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ORIGINAL ARTICLE

Traditional Use of Ethnomedicinal Plants among People of Kapurthala District, Punjab, India

Jaskirat Kaur, Rajinder Kaur, Avinash Kaur Nagpal

Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, Punjab, India

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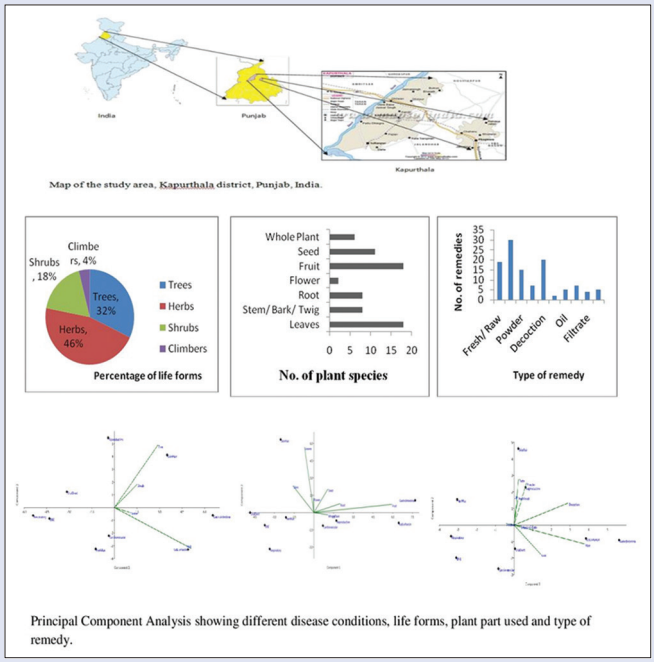
ABSTRACT

Background: Plant-derived products have a vital biological role against various diseases. The present study was carried out to document and investigate the existing ethnomedicinal knowledge on local flora of Kapurthala district, Punjab, India. **Materials and Methods:** The ethnomedicinal investigation was carried out from March 2015 to October 2017. Key informants, rural as well as urban, i.e., herbal doctors, homemakers, farmers, elders, etc., were selected using snowball sampling method. Information on ethnomedicinal importance of plants of this region and methods of preparation and administration was gathered by questionnaire-based personal interviews, group discussions, informal meetings, and field observations with local people. **Results:** Fifty plant species belonging to thirty families were informed to be used for medicinal purposes. Fruits and leaves were the most used plant parts. The most commonly used mode of administration was raw form or juice of plant parts. Most of the information was recorded for the treatment of gastrointestinal problems. **Conclusions:** This study reveals the interesting use of plants by the local people of Kapurthala district, which shows that use of medicinal plants still exists. However, because of modernization, traditional knowledge is losing at high rate; there is a need to conserve our ancestral knowledge. Further, medicinal plants should be examined for pharmacological and phytochemical studies for novel drug discovery.

Key words: Ethnomedicinal plants, Kapurthala district, principal component analysis, Punjab

SUMMARY

- Ethnomedicinal plants have a significant role in traditional systems of health care for the treatment of various diseases. However, recently, in the name of modernization and easy availability of synthetic drugs, they are neither used nor explored even for common ailments. Traditional knowledge of plants is losing at higher pace, and there is a need to document and conserve our ancestral knowledge. Plants should be scrutinized for their phytochemical and pharmacological validation. This will help in the development of novel drugs from natural sources.



Map of the study area, Kapurthala district, Punjab, India.

Principal Component Analysis showing different disease conditions, life forms, plant part used and type of remedy.

Abbreviations used: CM: Complementary medicine; WHO: World Health Organization; AYUSH: Ayurveda, Yoga and Naturopathy, Unani, Siddha, Sowa Rigpa and Homoeopathy; PCA: Principal component analysis; PC: Principal component

Correspondence:

Prof. Avinash Kaur Nagpal,
Department of Botanical and Environmental Sciences, Guru Nanak Dev University,
Amritsar, Punjab, India.
E-mail: avnagpal@yahoo.co.in

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INTRODUCTION

Several traditional systems of health care rely on the use of plants for the treatment of a wide variety of diseases. Traditional medicine, also known as complementary medicine (CM) in some countries, is an important component of health services around the globe. According to the World Health Organization (WHO), "Traditional medicine is the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness" (http://www.who.int/medicines/areas/traditional/definitions/en/). The terms "complementary medicine" or "alternative medicine" refer to a broad set of health-care practices that are not part of that country's own traditional

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or conventional medicine and are not fully integrated into the dominant health-care system (http://www.who.int/medicines/areas/traditional/definitions/en/).

Very recently, the WHO developed traditional medicine strategy 2014–2023 to address some of the important issues regarding the safety, quality, availability, effectiveness, and regulation of traditional (T) and CM. According to a latest estimate by Kew (2016), there are 391,000 vascular plant species known to exist globally, of which at least 31,128 species have a documented use and 17,810 species have been used as medicine.[1] Traditional knowledge on the medicinal uses of plants developed over 1000 of years was gathered mostly by oral communication from one generation to the next. During the later half of the last century (20th century), there was a considerable decline in the use of home remedies for the treatment of various diseases due to easy availability of allopathic drugs and multispecialty hospitals. However, the last few decades have witnessed an increasing global interest in the use of plant-derived medicines as they are considered safer than the synthetic drugs.[2] In India, a separate Ministry of "AYUSH" was formed in 2014 with the aim of providing infrastructure and framing policies for education and research in Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy.

Plants have been used not only for traditional medicine but also in the development of modern medicinal drugs. Many of the medicinal drugs are compounds isolated from plants or their derivatives. Hence, the traditional knowledge on medicinal plants is useful not only for health care but also in the development of the present-day pharmaceuticals. However, this folk knowledge is disappearing at a faster pace as it is believed to be possessed by the elderly people, and there is lack of interest among the younger generation to acquire this wealth of knowledge.[3,4] Hence, there is an urgent need to document the indigenous knowledge which may be helpful in the designing of new drugs besides providing primary health care. The transmission of medicinal plant knowledge through books, scripts, and other media plays a powerful impact on the use of medicinal plants.[5] Hence, the present study was planned to identify knowledgeable resource persons from different sections of the society of Kapurthala district, Punjab, India, and document their knowledge on medicinal uses of plants. Though various studies are available indicating the medicinal importance of different plants, not enough information is available on how to use these plants for the treatment of various diseases. This necessitates documentation of methods on how to use plants against various diseases. The present article also aims to provide firsthand information gathered from the local population of Kapurthala on different methods of herbal preparations and their mode of administration.

