Asian Journal of Ethnobiology

| Asian J Ethnobiol | vol. 6 | no. 2 | November 2023 |
| E-ISSN 2580-4510 |

Onopordum carmanicum (Bornm.) Bornm., photo by Jose Maria Escolano

Asian Journal of Ethnobiology

| Asian J Ethnobiol | vol. 6 | no. 2 | November 2023 | E-ISSN 2580-4510 |

Published semiannually **PRINTED IN INDONESIA**

E-ISSN: 2580-4510

Asian Journal of Ethnobiology

| Asian J Ethnobiol | vol. 6 | no. 2 | November 2023 |

ONLINE
http://smujo.id/aje

e-ISSN
2580-4510

PUBLISHER
Society for Indonesian Biodiversity

CO-PUBLISHER
Universitas Padjadjaran, Sumedang, Indonesia

OFFICE ADDRESS
Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran. Jl. Raya Bandung-Sumedang Km 21, Jatinangor, Sumedang 45363, West Java, Indonesia. Tel. +62-22-7796412 line 104, Fax. +62-22-7794545, email: editors@smujo.id

PERIOD OF ISSUANCE
May, November

Society for Indonesian Biodiversity

Universitas Padjadjaran Sumedang, Indonesia

Published by Smujo International for The Society for Indonesian Biodiversity and Universitas Padjadjaran Sumedang, Indonesia

GUIDANCE FOR AUTHORS

Aims and Scope *Asian Journal of Ethnobiology* **(Asian J Ethnobiol)** encourages submission of manuscripts dealing with relationships between humans and their biological nature, including ethnobotany, ethnomycology, ethnozymology, ethnozoology, ethnoecology, traditional environmental/ ecological knowledge, ethnometereology, ethnoastronomy, ethnomedicine, ethnopharmacognosy, ethnoveterinary, ethnogastronomy, urban ethnobiology, linguistic ethnobiology, ethical and legal aspects of the biodiversity conservation and other related fields of study within anthropology and biology; as well as impact of economic activity on individuals in community and its social consequences.

Article types The journal seeks for: (i) **Research papers**, (ii) **Reviews**, and (iii) **Short communications**. Original full-length research manuscripts are limited to 8,000 words (including tables and figures) or proportional to articles in this publication number (beyond that, it should be with notice). Review articles are also limited to 8,000 words, while Short communications should be less than 2,500 words, except for pre-study (can be more).

Submission: The journal only accepts online submissions through the open journal system **(https://smujo.id/aje/about/submissions)** or, for login problems, email the editors at unsjournals@gmail.com (or editors@smujo.id). Submitted manuscripts should be the original works of the author(s). Please ensure that the manuscript is submitted using the template, which can be found at (https://biodiversitas.mipa.uns.ac.id/D/template.doc). The manuscript must be accompanied by a cover letter containing the article title, the first name and last name of all the authors, and a paragraph describing the claimed novelty of the findings versus current knowledge. Please also provide a list of five potential reviewers in your cover letter. They should come from outside your institution and better from three different countries. Submission of a manuscript implies the submitted work has not been published (except as part of a thesis or report, or abstract) and is not being considered for publication elsewhere. When a group writes a manuscript, all authors should read and approve the final version of the submitted manuscript and its revision; and agree on the submission of manuscripts for this journal. All authors should have made substantial contributions to the concept and design of the research, acquisition of the data and its analysis, drafting the manuscript, and correcting the revision. All authors must be responsible for the work's quality, accuracy, and ethics.

Ethics Author(s) must be obedient to the law and/or ethics in treating the object of research and pay attention to the legality of material sources and intellectual property rights.

Copyright If the manuscript is accepted for publication, the author(s) still hold the copyright and retain publishing rights without restrictions. For the new invention, authors must manage its patent before publication.

Open Access The journal is committed to free-open access that does not charge readers or their institutions for access. Readers are entitled to read, download, copy, distribute, print, search, or link to the full texts of articles, as long as not for commercial purposes. The license type is CC-BY-NC-SA.

Acceptance Only articles written in US English are accepted for publication. Manuscripts will be reviewed by editors and invited reviewers (double-blind review) according to their disciplines. Authors will generally be notified of acceptance, rejection, or need for revision within 1 to 2 months of receipt. Manuscripts will be rejected if the content does not align with the journal scope, does not meet the standard quality, is in an inappropriate format, or contains complicated grammar, dishonesty (i.e., plagiarism, duplicate publications, fabrication of data, citations manipulation, etc.), or ignoring correspondence in three months. The primary criteria for publication are scientific quality and significance. **Uncorrected proofs** will be sent to the corresponding author by system or email as .doc or .docx files for checking and correcting typographical errors. The corrected proofs should be returned in 7 days to avoid publication delays. The accepted papers will be published online in chronological order at any time but printed at the end of each month.

Free of charge This publication is dedicated entirely to the advancement of science and technology, therefore author(s) or author institution(s) are not subject to publication fees. **Reprint** Authors or other parties may freely download and distribute. However, a printed request will be charged. It may be purchased when ordering by sending back the uncorrected proofs by email.

Manuscript preparation Manuscript is typed on A4 (210x297 mm^2) paper size, in a single column, single space, 10-point (10 pt) Times New Roman font. The margin text is 3 cm from the top, 2 cm from the bottom, and 1.8 cm from the left and right. Smaller lettering sizes can be applied in presenting tables and figures (9 pt). Word processing program or additional software can be used; however, it must be PC compatible, use the template, and be Microsoft Word based (.doc or .rtf; not .docx). **Scientific names** of species (incl. subspecies, variety, etc.) should be written in italics, except in italicized sentences. Scientific names (genus, species, author) and cultivar or strain should be mentioned completely for the first time mentioning it in the body text, especially for taxonomic manuscripts. The genus name can be shortened after the first mention, except in early sentences, or where this may generate confusion; name of the author can be eliminated after the first mention. For example, *Rhizopus oryzae* L. UICC 524 can be written hereinafter as *R. oryzae* UICC 524. Using trivial names should be avoided. **Biochemical and chemical nomenclature** should follow the order of the IUPAC-IUB. For DNA sequences, it is better to use Courier New font. Standard chemical abbreviations can be applied for common and clear used, for example, completely written butilic hydroxyl toluene (BHT) to be BHT hereinafter. **Metric measurements** should use IS denominations, and other systems should use equivalent values with the denomination of IS mentioned first. A dot should not follow abbreviations like g, mg, mL, etc. Minus index (m^{-2}, L^{-1}, h^{-1}) suggested being used, except in things like "per-plant" or "per-plot." **Mathematical equations** can be written down in one column with text; in that case, they can be written separately. **Numbers** one to ten are written in words, except if it relates to measurement, while values above them are written in number, except in early sentences. The fraction should be expressed in decimal. In the text, it should be used "%" rather than "percent." Avoid expressing ideas with complicated sentences and verbiage/phrasing, and use efficient and effective sentences.

The title of the article should be written in compact, clear, and informative sentence, preferably not more than 20 words. Name of author(s) should be completely written, especially for the first and the last name. **Name and institution** address should also be completely written with street name and number (location), postal code, telephone number, facsimile number, and email address. We choose local names in Bahasa Indonesia for universities in Indonesia. The mention of "strata" program, should be avoided. Manuscript written by a group, author for correspondence along with address is required (marked with "♥"). **The title page** (first page) should include title of the article, full name(s), institution(s) and address(es) of the author(s); the corresponding authors detailed postage and e-mail addresses (P), and phone (O) and fax numbers (O).

Abstract A concise abstract is required (about 200 words). The abstract should be informative and state briefly the aim of the research, the principal results and major conclusions. An abstract is often presented separately from the article, thus it must be able to stand alone (completely self-explanatory). References should not be cited, but if essential, then cite the author(s) and year(s). Abbreviations should be avoided, but if essential, they must be defined at their first mention. **Keywords** are about five words, covering scientific and local name (if any), research themes, and special methods used; and sorted from A to Z. **Abbreviations** (if any): All important abbreviations must be defined at their first mention there. **Running title** is about five words.

Introduction is about 600 words, covering the aims of the research and provide an adequate background, avoiding a detailed literature survey or a summary of the results. **Materials and Methods** should emphasize on the procedures and data analysis. **Results and Discussion** should be written as a series of connecting sentences, however, for a manuscript with long discussion should be divided into subtitles. Thorough discussion represents the causal effect mainly explains why and how the results of the research were taken place, and do not only re-express the mentioned results in the form of sentences. **Concluding** sentence should be given at the end of the discussion. **Acknowledgements** are expressed in a brief; all sources of institutional, private and corporate financial support for the work must be fully acknowledged, and any potential conflicts of interest are noted.

Figures and Tables of a maximum of three pages should be clearly presented. The title of a picture is written down below the picture, while the title of a table is written above the table. Colored figures can only be accepted if the information in the manuscript can lose without those images; the chart is preferred to use black and white images. The author could consign any picture or photo for the front cover, although it does not print in the manuscript. All images property of others should be mentioned the source. Author is suggested referring to Wikipedia for international boundaries and Google Earth for satellite imagery. If not specifically mentioned, it is assumed to refer to these sources. **There is no appendix**, all data or data analysis is incorporated into Results and Discussions. For broad data, it can be displayed on the website as a supplement.

References Preferably 80% of it comes from scientific journals published in the last 10 years. In the text, give the author names followed by the year of publication and arrange from oldest to newest and from A to Z; in citing an article written by two authors, both of them should be mentioned; however, for three and more authors only the first author is mentioned followed by et al. For example, Saharjo and Nurhayati (2006) or (Boonkerd 2003a, b, c; Sugiyarto 2004; El-Bana and Nijs 2005; Balagadde et al. 2008; Webb et al. 2008). Extent citation should be avoided, as shown with the word "cit." Reference to unpublished data and personal communication should not appear in the list but should be cited in the text only (e.g., Rifai MA 2007, pers. com. (personal communication); Setyawan AD 2007, unpublished data). In the reference list, the references should be listed in alphabetical order. Names of journals should be abbreviated. Always use the standard abbreviation of a journal's name according to the **ISSN List of Title Word Abbreviations** (www.issn.org/2-22661-LTWA-online.php). Please include DOI links for journal papers. The following examples are for guidance.

Journal:

Saharjo BH, Nurhayati AD. 2006. Domination and composition structure change at hemic peat natural regeneration following burning; a case study in Pelalawan, Riau Province. Biodiversitas 7: 154-158. DOI: 10.13057/biodiv/d070213.

The usage of "et al." in long author lists will also be accepted:

Smith J, Jones M Jr, Houghton L et al. 1999. Future of health insurance. N Engl J Med 965: 325-329. DOI: 10.10007/s002149800025.

Book:

Rai MK, Carpinella C. 2006. Naturally Occurring Bioactive Compounds. Elsevier, Amsterdam.

Chapter in the book:

Webb CO, Cannon CH, Davies SJ. 2008. Ecological organization, biogeography, and the phylogenetic structure of rainforest tree communities. In: Carson W, Schnitzer S (eds.). Tropical Forest Community Ecology. Wiley-Blackwell, New York.

Abstract:

Assaeed AM. 2007. Seed production and dispersal of *Rhazya stricta*. 50th annual symposium of the International Association for Vegetation Science, Swansea, UK, 23-27 July 2007.

Proceeding:

Alikodra HS. 2000. Biodiversity for development of local autonomous government. In: Setyawan AD, Sutarno (eds.). Toward Mount Lawu National Park; Proceeding of National Seminary and Workshop on Biodiversity Conservation to Protect and Save Germplasm in Java Island. Universitas Sebelas Maret, Surakarta, 17-20 July 2000. [Indonesian]

Thesis, Dissertation:

Sugiyarto. 2004. Soil Macro-invertebrates Diversity and Inter-Cropping Plants Productivity in Agroforestry System based on Sengon. [Dissertation]. Universitas Brawijaya, Malang. [Indonesian]

Information from the internet:

Balagadde FK, Song H, Ozaki J, Collins CH, Barnet M, Arnold FH, Quake SR, You L. 2008. A synthetic *Escherichia coli* predator-prey ecosystem. Mol Syst Biol 4: 187. DOI: 10.1038/msb.2008.24. www.molecularsystembiology.com.

THIS PAGE INTENTIONALLY LEFT BLANK

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 6, Number 2, November 2023
Pages: 75-114

E-ISSN: 2580-4510
DOI: 10.13057/asianjethnobiol/y060201

Ethnobotanical studies of plant resources of Taftan Mountain, Sistan and Baluchestan in southeastern region of Iran

BAHRAM RIGI HOSSEIN ABADI[1,♥], CHRISTOPH NEINHUIS[1], ROJA SAFAEIAN[2], THEA LAUTENSCHLÄGER[1]

[1]Department of Biology, Institute of Botany, Faculty of Sciences, Technische Universität Dresden. 01062 Dresden, Germany. Tel.: +49-351-463-39450, Fax.: +49-351-463-37749, ♥email: bahram.rigi_hossein_abadi@tu-dresden.de

[2]Department of Natural Resources and Environmental Engineering, School of Agriculture, Shiraz University. Shiraz 71441-65186, Iran

Manuscript received: 2 February 2023. Revision accepted: 25 June 2023.

Abstract. *Abadi BRH, Neinhuis C, Safaeian R, Lautenschläger T. 2023. Ethnobotanical studies of plant resources of Taftan Mountain, Sistan and Baluchestan in southeastern region of Iran. Asian J Ethnobiol 6: 75-114.* Due to poverty, lack of proper access to cities, the inadequacy of health services, and the availability of indigenous remedies, plant usage still is an important part of the cultural heritage in Baluchestan, Iran. Our study was conducted between 2018 and 2020 in Taftan Mountain area to report the traditional uses of the endemic plant species. During 40 field trips, 54 informants were interviewed. Totally, 3199 citations and 102 species belonging to 43 families were reported. Medical purposes comprised 75% of citations and 25% were referred to non-medical purposes. Medicinal plants were used against 178 disorders, and decoction was the most commonly applied method of preparation. Leaves were the most frequently used plant parts. Although most recorded species belong to Apiaceae, Asteraceae, and Lamiaceae, most citations belong to Lamiaceae followed by Asteraceae and Apiaceae. Most of the local people in the area still use the plants especially for treating their ailments. Women contributed more than men to the citations. The highest values for the ethnobotanical indices RFC and CI were recorded for *Pistacia atlantica* Desf., while the diseases brucellosis, callus, and eye infection had the highest FIC-value (1). Information regarding traditional knowledge is limited to elders; therefore, it needs to be recorded and saved for future generations.

