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An Ethno-Pharmacological Study of Wound Healing Medicinal Plants Used by Traditional Healers in Dhamtari, Chhattisgarh, India

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Abstract: Ethno-pharmacology is "the multidisciplinary scientific investigation of the biologically active substances that are customarily used." As a result, the ethno-pharmacological approach is founded on a corpus of research encompassing pharmacology, chemistry, and botany, among other fields. The research was conducted in the Indian state of Chhattisgarh's Dhamtari areas. Fifteen families and a total of eighteen therapeutic plants with ethno-pharmacological potency, particularly in wound healing, were identified at the study site. In the research areas, extensive field surveys were carried out between March 2021 and February 2023. On field excursions, native knowledge of wild medicinal plants was gathered through conversations, questionnaires, and in-person interviews. Plants were arranged according to their scientific names, families, common names, and parts that were utilised to cure or promote wound healing. In the survey, the dominant families of plants like Amaranthaceae, Liliaceae, and Fabaceae had two (02) species of medicinal importance, particularly for wound healing treatment. The Dhamtari region's rural inhabitants have traditionally utilised native flora for primary healthcare and the treatment of a variety of ailments. On the other hand, hardly much was recorded regarding traditional knowledge of therapeutic herbs. The Dhamtari people of the countryside claimed that as society developed, newer generations became less interested in the traditional knowledge of therapeutic herbs. Therefore, before they become extinct and are no longer available, it is imperative to document ethno-medicinal plants that can heal wounds. In order to properly conserve plants and traditional knowledge for the future, this ethno-botanical database will be valuable to scientists, naturalists, planners, policymakers and chemists.

Introduction

Ethno-pharmacology is a branch of pharmacology that studies the traditional knowledge and use of medicinal plants and other natural substances by various ethnic groups (Mussin and Giusiano, 2020). It involves investigating how different cultures utilize plants, fungi, animals, and minerals for therapeutic purposes. Ethno-pharmacology combines elements of anthropology, botany, chemistry, and pharmacology to understand traditional medicine's cultural context and identify potential bioactive compounds (Sarkar et al., 2016, 2022; Mussin and Giusiano, 2020; Sanyal, (2022a&b). The key aspects of ethno-pharmacology include: Traditional Knowledge, where studying the traditional knowledge and practicing of different cultures related to the use of medicinal substances were achieved (*Maiti* et al., 2010, 2013; Süntar, 2020; Sarkar et al., 2024). This often involves understanding the methods of preparation, administration and the cultural beliefs associated with these remedies (Erfani, 2021; *Kar et al., 2022;* Ghosh et al., 2022; Jyotirmayee et al., 2023; Dhakar and Tare, 2023; Darro and Khan, 2023). In this study, isolating and characterizing bioactive compounds from traditional medicinal substances were performed. Identifying the chemical components responsible for the therapeutic effects observed in traditional medicines was documented in this study (Banerjee et al., 2014; Bose, 2018; Süntar, 2020; De and Sharma, 2023; De et al., 2023). Then, it is

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essential to validate the efficacy and safety of traditional remedies (Sarkar et al., 2021; Pimple et al., 2023). This involves testing extracts or isolated compounds in laboratory settings to understand their pharmacological properties. After that, ethical pharmacists often address issues related to the sustainable use and conservation of medicinal plants by collaborating with conservationists to ensure the preservation of biodiversity and traditional knowledge. Ethno-pharmacology has the potential to contribute to the discovery of new drugs and the development of alternative and complementary medicine. It also emphasizes the importance of respecting and preserving traditional knowledge while promoting sustainable practices and biodiversity conservation (Süntar, 2020).

Rural populations worldwide rely on traditional local knowledge of medicinal plants for primary treatment (Saba, 2014; Singh and Arora, 1978; Acharya et al., 2022). The study of the relationships between plant environments and pre-colonial human societies is known as ethno-botany. Throughout the years, traditional medicinal herbs have been known to rural populations (Puratchikody et al., 2006; Juneja et al., 2019). In order to find contemporary medications derived from naturally occurring medicinal plant resources, ethno-pharmacological study is crucial (Idolo et al., 2010; Mahmood et al., 2013).

