

Unveiling the Ethnomedicinal Significance of Plants Utilization Among Tribal Communities in Southern Pali District, Rajasthan, India

Sarika and Prof. Dinesh Hans*

*Department of Botany, SRK, Govt. P.G. College, Rajsamand, Mohanlal Sukhadia University
Udaipur (Rajasthan), India 313001*

***Corresponding Author**

Prof. Dinesh Hans

Email: drdineshhans@gmail.com

Abstract:

The present study delves into the intricate web of ethnomedicinal knowledge held by the tribal communities residing in the remote landscapes of Pali district, Rajasthan, India. Conducted in 2021, the investigation aimed to document the indigenous utilization of medicinal plants, extending its reach across different seasons to capture a comprehensive spectrum of traditional remedies. Local inhabitants, seasoned elders, traditional herbalists and local vendors shared their insights, interwoven with the threads of ancient practices. The study amalgamated this experiential wisdom with literary consultations, revealing a diverse range of botanical solutions to various health challenges. The exploration encompassed remedies for fever, gastrointestinal disorders, skin ailments, kidney issues and respiratory infections. Each chapter unraveled the botanical identities, vernacular nomenclature, plant parts harnessed and methods of application. This revelation highlights the profound relationship between humans and their botanical companions, showcasing nature's role not only as a resource but also as a collaborator in healing. Ultimately, this study underscores the harmonious coexistence of traditional wisdom and contemporary inquiry, creating a bridge between the past, present and an enriched future of healthcare interwoven with nature's bounty.

Keywords: Ethnomedicinal Knowledge, Tribal Communities, Traditional Remedies, Indigenous Medicinal Plants, Healthcare Traditions

Introduction:

The progress and evolution of human civilization have long been intertwined, both consciously and unconsciously, with the natural environment, particularly the world of plants. Primitive societies, deeply connected to nature, heavily relied on their surroundings for survival. Through a process of trial and error, they acquired knowledge about the economic and medicinal properties of various plants. This indigenous knowledge became an integral part of the lives of communities dependent on their natural surroundings, particularly the tribal people, also known as Adivasis in India.

Ethnobotany is a multidisciplinary field that demands proficiency in several areas, including botanical expertise for the proper identification and preservation of plant specimens, anthropological knowledge for comprehending cultural concepts around the perception of plants and linguistic competence for transcribing local terms and understanding native morphology, syntax and semantics (Anderson *et al.*, 2012). However, gaining precise knowledge from native healers can be challenging, as they may be hesitant to share their knowledge with outsiders. The world exhibits a vast diversity of biological resources and only a fraction of this potential has been explored. In certain regions, conserving natural biodiversity may be more beneficial than utilizing land for activities such as pasture or timber extraction. Identification of medicinal plants can be achieved through diverse methods, such as random screening, taxonomic sampling, or ethnobotanical collecting (Mulder and Coppolillo, 2005). Investigations have demonstrated that compounds derived from ethnobotanical research exhibit greater potency than those obtained through random screening, highlighting the high potential for product development.

Rajasthan is the largest state in India, with a population of approximately 12.44% belonging to various tribal communities such as Bhil, Bhil-Meena, Damor, Dhanka, Garasia, Kathodi, Kokna, Kolidhor, Naikara, Patelia, Meena and Seharlia who reside in remote areas with limited access to basic infrastructure facilities (Sharma *et al.*, 2011). The state is also home to several nomadic tribes such as Banjara, Gadolia-Lohar, Kalbelia, Sikligar, Kanjar, Sansi and Bagri, which further enhance its ethnic heritage. These ethnic groups maintain close communication with one another, resulting in the sharing of ethnobotanical knowledge.

In the southern Pali district of Rajasthan, India, a comprehensive exploration of plants possessing ethnomedicinal importance has revealed a wealth of traditional knowledge practiced by various tribal communities (Figure 1). These practices are documented in a study focusing on the herbal formulations employed by tribes in the region. The study highlights a diverse range of plant species and their medicinal uses within these indigenous communities. Among the documented plants, *Azadirachta indica*, commonly known as Neem, is utilized for its leaves in the form of poultices applied locally. This practice is particularly common among the Sahariya, Bhil, Kalbelia and Meena tribes. Similarly, the roots of *Calotropis procera* have been identified to be applied locally, with the plant being recognized among the Kalbelia and Garasia tribes. The *Areca catechu* plant holds significant importance, with its bark and flower tops being formulated into a juice infused with asafoetida. This preparation finds use among the Sahariya tribe. Another noteworthy plant is *Tecomella undulata*, whose bark and branches are chewed among the Bhil and Garasia tribes (Sharma and Kumar, 2011).