Keywords: Baluchestan, ethnobotany, Iran, medicinal plants, Taftan Mountain

INTRODUCTION

Nowadays, there is a growing interest in using traditional medicine or in combination with modern medicine. Traditional medicine remains the main source of treatment for health problems for most people in developing countries, as medicinal plants are usually accessible and inexpensive (Motlhanka and Nthoiwa 2013). In addition to community health care, this traditional heritage is linked to cultural practices. Some modern medical research is based on ethnobotanical studies and traditional knowledge, and many medicines have been derived from plants. For example, an estimated 25% of the world's prescribed medicines are derived from plants, and 121 such compounds are currently in use (Sahoo et al. 2010). There are about 35,000 to 70,000 plant species used for medicinal purposes worldwide (Farnsworth and Soejarto 1991), of which 6,500 species are used in Asia (Karki and Williams 1999). Iran comprises ca. 7300 vascular plant species (Akhani 2006) and is the second richest country of plant diversity in SW Asia after Turkey (Davis et al. 1994). The country also has a long history of using medicinal plants. One of the earliest modern ethnobotanical works is a study by Hopper and Field (1973) on useful plants and drugs in Iran and Iraq. Shokri and Safaian (1993) also provided a list of 210 medicinal plants used in Mazandaran Province. Ghorbani (2005) conducted an ethnobotanical survey in the Turkmen Sahra region of northern Iran, documenting 136 species from 51 families. The remarkable use and commercialization of medicinal plants to alleviate and cure health problems and ailments in all regions of the country underline the importance of these natural resources for folk medicine and the culture of the Iranian people (Emami et al. 2012). At the same time, traditional knowledge of medicinal plants is in danger of being lost due to the loss of traditional community life because of urbanization, besides the distinct problems of some species (Mosaddegh et al. 2012). Therefore, there is an urgent need to conduct ethnobotanical studies in Iran to capture all the knowledge about folk medicine practiced by the locals (Naghibi et al. 2005). Baluchestan is in a semi-arid area and part of the Irano-Turanian region and the Sahara-Indian region. Many plant species used for medicinal and other purposes occur in Taftan Mountain area, indicating the rich indigenous knowledge of Baluch tribes living in the area (Maleki and Akhani 2018). Some researchers have studied the traditional pharmacopeia and medicinal plants in different areas of Iran (Rajaei and Mohamadi 2012; Amiri and Joharchi 2013; Dolatkhahi et al. 2014; Farouji and Khodayari 2016). Unfortunately, very little attention has been paid to the ethnobotanical aspects of plants in Baluchestan (Moghadam 2018). Recently, two ethnobotanical studies have been published from the region: near Saravan in southern Taftan (Sadeghi et al. 2014) and from some villages around Taftan Mountain (Maleki and Akhani 2018). Local people collect the plants and keep them in their houses to treat themselves and

others against diseases or to use as food. Selling plant material to residents of other villages and towns is an important source of income for local people in the study area. Recently, Maleki and Akhani (2018) documented the ethnobotanical uses of a number of species in the region but did not include information on other uses of the plants besides their medicinal uses. In addition, they did not mention the medicinal use of plants in treating of gunshot wounds and accidents, which are common in the region.

This study aims to identify the potential of medicinal plants in the flora of this region and focuses on all the uses of the plants not only in Taftan Mountain and the surrounding villages but also in more distant villages and cities that, concerning their demands, rely on resources from the mountain area. Furthermore, we want to know whether the use of the plants is limited to the specific area near Taftan Mountain or is present in other areas in Baluchestan as well. Finally, in our study, we discuss the influence of age, gender, and distance from Taftan Mountain.

MATERIALS AND METHODS

Study area

Iran is divided into three bioclimatic zones: Caspian, Irano-Turanian, and Baluchi climates (Pabout 1979). Iran is one of the countries in the Middle East with different climates from arid to Mediterranean climates (Kottek et al. 2006). A large part of the country is covered by dry and semi-dry lands mostly located in the eastern half of Iran (Ebrahimi-Khusfi and Sardoo 2021). Taftan Mountain, situated in the Sistan and Baluchestan Province with a height of 3,941 meters above sea level, is the highest mountain in southeastern Iran. The province of Sistan and Baluchestan is located in the Southeastern part of Iran and has an area of 181,578 km². It is the second-largest province of the country with 1.4 million inhabitants, and it is the only province in which the majority of the population resides in rural areas (Roudi et al. 2017). The capital of Sistan and Baluchestan Province is Zahedan and the nearest city to the study area is Khash (Figure 1). Khash in Baluchi is called "Wash" which means "good weather". Data sampling was carried out between 27° 51′ 12″ and 29° 27′ 06″ northern latitude and between 60° 27′ 50″ and 61° 27′ 05″ eastern longitude at an altitude between 1633 and 2553 m.

The Taftan area is characterized by typical Irano-Turanian vegetation. The indigenous people of the region are various Baluch tribes, mostly farmers and ranchers. Their language is Balochi and they have their own dress called Balochi. Their religion is Islam and Sunni, and due to the lack of facilities and being far from cities, most are illiterate.

In terms of finance, they are poor but the collection and selling of medicinal plants from nature play minor roles in their economy. Taftan has erupted lavas ranging from basaltic andesite to dacite. The dominant rock is andesite, with SiO2 content ranging from 49.8 to 63.5% (Biabangard and Moradian 2008). The flat plains surrounding the massif are covered by Artemisia steppes with scattered shrubs of *Zygophyllum eurypterum* Boiss. & Buhse (Ebrahimi et al. 2015). The climate of the area can be deduced only from the Khash and Zahedan weather stations. Khash has a tropical desertic bioclimate with an annual precipitation of 151 mm and a mean annual temperature of 20.1°C. The absolute minimum temperature might fall as low as -10°C and the absolute maximum temperature recorded is 43.4°C (Ebrahimzadeh 2009; Hashemzade 2013; Djamali et al. 2011).

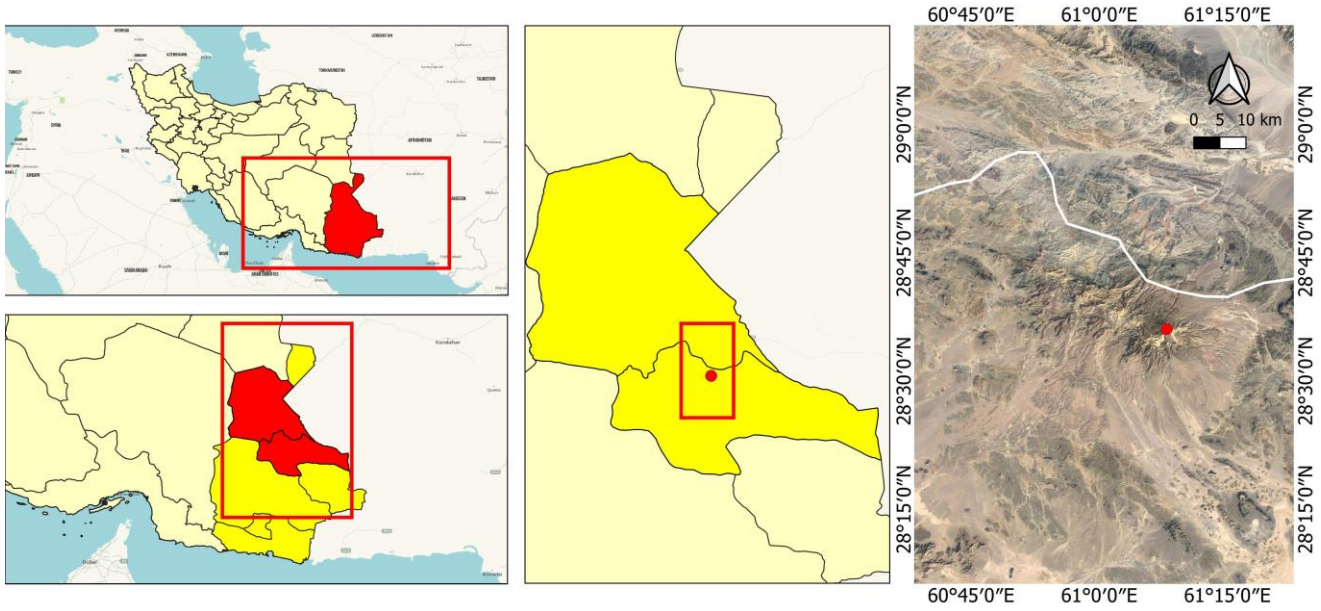

Figure 1. A. Location of Iran in the Asia map, B. Province of Sistan and Baluchestan in Iran, C. Location of the study area in the province, D. Photo of Taftan Mountain with the covered vegetation

Data collection

Fieldwork was carried out during spring and summer (March-July) from 2018 until 2020. During each visit, plant specimens and the respective data on plant use were collected from 22 villages (Anari, Anjareh, Chahe nali, Dareh gol, Dehpabid, Esmaeil abad, Goharkoh, Jemchen, Kahnuk, Karvandar, Koteh, Mirabad, Mirjaveh, Nok abad, Poshte koh, Sangan, Nazil, Seyedabad, Shahrek, Shuru, Tamin, and Torshab) and two cities (Khash and Zahedan) throughout the Taftan Mountain. Information was recorded through semi-structured interviews with knowledgeable and experienced local people like village elders, traditional doctors, and herbalists. At the beginning of each yearly fieldwork in the spring, random and planned preliminary visits were made to check the vegetation and climate conditions and make arrangements with local people in the area. Prior to the information collection, a brief group discussion was held with the key informants, in which the objectives of the research were explained to them and informants were made aware of the importance of the study. This was done to acknowledge the informant's cooperation in preserving the traditional knowledge of the study area and build their confidence in providing reliable information. The interviews were conducted in Baluchi which is the local language in Baluchestan. The interviewees were interviewed at their homes and the herbalists at their local drug stores (Figure 2).

Most of the interviews were taken from the informants using a voice recorder which turned out to be most effective and helped the respondents to recall their gathered information. Images were also taken to facilitate the identification and documentation of the specimens. Due to the mountainous and rocky nature of the surrounding area of Taftan Mountain, causing the low population density, the study area was categorized into three different zones; zone A, B, and C according to the distance from Taftan Mountain (Figure 3).

During the interviews, informants were asked about the vernacular names of each plant, their uses, the used plant part (i.e., leaves, root, stem, etc.), mode of preparation (i.e., decoction, infusion, powder, etc.), type of application (i.e., oral, dermal), ailment treated, other uses beside medicinal application and most commonly used plants in the area. Each time a plant was mentioned as used, it was considered a single 'use record' (Amiguet et al. 2005). For example, if plant A was used to treat fever, a single-use record was noted; however, using plant A to treat fever and diarrhea, resulted in two use records. The classification of individual citations by use categories is followed by Cook (1995). For identification, plant voucher specimens were collected, dried, and stored at the Herbarium Dresdense (DR), Technische Universität Dresden, Germany. To avoid mistakes in the identification of species and considering that the same vernacular name often refers to more than one species, sometimes botanically quite different, interviewed people were asked to identify the plants in the field. Thus, only reports for which the informant was able to indicate and collect the plant were considered. The collected plant specimens were identified with the help of Flora Iranica (Rechinger 1963-2015), Flora of Iran (Assadi et al. 1992-2012), and Color Flora of Iran (Ghahreman 1975-1999). For confirmation, the studied plant samples were compared with the already identified plant specimens preserved in the herbarium of University of Tehran, Iran. The plants were identified by Dr.Roja Safaeian, Dr.Barbara Ditsch, and Dr.Mousa Akbarluo.

Data analysis

The majority of the collected information in this study was collected in the field. Interview data were coded and sorted according to name, age, sex, location, distance from Taftan Mountain, local name, used parts, traditional use, and method of preparation. The parts of plants used by local people and healers for the preparation for different purposes were grouped under several classes (aerial parts, flower, fruit, fruit shell, latex, leaves, oil, pulp, resin, root, seed, and stem). The plant uses were placed into nine categories: medicinal use (M), nutrition, spices and herbal teas (N), domestic (D), animal feed (F), dental care and cosmetics (T), cigarettes (C), handicrafts (H), rituals (R) and the uses mentioned less than eight times were summarized in others (O) including bee bite, making honey, suture, rice colander and etc. Human ailments treated in the study area were assigned to 22 categories according to the WHO classification (2016). The mode of application was classified into body wash, Chol (The traditional method of Baluch tribes for the treatment of body, joint, and any other musculoskeletal pains (Maleki and Akhani 2018), dermal, foot soak, inhalation, mouthwashes, oral, pill, rub whole body, soaking body, suppository, suspension, and topical. For each investigation, it is necessary to compare the results with other studies, so the following quantitative ethnobotanical indices were calculated: Relative Frequency of Citations (RFC), Cultural Importance index (CI) as well as the Informant Consensus Factor (F_{IC}). The Relative Frequency of Citations presents the local significance of each plant species and is calculated for each species as the quotient of the Frequency of Citations (FC) and the total Number of informants (N) (Ahmad et al. 2014) (Formula 1). Tardío and Pardo-de-Santayana (2008) introduced the CI to allow comparison of data from different studies. If a species is mentioned in every use category, nine in our study, the CI would be this total number of use categories (Tardío and Pardo-de-Santayana 2008). In case the species is recorded for just a single-use category, the CI would be equal to the RFC (Formula 2). F_{IC} indicates the homogeneity of the knowledge of the informants (Heinrich et al. 1998) (Formula 3). Values differ from 0 (no concordance) to 1 (full accordance). High values, therefore, illustrate that healers use the same species for the treatment of the same illness (Lautenschläger et al. 2018).

$$RFC_S = \frac{FC_S}{N} = \frac{\sum_{1=1_1}^{1N} URi}{N}$$

Formula 1: Calculation of the Relative Frequency of Citations (RFC). s: species, FC: Frequency of Citation by one informant, N: total number of informants (Ahmad et al. 2014).

$$CI_S = \sum_{u=u_1}^{u_{NC}} \sum_{i=i_1}^{i_{NI}} \frac{URu_{ui}}{NI}$$

Formula 2: Calculation of the Cultural Importance Index (CI). s: species, u: use categories, N: total number of informants, i: informants, NC: the number of use categories, UR_{ui} = the use report of informant I in use (Tardío and Pardo-de-Santayana 2008).

$$F_{ic} = \frac{n_{ur} - n_t}{n_{ur} - 1}$$

Formula 3: Calculation of the Informant Consensus Factor (F_{ic}). n_{ur}: number of use-reports in each use category, n_t: number of taxa used (Trotter and Logan 1986).