MATERIALS AND METHODS

Study area

The study area, Kapurthala district (31.3656° N, 75.2946° E), lies in the northwestern part of Punjab, India. The Beas river separates it from the district Gurdaspur in the north and Amritsar and Tarn Taran in the west. According to the 2011 census, the district is spread over an area of 1633 km^2 with a population of 817,668 (http://www.pbplanning.gov.in.). Most of the population lives in rural areas, so five study sites were chosen including four villages, Ram Garh, Ahmadpur, Madhopur, and Pandori Jagir from each of the four divisions of the district, i.e., Bholath, Kapurthala, Phagwara, and Sultanpur lodhi, respectively, and the city. The district has semi-arid climate and experiences primarily four seasons, i.e., summer, monsoon, postmonsoon, and winter seasons. Winter season extends from December to February with temperature ranging from 4°C to 19°C. Summer season, also known as dry season, extends from April to June with temperature reaching 43°C–46°C; monsoon season extends from July to September when the weather is hot and humid and average rainfall is 718 mm; post-monsoon season extends from September to October. Between winter and summer is a transition period called spring (March–early April). Another transition period is autumn (October–November). It is between post-monsoon and winter. The average climatic temperature is 23.8°C. The driest month of the year is November. There is 6 mm of precipitation in November. The major precipitation fall is observed in July with 197 mm. As per a survey conducted in 2017, there are ten forest covers in the district; eight open and two moderate to dense with rich plant diversity (http://www.districtsofindia.com/index.aspx) [Figure 1].

Data collection and identification of plant species

The ethnomedicinal study was conducted from March 2015 to October 2017. A total of fifty local inhabitants both rural and urban including herbal doctors, homemakers, farmers, and elders were selected using snowball sampling and consulted for the present study.[6] Information on ethnomedicinal importance of plants of this region and methods of preparation and administration was gathered by questionnaire-based personal interviews, group discussions, informal meetings, and field observations with local people of both sexes and age groups (26–40, 41–60, and >60 years).

Format of questionnaire

Personal information:

- Name of the informant
- Sex
- Date of birth/age
- Address
- Education
- Occupation.

Ethnomedicinal information:

- Local name of the plant/common name
- Habitat
- Part of plant used
- Cultivated/wild
- Method of collection/storage
- Name(s) of the disease(s) treated
- Method(s) of drug preparation
- Mode of administration
- Dosage.
- Potential adverse reaction of plants

The interviews were conducted in English or Punjabi (local language) as per the convenience of the informants. Interviews were conducted in a cordial atmosphere and rapport was developed with the informants by listening to them with respect. Field trips were also carried out along with some informants to understand the habitat and availability of some plants. Photographs of the plants in the field were clicked and specimens were collected and identified by consulting herbarium specimens of respective plants housed in the Herbarium, Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, and consultation of different floras of the region and books on trees/shrubs.[7-13]

Statistical analysis

Principal component analysis (PCA) was used to analyze the multivariate data using PAleontological STatistics version 3.18 software (University of Oslo, Norway). It reduces the number of variables considerably in such a manner that a minimum number of variables can explain maximum variance for the given data. It was used to determine which of the nine major disease categories (dependent variable) was/were treated with

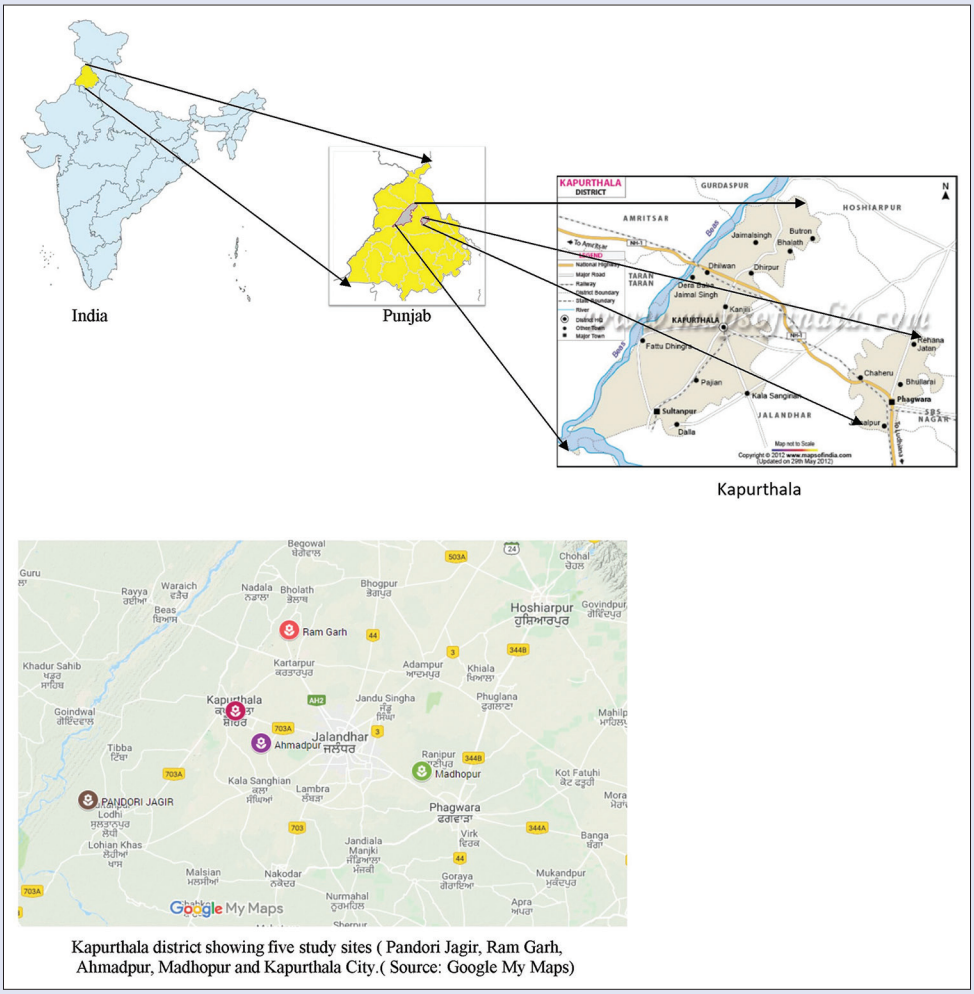

Figure 1: Map of the study area, Kapurthala district, Punjab, India

Table 1: Demographic data of informants

Demographic data of informants	Number of informants (%)
Section	
Gender	
Male	15 (30)
Female	35 (70)
Age group (years)	
26-40	15 (30)
41-60	21 (42)
>60	14 (28)
Occupation	
Homemakers	21 (42)
Farmers	7 (14)
Herbal doctors/vaid	12 (24)
Others (teachers, students, doctors, etc.)	10 (20)

which of the plant part, life form, and type of remedy used (independent variables).

