Quantitative ethnomedicinal investigation of medicinal plants used by traditional healers to treat various diseases in the district Dindori, Madhya Pradesh, India

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Research

Abstract

Background: Despite the wisdom of using medicinal plants for various diseases therapies by practitioners of Ayurveda and traditional medicine, the process of documenting this knowledge is untapped to date. The aim of the present study was to record the knowledge and utility of medicinal plants used as remedies for various diseases by traditional healers in Dindori, Madhya Pradesh.

Methods: Field surveys were conducted from January 2018 to December 2019 to collect ethnomedicinal data through semi-structured interviews and group discussions by using standard questionnaire. Reported data was analyzed using various ethnobotanical indices. All collected plant specimens were deposited in the Herbarium of Department of Botany, Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh for future reference.

Results: A total of 88 plant species belonging to 80 genera in 46 families were reported during current study and were used for the treatment of 65 different diseases categorized into 14 ailment categories. The highest ICF of 1.0 was noted for gynecological disorders, hair care and male infertility problem. *Cynodon dactylon* recorded highest UV and FL of 33.33 to 100%, respectively. Among plant parts, Leaves (40.33%) were most commonly used by traditional healers.

Conclusions: Traditional knowledge of plants was only passed on by passing of information from person to person using oral communication is on the verge of extinction. Hence, the medicinal plants and traditional treasures associated with it must be documented. The species reported with high use value (UV) and fidelity level value (FL) should be explored for further phytochemical and pharmacological investigation to authenticate this indigenous knowledge.

Keywords: Quantitative ethnobotany, Ethnomedicinal plants, Traditional healers, Dindori, Madhya Pradesh

Background

The World Health Organization reports that 80% of the world's population depend on traditional medicine as their main source of healthcare (WHO, 2013). India, one among the 12 mega-diversity centers of the world, provides approximately eight percent of the global biodiversity on 2% of the globe's surface due to the diversity of species and quantity of endemism seen across the various agroclimatic regions of the nation. There are more than 17,209 known species of flowers in India, and

more than 7918 of these have been documented to have some sort of therapeutic effect (Basu, 1994). More than 550 different ethnic groups make up around 8% of India's overall population. Over 5000 tribal communities with a predominance of forests are thought to cover 15% of the subcontinent's entire geographic area (D'Rozario et al., 2004). India is regarded as a significant trove of ethnobotanical treasure in this regard. However, owing to political and socioeconomic factors, traditional knowledge and practices have been neglected. Till recent past, ethnobotanists conducted several investigations on the use of therapeutic plants in conventional medicine in the areas of Madhya Pradesh in district Dindori (Prana et al., 2014; Pal, 2018; Ahirwar, 2018, Singh et al., 2022; Singh et al., 2022). In Madhya Pradesh, tribal communities use non-timber forest resources and preparations based on indigenous knowledge to address their healthcare requirements. Additionally, it has been shown that medicinal products derived from plants are safe and can help a wide range of health problems without causing any harm (Singh and Ahirwar, 2018). Dindori district, in the state of Madhya Pradesh, India, is home to a large tribal population and is considered to be one of the state's most tribally significant districts. Madhya Pradesh is one of the rich biodiversity states in India, and its holy mother, the Narmada River, flows right through the center of the district. Many people still practice traditional medicine in this area. Factors like geography, climate, topography, and soil all contribute to the diversity of plant life in the Dindori. There are no immediate contemporary medical facilities available to the people living in and around the remote tribal pockets of the area in Madhya Pradesh. Traditional beliefs and unreachable modern medical facilities thread them to depend on medicinal plants grown locally.

No prior in-depth research has been conducted in Dindori district. Previous studies have been carried out only on three blocks as Shahpura, Dindori and Mehadwani studied (Singh et al., 2022; Marko and Sandya, 2020). The current studies covered four blocks as Samnapur, Dindori, Bajag and Karanjiya and eleven villages including Ajhwar, Chichringpur, Jamgaon, Dhurkutta, Goura Kanhari, Chanda van Gram, Khamhera, Barnai, Khannat, Thadpathra and Raitwar. Some quantitative ethnobotanical research works have carried out from India (Vijayakumar et al., 2015; Ahirwar, 2017, 2020, 2022; Gupta et al., 2018; Wagh & Jain, 2020; Khajuria et al., 2021; Patra & Sharma, 2022; Rao et al., 2022; Lal et al., 2023) and abroad (Dapar et al., 2020; Weldearegay & Awas, 2021; Hosseini et al., 2022; Ali & Bussmann, 2023). However, literature survey revealed that, till date, almost all of the studies made from the state of Madhya Pradesh including district Dindori were focused on simple documentation of plants based knowledge emphasizing mainly on floristic studies (Prana et al., 2014; Pal, 2018; Ahirwar, 2018, 2020; Marko & Sandya, 2020; Pandey, 2021; Singh et al., 2022; Singh et al., 2022). Singh et al., (2022) conducted ethnomedicinal studies and applied statistical tools for survey from this region. Therefore, the main objectives of the study were (i) documentation of ethnobotanical knowledge of medicinal plants (ii) to compare the collected data with already published work (iii) and to analyze the ethnobotanical data by using various quantitative indices as Informant consensus factor (ICF), fidelity level (FL), relative frequency citation (RFC), Use value (UV), Pearson correlation coefficient (PCC) and Jaccard index (JI).

Materials and Methods

Study area

Dindori district is situated in the eastern part of Madhya Pradesh and this district is spread over an area of 7470 sq km and lies between the meridian of latitude 22°57' N and longitude 81°41' E. Dindori district is bounded by Umaria district in the north, Anuppur district in the east, Chhattisgarh state in the south and Mandla district in the west (Fig. 1-2). It is located at a minimum height of 885 feet and a maximum of 1100 feet above sea level. The climate of Dindori district is warm and temperate and the average temperature is 23.5°C with a maximum of 43.9°C and a minimum of 0°C. The annual average rainfall here is 1100 mm. Tropical forests are found in Dindori district and the main tribal communities of Dindori district are Gond, Baiga, Panika, Bharia etc.

Collection of data and ethnobotanical investigation

The present ethnobotanical investigation session was conducted during January 2018 to December 2019 in 11 tribal villages of district Dindori, namely Ajhwar, Chichingpur, Jamgaon, Dhurkutta, Chanda vangram, Khamhera, Barnai, Khannat, Raitwar, Thadpathra and Gaurkanhari etc. We used semi-structured questionnaire (SSQ) based interviews to conduct the survey (Jain and Mudgal, 1999) which was based on diseases classification system (Cook FEM. 1995). During the survey, we collected the medicinal plants that were used for the treatment of different illnesses through conducting interview of the local traditional healers (Fig.3). During this period of the study, we carried out survey in the village throughout walking tour. A total 113 informants, were participated and 64 of whom were men and 49 of whom were women. Informants were selected primarily based on their extensive indigenous knowledge as well as years of experience with utilizing medicinal plants. The majority of the informants had completed education up to the fifth standard, with 56.63 % of the male informants and 43.36 percent of the female informants falling into this category. The informants were grouped between two age groups, with the first group ranging from 40-60 years old and the second group from 61-80 years old (Fig. 4). The majority of the people who provided their information were between the ages of 50 to 70 years old. During the duration of the field studies, we gathered information about the utilization of medicinal plants in the form of data as well as photographs of the informants interviews, recordings, and herbarium sheets of plant specimens. Prior to publishing any of this information, we made sure to free and Prior Informed Consent (PIC) taken from every informants (International Society of Ethnobiology (ISE) Code of Ethics, 2006). We have gathered information in the local language 'Gondi' and mixed language, during our investigation in this area, we found that medicinal plants are using by traditional healers to cure a wide range of illnesses from generations to generations.

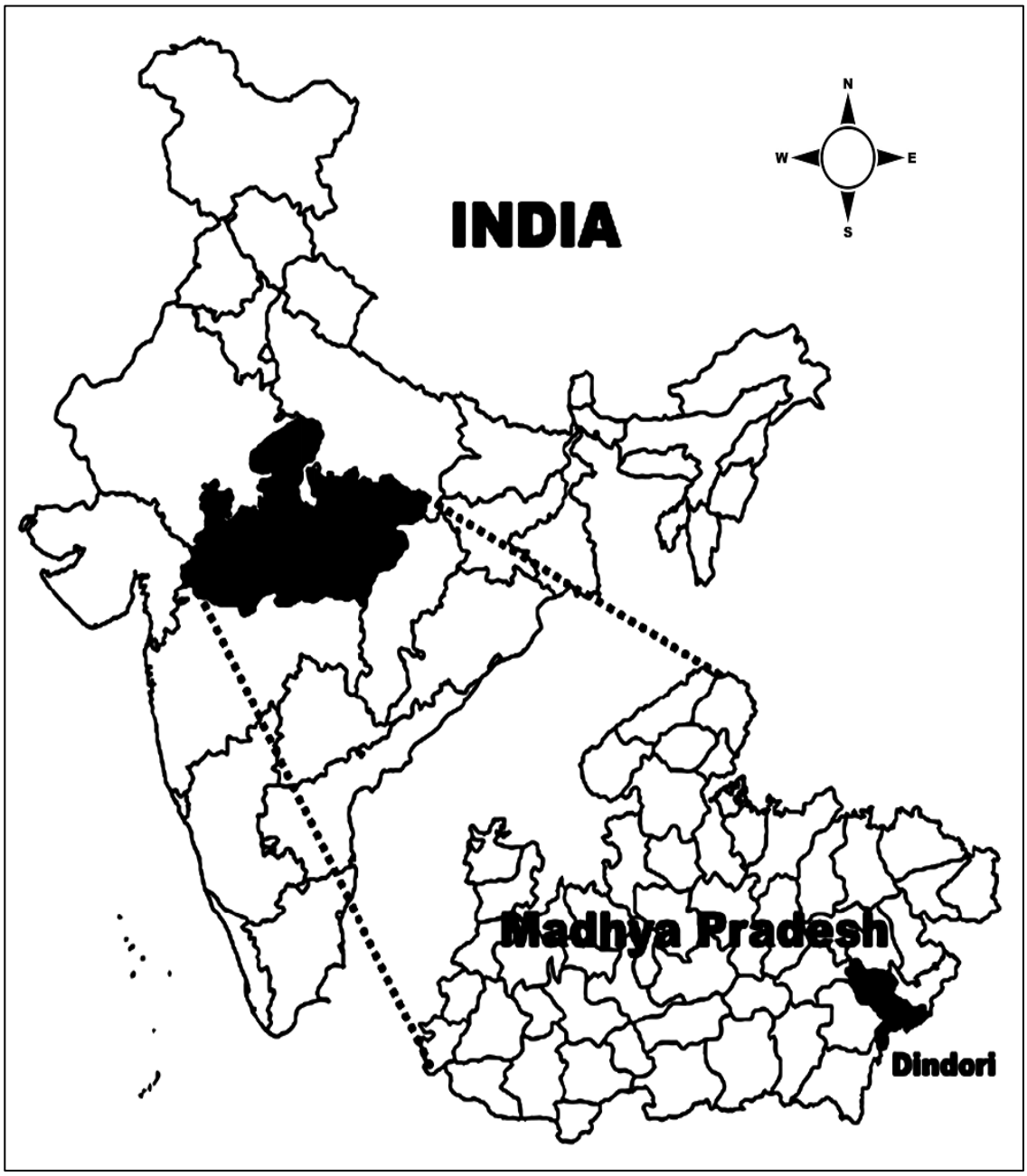

Figure 1. Location map of study area in district Dindori, Madhya Pradesh

However, the younger generations are currently does not seem very much interested to preserve the traditional approaches of their forefathers, which could lead to the elimination of this traditional knowledge. The study data was recorded through conversation with the informants in local-language, followed by interview, which was then translated into English with the assistance of a native translator.

Plant collection, identification and preservation

After the sustainable collection, standard method was followed for preparing herbarium of different parts of plants by assigning voucher numbers. Voucher samples of plants were prepared and identified, plants were arranged with their correct nomenclature including family name, local name and scientific name and their medicinal uses. Plant species were identified by Flora of Madhya Pradesh (Hooker, 1875; Singh et al., 2001) and their updated scientific names are taken from data base (POWO, 2023). Herbarium of plant twigs bearing voucher numbers were deposited in the Department of Botany, Guru Ghasidas Vishwavidyalaya (A Central University) Bilaspur, Chhattisgarh, India for future references.

