>	Santalaceae	Erra chandanam	Stem bark/ Wood	Tree	Oral	1. Wood extracted used in diabetes. 2. Wood (about 20 gms) ground with fruits of piper nigrum (pepper) given to cattle in intestinal disorders.
<i>Rauvolfia serpentine (L.) Benth. Ex Kurz</i>	Apocynaceae	Sarpagandha	Plant	Shrub	Spray	Plant used for millennia to treat insect stings and the bites of venomous reptiles.
<i>Rivea hypocrateriformis (Desr.) Choisy</i>	Convolvulaceae	Boddi teega	Root	Shrub	Oral	Root paste given after child birth in labor pain.
<i>Satalum album L.</i>	Santalaceae	Srigandham	Stem bark and wood	Tree	Ointment	1. Heart wood paste applied on the forehead for head ache and stress. 2. Fresh stem bark boiled in water and decoction given orally for 7 days for skin diseases. 3. Wood paste with salt applied to the wounds.
<i>Sapindus emarginatus vahl</i>	Sapindaceae	Kukudu-kayalu	Seed and fruit	Tree	Hair shampoo	1. Fruit juice used as a hair washes. 2. Seed decoction dropped into the nostrils in head ache.
<i>Soyimida febrifuga</i>	Meliaceae	Somichettu	Flower	Tree	Ear drops	Flowers juice boiled in gingelly oil (sesamum indicum) is filtered and 2 to 3 drops are instilled in the ear for ear-ache.
<i>Tephrosia purpurea (L.)</i>	Fabaceae	Vempalaku	Leaf and root	Shrub	Oral	1. Roots extract mixed with a pinch of salt for stomach pain.

					Head oil	2. Leaf oil applied on head for head ache, stress and cooling.
<i>Terminalia arjuna (Roxb.ex DC)</i>	Combretaceae	Thellamaddi	Leaf	Tree	Ear drops	Juice of the fresh leaves used as ear drop.
<i>Thespesia populnea (L.) Correa</i>	Malvaceae	Ganga raavi	Leaf	Tree	Ointment	Leaf paste mixed with gingelly oil (sesamum indicum) applied for swellings
<i>Tinospora cordifolia (Wild.) Miers</i>	Menispermaceae	Thippa teega	Stem bark and root	Herb	Ointment	1. The stem or root paste applied over for snake bite or scorpion sting. 2. Tuber extract given for stomach ulcers.
					Oral	
<i>Tragia involucrate L.</i>	Euphorbiaceae	Telukondi chettu	Root	Herb	Body lotion	Root paste mixed with gingelly oil (sesamum indicum) to apply for blisters and skin diseases.
<i>Vallisneria natans (Lour.) H.Hara</i>	Hydrocharitaceae	Neetiadugu tamara	Leaf	Herb	Oral	Leaf decoction used for stomach pains and for leucorrhoea.
<i>Vernonia cinerea (L.) Less</i>	Asteraceae	Saha devi	Whole plant	Herb	Oral	1. Fresh leaf juice used against eczema and ringworm. 2. Whole plant extract given against urinary infection and abdominal pain.
					Oral	
<i>Vitex negundo (L.)</i>	Lamiaceae	Sindhuvaramu	Leaf	Shrub	Oral and Spray	Leaves used in eczema, ring worm, skin diseases and control population of mosquitoes.
<i>Wattakaka volubilis (L.f.) Stapf/ Dregea volubilis (L.f.) Benth.ex.Hook.f</i>	Asclepiadaceae	Doodipala teega	Leaf	Shrub	Ointment	Leaf paste applied for boils and abscesses.
<i>Ximenia Americana L.</i>	Olacaceae	Konda nakkeru	Leaf	Herb	Ointment	Leaf paste applied for skin diseases and ulcers.
<i>Waltheria indica L.</i>	Malvaceae	Nalla benda	Whole plant and root	Shrub	Oral	1. Root powder given to get relief from pain of inflammations (dose is approximate). 2. Plant powder used for drying and healing of wounds.