The utilization of plant species as traditional remedies is a good substitute for medical facilities in rural areas of developing nations (Kumar et al., 2021; Hayta et al., 2014). Studies show that 80% of people in developing nations receive their primary treatment from traditional medicines. It's commonly said that these therapeutic plants are affordable, easy to locate in the neighborhood and safe (Fabricant et al., 2001; Nayak and Pereira, 2006). Studies by Gowthami et al. (2002) and Arti et al. (2014) indicate that 7500 plant species in India have been found to have medicinal applications in both traditional and modern medical systems (Arti et al., 2014; Gowthami et al., 2021).

In India, plants have been used for food and medicinal since the time of the Vedas. The earliest accounts of plant medicine can be found in the Rig Veda and the Atharvaveda (Rashid et al., 2008). Roughly 75% of India's population lives in rural areas. Most rural communities depend on natural resources, such as wild edible plants, to meet their needs during periods of food scarcity (Njoroge et al., 2004). Rural societies consume more than 800 different kinds of food plants (Phillips et al., 1994).

Since the dawn of time, humans have made substantial use of wild plants for a wide range of needs, including food, medicine, fiber and animal feed. Particularly in developing nations, it has been determined that wild edible plants are significant to humans and that maintaining a balance between population increase and agricultural productivity could be achieved through them (Rahman et al., 2004).

Reports state that 54 million indigenous people are living in India. People living in rural areas rely on trees and forest products to maintain daily activities. Musa et al. (2011), Zeeshan et al. (2021) and Phillips et al. (1994) all state that the majority of tribal communities still depend on regional traditional treatments to survive (Singh et al., 2014).

The indigenous population of these locations depends on these traditional medicinal plants for a range of ailments as these areas lack an efficient transportation system and access to quick medical care. This ancient knowledge of medicinal plants has been passed down from generation to generation without sufficient documentation. To the main occupants of natural ecosystems and traditional healers, it has occasionally been a "closely secret" (Antony et al., 2018; Pal et al., 2021; Chauhan, 2020).

The body goes through a complicated and well-coordinated biological process called wound healing to replace injured tissue. In order to repair the skin or other tissues after damage, a number of cellular and metabolic processes are involved. Due to their potential to heal wounds, medicinal plants have been utilised for ages in traditional medicine. Numerous of these plants have bioactive components that can speed up the healing process and lessen pain, inflammation, and infection. Medicinal plants have been used for various wound healing purposes since ancient times. Information on phyto-therapeutics is very helpful in searching for medications that help humanity with wound healing.

The ancient use of these traditional medicinal plants, which is recorded in classical literature like as "Charak Sanhita," "Sushrut Sanhita," and others, as well as by contemporary tribal healers, lends credence to their veracity. If it has undergone sufficient inspection, documentation, and enumeration, it will prove valuable in the future for the identification of novel medications.

Material and methodsStudy area

Dhamtari is a city and district located in the Indian state of Chhattisgarh. It is located in India's central region (Fig.1). The coordinates of Dhamtari are as follows: Longitude: 81.5520550 East, Latitude: 20.7129920

North. Situated in the heart of Chhattisgarh, Dhamtari is roughly 74 kilometres (46 miles) southwest of Raipur, the state capital. Travellers and tourists visiting the area may easily access it because of its excellent road connectivity to other major towns and cities in Chhattisgarh.

Dhamtari, in central India's state of Chhattisgarh, has a tropical climate that is both wet and dry. Seasons: Summer (March to June): Dhamtari mostly experiences hot, dry summers. This time of year can see extremely high temperatures, with daytime highs frequently reaching 40°C (104°F). Extreme heatwaves are common in the area, particularly in April and May. Winter (December to February): Compared to the rest of the year, Dhamtari's winters are very warm and dry. The range of comfortable daytime temperatures is 20°C to 25°C (68°F to 77°F), while the lowest nighttime temperatures are approximately 10°C (50°F).

The weather throughout this season is cool and pleasant. Rainfall: With an average yearly precipitation of 1,200 to 1,400 millimetres (47 to 55 inches), Dhamtari receives most of its rainfall during the monsoon season. The area's abundant vegetation and high agricultural output are a result of the heavy rainfall. Humidity: There is a fair amount of humidity, particularly during the monsoon season. Summertime heat and humidity can combine to create uncomfortable conditions.