RESULTS AND DISCUSSION

A total of fifty key informants (30% males and 70% females) belonging to different age groups, occupations, and education levels were selected [Table 1]. Out of all occupations, maximum information (60%) was provided by homemakers and herbal doctors; among different age groups, informants older than 40 years of age had more ethnomedicinal knowledge as compared to younger ones. This may be due to more knowledge sharing with relatives and friends, personal experiences, and interaction with the plants.[14] Herbal doctors were reluctant to reveal their knowledge, but on convincing that their information on plant remedies would be used exclusively for academic purposes and not for commercial use, they came up with positive response to share their knowledge. The basic reason for the relatively lesser ethnomedicinal knowledge of younger generation lies in the rapid urbanization, change in lifestyle, and increasing availability and use of allopathic drugs. These results are in conformity with some of the earlier studies carried out in Pakistan and Turkey.[4,15]

During ethnomedicinal survey, information on a total of fifty plant species from Kapurthala district belonging to thirty vascular plant families was documented [Table 2]. For each species, scientific name, common name, local name, habit, plant part used, disease treated, ethnomedicinal preparation, mode of administration, and possible adverse reaction are provided [Table 3]. Accession numbers for the specimens of the studied species housed in the herbarium of the Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, are also summarized in Table 3. These plant species have been reported to be used for 109 remedies to cure a wide range of disease conditions which are categorized into nine major categories, namely, skin and hair problems; gastrointestinal problems; reproductive disorders; cardiovascular ailments; kidney-, liver-, pancreas-, and urinary-related disorders; nervous system and

Table 2: List of families with number of plant species from Kapurthala district, Punjab, India, documented for ethnomedicinal usage

Family	Number of species
Acanthaceae	1
Aizoaceae	1
Amaranthaceae	1
Apiaceae	2
Apocynaceae	1
Asclepiadaceae	1
Asteraceae	2
Bombacaceae	1
Boraginaceae	1
Brassicaceae	3
Cannabaceae	1
Chenopodiaceae	2
Combretaceae	1
Cucurbitaceae	1
Euphorbiaceae	4
Fabaceae	5
Lauraceae	1
Lythraceae	2
Malvaceae	2
Moraceae	2
Myrtaceae	2
Nyctanginaceae	1
Papaveraceae	2
Rhamnaceae	1
Sapindaceae	1
Sapotaceae	1
Scrophulariaceae	1
Solanaceae	4
Vitaceae	1
Zygophyllaceae	1

musculoskeletal disorders; oro-dental diseases; ear, nose, and eye problems; and respiratory disorders. The dominant families with more than three plant species informed to be used for ethnomedicinal purposes include Fabaceae (*Arachis hypogaea* L., *Butea monosperma* (Lam.) Taub., *Tamarindus indica* L., *Tephrosia purpurea* (L.) Pers., *Trigonella foenum-graecum* L.), *Euphorbiaceae* (*Euphorbia hirta* L., *Jatropha curcas* L., *Phyllanthus emblica* L., *Putranjiva roxburghii* Wall.), and *Solanaceae* (*Lycopersicon esculentum* Mill., *Physalis peruviana* L., *Solanum nigrum* L., *Solanum tuberosum* L.) [Table 2]. These findings are in line with some of the earlier studies which also showed dominance of these families, namely, Fabaceae,[16-19] Solanaceae,[4,16,18,20] and Euphorbiaceae[16,18-20] for ethnomedicinal importance.

Out of the fifty medicinal plant species reported, the most commonly used life form was herbaceous life form (46%), followed by trees (32%), shrubs (18%), and climbers (4%) [Figure 2]. This research is in line with previous studies which also showed that herbs are dominant for curing diseases.[21-23] This is understandable as in any natural community, availability of herbaceous species is much more as compared to other habits (trees/shrubs/climbers); hence, they are more frequently used for medicinal purposes.[24] Venkatachalapathi *et al*.,[19] in their ethnomedicinal study on Irula tribes of Southern Western Ghats, India, also reported higher use of herbaceous life forms for medicinal purposes. Among different plant parts used for ethnomedicinal purposes, above-ground parts, i.e., leaves and fruits, are the most frequently used [Figure 3]. Easy collection and processing of leaves and fruits may be the reason for their maximum use.[25] Previous studies have also shown maximum use of leaves[26-28] and fruits[29] for the preparation of herbal formulations.

The major form of remedies used by informants is juice of plant parts (leaves/fruits/roots/whole plants) followed by decoction and raw

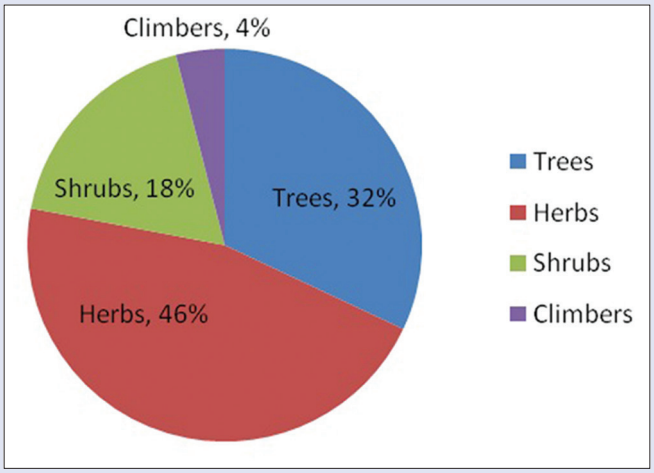

Figure 2: Percent life forms of the total number of plant species informed as used for ethnomedicinal purposes