Figure 2. Interview conducted during the field study in local people's home

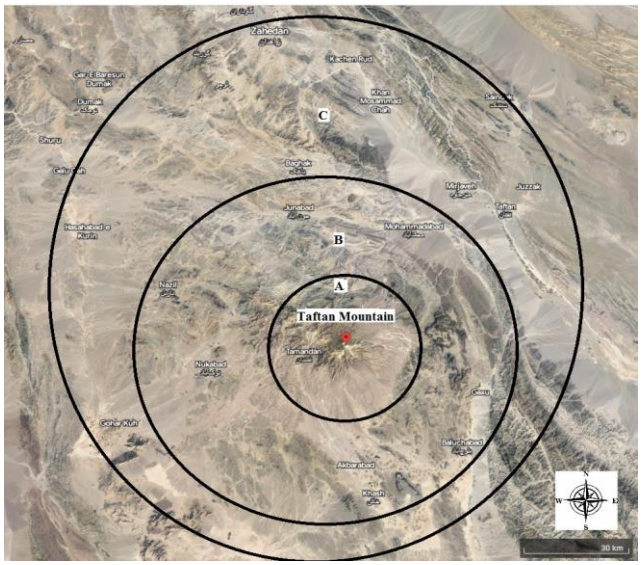

Figure 3. Taftan Mountain, Iran and three studied zones (Photo: Earth Resources Observation and Science (EROS) Center)

RESULTS AND DISCUSSION

Ethnobotanical knowledge according to gender, age, and distance

Gender

A total of 54 informants (23 males, i.e., 43% and 31 females, i.e., 57%) were selected from the 22 villages and two cities surrounding Taftan Mountain. The larger number of interviewed women is based on the belief of local people that women have better knowledge about the use of plants than men. In the current study, women contributed more to the number of citations (61%) and the reports on medicinal plants (66.7%) than men. A total number of 98 among 104 cited species were provided by women, again more than were provided by men. It is evident that women are important key sources of traditional knowledge as they are well informed regarding the values of the plants especially about local medicinal plants due to their role in Baluch families as responsible for the family's health. The present results are in agreement with the previous studies in Iran (Rajaei and Mohamadi 2012; Farouji and Khodayari 2016; Maleki and Akhani 2018), in neighboring Pakistan (Shedayi and Gulshan 2012; Abbas et al. 2014; Begum et al. 2014; Khan et al. 2016) or India (Sivasankari et al. 2014). Except in some cases (10%), the range of traditional information on the use of plants was the same between men and women. The results of our study in case of the influence of gender on plants usage in three different zones among Baluch tribes did not show any prominent difference except for some species like *Amygdalus spinosissima* Bunge., *Astragalus fischeri* Buhse. ex fisch., *Elaeagnus angustifolia* L. and *Populus alba* L. are mostly used by men for special purposes like agriculture and construction. On the other hand, men did not have information regards species like *Adiantum capillus-veneris* L., *Carthamus oxyacantha* M.Bieb, *Dorema ammoniacum* D.Don, *Myrtus communis* L., *Petroselinum sativum* L. and *Pycnocycla aucheriana* Dence. ex Boiss. var. *aucheriana* that are mostly related to cosmetic and beauty applications or medicinal uses concerning female health issues such as menstrual problems.

Age

Most of the local people in the three studied zones still require the plants especially for treating their ailments, resulting in 74% of the citations referring to the medicinal uses of plants. The age of the informants ranged from 22 to 92 years. Among them, 39% were above 65 years old, 55.5% were between 35 and 65 years, and 5.5% were younger than 35 years (Table 1).

As shown in Table 1, around 95% of ethnobotanical knowledge is limited to older people and people between 35 to 65 years old. The results were in line with those obtained by the previous similar research in Taftan (Maleki and Akhani 2018). Our results were also comparable to studies from Pakistan (Shedayi and Gulshan 2012; Murad et al. 2013; Abbas et al. 2014; Adnan et al. 2014; Khan et al. 2014a; Sivasankari et al. 2014; Yaseen et al. 2015; Khan et al. 2016; Abbas et al. 2017) and India (Muthu et al. 2006). Although we asked the young generation to participate in our study and act as informants, they unfortunately refused

and claimed that they had no knowledge about the use of the plants except few young people that lived in zone A.

Zones A, B and C and influence of distance from Taftan Mountain

The number of interviewees in zones A, B, and C were 11, 17, and 26 people, respectively. As can be seen in Figure 3, zone A is located in the mountainous region and the foothills therefore the low number of informants is not surprising, due to the mountainous and rocky nature of the area. On the other hand, due to rather strict religious regulations, communal restrictions, and an isolated society several limitations exist to interviewing women in zone A, leading to the low number of female interviewees (3) in comparison with the other zones. Zone C includes the capital of the province and some larger villages with less strict religious regulations. Therefore, the number of interviewed women from zone A to C increased. In addition, zones B and C provide better living conditions for local people in terms of climate and soil, resulting in more villages and large cities in these zones, which again explains the large number of interviewees in these two areas.

Due to the lack of facilities in the study area and the long distance to the cities, most of the local people in all three zones still depend on the plants especially for treating their ailments. While local people in zone A collect plants near their homes or in the surrounding habitats, people living in zones B and C travel to zone A to gather the plants for their consumption. In addition, they purchase required plants from local people in zone A and medicinal plants from the herbal drug stores in zones B and C. Selling plants is a substantial income source for the local population in the study area.

Plant uses in the studied area

The present study records 3,199 citations from 102 plant species out of 43 families for different purposes. Although most recorded species belong to Apiaceae and Asteraceae (12 species each) and Lamiaceae (11 species), followed by Fabaceae (10 species) and Rosaceae (7 species), the majority of citations belong to Lamiaceae (19%) followed by Asteraceae (12%) and Apiaceae (11%). Beside medical usage, people sell parts of various species such as *Tamarix mascatensis* Bunge, *Nannorrhops* H.Wendl. and *Peganum harmala* L. as fuelwood and handicrafts. All the investigated species are listed in Table 6, which reports the scientific names of plants, local names of plants, the family of plants, the used plant part, the preparation method, and ailments. As Table 6 shows, we found a wide variety of uses for the existing plants in the studied area.

Use categories

The survey reveals that 75% of all use reports concern medicinal purposes and 25% for non-medical purposes. The plant uses were categorized into nine categories and results indicated medicinal use (75%), nutrition, spices and herbal teas (12%), domestic (7%), dental care as well as cosmetics (2%), and animal feed (2%).

As shown in Figure 4, most of the non-medical uses belong to food (49.40%) followed by dairy farming (15.30%), local uses (14.80%), construction (6.52%), fodder (5.43%), agriculture (2.85%), agricultural tools (2.58%), firewood (1.63%) and other uses (1.49%).

Foods are all edible uses of plants; Dairy farmings are all the activities related to livestock and dairy products; Local uses are consists of all the unique uses of plants in the area by local people (Handicrafts, air disinfectant, clothes washing, local dance wood and etc.); Constructions are activities regarding house building; Fodders are livestock forage; Agriculture and agricultural tools are all the activities related to crops and agricultural tools; Other uses are uses mentioned less than ten times.

The main recorded application forms of medicinal plants were oral (64%), dermal (11.98%), Chol (9.46%), topical (7.70%) suspension (1.91%), inhalation (1.78%), rub whole body (0.73%), body wash (0.69%), suppository (0.52%), soaking body (0.49%), pill (0.41%) and mouth washes (0.33%).

Air disinfectant, clothes washing, comestible, tea flavoring, food, house building, livestock forage, nuts, paint Hizak (a bag made from animal leather and used for the production of milk and other dairy products, also as a refrigerator for maintaining milk) and vegetables are the most common uses of plants in the study area (Table 2).

Table 1. Sex, age, and distance variables of interviewed people in the study area

Variable	Informants		Total interviewees (%)	Citation (%)
	M	F		
Age group (years)				
$X \leq 35$	2	1	3 (5.5 %)	225 (7 %)
$35 \leq X \geq 65$	11	19	30 (55.5 %)	1634 (51%)
$65 \leq X$	10	11	21(39 %)	1340 (42 %)
Total	23	31	54	3199
Distance (kilometer)				
Zone (A) $X \leq 15$	8	3	11 (20.4 %)	649 (20.2 %)
Zone (B) $15 \leq X \geq 70$	5	12	17 (31.5 %)	1102 (34.5 %)
Zone (C) $70 \leq X$	10	16	26 (48.1 %)	1448 (45.3 %)
Total	23	31	54	3199

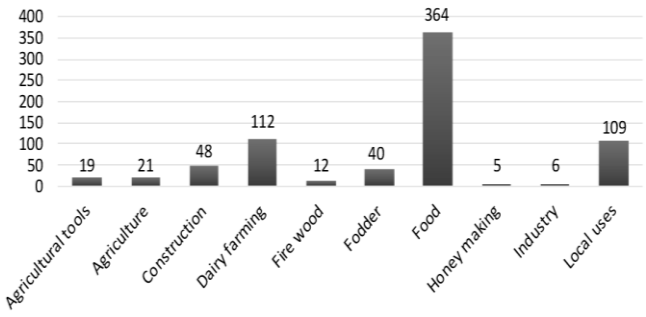

Figure 4. Non-medical citation of plants in the studied area

Plant parts used

For Baluch people leaves (34%) were the most frequently used plant parts followed by seeds and *aerial parts (14%), roots (9%), and resin (7%) (Table 3).

Our results are in agreement with the findings in similar studies in Iran (Amiri and Joharchi 2016; Mosaddegh et al. 2016; Maleki and Akhani 2018) in which the most widely used plant parts were leaves as well, followed by aerial parts. The same application of medicinal plants from the leaves were used, also substantiated by studies from other regions of Iran (Pirbalouti et al. 2012; Rajaei and Mohamadi 2012; Dolatkhahi et al. 2014; Farouji and Khodayari 2016). These results are in line with many ethnobotanical surveys in Pakistan and India reporting that mainly leaves, seeds, and aerial parts were used by the local communities to treat different ailments (Qasim et al. 2010; Qureshi 2012; Ullah et al. 2013; Sivasankari et al. 2014; Ishtiaq et al. 2015) or for the preparation of herbal medicines (Mahishi et al. 2005; Ignacimuthu et al. 2006; Ignacimuthu et al. 2008; Muthulingam 2015; Amjad et al. 2017). That leaves were the predominantly used part than other parts because they can be collected very easily compared, e.g., to underground parts (Giday et al. 2009) and from a physiological point of view leaves are active in photosynthesis and production of metabolites (Ghorbani 2005). Besides this, another important reason for using leaves could be justified by a conservational approach since digging out roots might be lethal for the plant and eventually may increase the extinction risk (Kadir et al. 2012).

Herbal therapies and preparations

According to our investigation, 2,411 citations (75%) referred to medical uses, and the first and most trusted option to treat ailments is the usage of available medicinal plants. Therefore, local people collect necessary medicinal plants from the area and preserve them in their homes. The human ailments classification was considered according to WHO classification and sorted into 22 categories. As shown in Figure 5 the main ailments are diseases of the digestive system (29%) followed by those of the musculoskeletal system (17%), certain infections and parasites as well as external causes of morbidity and mortality each (8%), diseases of the genitourinary system and diseases of the respiratory system each (7%). In more detail, medicinal plants used for stomach aches represent more than 14%, followed by those treating abdominal pain (13%), body pain (10%), infections, bone pain, and cold (9%), hand and leg pain, diarrhea (8%), vomiting, wounds (7%), and diabetes (6%).

In studies conducted in different areas of Iran (Mosaddegh et al. 2012; Dolatkhahi et al. 2014; Mosaddegh et al. 2016; Maleki and Akhani 2018) treating digestive system disorders, musculoskeletal pains and infections were most important, confirming our results. Other ethnobotanical studies (Pirbalouti et al. 2012; Rajaei and Mohamadi 2012; Amiri and Joharchi 2013; Khodayari et al. 2014; Naghibi et al. 2014; Farouji and Khodayari 2016) also show that plants are mostly used for curing digestive disorders that are in accordance with our results. In the case of ailments treated by plants, digestive system disorders, and stomach problems were the main diseases treated by local people of Baluchestan which is in agreement with studies conducted in Pakistan (Qureshi 2012; Shedayi and Gulshan 2012; Ullah et al. 2013; Khan et al. 2014a; Yaseen et al. 2015; Khan et al. 2018) and India (Sivasankari et al. 2014). It seems that local plants in the area have a wide variety of effective compounds for gastrointestinal diseases. Besides that, it is predictable that bad hygiene, fuelwood smoke inside houses, and other factors like water pollution are the most important causes of digestive system disorders among people in the area. This has led to the common use of local plants to treat and relieve these vast pains.

Table 2. Ten (10) Common non-medical uses of plants in the studied area

Uses of plants	UC	Citation	%
Vegetable	Nutrition, spices and herbal teas	116	25.84
Nuts	Nutrition, spices and herbal teas	55	12.24
House building	Domestic	48	10.7
Flavor of tea	Nutrition, spices and herbal teas	43	9.55
Comestible	Nutrition, spices and herbal teas	40	8.9
Food	Nutrition, spices and herbal teas	38	8.46
Paint hizak	Domestic	35	7.79
Livestock forage	Animal feed	33	7.4
Clothes washing	Dental care and cosmetics	21	4.67
Air disinfectant	Domestic	20	4.45

Note: UC**:** Use Categories, [1] Paint for bags made from animal leather used for making dairy products, and also as a refrigerator to keep milk fresh

Table 3. Plant parts used in the studied area

Plant parts used	Citation	%
Leaves	1092	34.1
Seed	469	14.66
*Aerial parts	468	14.62
Root	299	9.34
Resin	220	6.9
Fruit	184	6
Stem	178	5.3
Flower	143	4.46
Oil	65	2.1
Latex	62	2
Fruit shell	10	0.32
Pulp	9	0.2

Note: * Aerial parts: The whole of the plant except the root (i.e., flowers, leaves, and stem)

The most commonly applied methods of preparation were decoction (34%) followed by raw consumption (Using the plant parts without any action) (20%), powder (12%), vapor (8%), and soaking (make or allowing the plant parts to become thoroughly wet by immersing them in liquid) (7%) (Figure 6). The most common method of preparation and the most administered routes in different regions of Iran (Rajaei and Mohamadi 2012; Naghibi et al. 2014; Amiri and Joharchi (2016) were decoction and oral that was the same as the result of the current study. In many other studies conducted in Pakistan (Kayani et al. 2014; Khan et al. 2014a; Ahmad et al. 2015; Yaseen et al. 2015; Amjad et al. 2017; Khan et al. 2018) and India (Sarangzai et al. 2013) the major mode of preparation were decoction and powder. Oral administration in other regions of Pakistan (Ahmed et al. 2014; Khan et al. 2014a; Sivasankari et al. 2014) was the same most important administration method in our case study. Most of the plants in the present study are also consumed by mixing with honey, milk, water, and rock candy.