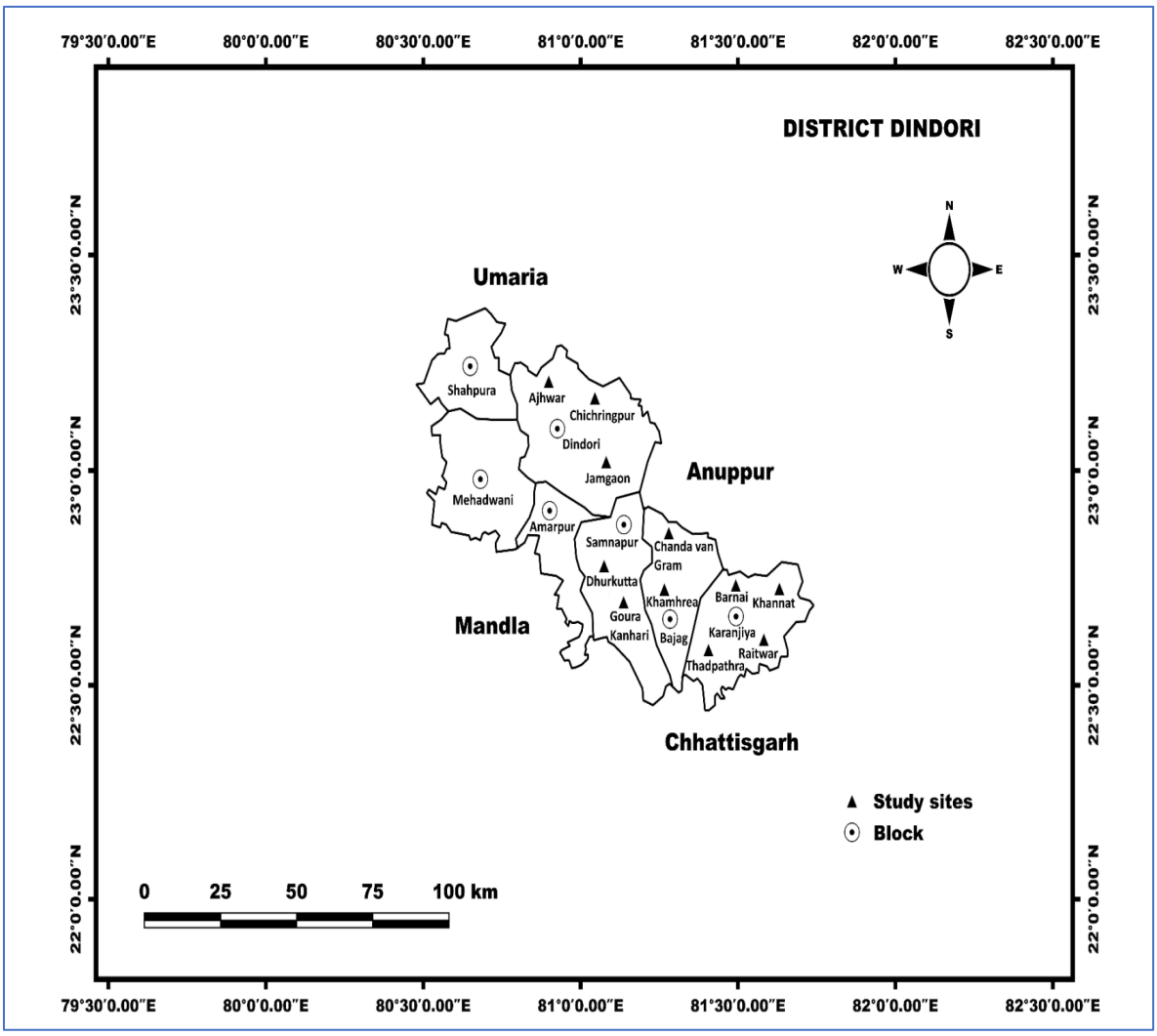

Figure 2. Map of the study area showing location of the survey as block Samnapur, block Dindori, block Bajag and Karanjiya block in district Dindori, Madhya Pradesh

Quantitative ethnomedicinal data analysis

Various quantitative indices were applied to analyze the ethnobotanical data obtained during the interviews, including Use value (UV) Relative frequency citation (RFC), Fidelity level (FL) and Informant consensus factor (ICF), Jaccard index (JI) as well as a Pearson correlation coefficient (PCC) was used.

Informant consensus factor (ICF)

An informant Consensus Factor (ICF) was found by the use of the following formula (Trotter and Logan, 2019; Heinrich et al., 1998).

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

Where N_t is the number of taxa utilized in that category, and N_{ur} is the number of the use reports for each diseases category. The ICF provides a value of (0 to 1). Informants with low ICF values (near to zero) disagree with one another on which plant to use, suggesting that either the selection process is unpredictable or there is a lack of exchange of knowledge regarding the use amongst informants. When the Informant Consensus Factor (ICF) is high, it means that there is consensus on the species utilized to treat a certain sickness category as well as that information is shared among experts (Gazzaneo et al., 2005).

Figure 3. Data collection: (a-f), Questionnaire interviews and Plant collection in forest area of district Dindori, Madhya Pradesh

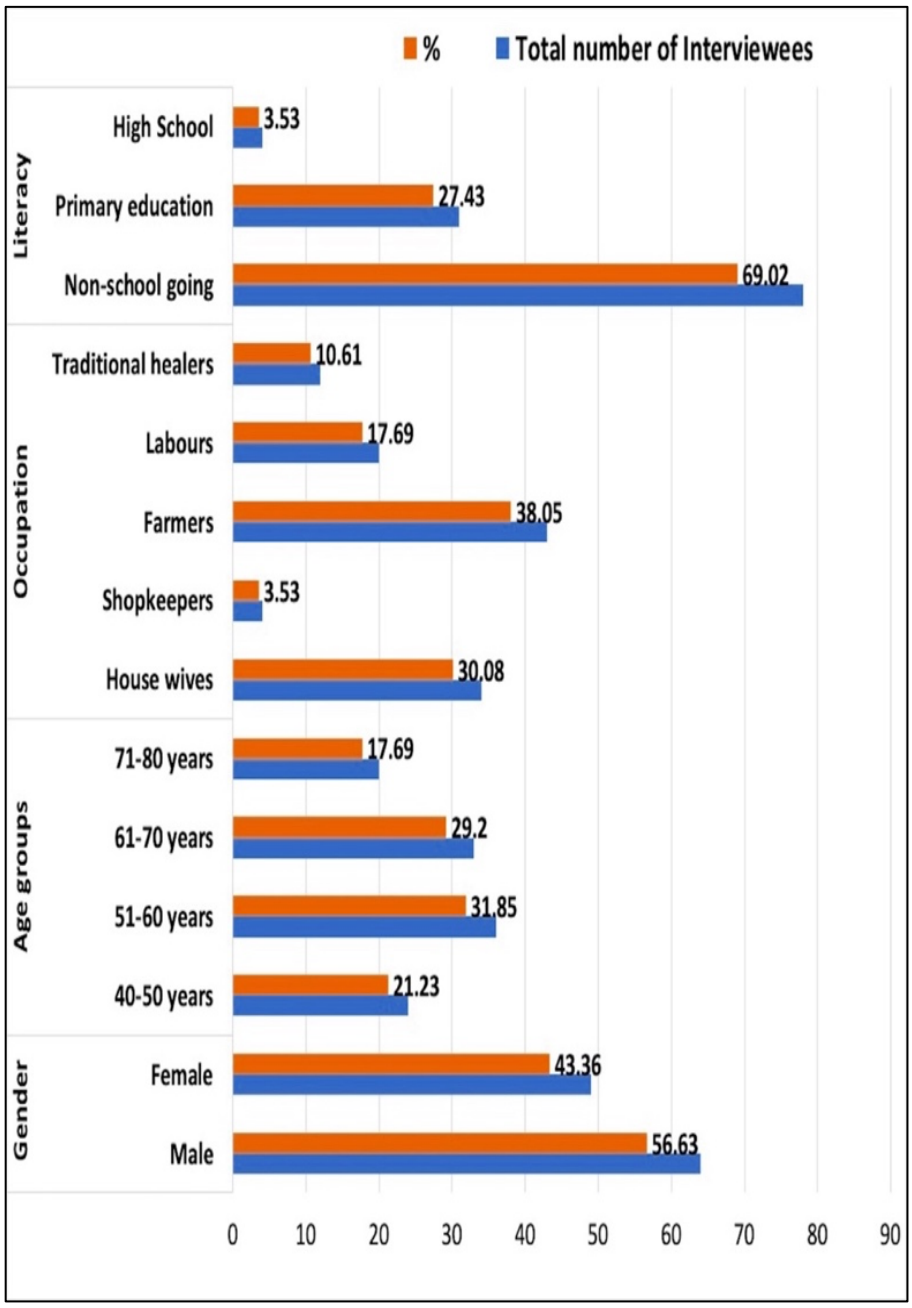

Figure 4. Social and demographic characteristics of informants

Fidelity level (FL)

where Np is the number of informants citing the use of the plant for a particular illness and N is the total number of informants citing the species for any illness. Increasing values of FL for a species indicate its uniqueness to treat a particular illness (Friedman et al., 1986).

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

R*elative Frequency Citation (RFC)*

The collected ethnomedicinal information was quantitatively analyzed using an index of relative frequency citation (RFC). This index shows the local importance of each species and it is given by the frequency of citation (FC, the number of informants mentioning the use of the species) divided by the total number of informants participating in the survey (N), without considering the use-categories (Faruque et al., 2018).

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

Use Value (UV)

Use value (UV) is the helpful in determining the plants with highest use in treating an ailment. Use values are highest when there are many use reports for a plant and low when there are few reports. Use value (UV) index for a species, including (Phillips and Gentry, 1993) Where 'Ui' refers to the number of uses specified by the informants for a particular species, and "N" refers to the total number the informants that were questioned during the research study. A lower Use Value (UV) score indicates that there are lower use experiences that the informants highlighted, while a higher score indicates that there are more use experiences that have been highlighted for a particular plant. Where 'N' is the total number of informants and 'Ui' is the number of uses that each individual informant provided for a certain species.

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

Pearson Correlation Coefficient (PCC)

The Pearson product-moment correlation coefficient provides a quantitative indices that measures how strongly two variables are related linearly. It is defined as the ratio to the covariance that exists between two variables compared to the standard deviations of those variables (Mukaka, 2012). The coefficient can be calculated using the following formula: where r, represents the Pearson correlation coefficient of the sample in question, x and y are the variables in question, and xi and yi, are the values for x and y for the individual in question it. A value of r that is equal to or below 0 implies that there has been no association between variables x and y, while a number that is equal to or above 0 suggests that there is a positive association. Higher levels of correlation are indicated by larger absolute values (Zhang et al., 2014). The square of the correlation, also known as r^2, is the metric that is used to measure the amount of variability in RFC that can be attributed to differences in UV (Bano et al., 2014; Barkatullah et al., 2015).

$$r = \frac{\sum_{i=1}^{n}(x_i - x)(y_i - y)}{\sqrt{\left[\sum_{i=1}^{n}(x_i - \bar{x})^2\right]\left[\sum_{i=1}^{n}(y_i - \bar{y})^2\right]}}$$

The correlation square (r^2) is generated by calculating the square of the value 'r' (Koop, 2013) and it is used to quantify the amount of cross-species variance in relative frequency citation (RFC) that can be explained by variation in use value (UV).

Jaccard index (JI)

We also analyzed the percentages of mentioned species and their medicinal uses to compute the Jaccard index (JI) for comparison with published data gathered from nearby regions. The following equations are used to determine JI:

$$JI = \frac{C \times 100}{(A + B - C)}$$

Where a represents the total number of species in area A, b represents the total number of species in area B, and c represents the total number of species that are found in both area A and area B (González-Tejero et al., 2008; Weckerle et al., 2018).

Results

Social and demographic characteristics of informants

In the current investigation, 113 informants ranging in age from 40 to 80 years old were interviewed in eleven different tribal settlements as Dindori, Samnapur, Bajag and Karanjiya located within the district of Dindori (Table 1). The remaining 43 informants are local people who had a great deal of information about medicinal plants and were practicing herbal medicine in their neighborhoods. A total of 12 traditional healers (herbalists) who were professionals in the field of folk medicines. The information was gathered from the informants in their native tongue, which was either Gondi and Bagheli.

Medicinal plants diversity and floristic analysis

The research revealed that inhabitants of the district Dindori in Madhya Pradesh make use of a total number 88 medicinally significant plant species, belongs to 46 different families and 80 different genera. The findings obtained in our study include a comprehensive account of various aspects related to plant usage. This includes the scientific name, common name, voucher sample number, growth form, specific plant parts employed, ailments addressed, preparation methods, application along with quantitative ethnobotanical analysis of the findings (Table 2). In the context of this research, Leguminosae was reported as the dominant plant family (13 species) followed by Lamiaceae (6 species), Euphorbiaceae (5 species), Combretaceae, Solanaceae (4 species) and Amaranthaceae, Compositae, Malvaceae, Moraceae (3 species each) (Fig. 5). According to the findings of our study, several species of plants, including *Glycyrrhiza glabra*, *Notholirion thomsonianum*, and *Podophyllum hexandrum*, are in grave danger as a result of excessive collection. The life forms of the 88 essential medicinal plants were very different from one another. The highest percentage of these trees contributions (35.40%) went towards the overall

number of plant species that were recorded, followed by herbaceous plants (33.37%), shrubs (15.17%), as well as climbers (5.6%) (Fig. 6). Herbal medicine is still very important to the local communities because of remote locations of their villages which have limited access to contemporary medical facilities. As a result, herbal medicine has become an essential component of the local communities in their health care system.

Table 1. Social and demographic profile of interviewees.