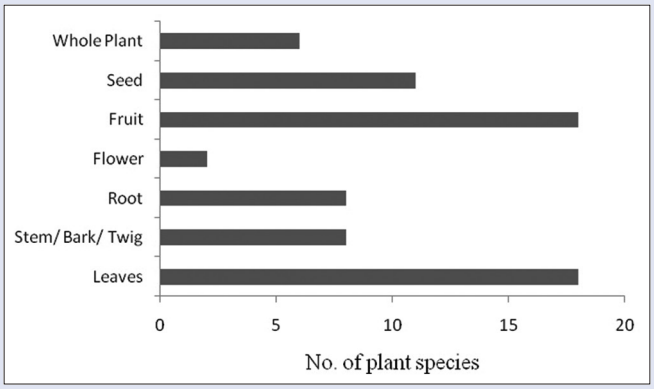

Figure 3: Frequency of plant species with respect to different plant parts used for ethnomedicinal purpose

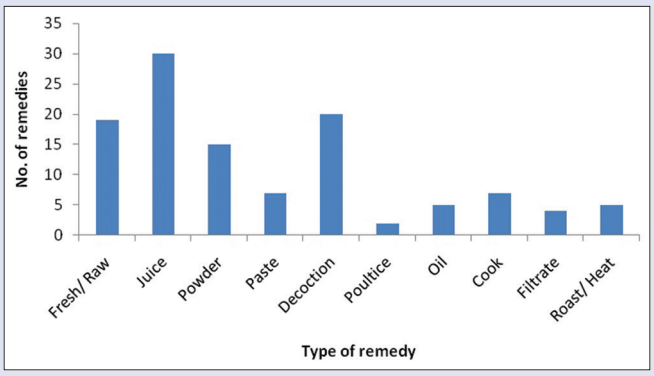

Figure 4: Frequency of different types of remedies used

consumption (mostly of fruits and roots as salads) [Figure 4]. In some earlier studies on tribal communities, decoction was the major form of remedy/preparation.[21,30-32] Sometimes, for the preparation of remedies, other ingredients are also used such as for impotency, powdered roots of *Argemone mexicana* L. with sugar candy are used; for ear pus and pain, ghee is applied on the *Calotropis procera* (Aiton) Dryand. leaves and put on fire for few seconds and juice is extracted and put in the ear; for

Table 3: Ethnomedicinal uses of plants of Kapurthala district, Punjab, India

Scientific name (Accession No.*) Common/local name family	Habit	Plant part used	Disease	Ethnomedicinal preparation and mode of administration	Potential adverse reactions
Abelmoschus esculentus (L.) Moench (5043) Ladyfinger/Bhindi Malvaceae	Herb	Fruits	1. Diabetes 2. Kidney stones 3. Indigestion	1. For diabetes, take two bhindi fruits and cut them from both sides. Add fruits into a glass of water. Let them soak for overnight. In the early morning, drink this water to control blood sugar level or diabetes and kidney stone 2. For kidney stone and indigestion, bhindi sabji is also used, it act as laxative	-
Arachis hypogaea L. (2646) Groundnut/Moogphali Fabaceae	Herb	Seeds	1. Cardiovascular diseases 2. Osteoporosis	For cardiovascular diseases and weak bones, add a handful of peanuts in your daily diet	It may cause allergy
Argemone mexicana L. (521) Mexican prickly poppy/ Satyanashi Papaveraceae	Shrub	1. Whole plant 2. Roots	1. Urine blockage 2. Skin diseases 3. Impotency	1. For urine retention, the whole plant is washed, dried, and powdered. Add 5 g of powder to 100 ml of water and heat the water at low flame till it reduces to half. Filter and drink twice a day 2. For eczema and skin problems, take fresh clean plant. Extract its juice and add mustard oil to it in the ratio of 2:1. Heat the mixture till water evaporate. Apply externally on the affected skin 3. For impotency, take powdered roots with sugar candy	It may cause diarrhea and vomiting Not suitable for use in pregnancy
Bacopa monnieri (L.) Wettst (5802) Indian pennywort/ Brahmi Scrophulariaceae	Herb	1. Whole plant 2. Leaves	1. Cough and cold 2. Nervous disorders 3. Mental health	1. For cold and cough, boil the whole plant in water and tie it in a cloth to form poultice. Apply this on the chest and repeat frequently 2. For nervous disorders and mental health, take a pinch of leaf powder twice daily	May cause extreme headache
Beta vulgaris L. (5767) Beetroot/Chukander Amaranthaceae	Herb	Roots	1. Digestive problems 2. Anemia 3. High blood pressure 4. Gastric ulcer	1. For indigestion, eat it as salad 2. For anemia and high blood pressure, drink root juice 3. For gastric ulcer, mix honey in the root juice and take empty stomach every morning	-
Boerhavia diffusa L. (117) Wine flower/Punarnava Nyctaginaceae	Herb	1. Leaves 2. Roots 3. Whole plant	1. Liver- and kidney-related problems 2. Gall stones 3. Anemia	1. It protects and heals liver and kidney. For rejuvenation of these organs, take 1 tbsp of leaf powder with milk daily 2. For kidney and gall stone, prepare decoction of root powder in water. Drink it as tea 3. For anemia, extract juice of the whole plant and consume 10-15 ml of juice for a month	-
Bombax malabaricum DC. (2891) Cotton tree/Semal Bombacaceae	Tree	1. Roots 2. Bark 3. Fruits	1. Leukorrhea 2. Wounds 3. Impotency	1. For leukorrhea, take 1 tbsp of semal root powder twice a day with water 2. For wounds, apply bark paste 3. For impotency, take 100 g of fruit powder with sugar. Add this to a glass of lukewarm water and drink it once a day	-
Brassica campestris L. (2505) Mustard/Sarson Brassicaceae	Herb	Seeds	1. Arthritis 2.Eczema 3. Ear pain 4. Paralysis	1. For arthritis, mix mustard seed oil and dry ginger powder and cook at low flame. Massage with this oil for relief 2. For eczema, mix 100 ml mustard oil with 10 g of desi kapur (camphor) and massage regularly 3. For ear pain, put 3-4 drops of mustard oil in ear 4. For paralysis in affected area, apply paste of ground mustard seeds and dry ginger powder in 2:1 ratio	-

Contd...