Diversity of medicinal plants

Medicinal plants were used against 178 disorders, of which abdominal pain, body pain, bones pain, cold, diabetes, diarrhea, hand and leg pain, infections, stomach ache, vomiting and wounds were the most common ailments in the study area. In this study, 78 medicinal plants belonging to 37 families were reported whereas Lamiaceae with 11 species was the predominant family followed by Apiaceae and Asteraceae each 9 and Fabaceae with 8 species. *Pistacia atlantica* Desf. with 236 citations was the most dominant species among all studied medicinal plants and is used to treat more than 55 ailments. The results in our study in case of uses of plant families like Lamiaceae and Asteraceae were in agreement with previous researches in Iran (Pirbalouti et al. 2012; Dolatkhahi et al. 2014; Naghibi et al. 2014; Farouji and Khodayari 2016). In studies conducted in Iran, plant families like Lamiaceae (Rajaei and Mohamadi 2012; Sadeghi et al. 2014; Sharififar et al. 2014) and Asteraceae (Kalvandi et al. 2007; Mood 2008; Dolatkhahi and Nabipour 2013; Khodayari et al. 2014; Mosaddegh et al. 2016; Maleki and Akhani 2018) were the largest numbers of medicinal species family but in Pakistan, Asteraceae and Lamiaceae (Shedayi and Gulshan 2012; Amjad et al. 2017) together were the most dominant ones. Asteraceae was the utmost family of use in studies in Pakistan (Qureshi 2012; Ullah et al. 2013; Ajaib et al. 2013; Khan et al. 2014a; Khan et al. 2014b; Ahmad et al. 2015; Khan et al. 2018) and India (Muthulingam 2015; Murtem and Chaudhry 2016) whereas in other studies in Pakistan (Sarangzai et al. 2013) and India (Sivasankari et al. 2014) the maximum number of species used for medicinal purposes belonged to the Lamiaceae. Overall, the results of the present research were in line with the results of all mentioned studies.

Ethnobotanical indices of the plants

The highest values of the ethnobotanical indices RFC and CI were recorded for *P. atlantica* (0.888) and (4.091), respectively (Table 4).

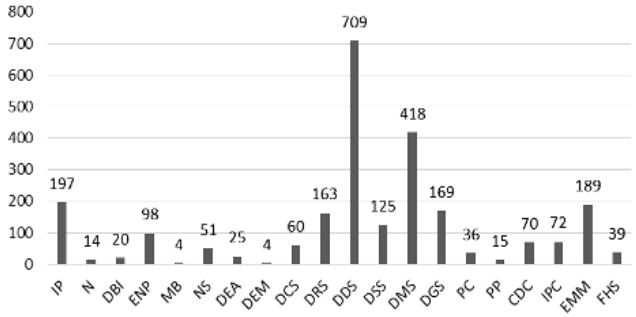

Figure 5. Ailments in the studied area (Human ailments classification according to World Health Organization (WHO)). Note: DSS: Diseases of the skin and subcutaneous tissue, DMS: D. of the musculoskeletal system and connective tissue, IP: Infectious and parasitic d., EMM: External causes of morbidity and mortality, DGS: D. of the genitourinary system, DRS: D. of the respiratory system, DDS: D. of the digestive system, ENP: Endocrine, nutritional and metabolic d., IPC: Injury, poisoning and certain other consequences of external causes, CDC: Congenital malformations, deformations and chromosomal abnormalities, DCS: D. of the circulatory system, NS: D. of nervous system d., FHS: Factors influencing health status and contact with health services, PC: Pregnancy, childbirth and the puerperium, DEA: D. of the eye and adnexa, DBI: D. of the blood and blood-forming organs and certain disorders involving the immune mechanism, PP: Certain conditions originating in the perinatal period, N: Neoplasms, DEM: D. of ear and mastoid process, MB: Mental and behavioral d

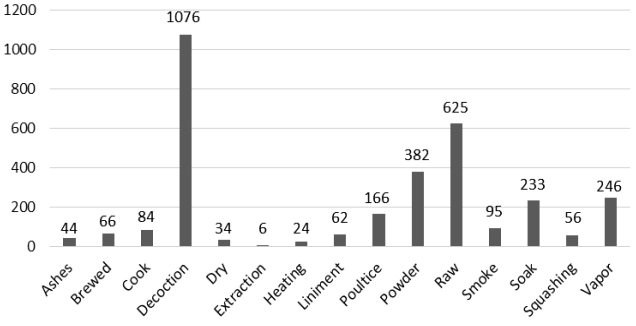

Figure 6. The most commonly applied methods of preparation in the studied area. Note: Ashes: Burning the plant parts to make ash for different usage, Brewed: Mixing with hot water, Cook: Cooking the plant parts to serve it for different purposes, Decoction: Boiling the plant parts in water until the volume of the water reduced to minimum or required amount, Dry: Not useable when the plant parts are green, Extraction: Taking out the extract of the plants in concentrated form by force, Heating: Heating the plant parts on fire to be warm for special usage. Liniment: Make a liquid or lotion, especially one add with oil, for rubbing on the body to relieve pain, Poultice: A soft, moist mass of plant materials lonely or mixed with the other natural materials, applied to the body to relieve soreness and inflammation and kept in place with a cloth, Powder: Preparing by the grinding of shade dried plant parts, Raw: Using the plant parts without any action, Smoke: Burning the plant parts and using the smoke of them, Soak: make or allow the plant parts to become thoroughly wet by immersing them in liquid, Squashing: Crush or squeeze plant parts with a force so that it becomes flat, soft, or out of shape to use them lonely or mix with other natural materials, Vapor: A substance of plant parts diffused or suspended in the air, especially useable in the Chol method

The highest concordance of the informants was found for brucellosis, callus, eye infection, leukaemia, and wart with a F_{IC}-value of one. The lowest referred to rheumatism, joint pain, back pain, chest pain, and female infections (Table 5). For example, to treat brucellosis only one species was mentioned in 8 use reports resulting in a F_{IC}-value of one.

Table 4. List of the 9 species with the highest Relative Frequency Citation (RFC) including used Plant Parts (PP), Use Categories (UC), Number of Citations (NC), and Cultural Importance index (CI)

Species	PP	UC	NC	RFC	CI
Achillea eriophora	L, R	M, T	91	0.629	1.684
Artemisia sieberi	AP, L	C, M, O, T	122	0.703	2.258
Berberis integerrima	F, R	C, D, M, N	82	0.629	1.517
Ferula assa-foetida	AP, L, RE, R	D, M, N, O, T	75	0.703	1.332
Mentha longifolia	AP, F, L, R	M, N, T	93	0.685	1.721
Peganum harmala	AP, F, L, S	D, H, M, R	100	0.703	1.85
Pistacia atlantica	FL, F, L, O, RE, S	D, M, N, O, T	236	0.888	4.091
Salvia mirzayanii	AP, FL, L	M	115	0.74	2.129
Thymus vulgaris	L	M, N, T	113	0.722	2.091

Note: Plant Parts: AP: Aerial Parts, F: Fruit, FL: Flower, LA: Latex, L: Leaf, O: Oil, R: Root, RE: Resin, S: Seed, ST: Stem. Use Category: C: Drugs and cigarettes, D: Domestic and charcoal, F: Hunting, fishing and animal feed, H: Handicrafts, M: Medicinal use, N: Nutrition, spices and herbal teas, R: Rituals, T: Dental care and cosmetics, O: Others

Table 5. List of the 10 highest and 5 lowest Informant Consensus Factors (FIC) of ailments with at least 5 citations

Diseases	WHO category	Species	F_{IC}	UR
Brucellosis	1	*Citrullus colocynthus*	1	8
Callus	12	*Calotropis procera*	1	11
Eye infection	7	*Salvia macrosiphon*	1	10
Leukemia	2	*Artemisia sieberi*	1	6
Wart	1	*Calotropis procera*	1	8
Burns	19	*Pistacia atlantica*	0.931	37
Fatty Liver	11	*Artemisia sieberi*	0.9	7
Bones fracture	13	*Berberis integerrima*	0.89	12
Tooth cleaning	11	*Berberis integerrima*	0.857	22
Anti parasite	1	*Mentha longifolia*	0.847	5
Rheumatism	11	*Ferula assa-foetida*	0.578	30
Joint pain	14	*Nigella sativa*	0.575	8
Back pain	11	*Bromus japonicus*	0.566	5
Chest pain	14	*Pistacia atlantica*	0.5	6
Female's infections	14	*Salvia macrosiphon*	0.4	5

Note: Use Reports (UR) WHO Category: 1: Infectious and parasitic d., 2: Neoplasms, 6: D. of nervous system d., 7: D. of the eye and adnexa, 9: Diseases of the circulatory system, 11: D. of the digestive system, 12: D. of the skin and subcutaneous tissue, 13: D. of the musculoskeletal system and connective tissue, 14: Diseases of the genitourinary system, 18: Congenital malformations, deformations and chromosomal abnormalities, 19: Injury, poisoning and certain other consequences of external causes, 20: External causes of morbidity and mortality

Table 6. Overview of all identified plants from Taftan Mountain, Iran and their usage by local people

Species	Usage	PP	Preparation	Administration	UC	Citation	Informant
Acantholimon stocksii Boiss., Plumbaginaceae, Kolahe Mir Hasan, 054914	Cloths washing	L,R	Powder		T	20	20
Achillea eriophora DC. Asteraceae, Brenjast/ Zamboul, 054896	Abdominal pain	L,R	Decoction	Oral	M	11	10
		L	Soak				
	Children's abdominal pain	L	Decoction	Oral	M	2	2
	Children's diarrhea	L	Decoction	Body wash, oral	M	3	3 (1*)
	Children's food poisoning	L	Decoction	Body wash	M	1	1*
	Children's vomiting	L	Decoction	Body wash, oral	M	3	3 (1*)
	Diabetes	L	Decoction, powder	Oral	M	5	4 (2*)
		R	Powder				
	Diarrhea	L	Decoction, soak	Oral	M	16	13
		R	Decoction				
	External skin tumor	R	Poultice	Dermal	M	1	1*
	Fat disease	L	Powder	Oral	M	3	2*
		R	Powder, soak				
	Food poisoning	L	Decoction	Oral	M	3	3
	Gingival infection	L,R	Powder	Oral	M	2	1*
	Hand and foot numbness	R	Poultice	Topical	M	1	1*
	Hand and leg pain	R	Powder	Oral	M	1	1
	Herpes simplex	L,R	Powder	Oral	M	2	1*
	Intestinal problems	L,R	Decoction	Oral	M	2	1
	Mouth infection	L,R	Powder	Oral	M	3	2 (1*)
		L	Raw				
	Mouth ulcers	R	Decoction	Oral	M	2	2*
	Nausea	L	Decoction, soak	Oral	M	4	3
	Oral candidiasis	L,R	Powder	Oral	M	2	1*
	Stomach ache	L	Powder	Oral	M	6	4 (2*)
		R	Decoction				
	Stomach troubles	L	Powder	Oral	M	1	1*
	Strengthen teeth	R	Powder	Oral	T	1	1
	Tongue infections	L	Raw	Oral	M	1	1
	Vomiting	L	Decoction, soak	Oral	M	11	8
	Wound caused by crashes	L	Decoction	Oral	M	2	2 (1*)
		R	Poultice	Dermal			
	Wounds	L	Decoction	Oral	M	1	1
	Wounds caused by gunshot	L	Decoction	Oral	M	1	1
Adiantum capillus-veneris L., Pteridaceae, Siyah lengok,	Diuretic	L	Decoction	Oral	M	2	2
	Menstrual problems	L	Decoction	Oral	M	5	5

Alhagi maurorum Medik., Fabaceae, Shenz/Toranjabin,054910	Abdominal pain	FL	Decoction	Oral	M	1	1
	Base for the production of watermelons	R	Raw	Agriculture	O	1	1
	Blood purification	R	Decoction	Oral	M	1	1*+ sugar
	Body pain	LA	Raw	Oral	M	1	1
	Burns	R	Powder	Oral	M	1	1*
	Children's abdominal pain	LA	Raw	Oral	M	1	1
	Children's diarrhea	R	Decoction	Oral	M	1	1
	Children's jaundice	LA	Decoction, raw	Oral	M	3	3(1+ boiled water)
	Children's vomiting	R	Decoction	Oral	M	1	1
	Cooling characteristics on children's body	LA	Raw	Oral	M	2	2
	Fat disease	LA	Decoction	Oral	M	3	3
	Kidney pain	R,FL	Powder	Oral	M	6	6
		LA	Decoction, raw				
	kidney stone	R,FL	Powder, raw	Oral	M	11	11*
		LA	Decoction, raw				
	Liver disorder	LA	Decoction	Oral	M	3	3
	Men's gonorrhoea	FL	Decoction	Oral	M	2	2
	Nerve relief	LA	Raw	Oral	M	1	1
	Stomach disorder	LA	Decoction	Oral	M	1	1
	Urinary tract infections	LA	Decoction	Oral	M	3	3
Allium oreophilum C.A.Mey., Amaryllidaceae, Dahlek, 067625	Vegetable	L	Raw	Edible	N	33	33
Allium schoenoprasum L., Amaryllidaceae, Pimalonk/Kasimalonk, 067626	Abdominal pain	ST	Decoction	Oral	M	3	3*
		R	Decoction, powder				
	Body pain	ST	Decoction	Oral	M	2	2
	Constipation	R	Decoction	Oral	M	1	1*
	Kidney pain	R	Decoction	Oral	M	1	1*
	kidney stone	R	Decoction	Oral	M	1	1*
	Nervous discomfort	ST	Decoction	Oral	M	4	4
	Vegetable	ST	Raw	Edible	N	11	11
Aloe vera, Asphodelaceae, Arveh	Back pain after childbirth	L	Poultice	Rub whole body	M	1	1*
	Bee bite	L	Powder	Dermal	M	1	1
	Blood clotting	L	Heating	Topical	M	2	2(1+ Coconut oil) +(1*)
			Poultice	Dermal			
	Bone pain after childbirth	L	Poultice	Rub whole body	M	1	1*
	Bones fracture	L	Poultice	Topical	M	1	1*+ salt
	Bones pain caused by women's breast duct closure	L	Poultice	Topical	M	1	1*
	Burns	L	Smoke	Dermal	M	3	3 *