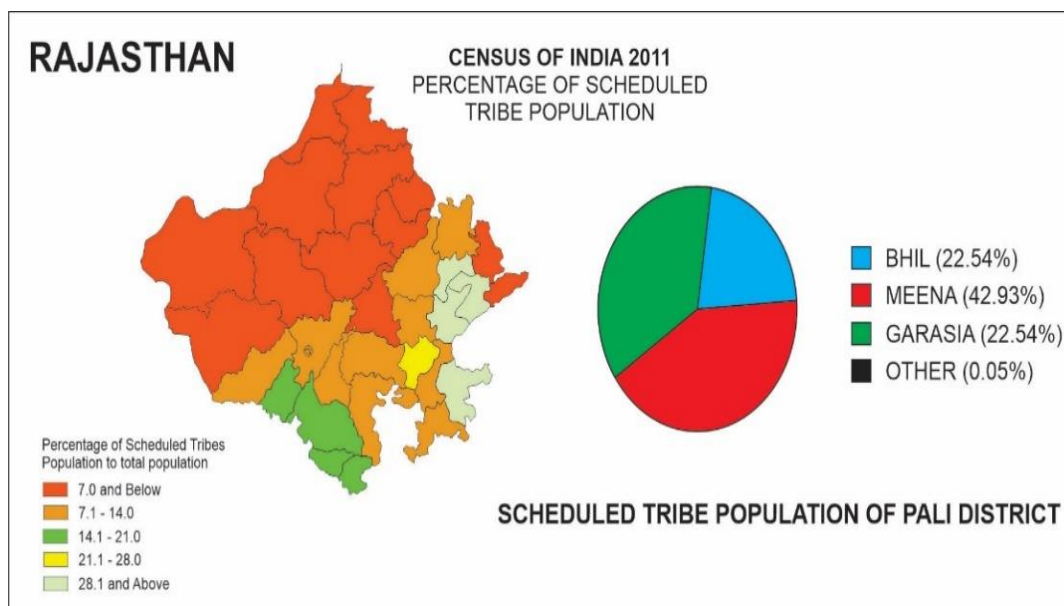


Figure 1. Rajasthan map showing percentage of scheduled tribe population

The current investigation diligently undertook extensive efforts to gather and document the invaluable ethnomedicinal knowledge held by the tribal communities residing in the Pali district of Rajasthan. This endeavor was driven by a commitment to uncover, understand and preserve the traditional healing practices and remedies that have been passed down through generations within these indigenous populations. Through a combination of immersive fieldwork, participatory interactions and insightful observations, a comprehensive repository of ethnomedicinal information was compiled, reflecting the deep-rooted wisdom of the tribal peoples in the region.

2. Materials and Methods:

2.1 Study area:

The Pali district is situated between latitudes 24.45 to 26.29 North and longitudes 72.47 to 74.18 East (Figure 2). It shares its borders with eight districts of Rajasthan, creating a connection with various regions. To its north lie Nagaur and Jodhpur districts, while its southeastern boundary is shared with Udaipur and Rajasmand districts. Adjacent to the northeast is the Ajmer district, while its western border touches the Barmer district. Further, Sirohi and Jalore districts are positioned to the south and west, respectively. The district spans a total geographical area of 12,387 square kilometers.

The climatic conditions of the study area, Pali district, demonstrate the arid to semi-arid nature of the region. The combination of high temperatures and low rainfall during certain periods of the year reflects the desert-like conditions that Rajasthan is known for. The reliance on the monsoonal rains for sustaining agriculture and water resources is evident from the observed rainfall patterns. The variations in relative humidity and temperature underscore the distinct seasons experienced by the region, with hot summers and relatively milder winters.

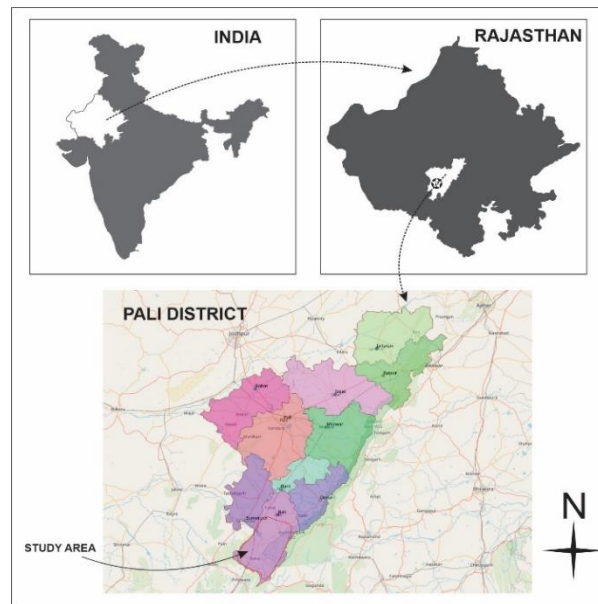


Figure 2 Map showing the location of the study area within Pali district, Rajasthan, India.

2.2 Survey:

The majority of the surveys were conducted in the southern region of Pali district (mainly Bali tehsil), along with its neighboring areas in Rajasthan. In addition to the surveys, supplementary information was collected from secondary sources within the study area. The surveys conducted in the study area followed two primary approaches: intensive surveys involving in-depth examinations of one or two villages over a span of about a week and extensive surveys encompassing multiple villages or localities within the radius of a selected village-camp. The data collection process involved a combination of interviews, observations and active participation.

According to the India census of 2011, the population of Bali stood at 19,880 individuals. Among this populace, males make up 50.67% (10,007), while females constitute 49.33% (9,873) of the total. Bali's average literacy rate is recorded at 64.28%, which falls below the national average of 74.04%. Specifically, 74.51% of males and 53.91% of females are literate. Notably, 11.72% of the total population is under the age of 6. Back in 1897, the population of Bali was around 6,000. The demographic makeup of Bali is primarily characterized by the Jain and Marwadi communities, which are also the most prosperous segments. However, a considerable number of individuals from these communities have relocated to various parts of India, engaging in business activities. Their visits to their ancestral town, such as Bali, are often centered around family marriage ceremonies.

During the study, interviews were categorized into two types: individual and group interviews. In the case of individual interviews, people were chosen randomly while on the move or upon entering huts, engaging with knowledgeable individuals from the village alongside figures like the headman (Figure 3). Group interviews involved interacting with multiple individuals simultaneously after explaining our purpose. Despite initial hesitations from women, their active participation gradually emerged.

These interviews were strategically conducted in diverse locations, including forest environments where tribal members were encouraged to discuss plant species' utility, particularly in group settings. Valuable insights were also gained from interviews held at the headman's hut or communal areas. Interviews at work sites were usually brief due to the tribal members' work commitments.



Figure 3. Interaction with tribal people lived in study area

3. Results and Discussion:

To comprehensively document the utilization of indigenous medicinal plants, an extensive survey was conducted in the remote regions of Pali district, Rajasthan, India, throughout the year 2021. The survey was meticulously designed to encompass diverse seasons, thereby facilitating the collection of a wealth of information. The indigenous knowledge concerning the medicinal properties of native plants was systematically gathered through interactions with a range of sources, including local residents, seasoned elders from rural communities, practitioners of traditional herbal medicine and local vendors specializing in herbal remedies (Figure 4). This holistic approach ensured a comprehensive understanding of the plants' applications. The gathered insights were further substantiated by referencing relevant literature, thus adding a scholarly perspective to the documentation process. By amalgamating experiential wisdom with empirical validation, this endeavor seeks to preserve and share the rich heritage of indigenous plant-based medicine in the Pali district.



