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

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Abstract

Ethnopharmological 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 ethno 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 Goothy 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, Kundurpthi, 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 expect 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 practioners 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 believes, 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].

$$F_{IC} = \frac{Nur - Nt}{Nur - 1}$$

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].
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 |  |
| Illeterates     | 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 Ethnobotanical 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**: Ethnobotanical studies and application of medicinal plants identified at Anantapuram district, India
| Plant name                                      | Family                  | Local name     | Part used | Growth form | Mode of Administration | Method of preparation and diseases                                                                 |
|------------------------------------------------|-------------------------|----------------|-----------|-------------|------------------------|----------------------------------------------------------------------------------------------------|
| *Adhatoda zeylanica L.* / *justicia adhatoda L.* | 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                                                                                       |
| *Aganosma dichotoma* (Roth)K.Schum/*Aganosma heynei (Spreng.) Ined.* | Apocynaceae             | Malati teega   | Root      | Shrub       | Oral                   | A decoction of root given as a tonic for fever.                                                   |
| *Alangium*                                     | Alangiaceae             | Vooduga        | Leaf      | Tree        | Plaster                | Boiled leaves made into paste and plastered over fractured bones.                                 |
| *Ammannia baccifera L.*                        | Lythraceae              | Agnivendrapu aku | Leaf      | Herb        | Body lotion            | Fresh leaves used in skin disease.                                                                |
| *Annona reticulate L.*                         | Annonaceae              | Ramaphalam     | Leaf      | Tree        | Spray                  | Leaves or seed paste applied on head to kill lice.                                                |
| *Azadirachta indica L.*                        | Meliaceae               | Vepa           | Leaf and seed | Tree | Oral                  | Leaf extracts or seed oil given orally as an anthelminic.                                         |
| *Bauhinia racemosa Lam*                         | Caesalpinioideae        | Kantasara teega | Root      | Shrub       | Oral                   | Root crushed with jiggery and the filtrate administered for fever for 3 days.                    |
| *Brassica nigra (L.*)                           | 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. |
| *Calophyllum inophyllum L*                      | 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. |
| *Calotropis gigantean (L.*)*                    | Asclepiadoideae         | Tella jilledu  | Leaf      | Shrub       | Body lotion            | Leaves heated with castor oil (ricinus communis) and applied on boils, blisters of skin diseases. |
| *Centella asiatica L.*                          | Apiaceae                | Saraswathi aku | Leaf      | Herb        | Oral                   | Leaf juice taken as for improving memory and useful skin disease.                                 |
| *Canthium dicoccum* (Gaertn.) / *Psydrax dicoccos Merr.*) / *Psydrax dicoccos Gaertn* | Rubiaceae               | Nalla halusu   | Stem      | Tree         | Oral                   | The bark paste is used treatment of fevers.                                                      |
| *Celastrus paniculatus Willd.*                  | Celastraceae            | Jyothshmati    | Seed      | Shrub       | Lotion                 | Seeds paste mildly heated and gently massaged for rheumatic pains.                                 |
| *Combretum albidum* G.Don                       | Combretaceae            | Yaada teega    | Leaf      | Herb        | Body lotion            | Warm leaf paste applied on boils, blisters and also for skin diseases.                             |
| *Convolvulus pluricaulis choisy*                | Convolvulaceae          | Shankapushpi   | Whole plant | Herb | Oral                  | Whole herb is used to improve memory, intelligence and also used in vomiting, toxic conditions.    |
**Cryptostegia grandiflora R.Br**
Periplocoideae  Pala teega  Latex  Twiner  Ointment
Latex applied for cuts and boils.

**Curcuma longa L.**
Zingiberaceae  Pasupu  Rhizome  Herb  Ointment
Fresh rhizome, ground with cow’s milk and castor oil applied on paronychia.