Table 3: Contd...

Scientific name (Accession No.*) Common/local name family	Habit	Plant part used	Disease	Ethnomedicinal preparation and mode of administration	Potential adverse reactions
Brassica rapa L. (4766) Turnip/Shalgam Brassicaceae	Herb	Roots	1. Indigestion 2.Internal inflammation 3. Piles	1. For indigestion and internal inflammation, eat root as salad or cook as a vegetable 2. For piles, drink fresh root juice 50 ml daily in the morning	Avoid use in hepatitis
Butea monosperma (Lam.) Taub. (1837) Flame of the forest/Tesu Fabaceae	Tree	Flowers	1. Skin problems 2.Excessive menstrual bleeding	1. For skin problems, mix flower powder (from dried flowers) with lime juice and apply on the affected skin 2. For heavy menstrual bleeding, drink decoction of flowers	Avoid use in pregnancy and breastfeeding
Calotropis procera (Aiton) Dryand. (791) Apple of Sodom/Aak Asclepiadaceae	Shrub	Leaves	1. Joint pain 2. Ear problems 3. Piles 4. Wounds	1. For rheumatism and painful joints, tie lukewarm leaves on the affected joints 2. For ear pus and pain, apply ghee on the leaves and put on fire for few seconds Extract the juice and put in ear 3. For piles, apply latex topically on the affected area 4. For wounds, apply warm leaf on the affected area	Avoid use in pregnancy and breastfeeding.
Cannabis sativa L. (78) Hemp/Bhang Cannabaceae	Herb	1. Leaves 2. Seeds	1. Skin cuts 2. Insect bites 3. Anxiety 4. Depression	1. For skin cuts and insect bites, paste of leaves is applied topically 2. For anxiety and depression, add 1 tbsp of seed powder to one cup of water. Boil it till it reduces to half. Take this in small amounts throughout the day	Acts as sedative, it affects the thinking and decision-making. It can cause sleeplessness. Excess intake may cause leukorrhea and spermatorrhea
Chenopodium album L. (112) White goosefoot/Bathu Chenopodiaceae	Herb	Leaves	1. Kidney stones 2. Internal swelling 3. Anemia	1. For kidney stones, eat it as saag 2. For internal swelling and anemia, tender leaves and branches are ground to extract their juice and take 10-15 ml of it daily with or without water	-
Cinnamomum camphora (L.) J. Presl (5838) Camphor wood/Kapoor Lauraceae	Tree	Bark	Skin diseases	For eczema, camphor mixed with coconut oil is applied topically to increase local blood flow, which reduces pain and swelling	Avoid use during pregnancy and breastfeeding
Cordia dichotoma G. Forst. (813) Indian Cherry/Lasoora Boraginaceae	Tree	1. Fruits 2. Bark	1. Constipation 2. Cough	1. For constipation, one or two fruits are eaten 2. For cough, prepare decoction of bark. Let it cool and then drink	Bark has infertility effect
Coriandrum sativum L.(4763) Coriander/Dhania Umbellifereae	Herb	Seeds	1. Indigestion 2. Headache	1. For indigestion, prepare decoction of seeds. Drink 10-20 ml, twice a day 2. For headache, paste of seeds is applied on the forehead	-
Daucus carota L. (564) Carrot/Gajar Umbellifereae	Herb	Roots	1. Anemia 2. Constipation 3. Gastric ulcer	1. For anemia, drink one glass of carrot juice 2. For constipation and gastric ulcers, eat it as salad	-
Eclipta alba (L.) Hassk (901) False daisy/Bhangra Asteraceae	Herb	Leaves	1.Wounds 2. Gum pain	For wounds and gum pain, apply juice of leaves on the affected area	Leaves may cause itching and dryness
Euphorbia hirta L. (83) Asthma weed/Dudhi Euphorbiaceae	Herb	Whole plant	1. Asthma 2. Lung problems 3. Diabetes	Add 10-15 g of washed plant into 1000 ml of boiling water. Cook for 10 min. Leave it and stand for half an hour. Filter it and drink in small amount throughout the day for 1 week only	Avoid in pregnancy. Prolonged use may cause infertility

Contd...

Table 3: Contd...