Name of Category	Interviewees categories	Total number of Interviewees	%
Gender	Male	64	56.63
	Female	49	43.36
Age groups	40-50 years	24	21.23
	51-60 years	36	31.85
	61-70 years	33	29.2
	71-80 years	20	17.69
Occupation	House wives	34	30.08
	Shopkeepers	4	3.53
	Farmers	43	38.05
	Labours	20	17.69
	Traditional healers	12	10.61
Literacy	Non-school going	78	69.02
	Primary education	31	27.43
	High School	4	3.53

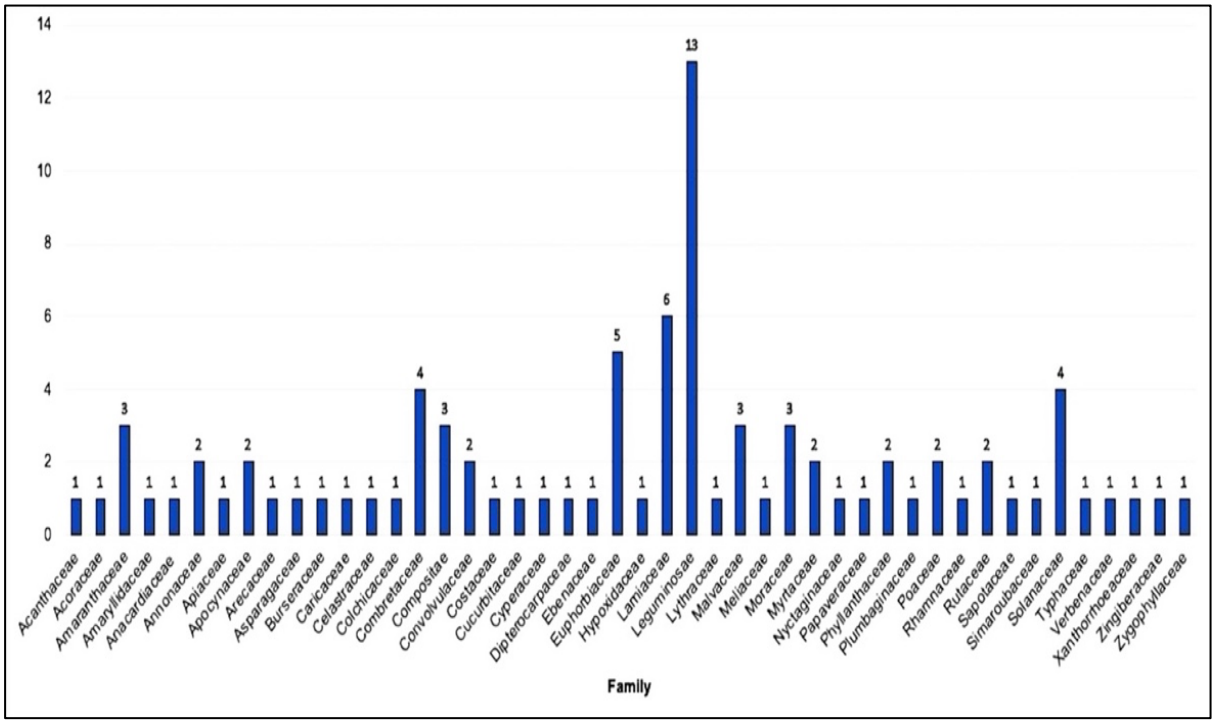

Figure 5. Plant Families with their number of species

Table 2. Ethnomedicinal plants to treat various diseases in district Dindori, Madhya Pradesh, India

Scientific name, family and voucher specimen number	Local name	Habit	Plants parts used and preparation	Disorders treated	FC	RFC	ΣUi	UR	UV
Abrus precatorius L. (Leguminosae) MPD107	Ghumchi	Shrub	Seed, powder	Menstrual disorder, Fever, Chest complaints, Tuberculosis	20	0.18	41	5	0.36
			Leaves, juice	Snake bite					
Abutilon indicum (L.) Sweet (Malvaceae) MPD132	Kanghi	Herb	Flower, paste	Asthma	17	0.15	30	3	0.27
			Leaves, paste	Piles					
			Seed, powder	Gonorrhea					
Acacia catechu (L.f.) Willd. (Leguminosae) MPD180	Khair	Tree	Stem bark, juice	Scabies	19	0.17	31	2	0.27
			Leaves, paste	Skin disease					
Acalypha indica L. (Euphorbiaceae) MPD120	Kuppi	Herb	Leaves, juice	Ringworm, Wound healing, Diuretic activity	27	0.24	51	4	0.45
			Leaves, decoction	Asthma					
Achyranthes aspera L. (Amaranthaceae) MPD137	Lathjeera	Shrub	Root, paste	Scorpion bite	35	0.31	69	3	0.61
			Root, decoction	Piles					
			Leaves, juice	Psoriasis					
Acorus calamus L. (Acoraceae) MPD115	Bach	Herb	Rhizome, poultice	Eczema	12	0.11	20	1	0.18
Adhatoda vasica Nees (Acanthaceae) MPD161	Adusha	Shrub	Leaves, juice	Whooping cough	23	0.20	45	3	0.40
			Root, decoction	Bloody diarrhea, Easy delivery					
Aegle marmelos (L.) Corrêa (Rutaceae) MPD69	Bel	Tree	Fruit, pulp infusion	Itching	12	0.11	20	1	0.20
Ageratum conyzoides (L.) L. (Compositae) MPD171	Jangli pudina/ Goat weed	Herb	Leaves, juice	Cuts and wounds, Colds, Headaches, Boils, Eczema, Burns	33	0.29	61	6	0.54
Ailanthus excelsa Roxb. (Simaroubaceae) MPD162	Mahaneem	Tree	Leaves, decoction	Sores	13	0.12	25	1	0.22

Albizia lebbeck (L.) Benth. Leguminosae MPD80	Sirish	Tree	Bark, juice	Toothache	12	0.11	24	1	0.21
Albizia odoratissima (L.f.) Benth. (Leguminosae) MPD185	Kala Sirish	Tree	Leaves, Poultice	Iching	11	0.10	19	1	0.17
Allium sativum L. (Amaryllidaceae) MPD153	Lahsum	Herb	Bulb, Pounded paste	Blisters	9	0.08	17	1	0.15
Aloe vera (L.) Burm.f. (Xanthorrhoeaceae) MPD127	Gwarpatha	Herb	Leaves, juice	Boils	3	0.03	9	1	0.08
Amaranthus spinosus L. (Amaranthaceae) MPD191	Chaulai	Herb	Leaves, Juice	Ringworm	13	0.12	24	1	0.21
Annona reticulata L. (Annonaceae) MPD58	Ramphal	Tree	Leaves, infusion	Carbuncles	10	0.90	19	1	0.17
Annona squamosa L. (Annonaceae) MPD156	Sitaphal	Tree	Leaves, juice	Insecticide	41	0.36	75	6	0.66
			Leaves, powder	Dysentery, Stomach ulcer, Toothache,					
			Fruit, paste	Hair growth, Body refreshment					
Argemone mexicana L. (Papaveraceae) MPD194	Pili Kateli	Shrub	Latex, poultice	Leprosy	23	0.20	41	2	0.36
			Root, paste	Skin disease					
Asparagus racemosus Willd. (Asparagaceae) MPD146	Satawar	Herb	Root, decoction	Hematuria	11	0.10	19	1	0.17
Azadirachta indica A.Juss. (Meliaceae). MPD87	Neem	Tree	Leaves, decoction	Smallpox	7	0.06	10	1	0.09
Boerhavia diffusa L. (Nyctaginaceae) MPD151	Punarnava	Herb	Leaves, Juice	Eczema	16	0.14	31	1	0.27

Bombax ceiba L. (Malvaceae) MPD165	Semala	Tree	Flower, Powder	Mouth ulcer	5	0.04	11	1	0.10
Boswellia serrata Roxb. ex Colebr. (Burseraceae) MPD133	Sallaya	Tree	Bark, juice	Skin disease	13	0.12	21	1	0.19
Butea monosperma (Lam.) Taub. (Leguminosae) MPD170	Palash	Tree	Stem bark, poultice Flower, powder	Scabies , Jaundice	11	0.10	29	2	0.26
Carica papaya L. (Caricaceae) MPD59	Papita	Tree	Latex, poultice	Itching	10	0.09	18	1	0.16
Cassia fistula L. (Leguminosae) MPD130	Amaltas	Tree	Root, decoction	Piles	14	0.12	29	1	0.29
Cassia siamea Lam. (Leguminosae) MPD184	Kasod	Tree	Leaves, poultice	Leukoderma	21	0.19	41	1	0.36
Cassia tora L. (Leguminosae) MPD178	Chakauda	Herb	Leaves, decoction Leaves, paste	Swelling, Eczema	16	0.14	31	2	0.27
Celastrus paniculatus Willd. (Celastraceae) MPD113	Mal-kangani	Climber	Seed, Powder	Leprosy	4	0.04	4	1	0.04
Centella asiatica (L.) Urb. (Apiaceae) MPD173	Brahmi	Herb	Root, Poultice Whole plant, decoction	Leprosy Diabetes	32	0.28	32	2	0.28
Chenopodium album L. (Amaranthaceae) MPD117	Bathua	Herb	Leaves, poultice	Cuts and wounds	9	0.08	16	1	0.14
Cicer arietinum L. (Leguminosae) MPD29	Chana	Herb	Leaves, decoction	Boils	17	0.15	31	1	0.27

Combretum albidum G.Don (Combretaceae) MPD121	Pilukhi	Climber	Bark, poultice	Leukoderma	11	0.10	21	1	0.19
Convolvulus prostratus Forssk. Convolvulaceae) MPD190	Shankhpushpi	Herb	Leaves, decoction	Scabies	15	0.13	14	1	0.12
Costus speciosus (J.Koenig) Sm. (Costaceae) MPD167	Jangali adrak	Herb	Rhizome, poultice	Small pox	15	0.13	12	1	0.11
Curculigo orchioides Gaertn. (Hypoxidaceae) MPD152	Kali musli	Herb	Root, Poultice	Eczema	8	0.07	14	1	0.12
Curcuma amada Roxb. (Zingiberaceae) MPD156	Haldi	Herb	Rhizome, Poultice	Sores	18	0.16	35	1	0.31
Cynodon dactylon (L.) Pers. (Poaceae) MPD115	Doobi	Herb	Leaves, paste	Menstrual disorders, Asthma	55	0.49	103	6	0.91
			Leaves, decoction	Gonorrhoea, Body pain, Scabies, Skin diseases					
Cyperus rotundus L. (Cyperaceae) MPD88	Nagarmotha	Herb	Rhizome, paste	Body strength	16	0.14	16	4	0.14
			Rhizome, decoction	Fever, Diuretic, Diarrhoea					
Dalbergia sissoo DC. (Leguminosae) MPD106	Shisam	Tree	Leaves, Juice	Itching	13	0.12	24	1	0.21
Datura metel L. (Solanaceae) MPD118	Dhatura	Shrub	Seed, Powder Fruit, powder	Leprosy, Skin disease	37	0.33	71	2	0.63
Diospyros melanoxylon Roxb. (Ebenaceae) MPD174	Tendu	Tree	Bark, Poultice	Pimples	16	0.14	34	2	0.30
			Root, decoction	Headache					
Eclipta alba (L.) Hassk. (Compositae) MPD125	Bhringraj	Herb	Leaf, juice decoction	Asthma, Cold	20	0.18	39	4	0.35
			Root, powder	Intestinal worms, Poison bite					

Eucalyptus tereticornis Sm. (Myrtaceae) MPD158	Liptish	Tree	Oil	Dry cough, Chest pain	8	0.07	15	2	0.13
Euphorbia hirta L. (Euphorbiaceae) MPD161	Dudhi/ Dudh ghas	Herb	Leaves, paste	Asthma	44	0.39	81	8	0.72
			Latex	Pimples					
			Flower, paste	Wounds, Body strength, Itching, Bloody diarrhea, Lactation					
			Whole plant, decoction	Leucorrhoea					
Ficus benghalensis L. (Moraceae) MPD149	Bargad	Tree	Fruit, powder	Sperm production, Gonorrhoea	63	0.56	61	7	0.54
			Bark, decoctio	White discharge, Diabetes, Lactation					
			Seed, paste	Body strength					
			Latex	Steatorrhea					
Ficus racemosa L. (Moraceae) MPD196	Gular	Tree	Fruit, poultice	Blisters	3	0.03	9	1	0.08
Ficus religiosa L. (Moraceae) MPD154	Peepal	Tree	Bark, poultice	Septic wounds	21	0.19	17	2	0.15
			Bark, powder	Breast abscess					
Gloriosa superba L. (Colchicaceae) MPD156	Kalihari	Climber	Root, poultice	Boils	26	0.23	21	2	0.19
			Whole plant, decoction	Used to abortifacient					
Hemidesmus indicus (L.) R. Br. ex Schult. (Apocynaceae) MPD194	Anantmul	Climber	Latex, poultice	Scabies	57	0.50	63	11	0.56
			Root, decoction	Leprosy, Skin diseases, Fever, Asthma, Bronchitis, Syphilis, Urinary diseases, Rheumatism, Leucorrhoea					
Hibiscus cannabinus L. (Malvaceae) MPD63	Patsan/Ambari	Herb	Flower, juice	Boils	11	0.10	23	1	0.20
Hyptis suaveolens (L.) Poit. (Lamiaceae) MPD130	Ban tulsi	Herb	Leaves, Juice	Cuts and wounds	12	0.11	25	1	0.22