Figure 4. Plant parts collected to be used for medicinal formulation by tribal people

Extensive documentation has been undertaken to capture the diverse array of plant-based formulations employed by the tribal communities inhabiting the study area. These formulations serve as remedies for a wide spectrum of health issues and are elaborated upon in the subsequent details (Table 1):

Table 1: Indigenous botanical remedies by local tribal communities

| Sr. No. | Plant Name | Plant Part Used | Health Category | Used by Tribe |
|---------|--|-----------------------------|--------------------------------|---------------|
| 1 | <i>Azadirachta indica</i> A. Juss. (Neem) | Fresh leaves, Tender leaves | Fever and febrifuge | Bhil |
| 2 | <i>Calotropis gigantea</i> Linn. (Milkweed) | Flowers | Fever and febrifuge | Garasia |
| 3 | <i>Piper longum</i> Linn. (Long Pepper) | Fruits | Fever and febrifuge | Bhil |
| 4 | <i>Saccharum officinarum</i> Linn. (Sugarcane) | Various components | Fever and febrifuge | Garasia |
| 5 | <i>Aegle marmelos</i> (L.) Correa (Wood apple) | Fruit | Digestive and gastrointestinal | Bhil |
| 6 | <i>Aerva javanica</i> (Burm.f.) Shult. (Desert cotton) | Root | Digestive and gastrointestinal | Garasia |
| 7 | <i>Aloe vera</i> (L.) Burm.f. | Leaves | Digestive and gastrointestinal | Bhil |
| 8 | <i>Calotropis procera</i> (Ait.) R. Br. (Milkweed) | Gynostegium | Digestive and gastrointestinal | Garasia |
| 9 | <i>Capparis decidua</i> (Forsk.) Edgew. (Bare caper) | Root | Digestive and gastrointestinal | Garasia |

| Sr. No | Plant Name | Plant Part Used | Health Category | Used by Tribe |
|--------|---|--------------------------------------|--------------------------------|---------------|
| 10 | <i>Citrullus colocynthis</i> (L.) Schrad. (Bitter cucumber) | Dried fruit powder | Digestive and gastrointestinal | Bhil |
| 11 | <i>Crotalaria burhia</i> Buch. - Ham. (Burhia rattlepod) | Root | Digestive and gastrointestinal | Bhil |
| 12 | <i>Cuminum cyminum</i> L. (Cumin) | Seeds | Digestive and gastrointestinal | Bhil |
| 13 | <i>Ferula asafetida</i> Linn. (Asafoetida) | Latex | Digestive and gastrointestinal | Bhil |
| 14 | <i>Ficus religiosa</i> L. (Sacred fig) | Knots (stem galls) | Digestive and gastrointestinal | Meena & Bhil |
| 15 | <i>Foeniculum vulgare</i> Mill. (Fennel) | Seed powder | Digestive and gastrointestinal | Meena & Bhil |
| 16 | <i>Indigofera cordifolia</i> (Heart leaf indigo) | Seeds | Digestive and gastrointestinal | Bhil |
| 17 | <i>Lawsonia inermis</i> Linn. (Heena) | Powdered seeds with clarified butter | Digestive and gastrointestinal | Garasia |
| 18 | <i>Mangifera indica</i> Linn. (Mango) | Crushed mango seed paste | Digestive and gastrointestinal | Bhil |
| 19 | <i>Nelumbo nucifera</i> Gaertn. (Lotus) | Seeds | Digestive and gastrointestinal | Meena & Bhil |
| 20 | <i>Polygonum plebeium</i> R. Br. (Knotweed) | Entire plant | Digestive and gastrointestinal | Meena & Bhil |
| 21 | <i>Sarcostemma viminalis</i> (Milk rope) | Plant extract | Digestive and gastrointestinal | Garasia |
| 22 | <i>Terminalia chebula</i> Retz. (Myrobalan) | Fruit powder | Digestive and gastrointestinal | Garasia |
| 23 | <i>Trachyspermum ammi</i> (Carom) | Seed powder | Digestive and gastrointestinal | Bhil |
| 24 | <i>Zingiber officinale</i> Rosc. (Ginger) | Rhizome in powdered form | Digestive and gastrointestinal | Bhil |
| 25 | <i>Allium sativum</i> Linn. (Garlic) | Roasted garlic flakes | Cold and cough | Garasia |
| 26 | <i>Brassica nigra</i> (Mustard) | Mustard oil in nostrils | Cold and cough | Meena & Bhil |
| 27 | <i>Cicer arietinum</i> L. (Chickpea) | Chickpea powder in milk with sugar | Cold and cough | Bhil |
| 28 | <i>Coriandrum sativum</i> Linn. (Coriander) | Decoction of coriander seeds | Cold and cough | Garasia |

| Sr. No | Plant Name | Plant Part Used | Health Category | Used by Tribe |
|--------|---|--|-------------------------------|---------------|
| 29 | <i>Curcuma longa</i> (Turmeric) | Turmeric powder with warm milk | Cold and cough | Bhil |
| 30 | <i>Justicia adhatoda</i> Linn. (Malabar nut) | Decoction of dry leaves | Cold and cough | Garasia |
| 31 | <i>Ocimum sanctum</i> Linn. (Basil) | Decoction of basil flowers | Cold and cough | Garasia |
| 32 | <i>Phoenix dactylifera</i> Linn. (Dates) | Boiled dates with milk | Cold and cough | Bhil |
| 33 | <i>Trachyspermum ammi</i> (Carom) | Inhaling vapors of roasted seeds | Cold and cough | Meena & Bhil |
| 34 | <i>Zingiber officinale</i> Rosc. (Ginger) | Fresh rhizome juice mixed with honey | Cold and cough | Bhil |
| 35 | <i>Allium sativum</i> Linn. (Garlic) | Boiled garlic flakes mixed with milk | Heart disease | Garasia |
| 36 | <i>Emblica officinalis</i> Gaertn. (Aonla) | Dried fruit with sugar candy (mishri) | Heart disease | Garasia |
| 37 | <i>Ficus religiosa</i> L. (Sacred fig) | Boiled green leaves | Heart disease | Meena & Bhil |
| 38 | <i>Terminalia arjuna</i> Roxb. (Arjuna) | Powdered bark with clarified butter or milk | Heart disease | Meena & Bhil |
| 39 | <i>Acacia nilotica</i> (Arabic tree) | Leaves mixed with Pedalium murex and kalmi shora | Kidney and urination problems | Garasia |
| 40 | <i>Boerhavia diffusa</i> L. (Red spiderling) | Leaves as a vegetable | Kidney and urination problems | Bhil |
| 41 | <i>Corbichonia decumbens</i> (Prostrate purslane) | Crushed leaves | Kidney and urination problems | Meena & Bhil |
| 42 | <i>Coriandrum sativum</i> Linn. (Coriander) | Seeds boiled in water | Kidney and urination problems | Bhil |
| 43 | <i>Ocimum basilicum</i> Linn. (Forest basil) | Sprouted seeds with curd | Kidney and urination problems | Garasia |