Scientific name (Accession No.*) Common/local name family	Habit	Plant part used	Disease	Ethnomedicinal preparation and mode of administration	Potential adverse reactions
Ficus religiosa L. (538) Sacred Fig tree/Peepal Moraceae	Tree	1. Bark 2. Fruits 3. Twigs 4. Leaves	1. Cuts and wounds 2. Burns 3. Infertility 4. Tooth/gum pain 5. Bleeding nose	1. For burns, cuts, and wounds, sprinkle dried bark powder on the affected area 2. For male and female infertility, fruit powder is used 3. For healthy tooth and gums, fresh twigs are used as toothbrush 4. For bleeding nose, put some drops of leaf juice, it will provide instant relief	-
Fumaria indica (Hausskn.) Pugsley (298) Fumewort/Pitpapra Papaveraceae	Herb	Leaves	1. Boils 2. Eczema 3. Gum infection	1. For boils and eczema, prepare decoction of leaves of pitpapra and neem. Drink regularly for few days 2. For gum infections, chew leaves	Avoid use in pregnancy and lactation
Grewia asiatica L. (6079) Phalsa/Falsa Tiliaceae	Tree	Fruits	1. Sun stroke 2. Acid reflux	Eat handful of Falsa fruit for sunstroke and acid reflux	
Helianthus annus L. (4927) Sunflower/Surajmukhi Asteraceae	Shrub	Seeds	1. Skin disorders 2. Internal dryness 3. Constipation	1. For skin lesions, seed oil is applied. 2. For internal dryness and constipation, seed oil is given orally	Avoid use in diabetes, pregnancy, and breastfeeding
Hibiscus rosa-sinensis L. (775) Shoe flower/Jasun Malvaceae	Shrub	1. Leaves 2. Flowers	1. Hair fall 2. High blood pressure 3. Menstrual cramps	1. For hair fall and dandruff, cook 10-15 leaves or flowers in 100 g of coconut oil at very low flame as coconut oil may catch fire at high flame. Cook for 20-30 min., drain, and keep this formed oil in bottle and use it 2. For high cholesterol and menstrual cramps, drink hibiscus tea (2 tbsp of dried flower add to one cup of hot water)	Avoid use in pregnancy. In males, it also reduces sperm production and in females, it causes miscarriage
Jatropha curcas L. (4188) Physic Nut/Jangli arandi Euphorbiaceae	Shrub	Seeds	1. Wounds 2. Constipation	Roast 3-4 seeds, take these with lukewarm water	Direct consumption of seeds causes vomiting, diarrhea, abdominal pain, and burning sensation in the throat
Justicia adhatoda L. (2956) Malabar nut/Adusa Acanthaceae	Shrub	Leaves	1. Cold and cough 2. Chronic bronchitis 3. Asthma 4. Bleeding nose	1. For cold, cough, bronchitis, and asthma, take fresh leaf juice with honey twice a day 2. For bleeding nose, take one tbsp of leaf juice thrice a day	Avoid the use of leaves in pregnancy, it can cause miscarriage
Lawsonia inermis L. (1461) Henna/Mehandi Lythraceae	Shrub	1. Leaves 2. Seed	1. Gray hair 2. Fungal infection of nails 3. Sun stroke 4. Inflammation	1. For gray hair and sun stroke, apply paste of henna leaves on hair. Leave it for 6-8 h 2. For fungal nails, apply paste as bandage over the nails 3. For inflammation due to burn, apply seed oil	It may be allergic
Luffa cylindrica (L.) M. Roem (1437) Sponge gourd/Tori Cucurbitaceae	Climber	Fruits	1. Diabetes 2. High cholesterol 3. Helmintic infection	It is eaten as vegetable	-
Lycopersicon esculentum Mill (561) Tomato/Tamatar Solanaceae	Herb	Fruits	1. Anemia 2. Dehydration 3. Kidney stones	1. For anemia, take 1-2 tomatoes without seeds and peel 2. For dehydration, take tomato as salad or juice without seeds	Avoid eating raw fruit in case of kidney stones

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Table 3: Contd...

Scientific name (Accession No.*) Common/local name family	Habit	Plant part used	Disease	Ethnomedicinal preparation and mode of administration	Potential adverse reactions
Mimosops elangi L. (5945) Bullet wood/Maulsari Sapotaceae	Tree	1. Bark 2. Fruits 3. Twigs	1. Gum/tooth ache 2. Infertility	1. For toothache, bark powder is applied 2. For infertility in females, fruit pulp is eaten 3. Twigs are used as toothbrush	Intake or prolonged exposure to its flowers may cause mild intoxication
Morus alba L. (631) Mulberry/toot Moraceae	Tree	Fruits	1. Anemia 2. Diabetes	For anemia and diabetes, fruits are eaten	-
Nerium indicum Mill. (728) Oleander/Kaner Apocynaceae	Shrub	1. Leaves 2. Twigs	1. Skin problems 2. Tooth problems	1. For skin problems, heat 10-15 leaves in 250 ml of mustard oil. Cool and rub on the affected area 2. For tooth problems, twig is used as toothbrush	Avoid intake of leaves as they may cause nausea, vomiting, and heart problems
Phyllanthus emblica L. (6404) Indian gooseberry/Amla Euphorbiaceae	Tree	Fruits	1. Indigestion 2. Weak immunity	1. For digestive problems, fruit is used which is an important constituent of *Triphala* 2. Amla murraba is used as an immunity booster	-
Physalis peruviana L. (2116) Cape gooseberry/ Rasbhari Solanaceae	Herb	Fruits	1. Inflammation 2. Liver problems 3. Diabetes	Fruit is eaten for its anti-inflammatory, hepatoprotective, and antidiabetic properties	High amount of its consumption can cause hepatic, renal, and hematological toxic effects
Psidium guajava L. (4161) Guava/Amrood Myrtacaeae	Tree	1. Fruits 2. Leaves	1. Mouth ulcers 2. Diabetes 3. Leukorrhea	1. For mouth ulcers, chew leaves 2. For diabetes, eat daily 1-2 fruits 3. For leukorrhea, leaf decoction is used as vaginal wash	-
Punica granatum L. (4113) Pomegranate/Anar Lythraceae	Shrub	1. Fruits 2. Seeds	1. Anemia 2. Helmintic infections 3. Indigestion 4. Piles	1. For anemia and helmintic infections, take one glass of pomegranate juice daily 2. For digestive problems and piles, seeds are taken	-
Putranjiva roxhburghii Wall. (5389) Lucky bean tree/ Putranjiva Euphorbiaceae	Tree	Seeds	Female infertility	Take ½ tbsp of seed powder twice a day	-
Raphanus sativus L. (608) Radish/Mooli Brassicaceae	Herb	Roots	1. Jaundice 2. Constipation	1. For jaundice, drink radish juice 2. For constipation, eat radish with meals as salad	Avoid in gallstone disease
Sapindus mukorossi Gaertn. (5061) India soapberry/Reetha Sapindaceae	Tree	Fruits	Dull hair	For dandruff and dull hair, soak 8-10 fruits in 500 ml of water for overnight. Filter and use the filtrate to wash hair	Avoid oral usage, especially in pregnancy
Solanum nigrum L. (945) Black nightshade/Mako Solanaceae	Herb	1. Leaves 2. Roots	1. Arthritis 2. Inflammation 3. Infertility	1. For arthritis, joint pain, and rheumatism, poultice of leaves is prepared and applied externally on the painful joints 2. For inflammation, leaves are cooked as vegetable 3. Roots are boiled and given to women to boost fertility	Avoid intake of leaves and roots it at higher doses

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Table 3: Contd...