	Children's nausea	L	Poultice	Rub whole body	M	1	1* + Animal oil
	Children's vomiting	L	Poultice	Rub whole body	M	1	1* + Animal oil
	Eczema	L	Poultice	Dermal	M	1	1*
	External skin tumor	L	Heating, poultice, powder Poultice	Dermal	M	4	4 (2*)
	Fever caused by women's breast duct losure	L	Poultice	Topical	M	1	1*
	Foot numbness	L	Poultice	Topical	M	1	1*
	Infection of the wounds	L	Poultice	Dermal	M	1	1* + Milk
	Infections	L	Poultice	Dermal	M	1	1*
	Internal skin tumor	L	Poultice	Dermal	M	1	1*
	Prevent infection	L	Poultice	Dermal	M	1	1*
	Remove a piece of bone from body	L	Poultice	Topical	M	1	1* + Milk
	Remove an external object from body	L	Poultice	Topical	M	1	1* + Milk
	Swelling	L	Poultice	Topical	M	1	1*
	Swelling caused by infection	L	Raw	Oral, topical	M	4	3
	Women's breast duct closure	L	Poultice	Topical	M	1	1*
	Wound caused by crashes	L	Poultice	Dermal	M	1	1*
Althaea officinalis L., Malvaceae, Gole Khatmi	Body pain	FL	Decoction, soak	Oral	M	2	2
	Bones pain	FL	Decoction, soak	Oral	M	4	4
	Cold	FL	Decoction, soak	Oral	M	4	4 (2* + rock candy)
	Cooling characteristics	FL	Soak	Oral	M	11	11 (2+ sugar)
	Hand and foot numbness	FL	Soak	Oral	M	1	1
	Hand and leg pain	FL	Soak	Oral	M	1	1
	Infections	FL	Decoction, soak	Oral	M	3	3(2* + rock candy)
	Joint pain	FL	Soak	Oral	M	1	1
	leg pain	FL	Soak	Oral	M	1	1
	Lung troubles caused by cold	FL	Decoction	Oral	M	2	2* + rock candy
	Nausea	FL	Soak	Oral	M	1	1
	Nerve relief	FL	Decoction, soak	Oral	M	4	4
	Nervous discomfort	FL	Soak	Oral	M	2	2
	Stomach function	FL	Soak	Oral	M	1	1
Amygdalus brahuica Boiss., Rosaceae, Archen, 054908	Abdominal pain	ST	Decoction	Oral	M	2	2
	Chest pain	ST	Decoction	Oral	M	1	1
	House building	ST	Raw	Construction	D	6	6
	Local dance wood	ST	Raw		R	3	3
	Nuts	F	Heating	Edible	N	1	1
	Paint Hizak***	R	Decoction	Milk production	D	1	1
	Preparing a wooden handle for agricultural implements	ST	Raw	Agriculture	D	7	7
	Protection against dangers	ST	Raw		O	2	2
	Severe cough	ST	Decoction	Oral	M	2	2

	Walking stick	ST	Raw		O	3	3
Amygdalus lycioides Spach, Rosaceae, Archen,	Comestible	S	Raw	Edible	N	6	6
Amygdalus scoparia Spach, Rosaceae, Govatam,054906	Alzheimer	F	Decoction	Oral	M	1	1+ honey
	Asthma	F	Decoction	Oral	M	3	3
	Back pain	AP	Vapor	Chol****	M	2	2
	Blood pressure	S	Dry	Oral	M	2	2
	Body pain	AP	Vapor	Chol***	M	7	7
		O	Liniment	Dermal			
	Bones pain	AP	Vapor	Chol****	M	1	1
	Diabetes	F,S	Dry	Oral	M	3	3
	Face masks	RE	Raw	Dermal	T	1	1
	Fat disease	S	Dry	Oral	M	1	1
	Hair growth	RE,F	Decoction	Topical	T	3	3
	Hand and leg pain	AP	Vapor	Chol****	M	4	4
	Increase brightness of eyes	F	Decoction	Oral	M	2	2
	Joint pain	AP	Vapor	Chol****	M	1	1
	Knee pain	AP	Vapor	Chol****	M	1	1
	Nuts	F	Heating	Edible	N	5	5(3+ seed of wheat)
	Paint Mashk**	R	Decoction		D	1	1
	Rheumatism	AP	Vapor	Chol****	M	2	2
	Rice colander	ST	Raw		D	2	2
	Tragacanth	RE	Decoction	Topical	T	1	1
Amygdalus spinosissima Bunge, Rosaceae, Archen,054941	Grafting almonds for better crop	ST	Raw	Agriculture	O	3	3
Apium graveolens L.,	Abdominal pain	L	Powder	Oral	M	1	1
Apiaceae, Kharasf, 054902	Accelerating post-coma consciousness	AP	Poultice	Topical	M	1	1
	Asthma	L	Decoction	Oral	M	1	1
	Back pain	L	Decoction	Soaking body	M	3	2 (1*)
		AP	Decoction	Oral			
			Vapor	Chol****			
	Blood clots of head	L,AP	Poultice	Topical	M	2	2*
	Body pain	L	Decoction	Soaking body	M	6	5 (2*)
			Poultice	Rub whole body			
		AP	Decoction	Oral			
			Vapor	Chol****			
	Bones pain	L	Decoction	Soaking body	M	7	5 (2*)
			Poultice	Rub whole body			
		AP	Decoction	Oral			

			Vapor	Chol****			
	Brain lesions	AP	Poultice	Topical	M	1	1*
	Children's pneumonia	L	Poultice	Rub whole body	M	1	1*
	External skin tumor	L	Poultice	Dermal	M	1	1*
	Female infertility	AP	Decoction	Suppository	M	1	1* + animal oil
	Fever caused by pain in joints and muscles	L	Poultice	Dermal	M	1	1*
	Hand and foot numbness	L	Poultice	Topical	M	1	1*
	Hand and leg pain	AP	Decoction	Oral	M	9	5
			Vapor	Chol****			
	Joint pain	AP	Vapor	Chol****	M	1	1
	Male infertility	AP	Decoction	Suppository	M	1	1* + animal oil
	Rheumatism	AP	Vapor	Chol****	M	1	1
	Severe cough	L	Poultice	Rub whole body	M	1	1*
	Stomach ache	L	Decoction, powder	Oral	M	3	3 (1*)
	Typhoid fever	L	Poultice	Dermal	M	1	1*
	Wound caused by crashes	L	Poultice	Dermal	M	1	1*
Artemisia aucheri boiss, Asteraceae, Barpi drannag, 054937	Better dairy product	l	Raw	Milk production	F	5	5
	Nausea	L	Decoction	Oral	M	3	3
	Nerve relief	L	Decoction	Oral	M	2	2
	Stomach ache	L	Decoction	Oral	M	4	4
	Vomiting	L	Decoction	Oral	M	1	1
Artemisia lehmanniana Bunge, Asteraceae, Barpi drannag, 054922	Bandaging wounds	F	Powder	Dermal	M	5	5
Artemisia santolina Schrenk, Asteraceae, Siyah deranag, 067619	Diarrhea	AP	Decoction	Oral	M	7	7
	External skin tumor	AP	Powder	Dermal	M	5	5
	Nausea	AP	Decoction	Oral	M	1	1
	Skin rash	AP	Powder	Dermal	M	3	3
	Vomiting	AP	Deccotion	Oral	M	5	5
Artemisia sieberi Besser, Asteraceae, Derannag, 054895	Abdominal pain	L,AP	Decoction	Oral	M	7	7
	Accelerating post-coma consciousness	AP	Poultice	Topical	M	1	1*
	Acne	AP	Decoction	Dermal	T	1	1
	Anemia	AP	Decoction	Oral	M	1	1
	Anti parasite	AP	Decoction	Oral	M	1	1
	Back pain	L	Decoction	Soaking body	M	2	2 (1*)
		AP	Vapor	Chol****			
	Bee bite	AP	Decoction, soak	Dermal	M	3	3
	Blood clots of head	AP	Poultice	Topical	M	2	2 *
	Body pain	L	Decoction	Soaking body	M	8	7 (3*)
			Poultice	Rub whole body			

		Powder	Oral			
	AP	Vapor	Chol****, inhalation			
Bones pain	L	Decoction	Soaking body	M	4	4 (3*)
		Poultice	Rub whole body			
	AP	Vapor	Chol****, inhalation			
Brain lesions	AP	Poultice	Topical	M	1	1
Children's abdominal pain	AP	Decoction	Body wash	M	1	1
Children's diarrhea	AP	Decoction	Body wash	M	2	2 (1*)
Children's food poisoning	L	Decoction	Oral	M	2	2 (1*)
	AP		Body wash			
Children's jaundice	AP	Decoction	Oral, pill	M	2	2
Children's nausea	AP	Poultice	Dermal	M	1	1* + animal oil
Children's vomiting	AP	Decoction	Dermal	M	2	2 (2*)
		Poultice	Body wash			
Diarrhea	L,AP	Decoction	Oral	M	9	7
	AP	Raw	Inhalation			
Digestive system disorders	L	Decoction	Oral	M	1	1
Fat disease	L,AP	Decoction	Oral, pill	M	7	7 (1*)
Fatty liver	L,AP	Decoction, soak	Oral, pill	M	7	7
Female's infections	L	Powder	Oral	M	1	1*
Fever caused by pain in joints and muscles	AP	Poultice	Dermal	M	1	1*
Hand and foot numbness	AP	Poultice	Topical	M	1	1*
Hand and leg pain	AP	Vapor	Chol****	M	3	3
Headache	AP	Vapor	Inhalation	M	1	1*
Infertility	L	Powder	Oral	M	1	1*
Jaundice	AP	Decoction	Oral	M	2	2
Joint pain	AP	Vapor	Chol****	M	2	2
Leukemia	AP	Decoction	Oral, pill	M	6	5
Liver disorder	AP	Decoction	Oral	M	1	1
Nausea	AP	Decoction	Dermal, oral	M	11	10
	L	Raw	Inhalation			
Nerve relief	AP	Decoction	Oral	M	1	1
Quit addiction	L	Decoction	Oral	C	2	1
Rheumatism	AP	Vapor	Chol****	M	1	1
Severe abdominal pain	L	Decoction, powder	Oral	M	2	1
Severe diarrhea	AP	Raw	Inhalation	M	2	1
		Decoction	Oral			
Skin allergy	AP	Decoction	Dermal	M	1	1
Stomach ache	AP	Decoction	Oral	M	1	1
Stomach function	AP	Decoction	Pill	M	1	1
Stomach troubles	AP	Decoction	Oral	M	2	2
Stomach ulcers	AP	Decoction	Oral	M	1	1

	Typhoid fever	AP	Poultice	Dermal	M	1	1*
	Vomiting	AP	Decoction	Dermal, oral	M	10	9
			Raw	Inhalation			
		L	Decoction	Oral			
	Wounds	AP	Raw	Inhalation	M	2	2
			Ashes	Dermal			
Asparagus officinalis L., Liliaceae, Marmotk	Abdominal pain	R	Decoction, powder	Oral	M	8	7 (3*)
	Body pain	R	Decoction, powder	Oral	M	4	4
	Constipation	R	Decoction	Oral	M	1	1*
	Diabetes	R	Decoction	Oral	M	1	1
	Female's infections	R	Decoction	Oral	M	1	1*
	Kidney pain	R	Decoction, powder	Oral	M	5	5 (1*)
	kidney stone	R	Decoction, powder	Oral	M	7	7 (2*)
Astragalus albispinus Sirj. & Bornm., Fabaceae, Kharok/ Jangok, 054915	Comestible	F	Raw	Edible	N	11	11
*Astragalus fasciculifoliu*s Boiss., Fabaceae, Govenjet	Chest infection	R	Decoction	Oral	M	2	2
	Children's broken head	F	Poultice	Topical	M	1	1*
	Children's chest infection	R	Decoction	Oral	M	1	1
	Children's chest pain	R	Decoction	Oral	M	1	1
	Children's shortness of breath	R	Heating	Oral	M	1	1*+ Milk
	Children's throat infection	R	Decoction	Oral	M	1	1
	Children's throat pain	R	Decoction	Oral	M	1	1
	Cold – prevention	R	Powder	Suspension	M	1	1+ milk
	Cough	L	Powder	Suspension	M	4	4 (1+ milk)
		R	Decoction	Oral			
	External skin tumor	R	Poultice	Dermal	M	1	1*
	Increase immunity	R	Decoction	Oral	M	2	2
	Infections	R	Decoction	Oral	M	3	3
	Lumbar vertebrae	R	Decoction	Oral	M	1	1
	Mouth ulcers	R	Raw	Topical	M	2	2
	Osteoporosis	R	Decoction	Oral	M	2	2
	Severe cough	R	Decoction	Oral	M	2	2+ milk
			Powder	Suspension			
	Stomach ulcers	R	Decoction	Oral	M	1	1
	Throat infection	R	Decoction	Oral	M	1	1
	Toothache	R	Raw	Topical	M	1	1
	Wounds	R	Decoction	Oral	M	1	1
Astragalus fischeri Buhse ex fisch, Fabaceae, Khorma Kourochok	Cleaning lumbar vertebrae	R	Decoction, powder	Oral	M	2	1+ honey
Astragalus mucronifolius Boiss.,	Eye kohl	R	Ashes	Topical	T	7	7

Fabaceae, Kalilak	Livestock forage	AP	Raw	Fodder	F	14	14
Berberis integerrima Bunge,	Additive to rice	F	Raw, soak	Edible	N	3	3
Berberidaceae, Zereshk Kohi/ Zarch,	Anti parasite	R	Decoction	Oral	M	1	1
054892	Back pain	R	Decoction	Oral	M	3	3
	Blood clotting	R	Decoction	Oral	M	2	2
	Blood pressure	F	Extraction	Oral	M	1	1
	Blood purification	F	Extraction, squashing	Oral	M	5	4
		R	Decoction				
	Blood regulation	F	Extraction	Oral	M	1	1
	Bones fracture	R	Decoction	Oral, pill, topical	M	22	18 (1*)
			Powder, soak	Oral			
	Bones pain	R	Decoction, powder	Oral	M	3	3 (1*)
	Dilute blood	R	Decoction	Oral	M	3	3
	Fatty liver	F	Squashing	Oral	M	12	10 (1*)
			Powder	Suspension			
		R	Decoction	Oral, pill			
	Hand and leg pain	R	Powder	Oral	M	1	1*
	Infections	R	Decoction	Oral	M	1	1
	Joint pain	R	Decoction	Oral	M	2	2
	Lumbar disc	R	Decoction	Oral	M	1	1
	Paint industry (yellow color)	R	Decoction	Industry	O	2	2
	Pickle	F	Soak	Edible	N	2	2
	Quit addiction	R	Decoction	Oral	C	1	1
	Stomach ache	R	Decoction, powder	Oral	M	2	2 (1*)
	Stomach ulcers	R	Decoction	Oral	M	1	1
	Stop the bleeding	R	Decoction	Oral	M	1	1
	Wound caused by crashes	R	Decoction	Oral	M	1	1
	Wounds	R	Decoction, soak	Oral	M	9	6
			Powder	Oral, suspension			
	Wounds caused by gunshot	R	Decoction	Oral	M	2	2
Bromus japonicus Houtt.,	Arthritis	AP	Vapor	Chol****	M	1	1
Poaceae, Nadag, 054918	Asthma	AP	Decoction	Oral	M	2	2
	Back pain	AP	Vapor	Chol****	M	2	2
	Body pain	AP	Decoction	Oral	M	10	9 (1*)
			Vapor	Chol****			
	Bones pain	AP	Vapor	Chol****	M	5	5
	Hand and leg pain	AP	Decoction	Oral	M	9	8
			Vapor	Chol****			
	Joint pain	AP	Vapor	Chol****	M	5	5
	Knee pain	AP	Vapor	Chol****	M	1	1
	Rheumatism	AP	Vapor	Chol****	M	2	2
Calotropis procera (Aiton)	Bee bite	LA	Raw	Dermal	M	5	5