| Sr. No | Plant Name | Plant Part Used | Health Category | Used by Tribe |
|--------|---|---|---------------------------------------|---------------|
| 44 | <i>Pedaliium murex</i> Linn. (Caltrops) | Boiled fruit filtrate | Kidney and urination problems | Garasia |
| 45 | <i>Ricinus communis</i> L. (Castor) | Seeds boiled in milk | Kidney and urination problems | Garasia |
| 46 | <i>Sesamum indicum</i> L. (Sesame) | Seed powder and jaggery powder | Kidney and urination problems | Meena & Bhil |
| 47 | <i>Azadirachta indica</i> A. Juss. (Neem) | Aqueous paste of neem leaves or neem leaf-infused water | Skin problems | Bhil |
| 48 | <i>Calotropis procera</i> (Milkweed) | Ash from fresh root tips mixed with butter | Skin problems | Garasia |
| 49 | <i>Cynodon dactylon</i> Pers. (Couch grass) | Paste of the whole plant | Skin problems | Bhil |
| 50 | <i>Justicia adhatoda</i> Linn. (Malabar nut) | Paste of boiled roots and leaves | Skin problems | Meena & Bhil |
| 51 | <i>Ocimum sanctum</i> Linn. (Basil) | Paste of basil leaves | Skin problems | Meena |
| 52 | <i>Polygonum plebeium</i> R. Br. (Knotweed) | Mixture of plant ash and oil | Skin problems | Meena & Bhil |
| 53 | <i>Psoralea corylifolia</i> Linn. (Psoralea) | Mixture of soaked seeds, dried fruit powder and mishri | Skin problems | Bhil |
| 54 | <i>Terminalia catappa</i> Linn. (Malabar almond) | Paste of tender leaves | Skin problems | Garasia |
| 55 | <i>Achyranthus aspera</i> Linn. (Chaff-flower) | Smoking dry apaamarga leaves, ash with honey | Respiratory tract infection and lungs | Meena & Bhil |
| 56 | <i>Amaranthus viridis</i> L. (Amaranth) | Boiling seeds and providing the filtrate | Respiratory tract infection and lungs | Garasia |
| 57 | <i>Calotropis porcera</i> (Milkweed) | Blend of ash from flowers sealed with honey | Respiratory tract infection and lungs | Bhil |

| Sr. No | Plant Name | Plant Part Used | Health Category | Used by Tribe |
|--------|--|---|---------------------------------------|---------------|
| 58 | <i>Citrullus colocynthis</i> (Bitter cucumber) | Ash from the fruit with water | Respiratory tract infection and lungs | Garasia |
| 59 | <i>Ficus glomerata</i> Roxb. (Fig) | Fusion of carom seed, nutmeg, cloves and jaggery with plant latex | Respiratory tract infection and lungs | Meena & Bhil |
| 60 | <i>Azadirachta indica</i> A. Juss. (Neem) | Consuming dried fruit powder with water | Respiratory tract infection and lungs | Bhil |
| 61 | <i>Boerhavia diffusa</i> L. (Red spiderling) | Wearing garlands made of stem pieces around the neck | Respiratory tract infection and lungs | Garasia |
| 62 | <i>Capparis decidua</i> (Bare caper) | Consuming a fine root powder with water | Respiratory tract infection and lungs | Garasia |
| 63 | <i>Nyctanthes arbor-tristis</i> Linn. (Jasmine) | Consuming leaf powder with water | Respiratory tract infection and lungs | Bhil |
| 64 | <i>Saccharum officinarum</i> Linn. (Sugar cane) | Offering sugar cane juice to jaundice patients | Respiratory tract infection and lungs | Garasia |
| 65 | <i>Trigonella foenum-graecum</i> Linn. (Fenugreek) | Intake of seed powder with water | Respiratory tract infection and lungs | Bhil |

3.1 Fever and febrifuge:

In the context of treating fever and its related symptoms, several ethnomedicinal plant-based formulations are employed by the local tribal communities (Figure 5). The botanical knowledge handed down through generations unveils a range of valuable remedies harnessing the potential of indigenous flora. One such remedy involves *Azadirachta indica* A. Juss., commonly known as Neem Tree or "Neem" in the local language. The fresh leaves of the Neem tree are harnessed by boiling them in water and the resulting infusion is ingested thrice a day to alleviate fever. Additionally, the practice of chewing 3-4 tender Neem leaves every morning supplements this treatment. *Calotropis gigantea* Linn., referred to as Milkweed or "Safed aak," is another botanical contender for treating fever. This shrub species contributes its flowers for medicinal use. Consumption of a single piece of the Milkweed flower with water is recommended once a day for a span of 3-4 days as part of the therapeutic protocol.

The indigenous insights of tribal healers also encompass *Piper longum* Linn., known as Long Pepper or "Pipli." This herbaceous plant offers its fruits as the medicinal component. The traditional method entails immersing the Long Pepper fruits in clarified butter (ghee) overnight, followed by frying them with a dash of salt. The resulting preparation is then chewed, allowing for its potential febrifuge properties to be efficaciously conveyed. Harnessing the attributes of *Saccharum officinarum* Linn., commonly termed as Sugarcane or "Ganna," a distinctive medicinal tea is concocted for addressing fever-related discomfort. This involves the usage of dried ginger, cloves, tulsi leaves, tea leaves, jaggery (sugarcane juice candy) and milk. Consumed before bedtime, this herbal fusion amalgamates the healing properties of its constituents to provide a holistic approach to fever management.