Ipomoea carnea Jacq. (Convolvulaceae) MPD137	Beshram	Shrub	Leaves, paste	Cuts and wounds	12	0.11	16	1	0.14
Jatropha curcas L. (Euphorbiaceae) MPD15	Ratanjot	Shrub	Latex, poultice	Burns	31	0.27	38	2	0.34
			Latex	Wounds of animals					
Jatropha gossypiifolia L. (Euphorbiaceae) MPD164	Lal ratanjot	Shrub	Leaves, decoction	Boils	13	0.12	27	1	0.24
Lantana camara L. (Verbenaceae) MPD170	Baramashiya	Shrub	Fruit, poultice	Carbuncles	9	0.08	21	1	0.19
Leucas aspera (Willd.) (Lamiaceae) MPD136	Bhodaki	Herb	Root, Poultice	Snakebite	6	0.05	19	1	0.17
Limonia acidissima Groff (Rutaceae) MPD105	Kaitha	Tree	Fruit, pulp juice	Pimples	12	0.11	21	1	0.19
Madhuca longifolia (J. Koenig ex L.) J. F. Macbr. (Sapotaceae) MPD172	Mawhaa	Tree	Bark, decoction	Stomach-ache	16	0.14	33	1	0.29
Mentha piperita var. citrata (Ehrh.) Briq. (Lamiaceae) MPD171	Pudina	Herb	Leaves, decoction	Dog bite	20	0.18	41	1	0.36
Momordica dioica Roxb. ex Willd. (Cucurbitaceae) MPD18	Padora/ Kheskha	Climber	Root, Poultice	Swelling	23	0.20	48	1	0.42
Ocimum tenuiflorum L. (Lamiaceae) MPD165	Tulsi	Herb	Leaves, Infusion	Scabies	3	0.03	9	1	0.08
Phoenix sylvestris (L.) Roxb. (Arecaceae) MPD120	Khajur	Tree	Leaves, Juice	Septic wounds	6	0.05	11	1	0.10

Phyllanthus emblica L. (Phyllanthaceae) MPD20	Amla	Tree	Fruit, powder	Leucorrhoea	9	0.08	19	1	0.17
Phyllanthus niruri L. (Phyllanthaceae) MPD103	Bhui Aanwala	Shrub	Juice, leaves	Boils	7	0.06	15	1	0.13
Physalis minima L. (Solanaceae) MPD131	Chirpati/ Popatiya	Herb	Root, poultice	Small pox	9	0.08	14	1	0.12
Plumbago zeylanica L. (Plumbaginaceae) MPD196	Chitrak	Shrub	Root, poultice Root, paste	Snakebite Leukoderma	28	0.25	41	2	0.36
Pongamia pinnata (L.) Pierre (Leguminosae) MPD148	Karanj	Tree	Seed, powder	Cure rheumatic problems	13	0.12	27	1	0.27
Pterocarpus marsupium Roxb. (Leguminosae) MPD100	Bijasal	Tree	Bark, Infusion	Eczema	17	0.15	18	1	0.16
Rauvolfia serpentina (L.) Benth. ex Kurz (Apocynaceae) MPD113	Sarpgandha	Shrub	Root, Powder Root, paste	Leukoderma Rat bites	19	0.17	34	2	0.30
Ricinus communis L. (Euphorbiaceae) MPD152	Arandi	Shrub	Seed, poultice Leaves, paste	Boils Scabies	21	0.19	36	2	0.32
Semecarpus anacardium L.f. Anacardiaceae MPD147	Bhilama	Tree	Seed, Poultice	Septic wounds	13	0.12	24	1	0.12
Shorea robusta Gaertn. (Dipterocarpaceae) MPD127	Sal/Sarai	Tree	Root decoction	Typhoid and fever	4	0.04	4	1	0.04
Solanum nigrum L. (Solanaceae) MPD187	Makoi	Herb	Fruit Poultice	Blisters	17	0.15	19	1	0.17

Syzygium cumini (L.) Skeels (Myrtaceae) MPD101	Jamun	Tree	Seed Powder	Eczema	14	0.12	19	1	0.17
Tamarindus indica L. (Leguminosae) MPD101	Imli	Tree	Seed Poultice	Scorpion bite	17	0.15	14	1	0.12
Tectona grandis L.f. (Lamiaceae) MPD84	Sagon	Tree	Bark decoction	Ringworm	15	0.13	28	1	0.25
Terminalia arjuna (Roxb. ex DC.) Wight & Arn. (Combretaceae) MPD38	Arajuna	Tree	Bark decoction	Scabies	18	0.16	31	1	0.27
Terminalia bellirica (Gaertn.) Roxb. (Combretaceae) MPD46	Bahera	Tree	Leaves paste	Cure carbuncle	8	0.07	14	1	0.12
Terminalia chebula Retz. (Combretaceae) MPD91	Harra	Tree	Fruit Poultice	Septic wounds	16	0.14	28	2	0.25
			Fruit paste	Piles					
Tribulus terrestris L. (Zygophyllaceae) MPD15	Gokhru	Herb	Fruit Poultice	Snakebite	10	0.09	14	1	0.12
Tridax procumbens (L.) L. (Compositae) MPD184	Baramashi/Ghamara	Herb	Leaves Juice	Cuts and wounds	12	0.11	19	1	0.17
Typha angustifolia L. (Typhaceae) MPD158	Ghavbajra	Herb	Inflorescence poultice	Scabies	11	0.10	18	1	0.16
Vitex negundo L. (Lamiaceae) MPD122	Nirgundi	Shrub	Leaves Juice	Leprosy	6	0.05	13	1	0.12
Withania somnifera (L.) Dunal (Solanaceae) MPD34	Aswagandha	Herb	Leaves paste	Skin diseases	7	0.06	15	1	0.13

Woodfordia fruticosa (L.) Kurz (Lythraceae) MPD191	Dhawai	Shrub	Flower Infusion	Septic wounds	3	0.03	10	1	0.09
Zea mays L. (Poaceae) MPD68	Makki	Herb	Seed powder	Pimples	3	0.03	9	1	0.08
Ziziphus jujuba Mill. (Rhamnaceae) MPD131	Ber	Tree	Leaves Juice	Sores	10	0.09	17	1	0.05

Abbreviations: RFC = Relative frequency citation; FC = Frequency citation; $\sum \boldsymbol{Ui}$= A species total number of uses, as reported by each individual informant; UV = Use values; UR = Use reports.

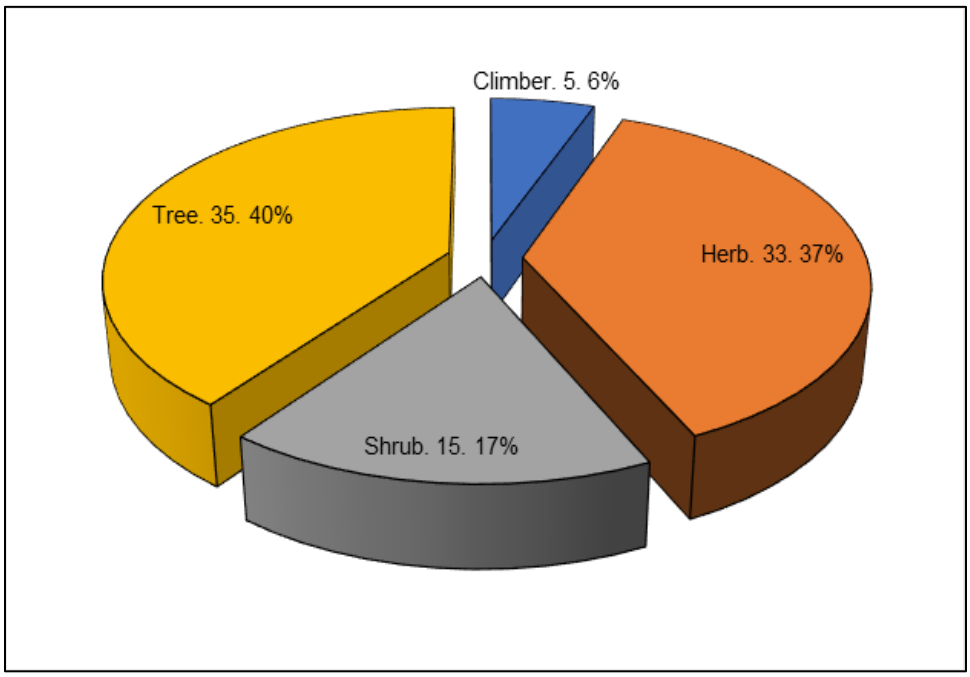

Figure 6. Percentage of Plants parts used in traditional healers

Plants parts used, preparation methods and administration

The present study found that root (20.17%) are the main part used in medicinal practices followed by fruit (12.10%), seed and bark (11.9%), latex (7.6%), flower (6.5%), rhizome (5.4%), whole plant (3.2%), stem (2.2%), oil, inflorescence and tuber (1.1% each) (Fig. 7). It was found that different preparation techniques were used on these plant components in order to cure a variety of illnesses. One of the most remarkable that may be uncovered through the study of herbal remedies is the sort of preparation used for traditional medicines using various approaches. The informants are using eight distinct ways of herbal treatments including poultices accounting for the largest share (30.25%), followed by decoction (26.21%), juice (21.17%), paste (20.16%), powder (16.13%), infusion (5.4%), latex (3.3%), and oil (1.1%) as the methods with the smallest contribution (Fig. 8). Oral and topical administration of herbal medicines applying regularly by native healers (Fig. 9) for Injury and poison (11 diseases), Dermatological problems (9 diseases), Inflammations and pains, Respiratory problems (6 diseases each), Abdominal diseases (5 diseases), Endocrine, nutritional and metabolic disorders, Mouth diseases (4 diseases each), Infection and parasitic diseases, Urinary and rectal problems (3 diseases each), Venereal and genital diseases (2 diseases), Body energizers, Gynaecological problems, Hair growth promoter and Male fertility problems (1 diseases each).

Informant consensus factor (ICF)

In this particular research, the reported diseases were broken down into a total of fourteen distinct ailment categories to calculate Informant consensus (ICF) (Trotter and Logan, 2019; Heinrich et al., 1998). The ICF number for each disease group is listed in Table 3. The derived ICF value provides an indication of the degree in which the informants share information about the medical care of each type of illness. The ICF value that was reported as being the highest was for Gynecological problems, female problems, Hair Care and male fertility problems (ICF=1.0) and the lowest ICF value was recorded for respiratory problems and endocrine, nutritional and metabolic disorders (0.91) for each of these. A higher ICF value suggests that less plant species was used by the informants who provided the data. Despite the fact that low ICF suggests the usage of a variety of plant species by the majority of informants. On the other hand, the ICF value is null when a relatively little number of informants report using a vast variety of plant species.

Fidelity Level (FL)

The value of the fidelity level was computed for the primary condition that was alleviated by the consumption of a certain plant species. In the current investigation, the value of the fidelity level varied anywhere from 33.33 to 100%. The highest value of FL was recorded (100%) twelve species viz., *Ageratum conyzoides* (used in cuts, wounds, colds, headaches, boils, eczema and burns), *Albizia lebbeck* (toothache), *Albizia odoratissima* (iching), Aloe vera (boils), *Annona reticulata* (Carbuncles), *Asparagus racemosus* (Hematuria), *Azadirachta indica* (Small pox), *Boswellia serrata* (Skin disease), *Centella asiatica* (Leprosy and Diabetes), *Cynodon dactylon* (Menstrual disorders, Asthma, Gonorrhea, Body pain, Scabies and Skin diseases), *Datura metel* (Leprosy and Skin disease) and *Euphorbia hirta* (Asthma, Pimples, Wounds, Body strength, Itching,

Bloody diarrhea, Lactation and Leucorrhoea). The least value (33.33%) was recorded for *Celastrus paniculatus* (used in Leprosy) (Table 4).