W.T.Aiton,	Bones pain	LA	Raw	Topical	M	1	1
Asclepiadaceae, Kark, 067623	Callus	LA	Raw	Topical	M	11	11
	Swelling of feet	L	Raw	Topical	M	4	4
	Wart	LA	Raw	Topical	M	8	8
Carthamus oxyacantha M.Bieb,	Kidney stone	L	Decoction	Oral	M	1	1
Asteraceae, Khar shotor, 067615	Stomach troubles	L	Decoction	Oral	M	2	2
Celtis caucasica Willd.,	Crackers for celebrations	F	Raw		R	6	6
Cannabaceae, Tak							
Cicer spiroceras Jaub. & Spach,	Abdominal pain	F	Decoction	Oral	M	4	4
Fabaceae, Torshak/Toroshpak,	Additive to food	F	Decoction	Edible	N	2	2
054899	Appetizer	FL	Raw	Oral	N	1	1
	Fat disease	L,FL	Powder	Oral	M	3	2
	Sauce	F	Decoction	Edible	N	1	1
	Stomach ache	L,FL	Powder	Oral	M	3	2
		F	Decoction				
	Vegetable	L,FL	Raw	Edible	N	2	1
	Vitamin C deficiency	FL	Raw	Oral	N	1	1
Citrullus colocynthis (L.) Schrad.,	Body pain	AP	Vapor	Chol****	M	4	4
Cucurbitaceae, Kalkoshtak, 067636	Bones pain	AP	Vapor	Chol****	M	4	4
	Brucellosis	L,AP	Vapor	Chol****	M	8	8
	Diabetes	F	Decoction, squashing	Foot soak	M	20	19 (1*)
		S	Dry	Oral			
	Ear pain	F	Decoction	Topical	M	3	3
	Fat disease	S	Dry	Oral	M	4	4
	Hand and leg pain	L	Vapor	Chol****	M	5	5
		F	Squashing	Foot soak			
	Infections	F	Squashing	Foot soak	M	2	2
	Joint pain	F	Squashing	Foot soak	M	3	3
		AP	Vapor	Chol****			
	Strengthen teeth	F	Dry	Mouth washing	T	3	3
Clypeola jonthlaspi L.,	Asthma	S	Decoction	Oral	M	1	1
Brassicaceae, Totari, 067620	Baking bread	S	Cook	Edible	N	2	(2+Popcorn's seed)
	Chest infection	S	Decoction, soak	Oral	M	7	7(2+ boiled milk) +(2+ milk
			Powder	Suspension			
	Cold	S	Decoction, soak	Oral	M	7	7 (2+ boiled milk) +(2+milk)
			Powder	Suspension			
	Cough	S	Raw	Oral	M	1	1
	House building	AP	Squashing	Construction	D	5	5

	Lung infection	S	Powder	Suspension	M	3	3+ milk
	Severe cough	S	Decoction	Oral	M	3	3 (2+ milk)
			Powder	Suspension			
	Stomach ache	S	Decoction	Oral	M	3	3 (2+ milk)
			Powder	Suspension			
	Stomach troubles	S	Raw, soak	Oral	M	3	3
	Throat infection	S	Decoction	Oral	M	4	4
					M	1	1*
Commiphora wightii (Arn.) Bhandari, Burseraceae, Goggol	Bronchitis caused by Smoke	L	Powder	Suspension			
	Cardiovascular disease	L	Powder	Suspension	M	1	1*
	Children's shortness of breath	L	Decoction	Oral	M	1	1*
	External skin tumor	L	Poultice, powder	Dermal	M	5	5 (2*)
	Fever caused by pain in joints and muscles	L	Decoction	Dermal	M	1	1*
	Kidney pain	L	Soak	Oral	M	4	4
	kidney stone	L	Decoction, powder, soak	Oral	M	7	7 (2*)
	Shortness of breath (by Smoke)	L	Powder	Suspension	M	1	1*
Cotoneaster nummularius Fisch. & C.A.Mey., Rosaceae, Siyah latt	House building	ST	Raw	Construction	D	7	7
	Preparing a wooden handle for agricultural implements	ST	Raw	Agriculture	D	5	5
Cotoneaster pruinosus G.Klotz, Rosaceae, Siyah latt,	Comestible	S	Raw	Edible	N	5	5
Cousinia stocksii C.Winkl., Asteraceae, Khar vashek/Polosh, 067616	Comestible	P	Raw	Edible	N	9	9
Descurainia sophia (L.) Webb ex Prantl, Brassicaceae, Khakshir, 067378	Abdominal pain	S	Decoction, soak	Oral	M	11	8 (2*+ (2 + sugar))
	Acne	S	Soak	Oral	T	5	5
	Anemia	S	Soak	Oral	M	1	1
	Children's intestinal obstruction	S	Soak	Oral	M	2	2
	Children's intestinal problems	S	Soak	Oral	M	2	2
	Constipation	S	Soak	Oral	M	4	4 (1*)
	Cooling characteristics	S	Soak	Oral	M	2	2 (2 + sugar)
	Fever	S	Soak	Oral	M	1	1
	Softness of Stomach	S	Soak	Oral	M	3	3 (1+ rock candy) +(1+ water)
	Softness of intestines in Ramadan	S	Soak	Oral	R	4	4
	Stomach ache	S	Soak	Oral	M	3	3 (1+ rock candy)
	Stomach function	S	Soak	Oral	M	2	2 (1 + sugar)
	Stomach troubles	S	Soak	Oral	M	5	5 (3*)+(1+ boiled water)
	Thirst in Ramadan	S	Soak	Oral	R	4	4

	Typhoid fever	S	Soak	Oral	M	1	(1+ rock candy)
Ducrosia anethifolia (DC.) Boiss., Apiaceae, Shotk/ Govatak, 054917	Abdominal pain	S	Decoction, powder, soak	Oral	M	6	5 (4*)+(1+ rock candy)
		L	Decoction				
	After childbirth	S	Powder	Oral, suspension	N	4	3 (1*)
			Decoction	Oral			
	Asthma	S	Decoction, powder	Oral	M	2	2 (1*)
	Back pain	AP	Vapor	Chol****	M	1	1
	Bloating	S	Decoction, powder	Oral	M	6	5 (1+ rock candy)
		L	Decoction				
	Blood clotting	S	Poultice	Dermal	M	2	1*
	Body pain	S	Decoction, poultice	Oral, rub whole body	M	4	3 (1*)
		AP	Vapor	Chol****			
	Body weakness after Childbirth	S	Powder	Suspension	N	1	1*
	Bone pain after childbirth	S	Powder	Suspension	N	1	1*
	Bones pain	S	Poultice	Rub whole body	M	2	2 (1*)
			Decoction	Oral			
	Childbirth thirst	S	Powder	Suspension	N	2	1*
			Decoction	Oral			
	Children's abdominal pain	L	Decoction	Oral	M	2	2
	Children's bloating	S,L	Decoction	Oral	M	3	3
	Constipation	S	Decoction	Oral	M	1	1
	Fat disease	S	Powder	Oral	M	1	1
	Female's infections	S	Decoction	Oral	M	1	1*
	Hand and leg pain	S	Decoction	Oral	M	2	2
		AP	Vapor	Chol****			
	Infections	S	Poultice	Dermal	M	1	1*
	Internal tumors	S	Decoction	Oral	M	1	1*
	Kidney pain	S	Decoction	Oral	M	1	1*
	kidney stone	S	Decoction	Oral	M	2	2 (2*)
	Menstrual irregularities	S	Powder	Oral	M	1	1
	Stomach ache	S	Decoction, powder	Oral	M	6	6 (3*)
			Powder	Suspension			
	Stomach function	S	Decoction	Oral	M	2	2
	Stomach troubles	S	Powder	Oral	M	2	2 (1*)
	Swelling	S	Poultice	Dermal	M	3	2*
			Powder	Oral			
Elaeagnus angustifolia L., Elaeagnaceae, Senjed	House building	ST	Raw	Construction	D	6	6
	Nuts	F	Raw	Edible	N	3	3
Elwendia persica (Boiss.) Pimenov & Kljuykov, Apiaceae, Ezbotk, 067617	Blood clots of head	S	Poultice	Topical	M	1	1*
	Children’s chest infection	S	Soak	Oral	M	2	2 (1+mother’s milk)
			Powder	Suspension			
	Children's chest pain	L	Decoction	Body wash	M	1	1

	Children's shortness of breath	S	Powder	Oral	M	2	2
	Children's throat pain	L	Decoction	Body wash	M	1	1
	Children's vomiting	R	Decoction	Oral	M	1	1* + rock candy
	Cold	S	Brewed, decoction, soak	Oral	M	6	6
	Cough	S	Brewed, decoction	Oral	M	3	3
	Fever caused by pain in joints and muscles	S	Poultice	Dermal	M	1	1*
	Fragrance	S	Decoction		T	1	1
	Hand and foot numbness	S	Poultice	Dermal	M	1	1*
	Infections	S	Decoction	Oral	M	3	3
	Intestinal problems	S	Decoction	Oral	M	1	1
	Jaundice	S	Brewed	Oral	M	3	3 + rock candy
	Kidney pain	S	Soak	Oral	M	3	3
	Severe cough	S	Decoction Smoke	Dermal, oral Inhalation	M	3	2
	Stomach ache	S	Powder, soak	Oral	M	5	5 (2*)
	Stomach troubles	S	Powder	Oral	M	1	1*
	Throat pain	S	Powder, soak	Oral	M	2	2
	Typhoid fever	S	Poultice	Dermal	M	1	1*
Ephedra intermedia Schrenk & C: A: Mez., Dipsaceae, Hommouk, 067381	Paint Hizak***	R	Decoction	Milk production	D	2	2
	Paint Mashk**	R	Decoction		D	1	1
	Stomach ache	R	Decoction	Oral	M	3	3
Eryngium bungei Boiss. Apiaceae, Kharoshk, 067614	Camel forage	AP	Raw	Fodder	F	7	7
Euphorbia buhsei Bioss. Euphorbiaceae, Mashirag, 054930	Infection of wounds	LA	Raw	Dermal	M	2	2
	Wounds	LA	Decoction, raw	Dermal	M	2	2 (1+ boiled animal oil)
Euphorbia gedrosiaca Rech.f., Aellen & Esfand. Euphorbiaceae, Lahm shirag, 054931	Back pain	FL	Decoction	Oral	M	4	4
	Body pain	FL	Decoction	Oral	M	5	5
	Bones pain	FL	Decoction	Oral	M	2	2
	Kidney pain	FL	Decoction	Oral	M	8	8
Ferula ammoniacum (D.Don) Spalik, M.Panahi, Piwczynski & Puchalka, Apiaceae, Poshk, 067629	Women's body hair removal	RE	Raw	Dermal	T	6	6
Ferula assa-foetida L., Apiaceae, Angozah, Rab, 054900	Accelerating post-coma consciousness	RE	Poultice	Topical	M	1	1*
	Anti parasite	AP L RE	Decoction Cook Decoction Raw	Oral Edible Oral Suppository	M	30	27
	Blood clots of head	RE	Poultice	Topical	M	1	1*

	Body pain	L	Decoction	Edible	M	1	1
	Bones pain	L	Cook	Edible	M	1	1
	Brain lesions	RE	Poultice	Topical	M	1	1*
	Children's bdominal pain	RE	Decoction	Oral	M	3	3
	Cold – prevention	R	Decoction	Oral	M	2	2
	Crop pest control	RE	Raw	Agriculture	D	10	10
	Food	L	Cook	Edible	N	10	10
	Hand and leg pain	L	Cook	Edible	M	1	1
	Intestinal problems	L	Cook	Edible	M	1	1
	Livestock parasitic ulcers	AP	Raw	Milk production	O	1	1
	Protect seeds against vermin	RE	Raw	Agriculture	O	7	7
	Stomach cleansing	L	Cook	Edible	M	1	1
	Suture	R	Decoction	Industry	O	1	1
	Toothache	RE	Decoction	Mouth washing	M	3	3
Ferula aucheri (Boiss.) Piwczynski, Spalik, M.Panahi & Puchalka, Apiaceae, Oshterk/Paterk, 054905	Accelerating post-coma consciousness	RE	Poultice	Topical	M	1	1*
	Anti parasite	L	Cook	Edible	M	4	4
		RE	Decoction	Oral			
	Bedsore	RE	Decoction	Oral	M	2	2
	Blood clots of head	R	Poultice	Topical	M	1	1*
	Body pain	L	Vapor	Chol****	M	2	2
	Bones pain	L	Vapor	Chol****	M	3	3
			Cook	Edible			
	Brain lesions	RE	Poultice	Topical	M	1	1*
	External skin tumor	RE	Poultice, powder	Dermal	M	9	9 (3*)
	Food	L	Cook	Edible	N	6	6
	Hand and Leg pain	L	Vapor	Chol****	M	6	6
			Cook	Edible			
	Infection of wounds	RE	Poultice	Dermal	M	1	1* + milk
	Infections	RE	Decoction, raw	Oral,topical	M	7	7
		L	Cook	Edible			
	Internal skin tumor	RE	Poultice	Dermal	M	1	1*
	Joint pain	L	Vapor	Chol****	M	2	2
	Kidney infections	RE	Decoction	Oral	M	2	2
	Kidney pain	RE	Decoction	Oral	M	1	1
	Remove a piece of bone from body	RE	Poultice	Topical	M	1	1* + milk
	Remove an external object from body	RE	Poultice	Topical	M	1	1* + milk
	Stomach ache	L	Cook	Edible	M	3	3
		R	Decoction	Oral			
	Toothache	R	Decoction	Mouth washing	M	1	1
	Wound caused by crashes	RE	Poultice	Dermal	M	1	1*
	Wounds	RE	Raw	Topical	M	6	6
			Decoction, powder	Dermal			
Ferula ovina Bioss, Apiaceae,	Better dairy products	L,AP	Raw	Milk production	F	7	7