Data Collection

Between March 2021 and February 2023, several in-depth field investigations were conducted in the research region presented in Fig. 2. The obtained plant specimens were mounted, dried, and labeled on herbarium sheets with the collecting date and method. Conventional taxonomic literature was utilized to identify the plants.

On field excursions, native knowledge of wild medicinal plants was gathered through conversations, questionnaires, and in-person interviews. It was observed that persons between the ages of 50 - 65 made up the majority of replies. Each informant voluntarily agreed to participate in the interviews and was free to end them anytime. Locals assisted with the field investigation, and samples of significant medicinal plants were gathered utilizing informants' information and local identification. The plant species were identified with the help of standard taxonomic literature viz., Flora of Madhya Pradesh Vol II (Khanna K, 1997)

Results and discussion

In the present investigation, 18 medicinal plants belonging to 15 families were found that the tribal people use to cure and heal wounds. Table 1 shows plants by family, scientific name, local name, portion used, and

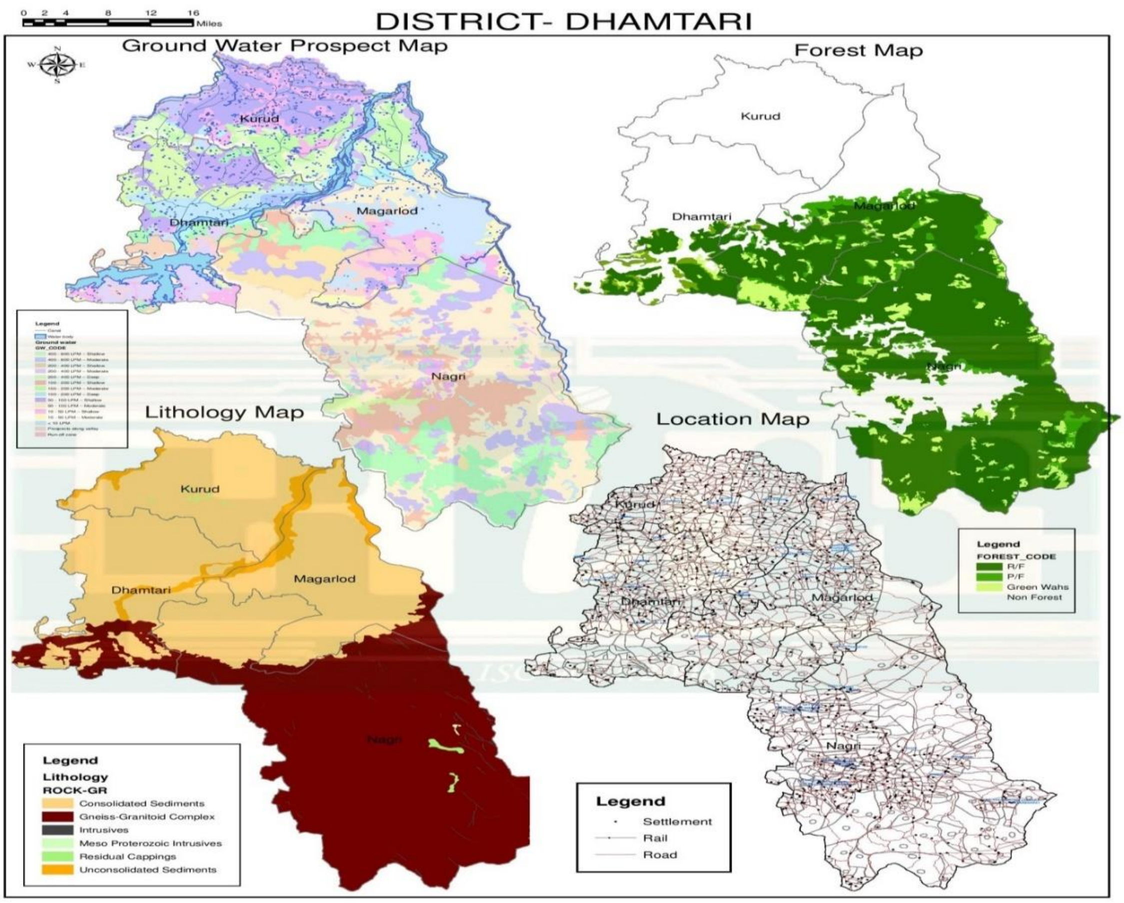

Figure 1. Study area: Dhamtari, Chhattisgarh, India

mode of preparation in alphabetical order. According to the study, the dominant family, with two species of medicinal importance particularly for wound healing, was Amaranthaceae, Liliaceae and Fabaceae.