3.2 Digestive and gastrointestinal disorder:

Within the realm of digestive and gastrointestinal disorders, the indigenous knowledge of local tribal communities unveils an array of botanical solutions harnessed from the surrounding flora. These remedies stand as testaments to the intimate relationship between traditional healing practices and the rich diversity of plant life. *Aegle marmelos* (L.) Correa, commonly referred to as Wood apple or "Bael," takes center stage as a tree species contributing to these remedies. The fruit of the Bael tree is transformed into a therapeutic agent by being powdered and combined with *Foeniculum vulgare* Mill. (fennel) seed and isubgol. This formulation finds its application in addressing chronic dysentery. *Aerva javanica* (Burm.f.) Shult., known as Desert cotton or "Bui," is a herbaceous plant that plays a role in alleviating stomachache. The root of this plant is reduced to powder, which is then consumed with water, offering a potential remedy for such discomfort. *Aloe vera* (L.) Burm.f., recognized as Aloe vera or "Ganwar patha," is a herbaceous species. In this context, the leaves of the Aloe vera plant are ingested as a vegetable, with the intent of treating constipation. *Calotropis procera* (Ait.) R. Br., identified as Milkweed or "Aak," contributes its gynostegium for medicinal use. A paste of the gynostegium, rendered aqueous, is combined with a few drops of ghee and water. This preparation holds promise in relieving stomachache in children. *Capparis deciduas* (Forsk.) Edgew., known as Bare caper or "Ker," employs its root in addressing the health needs of patients suffering from typhoid. The root is transformed into an aqueous paste, administered with water to impart its potential therapeutic effects. The botanical offerings of *Citrullus colocynthis* (L.) Schrad, colloquially termed Bitter cucumber or "Tumba," are harnessed through dried fruit powder mixed with salt. This mixture is taken with water to mitigate stomachache. Additionally, the combination of dried fruit powder, black pepper and rock salt is used to alleviate constipation. *Crotalaria burhia* Buch. -Ham., referred to as Burhia rattlepod or "Khimp," presents its powdered roots as a remedy for stomachache. This root preparation, when taken with lukewarm water, offers a potential relief from the discomfort. *Cuminum cyminum* L., commonly known as Cumin or "Jeera," is an herbaceous plant whose seeds are employed in a decoction. This concoction, combined with rock salt and lemon juice, is administered to combat stomachache. Harnessing the properties of *Ferula asafetida* Linn., recognized as Asafoetida or "Hing," the latex of the plant is transmuted into a powder. This powder, mixed with water, serves as a massage for the abdomen and is also consumed to alleviate abdominal pain. *Ficus religiosa* L., known as Sacred fig or "Peepal," contributes its knots (stem galls) to address constipation. The dried powder of these knots is taken with water, offering a potential solution to this discomfort.

The medicinal potential of *Foeniculum vulgare* Mill., referred to as Fennel or "Saunf," is harnessed through a mixture of its seed powder, Trigonella foenum-graecum (fenugreek) seed powder, F. asafoetida (hing) and black salt. This combination, when consumed with water, serves as a means to manage acidity. *Indigofera cordifolia*, commonly termed Heart leaf indigo or "Gokhru," employs its seeds in addressing typhoid. A preparation involving the boiling of seeds and subsequent administration of the filtrate for three days is considered beneficial. *Lawsonia inermis* Linn., known as Heena or "Mehndi," employs its powdered seeds in collaboration with clarified butter. These components are amalgamated into small balls and consumed twice a day to address dysentery accompanied by mucus. *Mangifera indica* Linn., recognized as Mango or "Aam," offers a remedy for children experiencing diarrhea. A paste of crushed mango seed (giri) is combined with water or curd, presenting a potential solution to this discomfort. *Nelumbo nucifera* Gaertn., commonly referred to as Lotus or "Kamal," employs its seeds in a mixture composed of lotus seeds, a small amount of salt, Piper nigrum seeds and lemon juice. This mixture is provided to patients experiencing vomiting. *Polygonum plebeium* R. Br., known as Knotweed or "Lalbuti," employs its entire plant in the creation of a decoction used to address colic complaints. *Sarcostemma viminalis* (L.) R. Br., recognized as Milk rope or "Khir-khimp," utilizes its plant extract to manage digestive disorders. *Terminalia chebula* Retz., referred to as Myrobalan or "Harad," utilizes slightly fried fruit powder as a remedy, taken with water. *Trachyspermum ammi* (Linn.) Sprague, commonly known as Carom or "Ajwain," employs a mixture of seed powder, a small amount of F. asafoetida (hing) and black salt. This preparation is consumed with water to address gastric problems. Finally, *Zingiber officinale* Rosc., recognized as Ginger or "Adrak," utilizes its rhizome in powdered form, mixed with a small amount of salt and consumed with water to alleviate abdominal pain. These ethnomedicinal practices underline the profound connection between local plant resources and the alleviation of digestive and gastrointestinal disorders within tribal communities.

3.3 Cold and cough:

Within the context of addressing diverse health concerns, the indigenous knowledge of local tribal communities draws upon an array of botanical resources, each offering distinctive remedies. *Allium sativum* Linn., commonly known as Garlic or "Lahsun," plays a significant role by utilizing roasted garlic flakes as a therapeutic agent (Figure 6). Administered before bedtime, these flakes are consumed and for children, a blend with jaggery is employed. *Brassica nigra*, recognized as Mustard or "Saron," employs a unique method of administration. Two drops of mustard oil are placed into the nostrils, potentially harnessing its beneficial properties. *Cicer arietinum* L., known as Chickpea or "Channa," utilizes chickpea powder (besan) in its remedy. Roasted and added to milk with sugar, this mixture is consumed before bedtime. *Coriandrum sativum* Linn., commonly referred to as Coriander or "Dhaniya," employs the decoction of coriander seeds in its approach. *Curcuma longa*, recognized as Turmeric or "Haldi," employs the vibrant rhizome. A half teaspoon of turmeric powder, when combined with warm milk, becomes an evening ritual with potential health benefits. *Justicia adhatoda* Linn., known as Malabar nut or "Adua," capitalizes on its leaves. A decoction made from finely crushed dry leaves, complemented by mishri (sugar candy) and ginger, is ingested thrice a day. *Ocimum sanctum* Linn., commonly referred to as Basil or "Tulsi," takes its flowers into medicinal service.