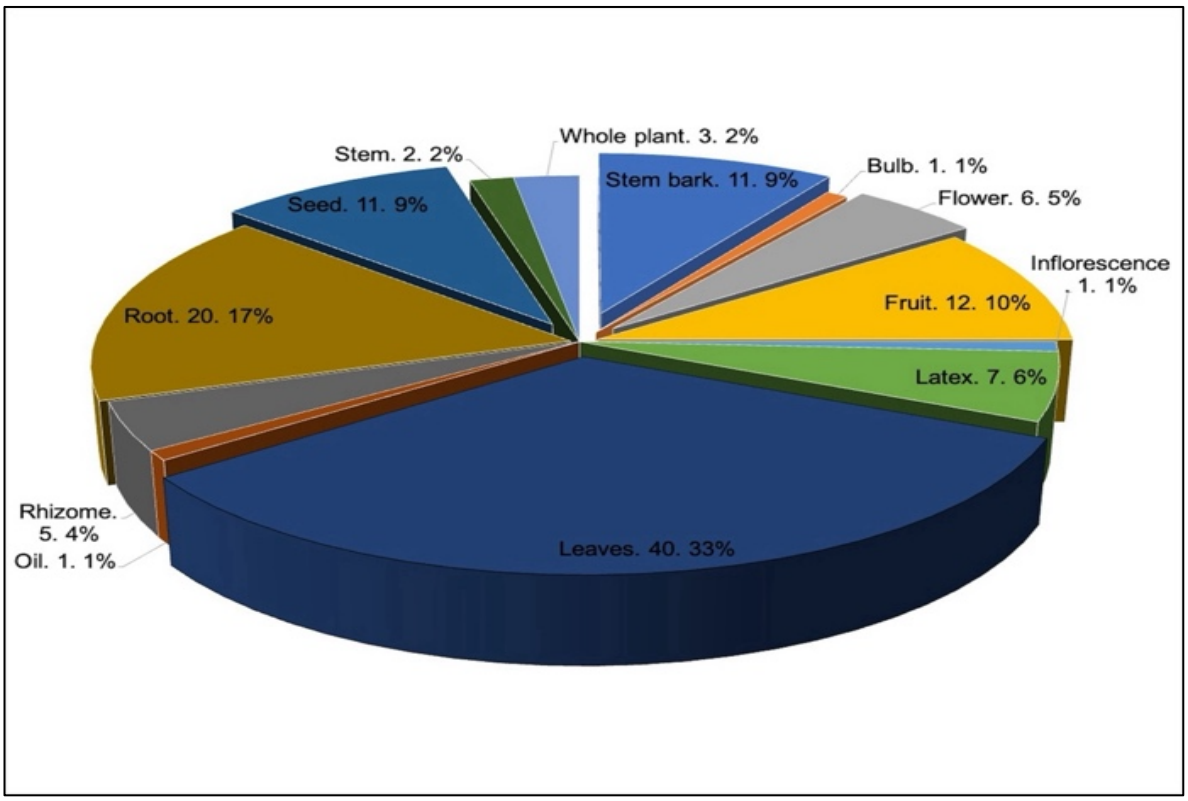

Figure 7. Percentage of plant parts used in herbal preparations

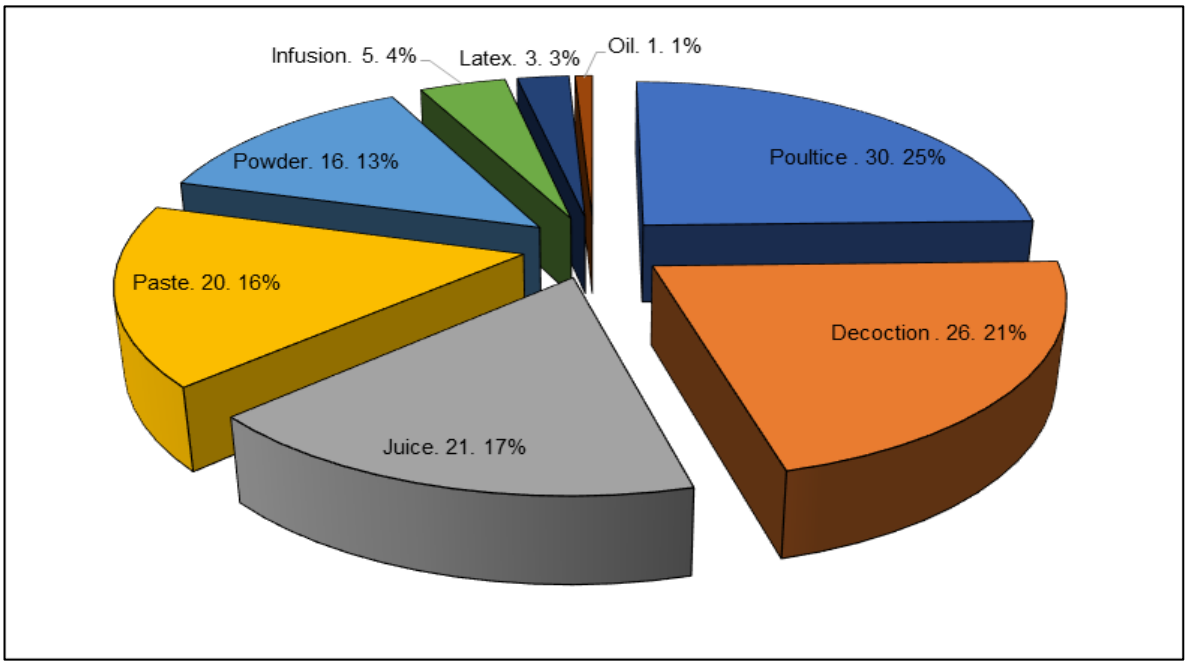

Figure 8. Preparation methods of traditional medicine

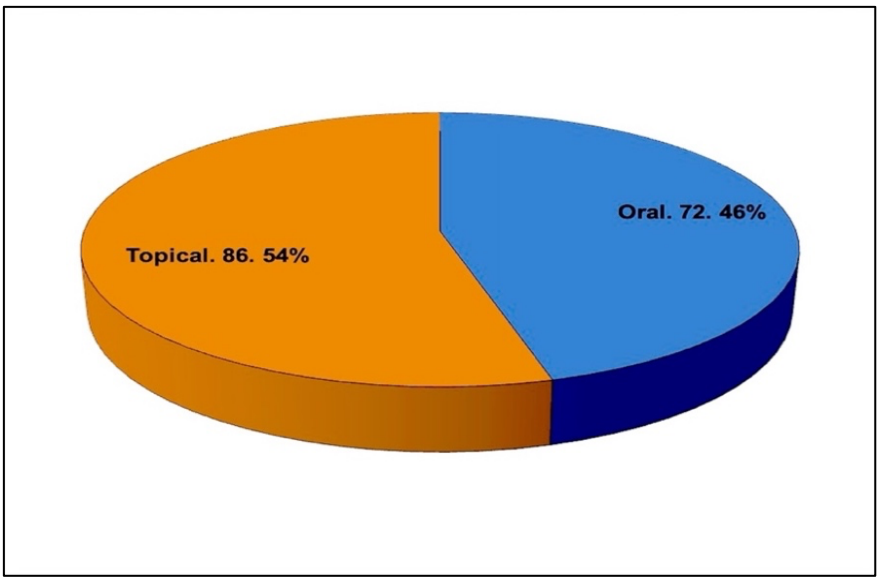

Figure 9. Categories of traditional healers mode of remedy application

Table 3. Informant consensus factor (ICF) for prevalent categories of diseases

Ailment categories	Disorders under ailment category	Number of diseases	Number of use reports	Number of taxa used	ICF
Abdominal diseases	Diarrhea, dysentery, intestinal worms, stomach ulcer, stomach-ache	5	101	7	0.94
Body energizers	Body strength	1	40	4	0.92
Gynaecological problems	Easy delivery, Abortifacient, leucorrhoea, menstrual disorder, white discharge	1	17	1	1.0
Dermatological problems	Boils, breast abscess, carbuncles, eczema, iching, leprosy, pimples, psoriasis, skin disease	9	751	38	0.95
Endocrine, nutritional and metabolic disorders	Diabetes, diuretic, jaundice, lactation	4	67	7	0.91
Hair growth promoter	Hair growth	1	17	1	1.0
Infection and parasitic diseases	Ringworm, scabies, small pox	3	310	15	0.95
Inflammations and pains	Body pain, fever, headache, rheumatism, swelling, typhoid	6	168	12	0.93
Injury and poison of external causes	Burns, cuts, dog bite, insecticide, poison bite, rat bites, scorpion bite, septic wounds, snake bite, wound	11	459	27	0.94
Male fertility problems	Spermatorrhea	1	9	1	1.0
Mouth diseases	Blisters, mouth ulcer, sores, toothache	4	205	9	0.96

Respiratory problems	Asthma, bronchitis, chest pain, cold, cough, tuberculosis	6	147	14	0.91
Urinary and rectal problems	Hematuria, piles, urinary diseases	3	115	6	0.96
Venereal and genital diseases	Gonorrhea, syphilis	2	44	4	0.93

Table 4. Fidelity level (FL) of ethno-medicinal plants of study area

Scientific name	**Number of informants reported of the taxa**	**Number of disorders treated**	**Number of uses most frequently determined by the informants**	**Fidelity level (FL)**
Abrus precatorius L.	45	5	41	91.11
Abutilon indicum (L.) Sweet	35	3	30	85.71
Acacia catechu (L.f.) Willd.	40	2	31	77.5
Acalypha indica L.	60	4	51	85
Achyranthes aspera L.	71	3	69	97.18
Acorus calamus L.	23	1	20	86.96
Adhatoda vasica Nees	50	3	45	90
Aegle marmelos (L.) Corrêa	25	1	23	92
Ageratum conyzoides (L.) L.	61	6	61	100
Ailanthus excelsa Roxb.	30	1	25	83.33
Albizia lebbeck (L.) Benth.	24	1	24	100
Albizia odoratissima (L.f.) Benth.	19	1	19	100
Allium sativum L.	18	1	17	94.44
Aloe vera (L.) Burm.f.	9	1	9	100
Amaranthus spinosus L.	25	1	24	96
Annona reticulata L.	19	1	19	100
Annona squamosa L.	76	6	75	98.68
Argemone mexicana L.	42	2	41	97.62
Asparagus racemosus Willd.	19	1	19	100
Azadirachta indica A.Juss.	10	1	10	100
Boerhavia diffusa L.	32	1	31	96.88
Bombax ceiba L.	15	1	11	73.33
Boswellia serrata Roxb. ex Colebr.	21	1	21	100
Butea monosperma (Lam.) Taub.	30	2	29	96.67
Carica papaya L.	36	1	18	50
Cassia fistula L.	35	1	29	82.86
Cassia siamea Lam.	42	1	41	97.62
Cassia tora L.	32	2	31	96.88
Celastrus paniculatus Willd.	12	1	4	33.33
Centella asiatica (L.) Urb.	32	2	32	100
Chenopodium album L.	17	1	16	94.12
Cicer arietinum L.	35	1	31	88.57
Combretum albidum G.Don	25	1	21	84
Convolvulus prostratus Forssk.	15	1	14	93.33
Costus speciosus (J.Koenig) Sm.	15	1	12	80
Curculigo orchioides Gaertn.	16	1	14	87.5
Curcuma amada Roxb.	36	1	35	97.22
Cynodon dactylon (L.) Pers.	103	6	103	100
Cyperus rotundus L.	17	4	16	94.12
Dalbergia sissoo DC.	25	1	24	96
Datura metel L.	71	2	71	100
Diospyros melanoxylon Roxb.	35	2	34	97.14

Eclipta alba (L.) Hassk.	40	4	39	97.5
Eucalyptus tereticornis Sm.	16	2	15	93.75
Euphorbia hirta L.	81	8	81	100
Ficus benghalensis L.	63	7	61	96.83
Ficus racemosa L.	10	1	9	90
Ficus religiosa L.	21	2	17	80.95
Gloriosa superba L.	26	2	21	80.77
Hemidesmus indicus (L.) R. Br. ex Schult.	65	10	63	96.92
Hibiscus cannabinus L.	25	1	23	92
Hyptis suaveolens (L.) Poit.	27	1	25	92.59
Ipomoea carnea Jacq.	18	1	16	88.89
Jatropha curcas L.	39	2	38	97.44
Jatropha gossypiifolia L.	28	1	27	96.43
Lantana camara L.	25	1	21	84
Leucas aspera (Willd.)	20	1	19	95
Limonia acidissima Groff	25	1	21	84
Madhuca longifolia (J. Koenig ex L.) J. F. Macbr.	34	1	33	97.06
Mentha piperita var. citrata (Ehrh.) Briq.	45	1	41	91.11
Momordica dioica Roxb. ex Willd.	49	1	48	97.96
Ocimum tenuiflorum L.	11	1	9	81.82
Phoenix sylvestris (L.) Roxb.	14	1	11	78.57
Phyllanthus emblica L.	21	1	19	90.48
Phyllanthus niruri L.	18	1	15	83.33
Physalis minima L.	15	1	14	93.33
Plumbago zeylanica L.	42	2	41	97.62
Pongamia pinnata (L.) Pierre	28	1	27	96.43
Pterocarpus marsupium Roxb.	21	1	18	85.71
Rauvolfia serpentina (L.) Benth. ex Kurz	38	2	34	89.47
Ricinus communis L.	40	2	36	90
Semecarpus anacardium L.f.	25	1	24	96
Shorea robusta Gaertn.	5	1	4	80
Solanum nigrum L.	26	1	19	73.08
Syzygium cumini (L.) Skeels	28	1	19	67.86
Tamarindus indica L.	20	1	14	70
Tectona grandis L.f.	30	1	28	93.33
Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	60	1	31	51.67
Terminalia bellirica (Gaertn.) Roxb.	30	1	14	46.67
Terminalia chebula Retz.	39	2	28	71.79
Tribulus terrestris L.	25	1	14	56
Tridax procumbens (L.) L.	25	1	19	76
Typha angustifolia L.	36	1	18	50
Vitex negundo L.	22	1	13	59.09
Withania somnifera (L.) Dunal	17	1	15	88.24
Woodfordia fruticosa (L.) Kurz	20	1	10	50
Zea mays L.	18	1	9	50
Ziziphus jujuba Mill.	34	1	17	50

Relative Frequency Citation (RFC)

The values ranged from 0.90 to 0.03, inclusive of RFC (Table 5). The highest values of RFC were found for the Annona reticulata (0.90 respectively), followed by the *Ficus benghalensis* (0.56), the *Hemidesmus indicus* (0.50), and the *Cynodon dactylon* (0.49).

Use value (UV)

In ethnobotany, use value is a quantitative index of a plant's significance in a certain study area. The usage values of the plant species in the current research region vary from 0.91 to 0.04 (Table 2). In the current study, the highest use value was

reported for *Cynodon dactylon* (menstrual disorders, asthma, gonorrhea, body pain, scabies, skin diseases) (UV=0.91), followed by *Euphorbia hirta* (asthma, pimples, wounds, body strength, itching, bloody diarrhea, lactation, leucorrhoea) (UV=0.72), *Annona squamosa* (ringworm) (UV=0.66), *Datura metel* (leprosy, skin disease) (UV=0.63), *Achyranthes aspera* (scorpion bite, piles, psoriasis) (UV=0.61). The lowest use value was recorded for *Adhatoda vasica* and *Acalypha indica* (UV=0.04 each). The lowest use value (UV=0.04) was recorded for *Adhatoda vasica* and *Acalypha indica* (UV=0.04 each). The highest use value of more significant the particular plant species.