Kamah, 067380	Body pain	AP	Vapor	Chol****	M	1	1
	Hand and leg pain	AP	Vapor	Chol****	M	1	1
	Increase immunity	L	Decoction	Oral	M	3	3
	Rubber manufacturing industry	LA	Raw	Industry	O	2	2
Foeniculum vulgare Mill., Apiaceae, Raz, 054903	Abdominal pain	S	Powder	Suspension	M	2	2 (1*)
	After childbirth	S	Decoction	Oral	N	3	3 (1*)
	Bread flavor	S	Powder	Suspension	N	5	5 (1+ Flour)
	Children's abdominal pain	S	Powder, raw	Edible	M	1	1
	Children's severe crying	S	Decoction	Oral	M	1	1
	Cooling characteristics on children's body	S	Decoction	Oral	M	1	1
	Digestive system disorders	S	Powder	Oral	M	1	1
	Female's infections	S	Powder	Oral	M	5	5
	kidney stone	S	Powder	Oral	M	2	2
	Set Ladies monthly menstruation	S	Powder	Oral	M	2	2
	Stew flavor	S	Raw	Edible	N	1	1
	Stomach ache	S	Powder	Oral	M	5	5 (1*)
	Urinary tract infections	S	Powder	Oral	M	2	2
Fortuynia garcinii (Burm.f.) Shuttlew., Brassicaceae, Kalmak, 054920	Accelerating post-coma consciousness	L	Poultice	Topical	M	1	1 (1*)
	Alzheimer	L	Decoction	Topical	M	1	1
	Blood clots of head	L	Poultice	Topical	M	1	1 (1*)
	Brain lesions	L	Poultice	Topical	M	1	1 (1*)
	Cough	L	Powder	Oral	M	1	1
	Severe cough	L	Powder	Oral	M	2	2
Gaillonia macrantha Blatt. & Hallb, Rubiaceae, Tosso/Khar toos, 067631	Abdominal pain	L	Decoction	Oral	M	3	3
	Bloating	L	Decoction	Oral	M	1	1
	Children's abdominal pain	L	Powder	Oral, suspension	M	3	3 (1+animal oil/mother's milk + rock candy)
			Decoction	Oral			
	Children's bloating	L	Decoction	Oral	M	1	1
	Children's severe crying	L	Powder	Oral	M	1	1
	Children's stomach Function	L	Decoction	Oral	M	4	4 (1+ mother's milk+rock candy)
			Powder	Oral, suspension			
	Children's supplemental food after childbirth	L	Powder	Suspension	M	2	2 (2+ animal oil+ rock candy)
	Diarrhea	L	Decoction	Oral	M	4	4
	Jaundice	L	Decoction	Oral	M	2	2
	Stomach function	L	Powder	Oral	M	2	2
			Decoction	Oral			

	Vomiting	L	Decoction	Oral	M	3	3
Glycyrrhiza glabra L., Fabaceae, Maddoh/Shirin Bayan, 054894	Back pain	AP	Vapor	Chol****	M	1	1
	Body pain	AP	Vapor	Chol****	M	4	4
	Bones pain	AP	Vapor	Chol****	M	4	4
	Bronchitis	R	Decoction	Oral	M	1	1
	Children's stomach pain	R	Decoction	Oral	M	1	1
	Hair loss	R	Decoction	Oral	T	1	1
	Hand and leg pain	AP	Vapor	Chol****	M	5	5
	Joint pain	AP	Vapor	Chol****	M	4	4
	Kidney pain	R	Decoction	Oral	M	5	5
	Knee pain	AP	Vapor	Chol****	M	1	1
	Lung infection	R	Decoction	Oral	M	1	1
	Osteoporosis	R	Decoction	Oral	M	2	2
	Quit smoking	R	Powder	Oral	C	1	1
	Rheumatism	AP	Vapor	Chol****	M	2	2
	Runny nose	R	Decoction	Oral	M	1	1
	Stomach ache	R	Decoction, powder	Oral, pill	M	18	16 (2*)
		AP	Decoction	Oral			
	Stomach cancer	R	Decoction	Oral	M	2	2
	Stomach diseases	R	Decoction	Oral	M	1	1
	Stomach infection	R	Decoction	Oral	M	2	2
	Stomach troubles	R	Decoction, powder	Oral	M	2	1 (1*)
	Stomach ulcers	R	Decoction	Oral	M	4	4
Haloxylon salicornicum (Moq.) Bunge ex, Amaranthaceae, Terat, 054912	After childbirth	AP	Vapor	Chol****	M	2	2
	Hair loss in women after childbirth	AP	Vapor	Chol****	M	2	2
	Paint Hizak***	L	Decoction	Milk production	D	4	4
	Paint Mashk**	L	Decoction		D	2	2
	Tooth loss in women after childbirth	AP	Vapor	Chol****	M	2	2
	Urticaria	AP	Vapor	Chol****	M	3	3
Hordeum aegiceras Nees ex Royle, Poaceae, Joe	Baking bread	S	Cook	Edible	N	1	1
	Body pain	ST	Vapor	Inhalation	M	1	1 (1*)
	Bones pain	ST	Vapor	Inhalation	M	1	1 (1*)
	Cooling characteristics	S	Powder	Oral	M	1	1
	Diabetes	S	Powder	Oral	M	1	1
	Headache	ST	Vapor	Inhalation	M	1	1 (1*)
	Physical strength	S	Powder	Oral	M	1	1
	Wounds	AP	Squashing	Oral	M	2	2
Hyoscyamus malekianus Parsa, Solanaceae, Kermeshan/Samahkosh, 054921	Anti parasite	L	Decoction	Oral	M	2	2
	Killing a larva in body	L	Decoction	Oral	M	1	1

Juglans regia L., Juglandaceae, Gerdo, 054946	Diabetes	L	Decoction	Oral	M	2	2
	Paint Hizak***	R	Decoction	Milk production	D	7	7
Launaea acanthodes (Boiss.) Kuntze, Asteraceae, Chazho/ Kontak, 054919	Strainer for livestock milk	AP	Raw	Milk production	D	11	11
Linum usitatissimum L. Linaceae, Barza	Children's throat infection	L	Decoction	Oral	M	2	2
	Children's throat pain	L	Decoction	Oral	M	2	2
	Cold	L	Powder	Suspension	M	2	2 (2*)
	External skin tumor	L	Poultice	Dermal	M	1	1*
	Infection of the wounds	L	Powder	Dermal	M	2	2
	Throat infection	L	Decoction	Oral	M	1	1
	Throat pain	L	Decoction	Oral	M	1	1
	Warming characteristics	L	Decoction	Oral	M	2	2
Lycium depressum Stocks, Solanaceae, Zirok bakhti, 054939	Children's chest infection	L	Powder	Topical	M	1	1
	Children's chest pain	L	Powder	Topical	M	1	1
	Children's pneumonia	L	Poultice	Rub whole body	M	1	1*
	Children's shortness of breath	L	Powder	Dermal	M	2	2
	Children's throat pain	L	Powder	Topical	M	1	1
	Fever	F	Decoction	Oral	M	1	1
	Preparing a wooden handle for agricultural implements	ST	Raw	Agriculture	D	4	4
	Severe cough	L	Poultice	Rub whole body	M	1	1*
	Stomach ache	F	Decoction	Oral	M	2	2
	Cooling characteristics	L	Powder	Oral	M	2	2
Marrubium anisodon K.Koch, Lamiaceae, Spidroshk, 054942	Cooling characteristics on children's body	L	Powder	Oral	M	2	2
	Men's gonorrhea	L	Powder	Topical	M	7	7
Medicago sativa L., Fabaceae, Alap	Anemia	AP	Cook, raw	Edible	M	2	1
	Body pain	AP	Vapor	Chol****	M	2	2
	Bones pain	AP	Vapor	Chol****	M	1	1
	Diabetes	AP	Cook, heating	Edible	M	2	2
	Female infertility	AP	Cook, raw	Edible	M	4	4
	Hand and leg pain	AP	Vapor	Chol****	M	2	2
	Joint pain	AP	Vapor	Chol****	M	1	1
	Male infertility	AP	Raw	Edible	M	4	4
	Warming characteristics	AP	Raw	Edible	M	1	1
Mentha longifolia (L.) L., Lamiaceae, Porchenk, 054891	Abdominal pain	FL	Decoction	Oral	M	3	3 (1*)
		L	Powder				

	Asthma	L	Raw	Oral	M	3	3
	Bloating	FL,L	Decoction	Oral	M	2	2 (1*)
	Blood pressure	R	Powder	Oral	M	1	1
	Blood regulation	R	Powder	Oral	M	1	1
	Body pain	AP	Vapor	Chol****	M	3	3
	Bones pain	AP	Vapor	Chol****	M	3	3
	Children's vomiting	FL	Decoction	Oral	M	1	1*
	Cold	L	Decoction, raw	Oral	M	3	3
	Cooling characteristics	L	Powder	Oral, suspension	M	2	2 (1+ boiled milk)
	Diarrhea	R,FL	Decoction	Oral	M	8	8(1*) + (1+ rock candy)
		L	Powder, raw				
	Digestive system Disorders	L	Raw	Oral	M	3	3
	Dysentery	FL	Decoction	Oral	M	2	2 (1*+1+rock candy)
	Flavor of tea	L	Raw		N	14	14
	Food	L	Raw	Edible	N	2	2 (1+ yoghurt) + (1+whey)
	Food Poisoning	FL	Decoction, raw	Oral	M	4	4 (1*) + (1= rock candy)
	Hand and leg pain	AP	Vapor	Chol****	M	2	2
	Intestinal problems	F	Decoction	Oral	M	1	1*
	Joint pain	AP	Vapor	Chol****	M	1	1
	Men's gonorrhea	L	Decoction	Oral	M	1	1 + Tea
	Nausea	L,R	Decoction	Oral	M	3	2 + rock candy
	Nerve relief	L	Decoction, raw	Oral	M	3	3
	Severe abdominal pain	L	Powder	Oral	M	1	1
	Stomach ache	R	Decoction	Oral	M	8	8*
		L	Powder, raw				
	Stomach diseases	F	Decoction,raw	Oral	M	2	2
	Stomach function	L	Raw,powder	Oral	M	3	3
	Stomach troubles	L	Powder	Oral	M	1	1*
	Tea	R	Powder		N	1	1
	Tooth cleaning	L	Raw	Topical	T	5	5
	Vomiting	FL,L,R	Decoction	Oral	M	6	6(1*) + (3+ rock candy)
Myrtus communis L., Myrtaceae, Mort	Children's antiparasite	L	Squashing	Suppository	M	3	3
	Hair loss	L	Decoction	Topical	T	1	1
	Herpes simplex	O	Raw	Topical	M	1	1
	Oral candidiasis	O	Raw	Topical	M	1	1
	Skin allergy	L	Smoke	Dermal	M	3	3
	Urticaria	L	Smoke	Dermal	M	4	4
Nannorrhops H.Wendl., Arecaceae, Pish	Handicrafts	L	Raw		H	3	3
	House building	ST	Raw	Construction	D	5	5
	Making a Basket	L	Raw		D	2	2
	Making a broom	L	Raw		D	1	1
	Providing local shoes (Savas)	L	Raw		H	7	7

	Rice colander	L	Raw		O	2	2
Nigella sativa L., Ranunculaceae, Siyah danag	Bloating	S	Powder	Oral	M	8	8
	Cancer	S	Powder	Suspension	M	2	2 +honey
	Joint pain	O	Heating	Topical	M	2	2
	Nerve relief	S	Decoction	Oral	M	1	1
	Rheumatism	O	Liniment	Dermal	M	8	7 + honey
			Decoction	Oral			
Olea europaea L., Oleaceae, Hat/Khat	Back pain during pregnancy	L	Brewed, decoction	Oral	M	3	3
	Body pain during pregnancy	L	Brewed, decoction	Oral	M	3	3
	Chest infection	L	Decoction	Oral	M	2	2
	Children's jaundice	L	Brewed, decoction	Oral	M	2	2
	Fat disease	L	Brewed, decoction	Oral	M	3	3
	Paint Hizak***	L	Decoction	Milk production	D	7	7
	Paint Mashk**	L	Decoction		D	7	7
	Walking stick	ST	Raw		D	3	3
Onopordum carmanicum (Bornm.) Bornm., Asteraceae, Khar maryam/Mazarkah, 054943	Body pain	FL	Vapor	Inhalation	M	1	1*
	Bones pain	FL	Vapor	Inhalation	M	1	1*
	Headache	FL	Vapor	Inhalation	M	1	1*
	Kidney pain	FL	Decoction, raw	Oral	M	4	3
		L	Deccotion				
	kidney stone	L	Decoction	Oral	M	2	2
Peganum harmala L., Nitrariaceae, Espantan/Dodeni, 054898	Abdominal pain	S	Raw	Oral	M	5	5
	Abortion	AP	Cook	Edible	M	1	1
	Air disinfectant	S	Smoke		D	20	20
	Bloating	S	Raw	Oral	M	8	8
	Body pain	AP	Vapor	Chol****	M	3	3
	Bones pain	AP	Vapor	Chol****	M	5	5
	Children's shortness of breath	S	Ashes	Dermal	M	4	4
			Brewed	Oral			
	External skin tumo	AP,S	Poultice	Dermal	M	2	2*
	Female's infections	S	Decoction	Oral	M	1	1*
	Hand and leg pain	L,AP	Vapor	Chol****	M	6	6
	Handicrafts	F	Raw		H	13	13
	Joint pain	AP	Vapor	Chol****	M	3	3
	Kidney pain	S	Decoction	Oral	M	1	1*
	kidney stone	S	Deccotion	Oral	M	3	3 (2*)
	Protect against the Evil's eye	S	Smoke		R	13	13
	Severe cough	S	Raw	Oral	M	1	1
	Stomach ache	S	Powder, raw	Oral	M	5	5 (1*)
	Stomach function	S	Raw	Oral	M	1	1
	Stomach troubles	S	Raw	Oral	M	2	2

	Wound caused by crashes	S	Poultice	Dermal	M	1	1*
	Wounds	S	Smoke	Dermal	M	2	2
			Decoction	Oral			
Perovskia atriplicifolia Benth., Lamiaceae, Vek, 054940	Back pain	L	Decoction	Soaking body	M	3	2 (1*) + (1+ flour+ garlic)
		AP	Vapor	Chol****			
			Cook	Edible			
	Body pain	L	Decoction	Soaking body	M	5	5 (1*)
		AP	Vapor	Chol****			
		FL	Decoction	Oral			
	Bones pain	L	Decoction	Soaking body	M	3	3 (1*)
		AP	Vapor	Chol****			
	Hand and leg pain	AP	Vapor	Chol****	M	3	3
	Joint pain	AP	Vapor	Chol****	M	3	2 (1*)
			Cook	Edible			
	Knee pain	AP	Vapor	Chol****	M	2	1+ flour+ garlic
			Cook	Edible			
	Making honey	FL	Raw		O	5	5
	Rheumatism	AP	Vapor	Chol****	M	2	1+ flour+ garlic
			Cook	Edible			
	Urticaria	L,FL	Soak	Body wash	M	2	2
Petroselinum crispum (Mill.) Fuss, Apiaceae, Japari, 067618	Anemia	S	Powder	Oral	M	3	3
	Anorexia	S	Powder	Oral	M	1	1
	kidney stone	S	Powder	Oral	M	1	1
Pistacia atlantica Desf., Anacardiaceae, Govan/Govanjak, 054890	Abdominal pain	RE	Decoction	Oral	M	1	1
	Accelerating the post-coma consciousness	RE	Poultice	Topical	M	2	2*
		O	Liniment				
	Aromatize Hizak***	ST	Ashes	Milk production	D	5	5
	Aromatize Mashk**	ST	Ashes		D	5	5
	Arthritis	O	Liniment	Dermal	M	1	1
	Asthma	O	Raw	Oral	M	1	1
	Back pain	RE	Squashing	Dermal	M	6	6*
	Bedsore	RE	Smoke	Dermal	M	1	1
	Bladder infection	RE	Decoction	Dermal	M	1	1
	Bloating	RE	Decoction	Oral	M	1	1
	Blood clots of head	RE	Poultice	Topical	M	2	2*
		O	Liniment				
	Blood clotting	RE	Poultice	Topical	M	1	1*
	Body pain	O	Liniment	Dermal	M	4	4
		L	Decoction				
	Bones pain by gunshot	RE	Poultice	Dermal	M	2	2*
	Brain lesions	RE	Poultice	Topical	M	2	2*