Rhizome (16%), Tuber (5%) were the most often used parts for wound healing treatments by the tribal people represented in Figure 3.

In Fig. 4, various plant families used for wound

Figure 2. Sample collection from study area: Dhamtari, Chhattisgarh, India.

Fig. 3A *Abelmoschus esculentous*

Fig. 3B. *Acalypha indica*

Fig. 3C. *Achyranthes aspera*

Based on primary sources and locally accessible medicinal plants used by the tribal members for wound healing, the survey documented the information. Leaves (44%), Fruits (5%), whole plants (16%), Root (11%),

healing are depicted according to survey results. The findings indicate that Amaranthaceae, Liliaceae and Fabaceae hold the top spot among plant families from which native people used it to treat wounds.

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Fig. 3D. ***Acorus calamus***

Fig.3E. ***Amaranthus caudatus***

Fig. 3F. .*Argemone maxicana*

Fig. 3G. ***Asparagus racemosus***

Fig. 3H. ***Bauhinia variegate***

Fig. 3I. ***Boerhaavia diffusa***

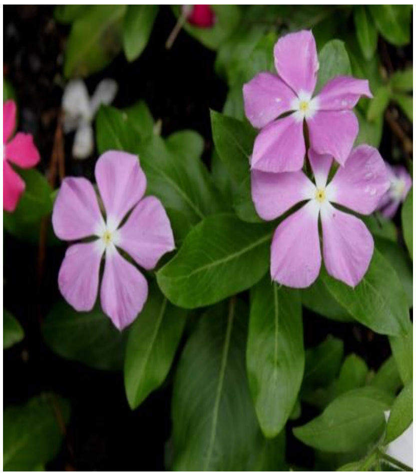

Fig. 3J. ***Catharanthus roseus***

Fig. 3K. ***Centella Asiatic***

Fig. 3L. ***Curculigo orchids***

Fig. 3M. ***Curcuma longa***

Fig. 3N. ***Cyperous scariosus***

Fig. 3O. ***Gloriosa superba***

Fig. 3P. ***Mimosa pudica***

Fig. 3Q. ***Oxalis corniculcta***

Fig. 3R. ***Ocimum sanctum***

Figure 3. (A-R). Some Medicinal plants.

Table 1. Ethno-pharmacological plants for the purpose of wound healing activities in the Dhamtari, regions of Chhattisgarh state, India

Sl. No	Scientific Name	Local Name	Family	Parts Used	Mode of preparations
1	*Abelmoschus esculentous* L. (Moench)	Bhendi	Malvaceae	Fruit	Fruit paste is applied to the wounds
2	*Acalypha indica* L.	Muktojhuri	Euphorbi-aceae	Leaves	Leaf juice applied to the wound
3	*Achyranthes aspera* L.	Chirchira	Amaranth-aceae	Whole plant	The whole plant is grinded into paste and then applied to the wounds
4	*Acorus calamus* L.	Gorbach	Acoraceae	Rhizome	A paste of rhizome is applied to wounds
5	*Amaranthus caudatus* L.	Marshisak	Amaranth-aceae	Leaves	Leaf paste is applied to wounds for quick healing.
6	*Argemone maxicana* L.	Peeli kater	Papavera-ceae	Whole plant	Roots paste is applied to the wounds.