A decoction consisting of 5-6 flowers, along with jaggery and turmeric, is administered before bedtime. *Phoenix dactylifera* Linn., recognized as Dates or "Khajoor/Chuar," employs dried dates as a resource. Boiling these dates with milk offers a remedy taken before bedtime. *Trachyspermum ammi* (Linn.), commonly known as Carom or "Ajwain," presents a unique approach. Seeds roasted on an iron frying pan are wrapped in cloth, enabling patients to inhale their beneficial vapors. *Zingiber officinale* Rosc., identified as Ginger or "Adrak," harnesses the juice of its fresh rhizome. Administered three times a day, mixed with honey, this concoction holds potential in promoting health.

3.4 Heart disease

A compilation of indigenous medicinal practices reveals a variety of plant-based interventions. *Allium sativum* Linn., commonly known as Garlic or "Lahsun," a herb from the Alliaceae family, is administered as boiled flakes mixed with milk, often consumed in the early morning. Another valuable resource is *Emblica officinalis* Gaertn., also known as Aonla or "Aamla," a tree from the Euphorbiaceae family. Its fruit, when dried and combined with sugar candy (mishri), is ingested with water. The *Ficus religiosa* L., Sacred fig or "Peepal," a tree from the Moraceae family, employs its green leaves. Boiling 15 leaves in a glass of water until reduced to one-third creates a solution taken in three doses throughout the day. Furthermore, *Terminalia arjuna* Roxb., known as Arjuna or "Arjun," a tree belonging to the Combretaceae family, employs its bark. Powdered bark, mixed with clarified butter or milk, is consumed twice or thrice daily for a span of 15 days. These insights underscore the diverse ways in which indigenous plants are harnessed for health and well-being in the Pali district.

3.5 Kidney and urination problem

Addressing kidney and urination problems through indigenous botanical solutions unveils a spectrum of plant-based interventions. *Acacia nilotica* (L.) Delile, commonly known as Arabic tree or "Babool," is a tree from the Mimosaceae family. Its leaves, when finely mixed with *Pedaliium murex* (gokhru) and kalmi shora, offer a remedy when taken before bedtime. *Boerhavia diffusa* L., the red spiderling or "Lal sathi," a herb from the Nyctaginaceae family, offers diuretic effects when its leaves are cooked and consumed as a vegetable. *Corbichonia decumbens* (Forssk.) Jacq ex Exell, known as Prostrate purslane or "Pathar-chatti," employs crushed leaves to address kidney stone problems. *Coriandrum sativum* Linn., Coriander or "Dhaniya," a herb from the Apiaceae family, requires boiling its seeds in water to produce a liquid that combats urination issues. *Ocimum basilicum* Linn., Forest basil or "Ban tulsi," a herb from the Lamiaceae family, utilizes sprouted seeds consumed with curd to alleviate urinary problems. *Pedaliium murex* Linn., commonly called Caltrops or "Gokhru," a herb from the Pedaliaceae family, relies on boiled fruit filtrate as a diuretic. *Ricinus communis* L., Castor or "Arandi," a shrub from the Euphorbiaceae family, involves boiling seeds in milk and consuming the preparation to address kidney problems. Lastly, *Sesamum indicum* L., Sesame or "Til," a herb from the Pedaliaceae family, recommends a mixture of seed powder and jaggery powder to be consumed before sleep. These diverse botanical approaches illuminate the intricate synergy between indigenous plant knowledge and kidney-related wellness.

3.6 Skin problems

Unveiling botanical solutions for skin-related ailments reveals an array of indigenous interventions. *Azadirachta indica* A. Juss., commonly known as Neem Tree or "Neem," a tree from the Meliaceae family, advocates applying an aqueous paste of neem leaves or using neem leaf-infused water for bathing to alleviate skin irritation. *Calotropis procera* (Ait.) R. Br., the Milkweed or "Aak," a shrub from the Asclepiadaceae family, suggests using ash from fresh root tips mixed with butter to treat eczema-affected areas. *Cynodon dactylon* Pers., Couch grass or "Doob," an herb from the Poaceae family, encourages applying a paste of the whole plant on eczema-prone skin. *Justicia adhatoda* Linn., the Malabar nut or "Adusa," a tree from the Acanthaceae family, advocates a paste prepared from boiled roots and leaves to be applied twice daily for eczema relief. *Ocimum sanctum* Linn., Basil or "Tulsi," a herb from the Lamiaceae family, recommends applying a paste of its leaves to eczema-affected areas. *Polygonum plebeium* R. Br., Knotweed or "Lalbuti," an herb from the Polygonaceae family, underscores applying a mixture of plant ash and oil to address eczema. *Psoralea corylifolia* Linn., Psoralea or "Bavachi," a herb from the Fabaceae family, suggests a mixture of soaked seeds, dried fruit powder of *Emblica officinalis* and mishri soaked in water for leucoderma treatment. *Terminalia catappa* Linn., Malabar almond or "Jangli badam," a tree from the Combretaceae family, recommends applying a paste of tender leaves to soothe eczema-prone areas. These botanical insights illuminate the harmony between indigenous plant wisdom and holistic skin wellness.