Statistical analysis of the link between Relative Frequency Citation (RFC) with Use Value (UV)

The value of the Pearson correlation coefficient (PPC) r came out to be 0.8761 when it was computed (Table 5). This is a powerful example of a positive correlation, which indicates that a link exists between high scores on the x variable and high scores on the y variable. The coefficient of determination, shown by the number r^2, came out to be 0.7676). Because of the strong association, it can be deduced that RFC with UV have a relation that is linear across all species (Bano et al., 2014; Barkatullah et al., 2015).

Table 5. Summary of the statistics for the relative frequency citation (RFC) and the use value (UV)

Mean		Standard deviation	Minimum	Maximum
RFC	0.15545	0.13000	0.03	**0.90**
UV	0.24272	0.16092	0.04	**0.91**
Pearson correlation Coefficient (PCC) analysis on the relationship between RFC and UV.				
Correlation (r)	0.8761			
Correlation square (r^2)	0.7676			

Jaccard index (JI)

The Jaccard index (JI) indices that were computed (Table 6) ranged somewhere between 2.88 and 12.35. The degree of similarity between this research and one that was carried out in Madhya Pradesh was found to be the greatest, while the degree of similarity between this study and one that was carried out in Himachal Pradesh was found to be the lowest.

Table 6. Comparison of local and neighboring countries using the Jaccard index (JI)

Study of the area		Indices			Jaccard index (JI)		References
		S.N.	A	B	C		
Madhya Pradesh	Dindori district	1	77	23	11	12.35	Singh and Ahirwar, 2018
	Dhar district	2	86	24	12	12.24	Alawa et al., 2016
	Uttarakhand, India	4	74	102	14	8.64	Dwivedi et al., 2019
Neighboring states	Rajasthan, India	5	83	12	5	5.55	Maheshwari and Sharma, 2019
	Himachal Pradesh, India	6	85	22	3	2.88	Rani and Rana, 2014

Legend: A = Number of species that have been documented in the current research area a, B = Number of species that have been documented in another study area b, C = Number of species that are shared by both areas a and b, and S.N. = Serial number.

Discussion

Social and demographic characteristics of informants

There were 113 people identified as potential informants, 64 of whom were male and 49 of whom were female (Table 1). The number of male informants was slightly higher than the number of female informants for the purpose of sharing their information. Similar studies have shown that male informants predominate in healing practices (Rao et al., 2022; Lal et al., 2023; Ahmed et al., 2014; Mir et al., 2021). This is consistent with the findings of the majority of ethnobotanical research conducted all over the globe. There are just a few studies that were narrated by female participants as dominating informants in practicing herbal medicines in support of our research (Bibi et al., 2014; Yemele et al., 2014), just a few studies were narrated by female participants. On the other hand, both men and women who participated in the survey gave equal contributions to the traditional medicinal practice in (Kapodar et al., 2015). It is interesting to note that women were the ones who used to practice all of the different food-based remedies since they were the ones who cooked the meals and took

care of their families' basic medical needs. In the region under research, males are more likely to use herbal medicines made from wild plants than women. This is likely due to the fact that women have a more difficult time gathering medicinal plants from more remote parts of the forest. Men are the primary sources of information used in the practice of making herbal remedies from locally accessible ethnomedicinal plants (Boughrara and Belgacem, 2016).

Medicinal plants diversity and floristic analysis

In the present investigation, the families Leguminosae (13 species) and Lamiaceae (6 species) were found to be the most significant in terms of the number of taxa (4 species each). This was followed by the families Euphorbiaceae (5 species), Combretaceae, as well as Solanaceae. There are less than three species represented in each of the remaining four families. In the same manner that Leguminosae was also found to be prominent among the ethnic groups in earlier studies in Madhya Pradesh and other areas of the globe (Abe and Ohtani, 2013; Ong & Kim, 2014; Kankara et al., 2015; Lal and Sahu, 2016; Gupta et al., 2018; Al-Fatimi, 2019; Najem et al. 2019; Singh et al., 2022; Rao et al., 2022; Hussain et al. 2022; Lal et al., 2023, which is in line with the results of our study. It is possible that this family is so dominant because of its tree-like life form, its widespread dispersion, and its abundance in the area under investigation (Rao et al., 2022; Thakur, 2015). Trees accounted for 35.40 % of the recorded plant species, while herbs made up 33.37 %, shrubs made up 15.17 percent, and climbers made up 5.60 %. The life form surrounding the species was investigated utilizing the flora of Madhya Pradesh, which provided the results (Singh et al., 2001). Our findings were in line with a number of research from Madhya Pradesh and other regions of the globe, where it has been reported that trees are the most often used plant species by locals and professionals (Thakur et al., 2015; Lawal et al., 2020; Kacholi and Amir, 2022). The wide diversity of trees in the environment is the reason why local populations in the region continue to employ herbal medicines as trees (Sharma et al., 2021; Mujuru et al., 2020).

Plants parts used, preparation methods and administration

According to the findings of this research, the most often utilized component of plants is the leaves. This is followed by the root (20.17%), the fruit (12.10%), the seed, the bark (11.9%), the flower (6.5%), the rhizome (5.4%), the entire plant (3.2%), the stem (2.2%), the oil (1.1%), and the inflorescence (1.1%). The leaf was discovered to be the predominant plant component used in previous investigations (Singh et al., 2022; Dutt et al., 2015) of its kind that were carried out in various locations throughout Madhya Pradesh as well as the rest of the globe. Researchers are of the belief that leaves are often employed in traditional medicines because they are simple to gather and because they are photosynthetically active, meaning that they contain more secondary metabolites than other parts of the plant (Nadaf et al., 2019). In addition, leaves are thought to be the most effective source of secondary metabolites. Topical usage, which accounts for 85.54% of all treatments administered by traditional healers, is far and by the most common approach, followed by oral consumption, which accounts for 72.45% of all treatments administered (Fig. 10). Our results were in line with few similar studies conducted earlier (Gebashe et al., 2019), Where *Cynodon dactylon* wsa reported to be used for skin diseases, wound, eye infection, allergy and bleeding. However, our results are in contradiction with other results reported in similar studies (Sharma et al., 2014; Rashid et al., 2020, 2015) in addition, the application of herbal medicine topically is an important type of herbal medicine administration that is utilized in the treatment of a wide range of external ailments (Sureshkumar et al., 2017). These illnesses include skin disorders, wounds, poison stings, muscular soreness, and rheumatism. However, there is a possibility that the doses utilized to treat certain diseases were not consistent with one another.

According to the information collected from the interviewees in the study area, the illnesses that were reported in this study were sorted into one of fourteen different illness categories before being used in the evaluation of ICF. The problems associated with male fertility, hair care, and gynecological health had the greatest ICF values (ICF=1.0 for each), followed by difficulties associated with the mouth, urinary tract, and rectal health (0.96 for each), and infections and parasite disorders (0.95). Gynecological disorders were also reported to have the highest ICF value in the studies that were similar to ours that were carried out in different other parts of the globe. The findings that were reported in our study are consistent with those found in studies that were carried out in other parts of the world (Balamurugan et al., 2018; Hu et al., 2020; Biswas et al., 2017). However, our findings did not agree with the findings of a number of past investigations that were carried out similarly (Singh et al., 2022; Rao et al., 2022; Pradhan & Mondal, 2023). A high ICF suggests that a limited number of plants were utilized to treat the disease, and that this information was effectively transmitted to the informants who lived in the tribal areas so that they could treat the ailment using species. Analyses of data by various ethnobotanical indices provide a well-defined criterion for defining the traditional knowledge of therapeutic species of plants held by the local population of an area in quantitative ethnobotanical investigations (Khan et al., 2015).

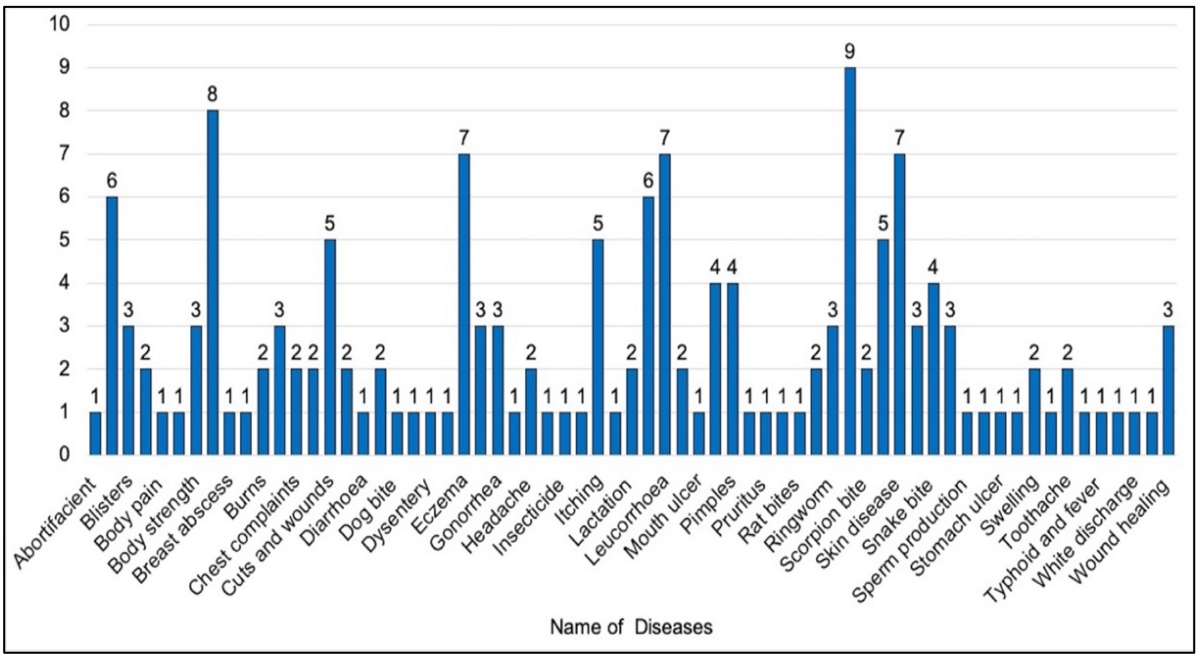

Figure 10. Number of plants used to treat various diseases ***Informant consensus factor (ICF)***

Use value (UV)

A number of plant species, including *Cynodon dactylon*, *Euphorbia hirta*, *Annona squamosa*, *Datura metel*, *Achyranthes aspera* etc. were discovered to have a high use value. The informants use *Cynodon dactylon* for menstrual disorders, asthma, gonorrhea, body pain, scabies and skin diseases. For several of the plants that the current investigation determined to have a high use value, phytochemical data are already available. In prior research, *Cynodon dactylon* was shown to contain alkaloids, tannins, etc. The plants exhibit antibacterial, anti-inflammatory, anti-pyretic, and other antidiabetic activities as a result of the existence of these secondary metabolites (Parihar and Sharma, 2021). In many of the earlier, comparable investigations carried out in various countries, *Cynodon dactylon* was shown to have the highest use value in our study (Sivasankari et al., 2014; Yaseen et al., 2019). That can be because there is more availability in the other research area.

Fidelity Level (FL)

It is clear that the species of medicinal plant that are most frequently used for the treatment of a certain illness by the people who live in the area have a higher level of fidelity than species that are not utilized in a repeating a similar way. In the present study the fidelity of twelve different plant species *Ageratum conyzoides* (Cuts, Wounds, Colds, Headaches, Boils, Eczema, Burns), *Albizia lebbeck* (Toothache), *Albizia odoratissima* (Lching), *Aloe vera* (Boils), *Annona reticulata* (Carbuncles), *Asparagus racemosus* (Hematuria), *Azadirachta indica* (Small pox), *Boswellia serrata* (Skin disease), *Centella asiatica* (Leprosy, Diabetes), *Cynodon dactylon* (Menstrual disorders, Asthma, Gonorrhea, Body pain, Scabies, Skin diseases), *Datura metel* (Leprosy, Skin disease) and *Euphorbia hirta* (Asthma, Pimples, Wounds, Body strength, Itching, Bloody diarrhea, Lactation, Leucorrhoea) was recorded 100% which is highest recorded value followed *Annona squamosa* (Insecticide, Dysentery, Stomach ulcer, Toothache, Hair growth, Body refreshment), *Momordica dioica* (Swelling), *Argemone mexicana* (Leprosy, Skin disease), *Cassia siamea* (Leukoderma), *Plumbago zeylanica* (Snakebite, Leukoderma), *Eclipta alba* (Asthma, Cold, Intestinal worms, Poison bite) etc. The remaining 59 species of plants have been taken for, and the level of fidelity documented for them is greater than 70%. Our results did not agree with a few previous studies (Lal et al., 2023), in which *Ageratum conyzoides* was found to be effective in treating a variety of conditions. It is possible that the enhanced effectiveness and improved healing qualities of these plants are what contribute to their high level of faithfulness. The plants that were found to have a higher fidelity level during this study were utilized not only in the region that this study focused on but also in other regions of India and other regions of the world (Mir et al., 2021; Hussain et al., 2022). The existence of a variety of secondary metabolites makes it feasible for medicinal plants to possess such a great potential for healing. It is speculated that the plants that are utilized in a repetitive approach possess a greater number of bioactive components (Cotton, 1996). The plant species recorded to higher fidelity level values could be proposed for use in future phytochemicals as well as pharmacological studies in order to extract multiple bioactive components that are responsible for the greater level of efficiency in the treatment of disease (Heinrich et al., 1998; Chekole, 2017).