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7	*Asparagus racemosus*	Satawar	Liliaceae	Root	Roots paste is applied to the wounds
8	*Bauhinia variegata*	Kachanar	Fabaceae	Leaves	Leaf paste is applied to the wounds
9	*Boerhaavia diffusa* L.	Punarnova	Nyctangi-naceae	Whole plant	Whole plant is first grind into paste and then applied to the wounds.
10	*Catharanthus roseus* (L.) G.Don.	Nayantara	Apocyn-aceae	Leaves	The paste of the leaves is applied to wounds
11	*Centella asiatica*	Thankun	Apiaceae	Leaves	Leaf paste is applied to wounds
12	*Curculigo orchioides* Gaertn	Kali Musali	Amaryllidaceae	Rhizome	Powdered dry rhizome is applied in wounds
13	*Curcuma longa*	Halud	Zingiberaceae	Rhizome	Rhizome is grinding into the paste and mixed with mustard oil and applied on the wounds.
14	*Cyperous scariosus* R. Br.	Muthaghas	Cyperaceae	Tuber	Paste of tuber is applied to wounds
15	*Gloriosa superba* (L.)	Kalihari	Liliaceae	Roots	Roots paste is applied to the wounds.
16	*Mimosa pudica* L.	Lajwanti	Fabaceae	Leaves	Leaves are crushed and applied to the wounds.
17	*Oxalis corniculcta Linn.*	Amrulsak	Oxalida-ceae	Leaves	Leaves are grinded into the paste and applied to wounds.
18	*Ocimum sanctum* L.	Tulsi	Lamiaceae	Leaves	The paste of the leaves is used for wound healing

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Table 2. Plants with wound healing activity and their model previously reported

Sl. No	Scientific Name	Active constituents	Extract /fraction	Pharmacological profile reported (Reference)
1	*Abelmoschus esculentous* L. (Moench)	Polyphenolic compounds, carotene, folic acid, thiamine, riboflavin, niacin, vitamin C, oxalic acid, and amino acids.	Green synthesized cerium oxide (CeO2) nanoparticles from *A. esculentus*	Male albino rats (9–10 weeks old, weighed between 220–250 g), wound diameter measurement model. (Pal et al., 2021, Marwa et al., 2023)
2	*Acalypha indica* L.	Saponins, flavonoids, terpenoids and cardiac glycosides	Ethanol leaf extract	Mice incision wound models (Laut, 2019)
3	*Achyranthes aspera* L.	alkaloids, carbohydrates, tannins, proteins, saponins and flavonoids	Aqueous and ethanol extracts of leaves	Healthy Wistar rats of either sex (150–200g), excision wound model and incision wound model (Edwin, 2008)

4	*Acorus calamus* L.	Acorenone, monoterpene hydrocarbons, sequestrine ketones, b-gurjunene, isoshyobunine, alpha-asarone, beta-asarone, calamusenone, camphone, shyobunone	Ethanolic leaf Extracts	Topical (Wistar albino rats) Incision & excision wound model (Pal et al., 2021; Jain, 2010)
5	*Amaranthus caudatus* L.	Phenolic acids such as ferulic, vanillic, syringic and sinapic acids	The whole plant extraction was performed using 65% ethanol	Wound incision model on rats (Paswan et al., 2020)
6	*Argemone maxicana* L.	Steroids and sterols, triterpenoids, alkaloids, flavonoids, saponins, tannins and phenolicsubstances,	Petroleum ether, chloroform, methanol and aqueous extracts of the leaves	Rats using excision (normal and infected), incision and dead space wound models respectively (Pal et al., 2021).
7	*Asparagus racemosus*	Sarsapogenin, two spirostanolic, two Furostanolic sponins, Sitosterol, Asparagamine A	The aqueous extract of the roots	In albino rats using incision and excision wound models in 200 mg/kg and 400mg/kg orally for 10 to 22 days (Kodancha et al., 2011)
8	*Bauhinia variegata*	Terpenoids, flavonoids, tannins, saponins, reducing sugars, steroids and cardiac glycosides	Bark extract	Albino rats were the experimental model. 36 albino rats were selected and divided into 6 groups of 6 rats each. 3 groups were used for the excision wound model and remaining 3 groups were used for incision wound model (Hiremath et al., 2013)
9	*Boerhaavia diffusa* L.	Amino acids, fatty acids, flavonoid, glycosides, isoflavonoids (rotenoids), steroids (ecdysteroid), alkaloids	Methanol and chloroform leaf extract	In-vitro (cell viability and wound scratch assays) In-vivo excision wound assays in rat models. (Pal et al., 2021; Juneja et al., 2019)
10	*Catharanthus roseus* (L.) G.Don.	Linolenic acid, ethyl ester, stearic acid, phytol, hexadecanoic acid, limonene, geraniol, citral	Ethanolic flower extract	Topical (Sprague Dawley rats) Incision, excision & dead space wound model (Pal et al., 2021; Nayak and Pereira, 2006)