3.7 Respiratory tract infection and lungs complaint

Navigating the realm of respiratory tract infections and lung ailments, indigenous remedies emerge as guardians of well-being. *Achyranthus aspera* Linn., the Chaff-flower or "Apaamarga" from the Amaranthaceae family, introduces the practice of smoking dry apaamarga leaves for asthma relief, coupled with administering ash from burnt dry plants mixed with honey. *Amaranthus viridis* L., the Amaranth or "Chulai," a herb from the Amaranthaceae family, recommends boiling its seeds and providing the resulting filtrate to pneumonia patients. *Calotropis porcera* (Ait.) R. Br., the Milkweed or "Aak," a shrub from the Asclepiadaceae family, advocates a blend of ash from 5 gm of flowers sealed in an earthenware pot with honey for asthmatic individuals. *Citrullus colocynthis* (L.) Schrad., the Bitter cucumber or "Tumba," a climber from the Cucurbitaceae family, prescribes taking ash from the fruit with water to mitigate asthma. *Ficus glomerata* Roxb., the Fig or "Gular," a tree from the Moraceae family, proclaims the fusion of carom seed, nutmeg, cloves and jaggery with plant latex for liver complaints and diabetes. *Azadirachta indica* A. Juss., the Neem Tree or "Neem," a tree from the Meliaceae family, signifies consuming one teaspoon of dried fruit powder with water twice a day to potentially regulate sugar levels. *Boerhavia diffusa* L., the Red spiderling or "Lal sathi," a herb from the Nyctaginaceae family, introduces wearing garlands made of stem pieces resembling beads around the neck to aid in jaundice recovery. *Capparis decidua* (Forsk.) Edgew., the Bare caper or "Ker," a shrub from the Capparaceae family, suggests consuming a fine powder of approximately 3 cm of root with water for liver ailment mitigation. *Nyctanthes arbor-tristis* Linn., the Jasmine or "Harsingar," a shrub from the Oleaceae family, proposes the consumption of one teaspoonful of leaf powder with water on a daily basis. *Saccharum officinarum* Linn., the Sugar cane or "Ganna," an herb from the Poaceae family, endorses offering sugar cane juice to jaundice patients.

***Trigonella foenum-graecum* Linn.**, the Fenugreek or "Methi," a herb from the Fabaceae family, underscores the intake of one teaspoon of dried seed powder early in the morning with water. This intricate tapestry of indigenous botanical interventions nurtures respiratory and lung well-being with nature's wisdom.

Traditional knowledge within local tribal communities has led to the utilization of various plant-based formulations to address a range of health issues. These remedies draw upon the medicinal properties of indigenous flora, although their efficacy may not always be substantiated by scientific evidence. Among the health concerns addressed, fever and febrifuge remedies employed four plants, with plant parts such as fresh leaves, tender leaves, flowers and various components from plants like ginger, cloves, tulsi leaves, tea leaves, jaggery and milk being used. For digestive and gastrointestinal disorders, an extensive 21 plants were harnessed, utilizing various plant parts such as fruits, seeds, roots and leaves. Health issues such as dysentery, stomachache, constipation and acidity were targeted. Cold and cough remedies encompassed 10 plants, using diverse plant parts including roasted garlic flakes, mustard oil, chickpea powder, coriander seeds, turmeric powder, dry leaves, flowers, dried dates, roasted seeds and fresh rhizome juice (Figure 3 and 4). Heart disease interventions featured four plants, with plant parts like boiled garlic flakes, dried fruit (e.g., Aonla), boiled green leaves and powdered bark utilized. Nine plants were employed for kidney and urination problems, with plant parts ranging from leaves to roots, seeds and powders. Lastly, skin problems were addressed using eight plants, incorporating neem leaves, ash from root tips, whole plant paste, boiled roots and leaves, basil leaves paste, plant ash and oil mixture, soaked seeds and dried fruit powder and tender leaves paste. In the context of respiratory tract infections and lung complaints, 10 plants were employed, including dry apaamarga leaves, boiled seeds, ash from flowers, ash from the fruit and various ingredient fusions, aiming to alleviate issues like asthma and pneumonia. It's important to exercise caution and consult healthcare professionals when considering traditional or herbal treatments, particularly for severe health conditions, as the effectiveness of these remedies can vary and scientific validation may be necessary.