Statistical analysis of the link between Relative Frequency Citation (RFC) with Use Value (UV)

The value of the Pearson correlation coefficient (PPC) r, came determined to be 0.8761 after being calculated. This is a powerful example of a positive correlation, which indicates that a correlation exists between high scores on the x variable and high scores on the y variable. (Fig. 11) shows that the value of r^2, also known as the coefficient of determination, was 0.7676. Because of the strong association, it can be deduced that RFC with UV have a relation that is linear across all species (Bano et al., 2014; Barkatullah et al., 2015). Our study findings are consistent with those found in studies of a similar nature that have been carried out in a variety of other regions throughout worldwide (Bibi et al., 2014; Vijaykumar et al., 2015; Wali et al., 2019; Amjad et al., 2017).

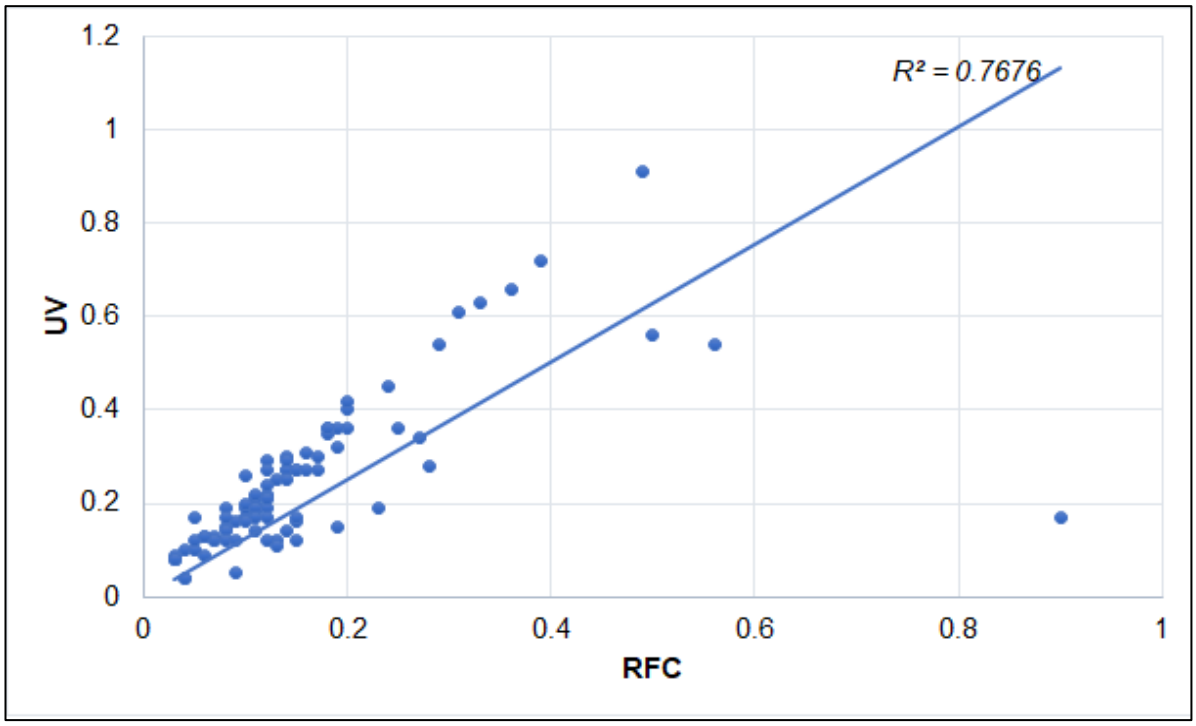

Figure 11. Relationship between Relative Frequency Citation (RFC) and Use value (UV)

Comparison of present study with previous reports

Jaccard index (JI)

We used the Jaccard index to compare our research to six other studies to show whether or not there was any homogeneity of application. Three different regions in Madhya Pradesh were investigated for their similarity to our study area using the Jaccard index (JI) formula; the Dindori district came out on top with a value of 12.35, accompanied by the Dhar along with values of 12.24. The Himachal Pradesh study yielded the lowest Jaccard index (JI) value (2.88) (Rani and Rana, 2014). For areas with a high Jaccard index (JI), this could indicate that they share a similar geological and cultural background. On the other hand, among three neighboring states (Uttarakhand, Rajasthan, and Himachal Pradesh), the highest similarity was found with the adjacent state of Uttarakhand, India (JI=8.64) while the lowest (JI=2.88) was from Himanchal Pradesh state.

Conclusion

Medicinal plants are the backbone of traditional medicine, and many people in impoverished countries still prefer to use them instead of modern pharmaceuticals. The purpose of this research was to draw attention to the therapeutic plants that may be used to meet the fundamental needs of the people living in the Dindori district of Madhya Pradesh. Interestingly, we report total of 88 plant species not previously reported as medicinal plants in this area. Furthermore, we document the first time a total of 65 new treated different diseases uses for 88 plant species. Forty-six plant families and eighty genera were represented among the 88 therapeutic plants reported from the research region. Based on their maximum FL and UV, local populations knew that *Cynodon dactylon*, *Euphorbia hirta*, *Annona squamosa*, and *Achyranthes aspera* were among the most valuable medicinal plants in the area. Also, the sustainable use of the medicinal plants needs to be ensured to improve the economic development of the local communities based on the premise of biodiversity conservation.

However, future pharmacological and for phytochemical investigations are required to verify their use. According to the current research, the study area's residents have a wealth of traditional knowledge that they have acquired from their ancestors, and the documenting of this priceless knowledge has led to the discovery of new facts about the region. Native communities still rely on medicinal plants as their main source of healthcare, but they are also concerned about the state of the wild flora. When compared to younger people, elderly people possessed a vast amount of indigenous knowledge. This knowledge gap may be the result of younger people's changing lifestyles, ethnic communities shifting perspectives, and the growing influence of industrialization, it is leading to the rapid loss of invaluable cultural information about the medicinal uses of plants. It is critical to promptly document the important plants along with associated knowledge and adopt the necessary conservation procedures in order to protect this treasure. According to the findings of the ethnobotanical questionnaire study, the Leguminosae family was the most represented, with 88 identified plants. Without intervention, many plants with therapeutic value will disappear from nature. We advise using species with high fidelity level value (FL) and use value (UV) for future phytochemical as well as pharmacological investigation in order to validate this indigenous knowledge. Also, new plant species should be submitted to pharmacological and phytochemical examinations since they may aid in the identification of future allopathic medicines.

Declarations

List of abbreviations: RFC = Relative frequency citation, FC = Frequency citation, $\sum Ui$ = A species total number of uses as reported by each individual informant, UV = Use values, UR = Use reports, FL = Fidelity kevel, ICF = Informant consensus factor, PCC = Pearson Correlation Coefficient, JI = Jaccard index

Ethics approval and consent to participate: This study did not involve the export of any animal or plant material. Information was obtained from the participants. All informants were orally consented.

Consent for publications: Oral permission was taken from all participants shown in images.

Availability of data and materials: The figures and tables supporting the results of this study are included in the article, and the original data sets are available from the first author upon request.

Conflicts of Interest: The authors declare that there are no conflicts of interest in this article.

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Authors' contributions: RKA Conceptualization, Investigation, Methodology, Supervision, Validation, Visualization, Writing – original draft, Data curation; VKG Writing – review & editing. All the authors approved the final manuscript after revision.

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Literature Cited

Abe R, Ohtani K. 2013. An ethnobotanical study of medicinal plants and traditional therapies on Batan Island, the Philippines. Journal of Ethnopharmacology,145(2): 554-565.

Ahirwar RK. 2017. Ethnomedicinal Investigations among the Baiga Tribes, District Anuppur, Madhya Pradesh, India. Nelumbo 59 (2):181-186.

Ahirwar RK. 2018. Ethnomedicinal Plants Used by Baiga Tribe of District Dindori, Madhya Pradesh. Indian Forester 144 (4):363-367.

Ahirwar RK. 2020. Ethnomedicinal Uses of some plants used by Gond tribe of Dindori District, Madhya Pradesh. Plant Archives 20 (1): 537-541.

Ahirwar RK. 2022. Diversity of medicinal plant traditionally used by Baiga tribes in District Umaria, Madhya Pradesh, India. Advances in Traditional Medicine 22:797-808.

Ahirwar RK. 2022. Medicinal Plants and Traditional Practices of Baiga Tribe in Amarkantak Region of Eastern Madhya Pradesh. In: El-Shemy HA. (Eds.). Natural Medicinal Plants, Pp. 139-146. IntechOpen Limited, London.

Ahmed N, Mahmood A, Tahir SS, Bano A, Malik RN, Hassan S, Ashraf A. 2014. Ethnomedicinal knowledge and relative importance of indigenous medicinal plants of Cholistan desert Punjab Province, Pakistan. Journal of Ethnopharmacology 155:1263-1275.

Al-Fatimi M. 2019. Ethnobotanical survey of medicinal plants in central Abyan governorate, Yemen. Journal of Ethnopharmacology 241:111973.

Alawa KS, Ray S, Dubey A. 2016. Folklore claims of some ethnomedicinal plants used by Bhil Tribes of Dhar District Madhya Pradesh. Bioscience Discovery 7(1): 60-62.

Ali E, Azhar MF, Bussmann RW. 2023. Ethnobotanical inventory and medicinal applications of plants used by the local people of Cholistan desert, Pakistan. Ethnobotany Research and Applications 25:21.

Amjad MS, Qaeem MF, Ahmad I, Khan SU, Chaudhari SK, Malik NZ, Shaheen H, Khan AM. 2017. Descriptive study of plant resources in the context of the ethnomedicinal relevance of indigenous flora: A case study from Toli Peer National Park, Azad Jammu and Kashmir, Pakistan. PLOS ONE 12(2):e0171896.

Balamurugan S, Vijayakumar S, Prabhu S, Morvin Yabesh JE. 2018. Traditional plants used for the treatment of gynecological disorders in Vedaranyam taluk, South India-An ethnomedicinal survey. Journal of Traditional and Complementary Medicine 8 (2): 308-323.

Bano A, Ahmad M, Hadda TB, Saboor A, Sultana S, Zafar M, Khan MPZ, Arshad M, Ashraf MA. 2014. Quantitative ethnomedicinal study of plants used in the Skardu valley at high altitude of Karakoram-Himalayan range, Pakistan. Journal of Ethnobiology and Ethnomedicine 10:43.

Barkatullah, Ibrar M, Rauf A, Hadda TB, Mubarak MS, Patel S. 2015. Quantitative ethnobotanical survey of medicinal flora thriving in Malakand Pass Hills, Khyber Pakhtunkhwa, Pakistan. Journal of Ethnopharmacology 169:335-346.

Basu SK. 1994. Health problems and health care of the tribal population of India. In: Mahanti N. (Eds.), Tribal Economy, Health, and Wasteland Development, Pp. 137. Inter-India Publications, New Delhi.

Bibi T, Ahmad M, Tareen RB, Tareen NM, Jabeen R, Rehman SU, Sultana S, Zafar M, Yaseen G. 2014. Ethnobotany of medicinal plants in district Mastung of Balochistan province-Pakistan. Journal of Ethnopharmacology 157:79-89.

Biswas S, Shaw R, Bala S, Mazumdar A. 2017. Inventorization of some ayurvedic plants and their ethnomedicinal use in Kakrajhore forest area of West Bengal. Journal of Ethnopharmacology 197:231-241.

Boughrara B, Belgacem L. 2016. Ethnobotanical study close to the population of the extreme northeast of Algeria: the municipalities of El Kala National Park (EKNP). Industrial Crops and Products 88:2-7.

Chekole G. 2017. Ethnobotanical study of medicinal plants used against human ailments in Gubalafto District, Northern Ethiopia. Journal of Ethnobiology and Ethnomedicine 13:55.

Cook FEM. 1995. Economic botany data collection standard. H.D.V. Prendergast, ed. Royal Bot. Gardens Kew, UK.

Cotton CM. 1996. Ethnobotany: Principles and Applications, John Willey & Sons., Chich-ester, UK.

D'Rozario A, Bera S, Mukherji D. 2004. A hand book of ethnobotany, first ed., Kalyani Publishers, New Delhi.

Dapar MLG, Alejandro GJD, Meve U, Liede-Schumann S. 2020. Quantitative ethnopharmacological documentation and molecular confirmation of medicinal plants used by the Manobo tribe of Agusan del Sur, Philippines. Journal of Ethnobiology and Ethnomedicine 16(1):1-60.

Dutt HC, Bhagat N, Pandita S, 2015. Oral traditional knowledge on medicinal plants in jeopardy among Gaddi shepherds in hills of northwestern Himalaya, J&K, India. Journal of Ethnopharmacology 168:337-348.

Dwivedi T, Kanta C, Singh LR, Sharma IP. 2019. A list of some important medicinal plants with their medicinal uses from Himalayan State Uttarakhand, India. Journal of Medicinal Plants Studies 7(2):106-116.

Faruque MO, Uddin SB, Barlow JW, Hu S, Dong S, Cai Q, Li X, Hu X. 2018. Quantitative ethnobotany of medicinal plants used by indigenous communities in the Bandarban District of Bangladesh, Frontiers in Pharmacology 9:40.

Friedman J, Yaniv Z, Dafni A, Palewitch D. 1986. A preliminary classification of the healing potential of medicinal plants, based on the rational analysis of an ethnopharmacological field survey among Bedouins in Negev Desert, Israel. Journal of Ethnopharmacology 16 275-287.