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11	*Centella asiatica*	Terpenes (monoterpenes, sesquiterpenes, diterpenes, triterpenes, tetraterpenes), phenolic compounds (flavonoids, phenylpropanoids, tannins), polyacetylenes group, alkaloids, carbohydrates, vitamin, mineral and amino acid.	Isolated asiaticoside sterile saline dosage form	In-vivo & In-vitro (Guinea pig & Sprague Dawley male rats) Chick chorioallantoic membrane and excision wound model (Pal et al., 2021; Shukla et al., 1999)
12	*Curculigo orchioides* Gaertn.	Phenols, tannins, alkaloids, saponin, flavonoids	Methanolic root extract	In-vivo (Male Swiss albino mice) Excision wound model (Pal et al., 2021, Singh et al., 2014)
13	*Curcuma longa*	Curcumin (diferuloylmethane), a flavonoid, and many volatile oils, including turmerone, atlantone, and zingiberone, are the active ingredients in turmeric.	South Asian spice turmeric	Alloxan-induced diabetic mouse model (Khan et al., 2019)
14	*Cyperous scariosus* R. Br.	Sesquiterpene, cyperene-1, cyperene-2, cyperenone, α-cyperone12, mustakone, β-selinene, sugetriol triacetate, sugenol, copadiene, epoxyguaienerotundone, cyperenol, cyperolone, eugenol, cyperol, isocyperol	Ethanolic tuber extract	Topical (Male Wistar rats) Incision, excision & dead space wound model (Pal et al., 2021)
15	*Gloriosa superba* (L.)	2-Octylcyclopropene-1-heptanol; Hexadecanoic acid ethyl ester; Timonacic; Phytol; 9,12-Octadecadienoic acid and 1,2-Benzenedicarboxylic acid	Ethanolic and methanolic extract	Carrageenan-induced edema in male albino rat model and found that the activity was observed in a dose-dependent manner from 100 to 200 mg/kg (Abhishek et al., 2011)
16	*Mimosa pudica* L.	Amino acid (d-Alanin, 1-Alanine ethyl amide), Carbohydrates, Quercetin, DPinitol, L-Mimosine, Mimosainic acid, Mimosinamine, P-coumaric acid	Ethanolic leaf extract	Topical (Sprague Dawely rats) Excision & burn wound models (Pal et al., 2021; Singh et al., 2010)
17	*Oxalis corniculcta Linn.*	Flavanoids, tannins, phytosterol, phenol, glycoseides, fatty acids and volatile oil.	Petroleum ether extract of whole plant	Using excision, resutured incision and dead space wound models in rats. (Badwaik et al., 2011)
18	*Ocimum sanctum* L.	Ascorbic acid, DPPH (2,2-Diphenyl-1-picrylhydrazyl), aluminium chloride, ferric chloride, nito blue tetrazolium (NBT), riboflavin	50% methanol (1 g/10 ml) leaf extract	The excise, the incise and dead space wound model and concentration (200 and 400 mg/kg) in rats (Bano et al., 2017)

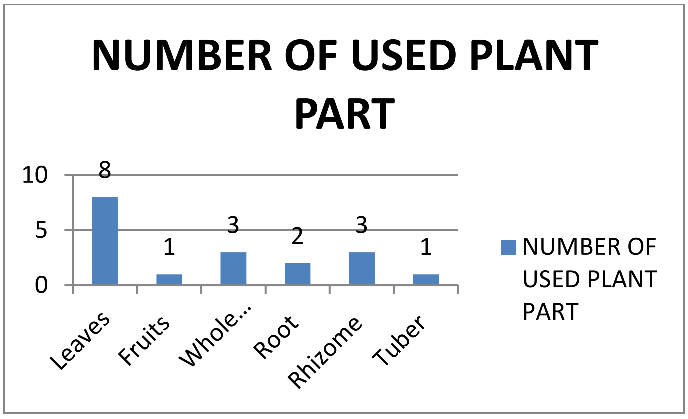

Figure 4. Diagram showing number of different used plant parts.

tribal people and included in this paper. This is because there is a dearth of organized information about the practical applications of these medicinally significant plant species in the region under study.