Scientific name (Accession No.*) Common/local name family	Habit	Plant part used	Disease	Ethnomedicinal preparation and mode of administration	Potential adverse reactions
Solanum tuberosum L. (4861) Potato/Aalu Solanaceae	Herb	Underground stems	1. Eye problems 2. Dark circles around eyes 3. Sun burn 4. Skin blemishes	1. For dark circles and welders flash, raw potato slices are wrapped in a clean cloth and placed over dark circles or the affected eye for about 20 min. Gently wash the eyes with warm water 2. For sun burns and skin blemishes, apply juice on the affected areas	-
Syzygium cumini (L.) Skeels (710) Java plum/Jamun Myrtacaeae	Tree	1. Fruits 2. Seeds	1. Diabetes 2. Acidity 3. Polyuria 4. Indigestion	1. For diabetes and acidity, eat handful of fruit daily 2. For diabetes and polyuria, take one tbsp of seed powder with a glass of lukewarm water daily in the morning 3. For indigestion, add 10-15 ml of fruit juice into a cup of water and drink	-
Tamarindus indica L. (5798) Tamarind/Imli Fabaceae	Tree	1. Fruits 2. Leaves	1. Constipation 2. Vomiting 3.Nausea in pregnancy 4. Abdominal gas 5. Parasitic worms	1. For constipation, ripen fruits have laxative effect 2. For vomiting and nausea in pregnancy, eat raw fruit 3. For abdominal gas and parasitic worms, prepare chutney of tender Imli leaves	-
Tephrosia purpurea (L.) Pers. (2333) Wild indigo/Sarpunkha Fabaceae	Herb	Whole plant	1.Abdominal pain 2. Jaundice	1. For abdominal pain and flatulence, drink decoction of whole plant 2. For jaundice, drink fresh juice (1-2 tbsp) of whole plant	Avoid use in diarrhea
Terminalia arjuna (Roxb. ex DC.) Wight and Arn. (1427) Arjun tree/Arjun Combretaceae	Tree	Bark	1. Heart tonic 2. Leukorrhea 3. Mouth ulcers 4. Oral problems	1. For heart problems, regular intake of 1 tbsp of bark powder with one cup milk is very effective 2. For leukorrhea, soak bark powder (2 tbsp) in water at night, drink this water next morning, or prepare decoction and drink 3. For mouth ulcers and oral problems, gargle with the decoction of fresh bark	-
Trianthema petandra L. (939) Giant pigweed/Itsit Aizoaceae	Herb	Leaves	1. Abdominal gas 2. Constipation 3. Irregular periods	1. For abdominal gas, constipation, and irregular periods, take decoction of leaves	-
Tribulus terresteris L. (140) Puncture vine/Bhakhra Zygophyllaceae	Herb	Whole plant	1. Kidney stones 2. Painful urination 3. Hematuria	1. For kidney stones and painful urination, prepare decoction of fruits or the whole plant in water and drink twice a day 2. For hematuria, add 2 tbsp of whole plant juice into a cup of buttermilk. Take this daily for few days	Avoid use in pregnancy, it can harm fetal development.
Trigonella foenum-graecum L. (580) Fenugreek/Methi Fabaceae	Herb	1. Seeds 2. Leaves	1. Obesity 2. Diabetes 3. Back ache 4. Hair fall and dandruff	1. For obesity and diabetes, soak 1-2 tbsp of seeds overnight in a glass of water. Drink it early in the morning 2. For backache, take 1 tbsp of seed powder with lukewarm water twice a day 3. For hair fall and dandruff, apply paste of methi leaves on the scalp	Avoid use in early stages of pregnancy, it can cause bleeding. It has oxytocin and uterine-stimulant actions.
Vitis vinifera L. (1856) Grapes/Saugi Vitaceae	Climber	Fruits	1. Constipation 2. Jaundice 3. Impure blood 4. Menopause 5. Joint pain	1. For constipation, put 8-10 raisins in warm milk 2. For jaundice and blood purification, eat one bowl of grapes daily 3. For menopause and joint pain, drink one glass of fresh fruit juice daily	It may cause stomach upset. Avoid in early stages of pregnancy

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Table 3: Contd...

Scientific name (Accession No.*) Common/local name family	Habit	Plant part used	Disease	Ethnomedicinal preparation and mode of administration	Potential adverse reactions
Ziziphus mauritiana Lam. (511) Indian plum/Ber Rhamnaceae	Tree	1. Fruits 2. Leaves	1. Chronic constipation 2. Weak bones 3. Hair fall 4. Wounds	1. A handful of fruit is used in case of chronic constipation to help regulate bowel movements and digestion 2. Fruits also strengthen bones 3. For hair fall, wash hair with decoction of leaves 4. For wounds, apply leaf paste	Avoid in acute diarrhea. Excessive amount may cause heat exhaustion

*Accession no. for the specimens housed in the herbarium of Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar

cold, cough, bronchitis, and asthma, fresh leaf juice of *Justicia adhatoda* L. is taken with honey twice a day; and for hematuria, 2 tbsp of whole plant juice of *Tribulus terrestris* L. added into a cup of buttermilk is used daily for few days. This is in line with some previous studies where medicinal plants were used in combination with other ingredients such as honey, sugar, and coconut oil for ethnomedicinal preparations by Irula and Kani tribes of Western Ghats, India,[19,26] and rural population of Izmir province, Turkey.[33] Among different ailments which have been reported to be cured using ethnomedicinal preparations, gastrointestinal disorders dominated the list. This is in accordance with the previous studies which also showed more number of ethnomedicinal remedies for gastrointestinal diseases as compared to other diseases/disorders.[21,34]

The study also revealed that for some plant species, different plant parts of a single species are used for the treatment of multiple health problems. For example, bark, fruits, twigs, and leaves of *Ficus religiosa* are used for several diseases including cuts and wounds, burns, infertility, tooth/gum pain, and bleeding nose. In an earlier study, Umair *et al.*[4] reported that fruits, bark, flowers, leaves, and roots of *Cassia fistula* L. were used for constipation, jaundice, eczema, rheumatism, etc., Similarly, Venkatachalpathi *et al.*[19] reported that leaves, bark, fruits, and seeds of *Syzygium cumini* (L.) Skeels were used for diabetes and dysentery.