Gazzaneo LRS, de Lucena RFP, de Albuquerque UP. 2005. Knowledge and use of medicinal plants by local specialists in an region of Atlantic Forest in the state of Pernambuco (Northeastern Brazil). Journal of Ethnobiology and Ethnomedicine 1:9.

Gebashe F, Moyo M, Aremu AO, Finnie JF, Van Staden J. 2019. Ethnobotanical survey and antibacterial screening of medicinal grasses in KwaZulu-Natal Province, South Africa. South African Journal of Botany 122:467-474.

González-Tejero MR, Casares-Porce lM, Sánchez-Rojas CP, Ramiro-Gutiérrez JM, Molero-Mesa J, Pieroni A, Giusti ME, Censorii E, de Pasquale C, Della A, Paraskeva-Hadijchambi D, Hadjichambis A, Houmani Z, El-Demerdash M, El-Zayat M, Hmamouchi M, ElJohrig S. 2008. Medicinal plants in the Mediterranean area: Synthesis of the results of the project Rubia. Journal of Ethnopharmacology 116:341-357.

Gupta VK, Kaushik A, Chauhan DS, Ahirwar RK, Sharma S, Bisht D. 2018. Anti-mycobacterial activity of some medicinal plants used traditionally by tribes from Madhya Pradesh, India for treating tuberculosis related symptoms. Journal of Ethnopharmacology 227:113-120.

Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. 1998. Medicinal plants in Mexico: healers' consensus and cultural importance, Social Science & Medicine 47(11):1859-1871.

Hooker JD. 1875. Flora of British India. Vol. I-VII, Reeve & Co. Ltd., London.

Hosseini SH, Sadeghi Z, Hosseini SV, Bussmann RW. 2022. Ethnopharmacological study of medicinal plants in Sarvabad, Kurdistan province, Iran. Journal of Ethnopharmacology 288:114985.

Hu R, Lin C, Xu W, Liu Y, Long C. 2020. Ethnobotanical study on medicinal plants used by Mulam people in Guangxi, China. Journal of Ethnobiology and Ethnomedicine 16:40.

Hussain S, Hussain W, Nawaz A, Badshah L, Ali A, Ullah S, Ali M, Hussain H, Bussmann RW. 2022. Quantitative ethnomedicinal study of indigenous knowledge on medicinal plants used by the tribal communities of Central Kurram, Khyber Pakhtunkhwa, Pakistan. Ethnobotany Research and Applications 23:1-31.

International Society of Ethnobiology. 2006. International Society of Ethnobiology Code of Ethics (with 2008 additions). http://ethnobiology.net/code-of-ethics/

Jain SK, Mudgal V. 1999. A handbook of ethnobotany, first ed., Bishen Singh Mahendra Pal Singh, Dehra Dun.

Kacholi DS, Amir HM. 2022. Ethnomedicinal survey of antidiarrheal plants of the Nyamwezi people of Nsenda ward in Urambo District, central western Tanzania. Ethnobotany Research and Applications 24:1-14.

Kankara SS, Ibrahim MH, Mustafa M, Go R. 2015. Ethnobotanical survey of medicinal plants used for traditional maternal healthcare in Katsina state, Nigeria. South African Journal of Botany 97:165-175.

Khajuria AK, Manhas RK, Kumar H, Bisht NS. 2021. Ethnobotanical study of traditionally used medicinal plants of Pauri district of Uttarakhand, India. Journal of Ethnopharmacology 276:114-204.

Khan MA, Islam MK, Siraj MA, Saha S, Barman AK, Awang K, Rahman MM, Shilpi JA, Jahan R, Rahmatullah EIM. 2015. Ethnomedicinal survey of various communities residing in Garo Hills of Durgapur, Bangladesh. Journal of Ethnobiology and Ethnomedicine 11:44.

Koop G. 2013. Analysis of economic data, fourth ed., John Wiley & Sons, United Kingdom.

Kpodar MS, Karou SD, Katawa G, Anani K, Gbekley HE, Adjrah Y, Tchacondo T, Batawila K, Simpore J. 2015. An ethnobotanical study of plants used to treat diseases in the Maritime region of Togo. Journal of Ethnopharmacology 181:263-273.

Lal M, Chandraker SK, Shukla R. 2023. Quantitative ethnobotanical study of therapeutic plants of Amarkantak hills in Achanakmar-Amarkantak Biosphere Reserve, Central India. Acta Ecologica Sinica 43(1):139-153.

Lal S, Sahu MS. 2016. Ethnobotanical observations from Sitanadi Wild life sanctuary Dhamtari, Chattisgarh, India. International Journal of Pharmacy & Life Sciences 7(9):5224-5233.

Lawal IO, Olufade II, Rafiu BO, Aremu AO, 2020. Ethnobotanical Survey of Plants Used for Treating Cough Associated with Respiratory Conditions in Ede South Local Government Area of Osun State, Nigeria. Plants 9(5):647.

Maheshwari S, Sharma A. 2019. Ethnobotanical studies on medicinal plants in Hadoti region of Rajasthan. Journal of Pharmacognosy and Phytochemistry 8(2):546-549.

Maleki T, Akhani H. 2018. Ethnobotanical and ethnomedicinal studies in Baluchi tribes: A case study in Mt. Taftan, Southeastern Iran. Journal of Ethnopharmacology 217:163-177.

Marko MK, Sandya GS. 2020. Ethnobotanical study of traditional medicinal plants used by tribe of Dindori district (M.P.). International Journal of Applied Research 6(10):90-93.

Mir TA, Jan M, Khare RK. 2021. Ethnomedicinal application of plants in Doodhganga forest range of district Budgam, Jammu and Kashmir, India. European Journal of Integrative Medicine 46:101366.

Mujuru L, Jimu L, Mureva A, Mapaura A, Nyakudyal W, Muvengwi J. 2020. Diversity of local knowledge on use of wild food and medicinal plants in communities around five biodiversity hotspots in Zimbabwe. Advances in Traditional Medicine 20:663-671.

Mukaka MM. 2012. Statistics Corner: A guide to appropriate use of Correlation coefficient in medical research. Malawi Medical Journal 24 (3):69-71.

Nadaf M, Joharchi M, Amiri MS. 2019. Ethnomedicinal uses of plants for the treatment of nervous disorders at the herbal markets of Bojnord, North Khorasan Province, Iran. Avicenna Journal of Phytomedicine 9(2):153-163.

Najem M, Ibijbijen J, Nassiri L. 2019. Quantitative ethnobotanical study of toxic plants used in the traditional pharmacopoeia of the central Middle Atlas-Morocco. Ethnobotany Research and Applications 18:1-17.

Ong HG, Kim YD. 2014. Quantitative ethnobotanical study of the medicinal plants used by the Ati Negrito indigenous group in Guimaras island, Philippines. Journal of Ethnopharmacology 157:228-242.

Pal MC. 2018. Investigation of ethnomedicinal plants used by tribal people of Dindori, Madhya Pradesh, India. The Social ION 7(2):36-44.

Pandey AK. 2021. An ethnobotanical study of medicinal plants in Atal Nagar (New Raipur) of Chhattisgarh, India. International Research Journal of Plant Science 12(1) 1-18.

Parihar S, Sharma D. 2021. *Cynodon dactylon*: A Review of Pharmacological Activities. Scholars Academic Journal of Pharmacy 11:183-189.

Patra S, Sharma S. 2022. Contemporary Ethnomedicinal Practices among the Gond Tribe of Bilaspur District, Chhattisgarh, India. Journal of Herbs, Spices & Medicinal Plants 28(1):1-14.

Phillips O, Gentry AH. 1993. The useful plants of Tambopata, Peru: II. Additional hypothesis testing in quantitative ethnobotany. Economic Botany 47:33-43.

POWO 2023. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet; http://www.plantsoftheworldonline.org/ Retrieved 31 October 2023.

Pradhan B. Mondal S. 2023. A quantitative ethnobotanical approach to assess knowledge richness on the use of plants among the Santal Medicine Men of Birbhum district, West Bengal, India. Ethnobotany Research and Applications 26:1-21.

Prana IC, Ahirwar RK, Singh GK. 2014. Traditional medicinal knowledge about some herbaceous plants used by Baiga tribes of Bajag Forest, District Dindori Madhya Pradesh India. International Journal of Science and Research 12(3):2232-2236.

Rani S, Rana JC. 2014. Ethnobotanical uses of some plants of Bhattiyat block in district Chamba, Himachal Pradesh (Western Himalaya). Ethnobotany Research and Applications 12 407-414.

Rao KS, Haran RH, Rajpoot VS. 2022. Ethnomedicinal Documentation of Folk Medicinal Plants Used by Tribal Communities Living in the Selected Villages of Pushprajgarh Block of Anuppur District, Madhya Pradesh, Central India. Traditional and Integrative Medicine 7(3):319-341.

Rashid S, Ganie NA, Rather HA, Dar RA, Dhurwey R. 2020. Study of tribal heritage of herbal medicines used as Cosmetics from Chhindwara, Madhya Pradesh. Wesleyan Journal of Research 12(4):144-151.

Sharma A, Patel SK, Singh GS. 2021. Traditional knowledge of medicinal plants among three tribal communities of Vindhyan highlands, India: an approach for their conservation and sustainability. Environmental Sustainability 4:749-783.

Sharma J, Gairola S, Sharma YP, Gaur RD. 2014. Ethnomedicinal plants used to treat skin diseases by Tharu community of district Udham Singh Nagar, Uttarakhand, India. Journal of Ethnopharmacology 158: 140-206.

Singh D, Bagchi D, Pathak R, Beohar P, Chaturvedi P, Ahirwar L. 2022. Ethno-Botanical Study of Medicinal Plants Used by Tribes in the Dindori District of Madhya Pradesh, India. Egyptian Journal of Botany 62(2):389-398.

Singh G, Dubey MK, Singh SRK, Meshram M. 2022. Socio-economic and livelihood pattern of ethnic group Baiga in Baiga-chak of Dindori district of Madhya Pradesh. The Pharma Innovation Journal 11(6):1791-1797.

Singh GK, Ahirwar RK. 2018. Phyto-diversity of Ethnomedicinal plants of Chanda forest range district Dindori, Madhya Pradesh. International Journal of Science and Research 6(1):213-216.

Singh NP, Khanna KK, Mudgal V, Dixit RD. 2001. Flora of Madhya Pradesh. Vol. III, Botanical Survey of India, Calcutta.

Sivasankari B, Anandharaj M, Gunasekaran P. 2014. An ethnobotanical study of indigenous knowledge on medicinal plants used by the village peoples of Thoppampatti, Dindigul district, Tamilnadu, India. Journal of Ethnopharmacology 153(2):408-423.

Sureshkumar J, Silambarasan R, Ayyanar M. 2017. An ethnopharmacological analyses of medicinal plants used by the Adiyan community in Wayanad district of Kerala, India. European Journal of Integrative Medicine 12:60-73.

Thakur AS. 2015. Floristic composition, life-forms and biological spectrum of tropical dry deciduous forest in Sagar District, Madhya Pradesh, India. Tropical Plant Research 2(2):112-119.

Trotter RT, Logan MH. 2019. Informant Consensus: A New Approach for Identifying Potentially Effective Medicinal Plants, In: Etkin NL. (Eds.), Plants and Indigenous Medicine and Diet, Pp. 91-112. Routledge, New York.

Vijayakumar S, Yabesh JM, Prabhu S, Manikandan R, Muralidharan B. 2015. Quantitative ethnomedicinal study of plants used in the Nelliyampathy hills of Kerala, India. Journal of Ethnopharmacology 161:238-254.

Wagh VV, Jain AK. 2018. Status of ethnobotanical invasive plants in western Madhya Pradesh, India. South African Journal of Botany 114:171-180.

Wali R, Rahman K, Raja NI, Qureshi R, Bussmann RW, Mashwani ZUR. 2019. A quantitative medico-botanical expedition of Fairy Meadows National Park, Diamir, Gilgit Baltistan, Pakistan. Ethnobotany Research and Applications 18 1-30.

Weckerle CS, de Boer HJ, Puri RK, Andel TV, Bussmann RW, Leonti M. 2018. Recommended standards for conducting and reporting ethnopharmacological field studies. Journal of Ethnopharmacology 210:125-132.

Weldearegay EM, Awas T. 2021. Ethnobotanical study in and around Sirso Natural Forest of Melokoza district, Gamo Goffa zone, southern Ethiopia. Ethnobotany Research and Applications 22:1-24.

World Health Organization. 2013. Factsheet 134. Traditional medicine, report by the secretariat, Geneva. https://apps.who.int/gb/ebwha/pdf_files/EB134/B134_24-en.pdf.

Yaseen G, Ahmad M, Shinwari S, Potter D, Zafar M, Zhang G, Khan Shinwari Z., Sultana S. 2019. Medicinal plant diversity used for livelihood of public health in deserts and arid regions of Sindh-Pakistan. Pakistan journal of Botany 51(2):657-679.

Yemele MD, Telefo PB, Lienou LL, Tange SR, Fodouop CS, Goka CS, Lemfack MC, Moundipa FP. 2014. Ethnobotanical survey of medicinal plants used for pregnant womens health conditions in Menoua division-west Cameroon. Journal of Ethnopharmacology 160:14-31.

Zhang X, Wang Y, Liang Q, Ma Z, Xiao C, Tan H, Gao Y. 2014. The Correlation between Chemical Composition, as Determined by UPLC-TOF-MS, and Acute Toxicity of Veratrum nigrum L. and Radix paeoniae alba. Evidence-Based Complementary and Alternative Medicine 13:892797.