						Ointment
<i>Withania somnifera L.Dunal</i>	Solanaceae	Ashwagandha	Leaves and fruit	Herb	Ointment	Berries and leaves are applied externally to tumors, tubercular glands and ulcers.
<i>Ziziphus oenoplia (L.) Mill</i>	Rhamnaceae	Gottikampa	Stem bark	Shrub	Ointment	Dried stem bark powder applied on cuts

The shrubs are more when compared to other habits due to high elevation ranges of the study site where shrubs are higher when compare to trees [33]. In the observation it was noticed that ethnic groups collect plants in wild forms due to poor cultivation of these medicinal plants [34]. Also the availability of these medicinal plants are less in number in the forests and if used in large amounts for medicinal purposes, in long term there is a chance of extinction from habitat. The people are collecting fresh plants and their parts from forest for the treatment as there is no storage method most of the other parts are in wastage form. The shrub was primary sources of medicine with 35%, followed by Tree 30%, Herb 21%, Twinner 5%, Straggle 5%, Climber 1%, Vine 1% and Thorny bush (2%) (Fig. 3). This study is similar to some other previously reported studies [35–38].

3.2 Plant parts used for treatment

The present information is about the traditional knowledge of ethnic people using native plants as medicine in the selected area. The information given by the rural people of Anantapuram district is valuable and has great importance in ethno botanical research. The common plant parts used are leaves, root, stem, bark, wood, seeds, flowers, latex, fruits and whole plant for different purposes. Similar survey was conducted in Anantapuram district and identified some important medicinal plants used for different diseases. Due to less availability of ethno botanical data of medicinal plants at Anantapuram district, we selected different regions and different methods to collect information. The treatment is based on various formulations which are prepared from single plant part for single disease and also in combination with other plants. The used plant parts in this study for preparations were leaves 37%, root 16%, seed 11%, stem 8%, Fruit 7%, whole plant 7%, Latex 5%, wood 3%, Rhizome 3%, Flower 1%, Resin 1%, and Tuber 1% (Fig. 4). The uses of different plant parts for human ailments are in similar to other reports [39, 40].

3.3 Forms of medication

The use of medicinal plants and their parts in different forms depends on the type of the disease. Mostly for skin disease paste or ointment form is required and for intestinal disorders oral form of medicine is

suitable [41]. In this study we observed that skin disorders are treated more than other diseases and Paste form is highest used among medication. Paste (29%) was most commonly used followed by Plant juice (18%), Extract (13%), decoction (12%), powder (17%) Latex (8%) Eaten raw (2%) and Seed oil (1%) (Fig. 5). These studies were matched with other reports in other ethnic groups [42–44].

3.4 Mode of Administration

The traditional medicine was given in different methods depending on the availability. Among different methods, the mode of Administration is as Oral 51%, followed by Ointment 22%, Body lotion 15%, Ear drops 7%, Spray 3%, Eye drops 1% and Nostril drops 1% (Fig. 6). Similarly other reporters identified same results supporting the data [45–47].

3.5 Taxonomy of Medicinal Plants

From the data collected, 66 medicinal plants of 66 species and 64 genera from 42 families were recorded in Anantapuram region. Apocynaceae and Euphorbiaceae represented the highest number of medicinal plants (5), which was followed by Convolvulaceae and Malvaceae (3) Asclepiadoideae (2), Lythraceae (2), Fabaceae (2), Meliaceae (2), Combretaceae (2), Asclepiadaceae (2), Oleaceae (2), Sapotaceae (2), Lamiaceae (2), Solanaceae (2), Piperaceae (2) Santalaceae (2), Acanthaceae (1), Alangiaceae (1), Annonaceae (1), Caesalpinioideae (1), Brassicaceae (1), Clusiaceae1 Apiaceae (1), Rubiaceae (1), Celastraceae (1), Periplocoideae (1), Zingiberaceae (1), Moraceae (1), Verbenaceae (1), Lygodiaceae (1), Anacardiaceae (1), Ochnaceae (1), Cactaceae (1), Pedaliaceae (1), Periplocaceae (1), Myrtaceae (1), Sapindaceae (1), Menispermaceae (1), Hydrocharitaceae (1), Asteraceae (1), Olacaceae (1), Rhamnaceae (1) (Table 4). However, other researches recorded that Lamiaceae, Orchidaceae, Asteraceae [48, 49] families has highest number of medicinal plants.