Although most of the documented species are used in daily routine as fruits, vegetables, and spices, i.e., *Abelmoschus esculentus* (L.) Moench., *A. hypogaea* L., *Beta vulgaris* L., *Brassica campestris* L., *Punica granatum* L., *T. foenum-graecum* L., etc., some possible adverse reactions of plants were also informed by informants. Some plant species such as *A. mexicana* L., *C. procera* (Aiton) Dryand., *Cinnamomum camphora* (L.) J. Presl, and *Hibiscus rosa-sinensis* L. were not allowed to be used during pregnancy and breastfeeding. Other possible adverse reactions informed were diarrhea, nausea, headache, infertility, itching, dryness, miscarriage, etc., [Table 3]. Some other studies have also documented the adverse reactions of different plant species.[35,36]

Most of the medicinal plant-based knowledge is passed from one generation to other generation orally. However, it is also observed that some people practice making herbal medicine at home with the help of books and media (television and the Internet). Therefore, documentation of these plants species in research articles or books may bring these plants species to researchers and common people.[5,37]

PCA was applied to see the effect of multidimensional variables, namely, life forms, plant parts used, and ethnomedicinal preparations on the treatment of nine major disease conditions. For each of these analysis, different variables were reduced to two main components (PC I and PC II) showing the highest variability.

PCA scatter plot for life forms [Figure 5] revealed that skin and hair problems and reproductive disorders are mainly treated with trees and shrubs, whereas herbs were used to treat gastrointestinal, kidney, liver, pancreas, and urinary-related disorders.

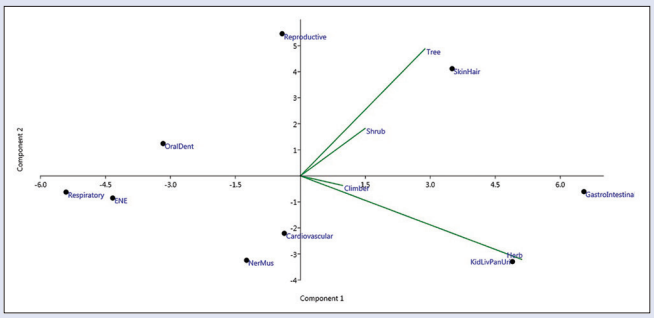

Figure 5: Principal component analysis showing different disease conditions and life forms of plant species used in their treatment

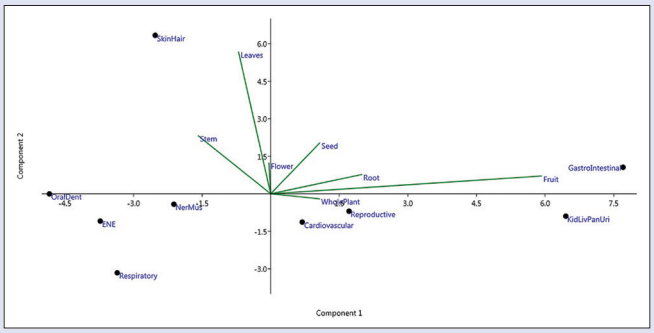

Figure 6: Principal component analysis showing different disease conditions and parts of plant species used in their treatment

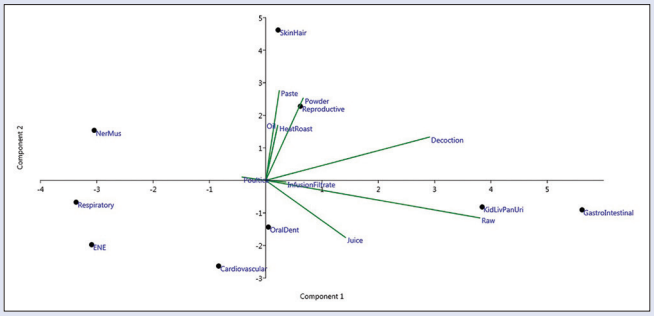

Figure 7: Principal component analysis showing different disease conditions and type of remedy of plant species used in their treatment

The scattered plot for plant parts [Figure 6] indicated that leaves were most frequently used for the treatment of skin and hair disorders, whereas

fruits were mostly used for the treatment of gastrointestinal, kidney, liver, pancreas, and urinary-related disorders. The plot also indicates that roots and seeds are used for the treatment of gastrointestinal problems.

The scattered plot for the preparation method [Figure 7] revealed that for the treatment of gastrointestinal problems and kidney, liver, pancreas, and urinary-related disorders, raw form of the plant parts (fruits, leaves, and roots) was most often used followed by decoction form. The latter was also useful for the treatment of reproductive disorders, whereas powder and paste forms were shown to be relatively more effective for the treatment of reproductive disorders.

Some of the plant species documented in this study are wild species such as *A. mexicana* L., *C. procera* (Aiton) Dryand., *Cannabis sativa* L., *E. hirta* L., *S. nigrum* L., and *T. terrestris* L., whereas, others are cultivated such as *A. esculentus* (L.) Moench., *Arachis hypogea* L., *Brassica campestris* L., *Coriandrum sativum* L., *Helianthus annus* L., and *L. esculentum* Mill. For maintaining endangered plant species, the conservation status for each plant also needs to be checked.[37] According to the Ministry of Environment, Forests and Climate Change, Government of India (2014), none of the fifty plant species mentioned in this study belonged to the threatened flora of Punjab (http://punenvis.nic.in). Although local people did not use any precise and clear mechanism for the conservation of plant species, they ensured that they practice sustainable harvesting system without harming the plants and thus also make sure their future availability. For example, while collecting the root part of trees and shrubs, they usually cut only a few roots and the main root was not cut, touched, or dug up. To minimize the effect on the growth and further development of tree, the small roots and lateral shoots were mainly harvested. While collection of bark, twig, and branches of trees or shrubs, if any plant shows sign of previous collection, then that plant was left untouched for its recovery. The main parts used for medicine were leaves and fruits; it is believed that they are available in abundance and hence, there is no need to conserve these main parts. Similar harvesting strategies used by people of Loita Maasai of Kenya have also been reported in an earlier study.[38]

CONCLUSIONS

The ethnomedicinal study of Kapurthala district, Punjab, India, revealed various uses of fifty plant species and richness of knowledge of key informants. Elderly people have more experience and knowledge than younger generation. Knowledge about the medicinal uses of plants is disappearing fast as a consequence of modernization, easy availability of allopathic drugs, and least interest of younger generation. This study is significant as it contributes to the preservation of traditional medicinal knowledge of local people of Kapurthala District, Punjab, India, which is eroding at a faster pace. It is suggested that medicinal plants should also be scrutinized for their pharmacological and phytochemical analysis for novel drug discovery.

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Conflicts of interest

There are no conflicts of interest.

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