Owing to inadequate documentation and relevant scientific inquiry, customary knowledge is gradually disappearing. The knowledge has been handed down through the generations and has been closely guarded by "folk medicine men" or "plant doctors" (Acharya et al., 2021). It is really difficult to take anything away from these people. Researchers, botanists, chemists, druggists, and many pharmaceutical companies will find great value and significance in the knowledge documented in this paper in isolating and identifying "active principles" or "secondary metabolites" for future novel drug discoveries and follow-up bioactivity studies.

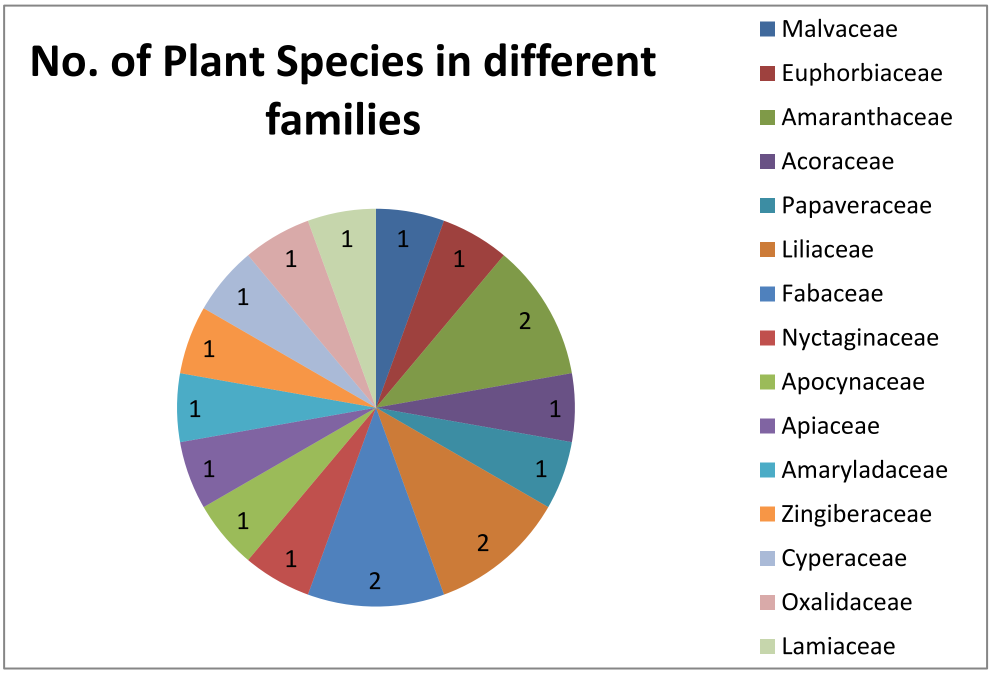

Figure 5. Diagram showing number of plant families used in wound healing treatment.

Conclusion

The present ethno-pharmacological investigation reveals that the traditional people use eighteen (18) medicinal plants belonging to fifteen (15) families, particularly for the purpose of wound healing treatment traditionally. Of these, Amaranthaceae, Liliaceae and Fabaceae with 2 species of each having medicinal importance particularly for wound healing treatment, was the dominant family. For the treatments of wound healing, the tribal people most commonly used Leaves (44%), Fruits (5%), whole plants (16%), Root (11%), Rhizome (16%), Tuber (5%). Researchers and other investigators will primarily rely on this conclusion to do additional research on the isolation of certain phytoconstituents from these medicinal plants to heal wounds. Researchers in the fields of ethno-medico-botany, phytochemistry, and pharmacology may find great value in the preliminary data gathered from the

Conflict of interest

There is no conflict of interest.

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