Table 4
Diversity of different species and families in Anantapuram district

S.No	Families	No. of Plants	No. of genus	Percentage of genus (%)	No. of Species	Percentage of Species (%)
1.	Acanthaceae	1	1	1.56	1	1.51
2.	Apocynaceae	5	5	7.99	5	7.6
3.	Alangiaceae	1	1	1.56	1	1.51
4.	Lythraceae	2	2	3.22	2	3.03
5.	Annonaceae	1	1	1.56	1	1.51
6.	Meliaceae	2	2	3.22	2	3.04
7.	Caesalpinioideae	1	1	1.56	1	1.51
8.	Brassicaceae	1	1	1.56	1	1.51
9.	Clusiaceae	1	1	1.56	1	1.51
10.	Asclepiadoideae	2	2	3.22	2	3.04
11.	Apiaceae	1	1	1.56	1	1.51
12.	Rubiaceae	1	1	1.56	1	1.51
13.	Celastraceae	1	1	1.56	1	1.51
14.	Combretaceae	2	2	3.22	2	3.04
15.	Convolvulaceae	3	3	4.74	3	4.54
16.	Periplocoideae	1	1	1.56	1	1.51
17.	Zingiberaceae	1	1	1.56	1	1.51
18.	Solanaceae	2	2	3.12	2	3.04
19.	Euphorbiaceae	5	4	6.85	5	7.6
20.	Moraceae	1	1	1.56	1	1.51
21.	Asclepiadaceae	2	2	3.12	2	3.04
22.	Oleaceae	2	2	3.22	2	3.04
23.	Verbenaceae	1	1	1.56	1	1.51
24.	Lygodiaceae	1	1	1.56	1	1.51
25.	Sapotaceae	2	2	3.22	2	3.03
26.	Anacardiaceae	1	1	1.56	1	1.51

S.No	Families	No. of Plants	No. of genus	Percentage of genus (%)	No. of Species	Percentage of Species (%)
27.	Ochnaceae	1	1	1.56	1	1.51
28.	Lamiaceae	2	2	3.22	2	3.04
29.	Cactaceae	1	1	1.56	1	1.51
30.	Malvaceae	3	3	4.74	3	4.54
31.	Pedaliaceae	1	1	1.56	1	1.51
32.	Periplocaceae	1	1	1.56	1	1.51
33.	Piperaceae	2	1	1.56	2	3.04
34.	Fabaceae	2	2	1.56	2	3.04
35.	Myrtaceae	1	1	1.56	1	1.51
36.	Santalaceae	2	2	3.22	2	3.04
37.	Sapindaceae	1	1	1.56	1	1.51
38.	Menispermaceae	1	1	1.56	1	1.51
39.	Hydrocharitaceae	1	1	1.56	1	1.51
40.	Asteraceae	1	1	1.56	1	1.51
41.	Olacaceae	1	1	1.56	1	1.51
42.	Rhamnaceae	1	1	1.56	1	1.51
		66	64	100	66	100

3.6. Informants consensus factors (F_{IC})

Informants consensus factors provide reliability for the given information in ethno botanical studies. The treated diseases were divided into 16 categories and for each disease the used report and number of taxa were recorded (Table 5). From the results of F_{IC} it was confirmed that Intestinal disorders (0.95%) has highest agreement of F_{IC} , followed by Toothache (0.92%), Fever (0.92%), Snake bite (0.90%), Eye drops (0.9%), Dermatological (0.89%), Headache (0.88%), Hair shampoo (0.87%), Cut and Wounds (0.85%), Boils and Burns (0.84%), Bronchitis/cough (0.83%), Earache (0.82%), Pain (0.82%), Antihelmintic (0.81%), Diabetes (0.81%) and Stress (0.63%). Similar to this work, other reports showed the F_{IC} values as an important method in ethno botanical surveys [50–52] showed that information given by local tribal people on traditional plant species using for diseases are still in practice in this region and has been coming from so many generations among specific families.