**Datura metel L.**
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

**Emblica officinalis Gaertn./Phyllanthus acidus (L.)**
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.

**Evolvulus alsinoides (L.)**
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.

**Ficus religiosa L.**
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.

**Gymnema sylvestre (Retz.) R.Br.ex.Sm**
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 lactogogue.
| **Hemidesmus indicus L**  
*R.Br.ex.Schult.* | Apocynaceae | Narunundi or nannari | Root | Shrub | Oral | Root used in oligospermia, gastritis, Stress relief, anorexia, menorrhagia. |
| **Holostemma ada kodien**  
*Schult* | Asclepiadoideae | Papacheru gaddalu | Root | Twiner | Oral | The root powder mixed with sour milk and along with butter milk for dysentery. |
| **Jasminum sambac (L.)** | 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. |
| **Jatropha curcas L.** | Euphorbiaceae | Nepalam | Latex | Shrub | Ointment | Latex applied on burns. |
| **Jatropha Gossypifolia L** | 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. |
| **Lantana Camara L./ Lantana x aculeate L.** | Verbenaceae | Akshenthalapula | Leaf | Shrub | Eye drop and lotion | Leaf juice squeezed into the eyes to treat eye disease and externally to treat cuts and skin diseases. |
| **Lawsonia Inermis L.** | 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. |
| **Lygodium flexuosum (L) Sw** | Lygodiaceae | Chepala kopailu | Rhizome | Twiner | Oral | Rhizome roasted and mixed with the toddy of caryota urens for better in toxicities. |
| **Madhuca indica J F Gmel/ Madhuca longifolia (J.Konig** | Sapotaceae | Ippa | Seed | Tree | Hair shampoo | Seed used as hair wash |
| Name                              | Family      | Genus       | Common name       | Part/Usage           | Description                                                                 |
|-----------------------------------|-------------|-------------|-------------------|----------------------|-----------------------------------------------------------------------------|
| *Mangifera indica* L.             | Anacardiaceae | Mamidi chettu | Resin Tree | Body lotion | Gum/resin applied on cuts.                                                 |
| *Mallotus philippensis (Lam.)*    | Euphorbiaceae | Sindhuram | Fruit Tree | Oral | A pinch of fruit powder mixed in milk is administered to the children before bedtime for antihelmintic. |
| *Manilkara zapota* (L.) P. Royen | Sapotaceae   | Sapota | Fruit Tree | Oral | Unripe fruits eaten in worm infestation.                                   |
| *Nerium oleander* L.              | Apocynaceae  | Erraganneru | Root Shrub | Oral | A paste from root used to cure worm infections and other skin diseases like scabies, eczema. |
| *Nyctanthes arbor-tristis* L.     | 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 |
| *Ochna Obtusata DC*               | 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. |
| *Ocimum Basilicum* L.             | 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. |
| *Opuntia stricta* (Ker Gawl.) L.D Benson/ *Opuntia dillenii* (Ker Gawl.) Haw | Cactaceae | Nagajamudu | Fruit Shrub | Oral | The baked fruit to be given for whooping cough. |
| *Oxystelma esculentum* (L.f)      | Apocynaceae  | DudhiPala | Whole plant Herb | Ointment | The latex of the plants is used as an antiseptic on cuts and wounds. |
| *Pavonia Zeylanica* (L.) Cav      | Malvaceae    | Karubenda | Leaf Shrub | Oral | Leaf juice used as vermifuge and purgative. |
| *Pedaliun murex* L.               | Pedaliaceae  | Pedda pelliaru | Seed Herb | Oral | Seeds powder given with milk to cure for joint pains. |
| *Pergularia daemia* (Forssk.) Chiov | Periplocaceae | Juttu-paku | Latex Twiner | Ointment | Latex applied on boils and blisters. |
| *Piper attenuatum* Buch.-Ham. *ex Miq.* | Piperaceae | Panu mirtyalu | Leaf and root Twiner | Oral | 1. Root paste used for tooth ache.  
2. Leaf juice given for cold and cough. |
| *Piper betle* L                   | Piperaceae   | Thamalapaku | Leaf Herb | Oral | Leaf juice helps for digestion. It is useful in bronchitis, asthma and cough |
| *Pongamia pinnata* L.             | Fabaceae     | Kanuga | Seed Tree | Body lotion | Seed oil used for skin diseases. |
| Plant Name                                      | Family       | Common Name | Part Used          | Use                                                                 |
|------------------------------------------------|--------------|-------------|--------------------|----------------------------------------------------------------------|
| *Psidium guajava L*                             | Myrtaceae    | Jamachettu  | Leaf               | Oral                                                                  |
| *Pterocarpus santalinus L.f*                    | Santalaceae  | Erna chandanam | Stem bark/ Wood   | 1. Wood extracted used in diabetes.                                  |
|                                                 |              |             |                    | 2. Wood (about 20 gms) ground with fruits of piper nigrum (pepper) given to cattle in intestinal disorders. |
| *Rauvolfia serpentine (L.) Benth. Ex Kurz*      | Apocynaceae  | Sarpagandha  | Plant Shrub Spray  | Oral                                                                  |
|                                                 |              |             |                    | Plant used for millennia to treat insect stings and the bites of venomous reptiles. |
| *Rivea hypocrateriformis (Desr.) Choisy*        | Convolvulaceae | Boddi teega  | Root Shrub Oral    | Root paste given after child birth in labor pain.                    |
| *Santalum album L.*                             | Santalaceae  | Srigandham  | Stem bark and wood | 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.                       |
| *Sapindus emarginatus vahl*                     | Sapindaceae  | Kukudu-kayalu | Seed and fruit   | Hair shampoo                                                          |
|                                                 |              |             |                    | 1. Fruit juice used as a hair washes.                                |
|                                                 |              |             |                    | 2. Seed decoction dropped into the nostrils in head ache.             |
| *Soymda febrifuga*                              | Meliaceae    | Somicchettu | Flower Tree        | Ear drops                                                             |
|                                                 |              |             |                    | Flowers juice boiled in gingelly oil (sesamum indicum) is filtered and 2 to 3 drops are instilled in the car for ear-ache. |
| *Tephrosia purpurea (L.)*                       | Fabaceae     | Vempalaku   | Leaf and root Shrub Oral | 1. Roots extract mixed with a pinch of salt for stomach pain.        |
Head oil