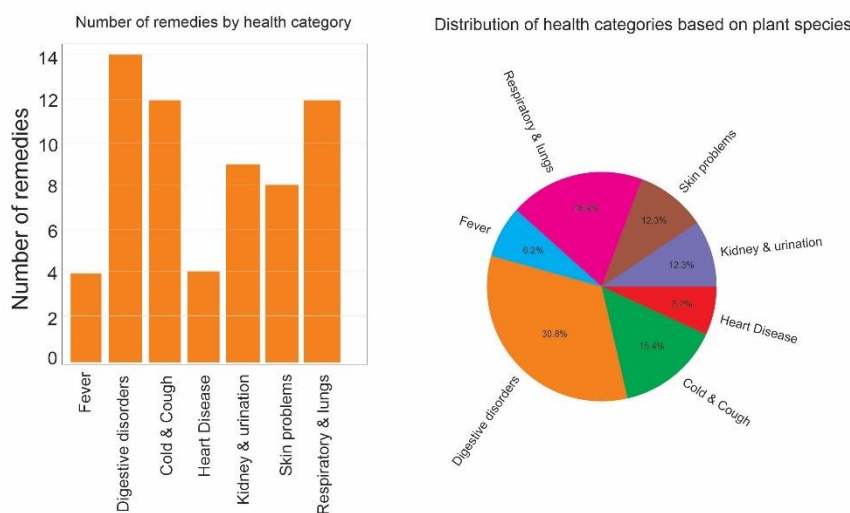


Figure 5. Number of remedies by health category and percent distribution

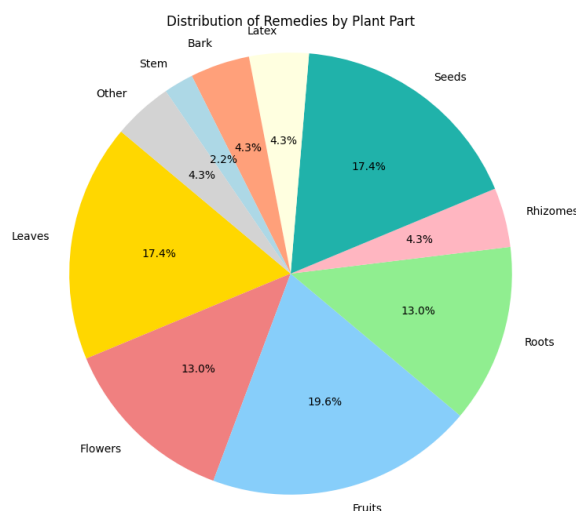


Figure 6. Percent distribution of remedies by plant part

4. Conclusion:

In culmination, the study embarks on a profound journey through the ethnomedicinal tapestry of indigenous plants, unveiling a treasure trove of traditional remedies nurtured by the communities in the remote areas of Pali district, Rajasthan, India. The meticulous survey conducted across seasons served as a compass, steering the research towards a panoramic understanding of plant utilization for diverse health concerns. Through engagement with local inhabitants, seasoned elders, traditional herbalists and local vendors, a mosaic of indigenous knowledge emerged, adorned with the pearls of ancient practices. This tapestry of wisdom was woven further by consulting literature, enriching the study's fabric with holistic insights

Diving into specific health realms, the study illuminated the intricate remedies for fever and febrifuge, digestive and gastrointestinal disorders, kidney and urination problems, skin afflictions and respiratory tract infections. Each chapter, a chapter of life in itself, delved into the botanical identities, local nomenclature, plant parts harnessed and modes of administration for ailments that have crossed paths with human existence since time immemorial. Remarkably, these indigenous remedies unveiled the symbiotic relationship between humans and their botanical cohabitants. The study's revelations emphasize the wisdom ingrained in local cultures, where nature is not merely a resource, but a partner in healing. This journey into the ethnomedicinal realm stands as a testament to the harmonious coexistence of traditional knowledge and modern exploration, providing a bridge between past and present and paving the way for a more enriched future where the synergy between nature and health is cherished and safeguarded.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interest

The authors report no declarations of interest

Reference:

- Ahmed, H. M. (2016). Ethnopharmacobotanical study on the medicinal plants used by herbalists in Sulaymaniyah Province, Kurdistan, Iraq. *Journal of Ethnobiology and Ethnomedicine*, 12(1), 1–17.
- Anderson, E. N., Pearsall, D., Hunn, E., & Turner, N. (2012). *Ethnobiology*. John Wiley & Sons.
- Balick, M. J., & Cox, P. A. (2020). *Plants, people and culture: the science of ethnobotany*. Garland Science.
- Bhandari, M. M. (1974). Famine foods in the Rajasthan Desert. *Economic Botany*, 28(1), 73–81.
- Chopra, I. C., Abrol, B. K., & Handa, K. L. (1960). Medicinal Plants of Arid Zones. Part-I. *Res. Ser.*, 13, 11–53.
- Dixit, R. D., & Mishra, R. (1976). Studies on ethnobotany of some less known medicinal plants of Ajmer forest division. *Rajasthan*, 19, 20–22.
- Gupta, R., & Dutta, B. K. (1967). Vernacular names of the useful plants of northwest indian arid regions. *Journal d'agriculture Traditionnelle et de Botanique Appliquée*, 14(10), 402–453.
- Gupta, R. K., & Saxena, S. K. (1968). Resources Survey of *Salvadora oleoides* and *S. persica* as oil yielding plants in arid regions of India. *Tropical Ecology*, 8(2), 140–152.
- Kala, S., Meena, H. R., Reeja, S., Subbulakshmi, V., Singh, A. K., Rashmi, I., & Singh, R. K. (2020). Revival of persistent native medicinal plants diversity through ravine restoration measures and their traditional uses in Chambal ravines of South-Eastern Rajasthan. *Journal of Pharmacognosy and Phytochemistry*, 9(3), 1179–1187.
- Katewa, S. S., & Galav, P. K. (2005). *Traditional herbal medicines from Shekhawati region of Rajasthan*.
- Khan, N., Ahmed, M., Ahmed, A., Shaukat, S. S., Wahab, M., Ajaib, M., Siddiqui, M. F., & Nasir, M. (2011). Important medicinal plants of chitral gol National park (cgnp) Pakistan. *Pak J Bot*, 2, 797–809.
- King, G. (1870). Notes on vegetable products used as food during late famine in Rajputana. *Trans. Bot. Soc. Edinb*, 10, 198.
- Mulder, M. B., & Coppolillo, P. (2005). *Conservation: linking ecology, economics and culture*. Princeton University Press.
- Paroda, R. S. (1979). Plant resources of Indian arid zone for industrial uses. Eds. Goodin J.R. and D.K. Northinton. In *Arid Land Plant Resources*. Texas Technical University, Texas (pp. 261–281).
- Raheja, P. C., & Sen, A. . (1964). *Resources in prospective in Recent Development in Rajasthan, Central Arid Zone Research Institute, Jodhpur, India*.
- Rajagopal Reddy, S., Madhusudhana Reddy, A., Philomina, N. S., & Yasodamma, N. (2011). Ethnobotanical survey of Sheshachalam hill range of Kadapa district andhra Pradesh, India. *Indian Journal of Fundamental and Applied Life Sciences*, 1(4).
- Sharma, H., & Kumar, A. (2011). Ethnobotanical studies on medicinal plants of Rajasthan (India): A review. *Journal of Medicinal Plants Research*, 5(7), 1107–1112.

- Sharma, N., Tanwer, B. S., & Vijayvergia, R. (2011). Study of medicinal plants in Aravali regions of Rajasthan for treatment of kidney stone and urinary tract troubles. *International Journal of PharmTech Research*, 3(1), 110–113.
- Singh, V. (1998). *Ethnobotany of Rajasthan (India)*. Scientific Publishers.
- Srivastava, T. N. (1977). Forest resources of Rajasthan. *Natural Resources of Rajasthan*, 1, 151–164.
- Vyas, L. N., & Gupta, R. S. (1962). An annotated list of medicinal plants of Alwar, Rajasthan: Ser. 1. *Proc. Raj. Acad. Sci*, 9(2), 49–55.
- Yumkella, K. K. (2011). *Agribusiness for Africa's prosperity*. Unido.