Table 5
Informants consensus factor of different diseases

Diseases	Number of Taxa (N_t)	No of Use reports (N_{ur})	F_{IC}
Intestinal disorders	11	234	0.95
Toothache	2	14	0.92
Fever	5	55	0.92
Snake bite	3	22	0.9
Eye drops	2	12	0.9
Dermatological	16	143	0.89
Headache	3	18	0.88
Hair shampoo	5	32	0.87
Cut and Wounds	8	48	0.85
Boils and Burns	9	54	0.84
Bronchitis/cough	5	25	0.83
Earache	5	24	0.82
Pain	9	46	0.82
Antihelmintic	5	23	0.81
Diabetes	3	12	0.81
Stress	5	12	0.63

3.7 Fidelity level (FL) value

In order to find species importance for given disease fidelity level values were calculated and recorded. Fidelity level is measured by calculating medicinal plants which are described by at least five or more members for being used for the taken disease and once considered plant was not taken for another disease. According to Fidelity level, the most important medicinal plant species were *Hemidesmus indicus* (Stress FL = 92.3%) followed by *Ammannia baccifera* (Skin disease FL = 85.7%) and *Gymnema sylvestre* (Diabetes FL = 85.7%) (Table 6). Among the plant species *Opuntia stricta* showed less Fidelity level (cough 42.8%). Similar studies were reported showing the Fidelity level values from previous reports [53–55].

Table 6
Fidelity level value of different medicinal plants against given disease

<i>Plant name</i>	Diseases	lp	lu	FL (%)
<i>Hemidesmus indicus L R.Br.ex.Schult.</i>	Stress	12	13	92.3
<i>Azadirachta indica L.</i>	Antihelmintic	24	26	92.3
<i>Ammannia baccifera L.</i>	Skin disease	24	28	85.7
<i>Gymnema sylvestre (Retz.) R.Br.ex.Sm</i>	Diabetes	18	21	85.7
<i>Pterocarpus santalinus L.f</i>	Intestinal disorders	16	19	84.2
<i>Bauhinia racemosa Lam</i>	Fever	23	28	82.1
<i>Calophyllum inophyllum L</i>	Tooth ache	21	26	80.7
<i>Madhuca indica J F Gmel/ Madhuca longifolia (J.Konig ex L)</i>	Hair wash	15	19	78.9
<i>Cryptostegia grandiflora R.Br</i>	Cuts and burn	22	28	78.5
<i>Lantana Camara L./ Lantana x aculeate L.</i>	Eye drops	11	14	78.5
<i>Oxystelma esculentum (L.f)</i>	Wound	12	18	66.6
<i>Psidium guajava L</i>	Pain	8	12	66.6
<i>Sapindus emarginatus vahl</i>	Head ache	8	12	66.6
<i>Ocimum Basilicum L.</i>	Ear ache	10	18	55.5
<i>Opuntia stricta (Ker Gawl.) L.D Benson/ Optunia dillenii (Ker Gawl.) Haw</i>	Cough	6	14	42.8

4. Conclusion

The present study on ethno botanical and traditional medicinal practices of Anantapuram district showed ethnic groups depends and uses different medicinal plants to cure diseases. This work included the medicinal plant species available with traditional values at Anantapuram region which are not reported or documented in mentioned diseases. To cure diseases which are commonly seen like fever to uncommon diseases like psoriasis, ulcers etc. are treated using plant parts in different forms and doses. However, the usage of plants traditionally and understanding the mechanism is on traditional believes. So, from these medicinal plants bioactive compounds can be identified and further used for developing drug. The drug development from plants will be an important contribution to cure many dangerous diseases in the society. Our studies identified some important medicinal plants and their form of usage for different diseases by the tribal people. In order to protect and preserve plants in their natural habitat, establishment of medicinal gardens of ex-situ conservation with the help of ethnic communities by regular monitoring

and evaluation is needed. The reported plants of Anantapuram region can be screened for compounds with therapeutic values using phytochemical and biochemical studies. This validation may help in identifying drugs from plants which can be used as drugs for inevitable diseases like cancer.

Declarations

Ethics approval and consent to participate

Not Applicable

Consent for publication

Not Applicable

Availability of data and materials

Data sharing not applicable to this article as no datasets were generated or analysed during the current study

Funding

No funding details are available

Competing interests

The authors declare that they have no competing interests

Authors' contributions

J.R.D carried out the ethano botanical studies, analysed data, and drafted the manuscript. P.K helped in collecting data, interviews and helped in the manuscript writing. M.K did statistical studies and final manuscript preparation. M.R.D designed the study, prepared manuscript and supervised the work. SB helped and coordinated to draft the final manuscript. All authors read and approved the final manuscript.