| Species                          | Family       | Common Name     | Part Used | Form   | Uses                                                                 |
|---------------------------------|--------------|-----------------|-----------|--------|----------------------------------------------------------------------|
| *Terminalia arjuna* (Roxb. ex DC) | Combretaceae | Thellamaddi     | Leaf      | Tree   | Ear drops                                                                 |
| *Thespesia populnea* (L.) Correa | Malvaceae    | Ganga raavi     | Leaf      | Tree   | Ointment                                                                 |
| *Tinospora cordifolia* (Wild.) Miers | Menispermaceae | Thippa teega   | Stem bark and root | Herb | Ointment                                                                 |
| 1. *Tragia involucrate* L. | Euphorbiaceae | Telukondi chettu | Root      | Herb   | Body lotion                                                             |
| 2. *Vallisneria natans* (Lour.) H.Hara | Hydrocharitaceae | Neetiadugu tamara | Leaf | Herb | Oral                                                                 |
| 1. *Vernonia cinerea* (L.) Less | Asteraceae   | Saha devi       | Whole plant | Herb | Oral                                                                 |
| 2. *Vitex negundo* (L.) | Lamiaceae    | Sindhuvaramu    | Leaf      | Shrub  | Oral and Spray                                                           |
| 1. *Wattakaka volubilis* (L.f.) | Asclepiadaceae | Doodipala teega | Leaf      | Shrub  | Ointment                                                                 |
| *Stapf/ Dregea volubilis* (L.f.) Benth.ex.Hook.f. |          |                 |           |        |                                                                        |
| *Ximenia Americana* L.          | Olacaceae    | Konda nakkera   | Leaf      | Herb   | Ointment                                                                 |
| *Waltheria indica* L.           | Malvaceae    | Nalla benda     | Whole plant and root | Shrub | Oral                                                                 |

- Leaf oil applied on head for head ache, stress and cooling.
- Juice of the fresh leaves used as ear drop.
- Leaf paste mixed with gingelly oil (sesamum indicum) applied for swellings.
- 1. The stem or root paste applied over for snake bite or scorpion sting.
- 2. Tuber extract given for stomach ulcers.
- Root paste mixed with gingelly oil (sesamum indicum) to apply for blisters and skin diseases.
- Leaf decoction used for stomach pains and for leucorrhoea.
- 1. Fresh leaf juice used against eczema and ringworm.
- 2. Whole plant extract given against urinary infection and abdominal pain.
- Leaves used in eczema, ring worm, skin diseases and control population of mosquitoes.
- Leaf paste applied for boils and abscesses.
- Leaf paste applied for skin diseases and ulcers.
- 1. Root powder given to get relief from pain of inflammations (dose is approximate).
- 2. Plant powder used for drying and healing of wounds.
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 Anantapurum 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), Alangia (1), Annonaceae (1), Caesalpinioideae (1), Brassicaceae (1), Clusiaceae (1), Apiaceae (1), Rubiaceae (1), Celastraceae (1), Periplocoideae (1), Zingiberaceae (1), Moraceae (1), Verbenaceae (1), Lygodiaceae (1), Anacardiaceae (1), Ochnaceae (1), Cactaceae (1), Pedaliaceae (1), Periploceae (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                     |
### 3.6. Informants consensus factors (F\textsubscript{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\textsubscript{IC} it was confirmed that Intestinal disorders (0.95%) has highest agreement of F\textsubscript{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\textsubscript{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.

| 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.  | Periplocaee | 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                      |
### 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

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

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**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. PK 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.

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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.