Acknowledgements

We are thankful to the ethnic communities, herbal doctors, village leaders of Anantapuram district, India for helping in gathering the information and hosting during the research period. We are grateful to Mounica Sura for helping to document the information and analysis the data.

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Figures



Figure 1

Study area selected for ethno botanical studies in Anantapuram district, Andhra Pradesh, India.



Figure 2

Collected medicinal plants from Anantapuram district, India A) *Adhatoda zeylanica* B) *Tephrosia purpurea* C) *Pterocarpus santalinus* D) *Hemidesmus indicus* E) *Phyllanthus acidus* F) Researcher with medicinal plants of Anantapuram district G) Villager interviewed for ethanobotanical studies H) Discussion with herbal doctor and village head

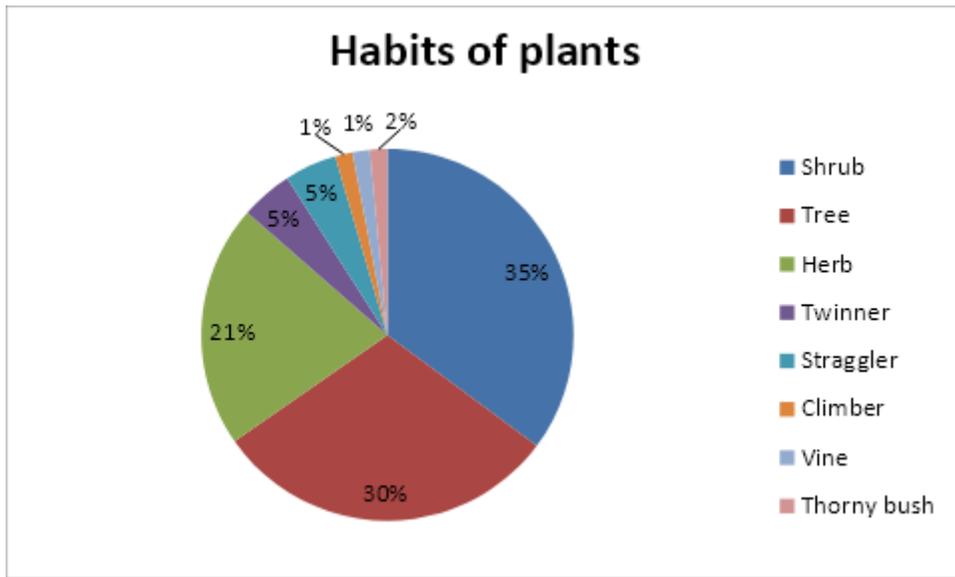


Figure 3

Habits of the medicinal plants identified in Anantapuram region

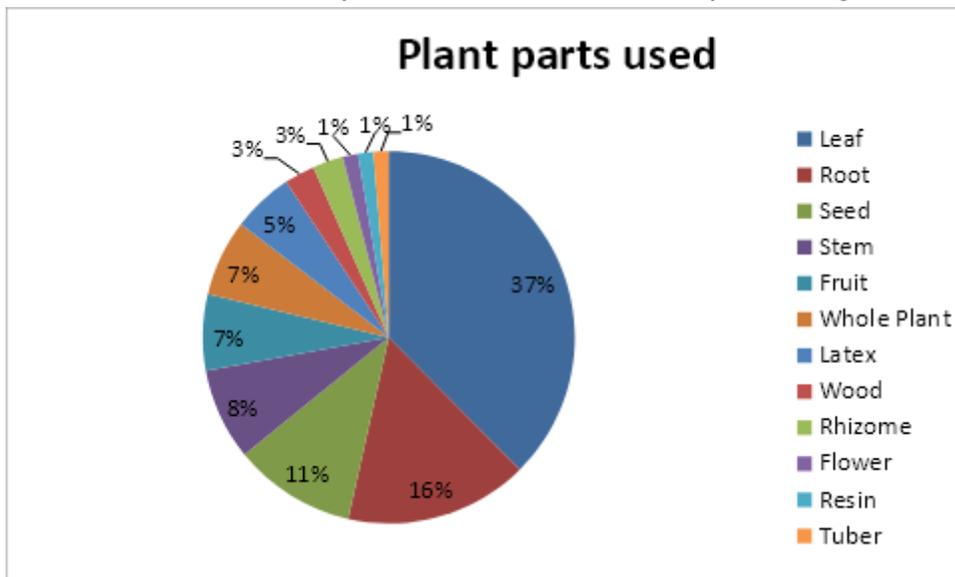


Figure 4

Parts of plants selected for treatment of various diseases

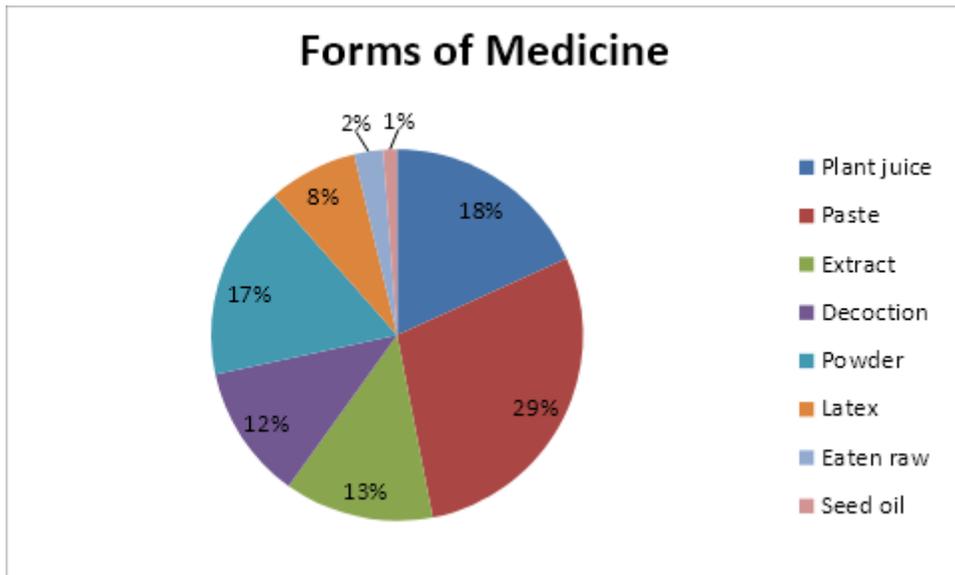


Figure 5

Forms of medicine prepared from different plant parts for the treatment of diseases

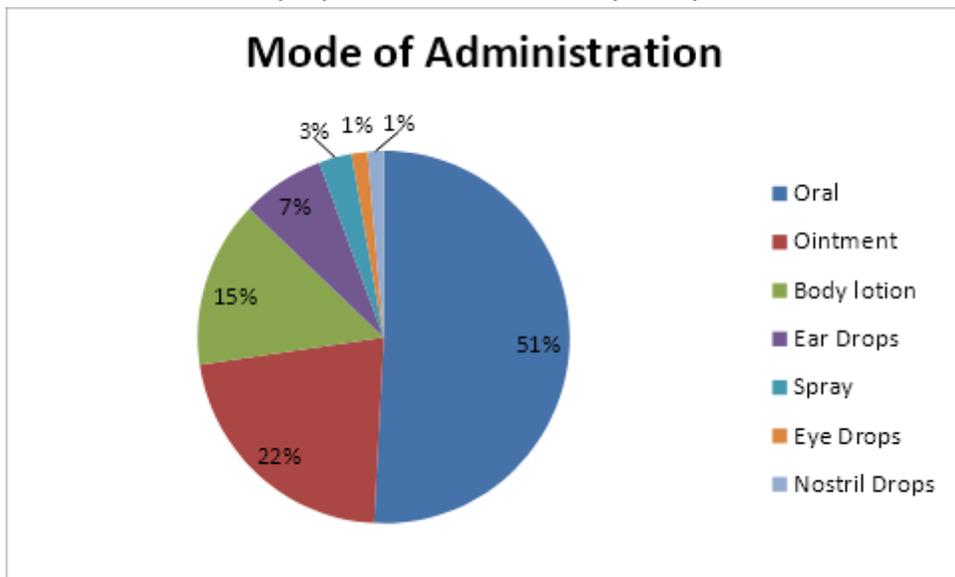


Figure 6

Mode of Administration of different forms of medicine for different diseases