	O	Liniment				
Burn with boiled water	RE	Liniment	Dermal	M	1	(1* + almond oil)
Burns	RE	Decoction, liniment, poultice, smoke	Dermal	M	36	24 (4*)+(5 = animal oil)
	O	Liniment				
Cataract	RE	Smoke	Topical	M	2	2
Children's dysentery	R	Decoction	Oral	M	1	1*
Children's infection	RE	Decoction	Oral	M	1	1*
Diabetes	L,FL,RE	Decoction	Oral	M	4	4 1+ rock candy
Diarrhea	RE	Powder	Suspension	M	2	2*
		Decoction	Oral			
Early childbirth	RE	Decoction	Oral	M	1	1
External skin tumor	RE	Decoction, liniment, poultice, smoke	Dermal	M	7	6 (4*)
	O	Liniment				
Female's infections	RE	Decoction	Oral	M	1	1+ animal oil
Fever by gunshot wound	F	Poultice	Dermal	M	2	2*
Food	RE	Cook	Edible	N	18	18
Foot numbness	O	Poultice	Topical	M	1	1*
Hair growth	O	Raw	Topical	T	4	4
Hair loss	RE	Raw	Topical	T	1	1
Heart disease	RE	Decoction	Oral	M	2	2
Infection by gunshot wound	RE	Poultice	Dermal	M	2	2*
Infections	O	Liniment	Dermal	M	26	16 (2*)+(1+animal oil)
	RE	Decoction, poultice, smoke	Dermal, oral			
Internal tumors	RE	Decoction	Oral	M	1	1*
Intestinal problems	RE,F	Decoction	Oral	M	3	3
Joint pain	O	Liniment	Dermal	M	4	4
Kidney infections	RE	Decoction	Dermal, oral	M	2	2 (1*)
Knife wounds	RE	Smoke	Dermal	M	1	1
leg pain	O	Liniment	Dermal	M	2	2
Lumbar disc	L	Squashing	Topical	M	1	1
Migraine	RE	Smoke	Inhalation	M	1	1
Nuts	F	Raw	Edible	N	16	16
Prevent infection	RE	Smoke	Dermal	M	2	1
	O	Liniment				
Prostatic problem	RE	Smoke	Inhalation	M	1	1*
Pulmonary problem	RE	Decoction	Pill	M	1	1*
Relieve muscle aches	O	Liniment	Dermal	M	2	2
Removing remains of skin lesions	RE	Smoke	Dermal, topical	M	4	2
	O	Liniment				
Rheumatism	O	Liniment	Dermal	M	1	1
Severe cough	RE	Decoction	Pill	M	1	1*
Severe headaches	RE	Smoke	Inhalation	M	1	1
Stomach ache	RE	Decoction, squashing	Oral	M	8	8 (3*)

			Powder	Suspension			
	Stomach Infection	RE	Decoction	Oral	M	3	3 (1+ animal oil)
	Stomach ulcers	RE	Decoction	Oral	M	1	1
	Suture	RE	Decoction	Industry	O	1	1
	Swelling	RE	Poultice	Dermal	M	1	1*
	Toothache	RE	Smoke	Inhalation	M	10	10 (1*)
			Powder, raw	Topical			
	Urinary tract infections	RE	Decoction	Oral	M	1	1*
	Vomiting	RE	Powder	Suspension	M	2	2*
			Decoction	Oral			
	Wound caused by crashes	RE	Liniment, poultice, powder	Dermal	M	5	5(1*)+ (4+*Pistacia atlantica* oil)
	Wound disinfectant	RE	Smoke	Dermal	T	2	1
		O	Liniment				
	Wounds	RE	Decoction, smoke	Dermal, oral	M	7	6
		O	Liniment	Dermal			
	Wounds caused by gunshot	R	Poultice, smoke	Dermal	M	4	3 (2*)
		O	Liniment				
Pistacia khinjuk Stocks, Anacardiaceae, Kasor	Nuts	F	Heating, raw	Edible	N	20	20
Plantago major L., Asteraceae, Barhang	Chest infection	S	Decoction	Oral	M	3	3 (2 + milk)
	Children's chest infection	S	Decoction	Oral	M	2	2 (1 + rock candy)
	Children's food supplement	S	Powder	Oral	N	1	1
	Children's intestinal problems	S	Decoction	Oral	M	1	1
	Children's throat infection	S	Decoction	Oral	M	1	1
	Cold	S	Decoction	Oral	M	3	3(1 + rock candy)
	Cough	S	Decoction	Oral	M	5	5 (2+ milk)+(1+rock candy)
	Diarrhea	S	Decoction	Oral	M	1	1
	Inflammation of the intestine	S	Decoction	Oral	M	1	1
	Throat pain	S	Decoction	Oral	M	1	1
Plantago ovata Forssk. Plantaginaceae, Danichk	Bloating	S	Decoction	Oral	M	1	1*
	Bones pain by gunshot	S	Poultice	Dermal	M	2	2*
	Cooling characteristics	S	Soak	Oral	M	5	5
	Dysentery	S	Decoction	Oral	M	1	1*
	External skin tumor	S	Heating	Dermal	M	2	2 + flour
	Fever by gunshot wound	S	Poultice	Dermal	M	2	2*
	Infection by gunshot wound	S	Poultice	Dermal	M	2	2*
	Infections	S	Soak	Oral	M	1	1
	Intestinal problems	S	Decoction	Oral	M	1	1*
	Reduce pain from burns	S	Poultice	Dermal	M	2	(2+milk+*Pistachia* oil)
	Softness of stomach	S	Soak	Oral	M	2	2

	Stomach ache	S	Soak	Oral	M	5	5
	Stomach bleeding	S	Soak	Oral	M	2	2
	Stomach infection	S	Soak	Oral	M	1	1
	Stomach troubles	S	Soak	Oral	M	6	6 (3*)
	Wounds caused by gunshot	S	Poultice	Dermal	M	2	2*
Populus alba L., Salicaceae, Spidar/Katok	House building	ST	Raw	Construction	D	9	9
	Providing local shoes (Savas)	ST	Raw		H	4	4
Pterocarpus santalinus L.f., Fabaceae, Ravando chandan, 067635	Asthma	ST	Decoction	Oral	M	1	1*
	Bladder infection	ST	Decoction	Oral	M	1	1*
	Bones fracture	ST	Powder	Topical	M	4	4
	Cold	ST	Decoction	Oral	M	1	1*
	Cold – prevention	ST	Decoction	Oral	M	1	1*
	Ear pain	ST	Decoction	Topical	M	1	1* + salt
	External skin tumor	ST	Poultice	Dermal	M	1	1*
	Gastrointestinal infection	ST	Decoction	Oral	M	1	1*
	Intestinal infection	ST	Decoction	Oral	M	1	1*
	Kidney infections	ST	Decoction	Oral	M	1	1*
	Knee pain	ST	Decoction	Oral	M	1	1*
	Lung cleansing	ST	Decoction	Oral	M	1	1*
	Set Ladies monthly menstruation	ST	Decoction	Oral	M	1	1*
	Throat pain	ST	Decoction	Oral	M	2	2 (1*)
	Wound caused by crashes	ST	Poultice, powder	Dermal	M	3	3 (1*)
	Wounds	ST	Powder	Dermal	M	1	1
	Wounds caused by gunshot	ST	Powder	Dermal	M	3	3
Pteropyrum aucheri Jaub. & Spach, Polygonaceae, Patompt/Karvankosh, 067632	Heat Hizak***	R	Ashes	Milk production	D	6	6
Pulicaria undulata (L.) C.A.Mey., Asteraceae, Bomadaran, 054904	Abdominal pain	L	Decoction	Oral	M	6	6
	Blood pressure	L	Decoction	Oral	M	3	3
	Children's diarrhea	L	Decoction	Oral	M	2	2
	Children's nausea	L	Decoction, soak	Oral	M	6	6
	Children's severe diarrhea	L	Soak	Oral	M	1	1
	Children's vomiting	L	Decoction, soak	Oral	M	4	4
	Diabetes	L	Decoction	Oral	M	3	3
	Diarrhea	L	Decoction, soak	Oral	M	5	5
	Female's infections	L	Decoction	Oral	M	1	1
	Food poisoning	L	Decoction	Oral	M	5	5
	Heart disease	L	Brewed	Oral	M	1	1
	Nausea	L	Soak	Oral	M	1	1
	Nerve relief	L	Decoction	Oral	M	2	2
	Prostatic problem	L	Decoction	Oral	M	2	2

	Stomach troubles	L	Brewed	Oral	M	1	1
	Stomach ache	L	Decoction	Oral	M	3	3
	Stomach troubles	L	Brewed, decoction	Oral	M	2	2
	Vomiting	L	Decoction, soak	Oral	M	5	5
Punica granatum L., Lythraceae, Anar	Acne	F	Poultice	Dermal	T	2	2*
	Paint Hizak***	F.SH	Decoction	Milk production	D	4	4
	Paint Mashk**	F.SH	Decoction		D	1	1
	Stomach ache	F.SH	Powder	Oral	M	1	1*
	Stomach troubles	F.SH	Powder	Oral	M	1	1*
	Stomach ulcers	F.SH	Powder	Oral	M	2	2 (1*)
Pycnocycla aucherana Dence. ex Boiss. var. Aucherana, Apiaceae, Sagi dantan, 067621	Body pain	AP	Vapor	Chol****	M	3	2
		L	Decoction	Dermal			
	Bones pain	AP	Vapor	Chol****	M	2	1
		L	Decoction	Dermal			
	Hand and leg pain	AP	Vapor	Chol****	M	3	2
		L	Decoction	Dermal			
	Rheumatism	L	Decoction	Dermal	M	1	1
Rhamnus persica Bioss., Rhamnaceae, Kharek, 054948	Paint Hizak***	R	Decoction	Milk production	D	3	3
Rhazya stricta Decne.,Apocynaceae, Harishark, 054929	Anti parasite	L	Decoction	Oral	M	3	3
	Bedsore	L	Powder	Dermal	M	2	2
	Body pain	AP	Vapor	Chol****	M	5	5
	Bones pain	AP	Vapor	Chol****	M	2	2
	Cooling characteristics	L	Decoction	Oral	M	2	2 (1+ gram flour)
	Diabetes	L	Decoction	Oral	M	1	1 + gram flour
	Eye disinfectant	L	Decoction	Topical	M	2	2
	Hand and leg pain	AP	Vapor	Chol****	M	5	5
	Increase brightness of the eyes	L	Decoction	Oral	M	1	1
	Joint pain	AP	Vapor	Chol****	M	1	1
	Mouth infection	L	Powder	Oral	M	1	1
	Mouth ulcers	L	Decoction	Oral	M	7	7 (2*)
			Powder	Mouth washing, oral			
	Tonsils infection	L	Powder	Topical	M	1	1
	Tooth cleaning	L	Raw		T	3	3
Rheum ribes L., Polygonaceae, Pil Goshk/Bandik, 054932	Anorexia	R	Decoction	Oral	M	2	2
	Baking bread	R	Cook	Edible	N	7	7
	Bloating	R	Decoction	Oral	M	2	2
	Diabetes	R	Powder	Oral	M	6	6
	Food	R	Powder	Edible	N	2	2 (1+ milk)

		F	Dry				
	Stomach ache	R	Decoction, powder	Oral	M	8	7 (2*)
		FL	Decoction				
	Stomach disorder	R	Decoction, powder	Oral	M	5	5 (2*)
	Stomach ulcers	R	Decoction, powder	Oral	M	6	5
Ribes orientale Desf., Grossulariaceae, Azat	Comestible	F	Raw	Edible	N	9	9
Rosa beggeriana Fisch & C.A. Mey, Rosaceae, Gole Mohamadi, 054897	Abdominal pain	FL	Extraction, powder	Oral	M	4	4 (2*)
	Constipation	FL	Decoction	Oral	M	2	2
	Cooling characteristics	FL	Soak	Oral	M	3	3 (1*)
	Flavor of tea	FL	Raw		N	3	3
	Fragrance	FL	Extraction		T	1	1
	Nerve relief	FL	Decoction	Oral	M	3	3
	Stomach function	FL	Soak	Oral	M	2	2
	Stomach troubles	FL	Decoction	Oral	M	3	3
	Vomiting	FL	Powder	Oral	M	1	1*
Ruta graveolens L., Rutaceae, Sadap	Accelerating post-coma consciousness	L	Poultice	Topical	M	1	1*
	Bloating	L	Decoction	Oral	M	5	5
	Blood clots of head	L	Poultice	Topical	M	1	1*
	Blood clotting	L	Poultice	Dermal	M	2	1 (2*)
	Body weakness after childbirth	L	Powder	Suspension	N	2	2 (1*)
			Decoction	Oral			
	Bone pain after childbirth	L	Powder	Suspension	N	1	1*
	Brain lesions	L	Poultice	Topical	M	1	1*
	Chest infection	L	Decoction	Oral	M	2	2
	Childbirth thirst	L	Powder	Suspension	N	2	1 (2*)
			Decoction	Oral	N		
	Children's pneumonia	L	Poultice	Dermal	M	1	1*
	Cold	L	Decoction	Oral	M	7	7
	Digestive system disorders	L	Decoction	Oral	M	1	1
	Female infertility	L	Decoction	Suppository	M	1	1*
	Flavor of tea	L	Decoction, raw		N	3	3
	Infections	L	Decoction	Oral	M	3	3
	Male infertility	L	Decoction	Suppository	M	1	1*
	Severe cough	L	Poultice	Dermal	M	1	1*
	Swelling	L	Poultice	Dermal	M	4	3 (2*)
			Decoction	Oral			
	Throat infection	L	Decoction	Oral	M	2	2
Rydingia persica (Burm.f.) Scheen & V.A.Albert, Lamiaceae, Golderr	Abdominal pain	L	Soak	Oral	M	2	2
	After childbirth	L	Soak	Oral	N	1	1
	Back pain	L	Soak	Oral	M	2	2 (1*)

			Decoction	Soaking body			
	Body pain	L	Soak	Oral	M	3	3 (1*)
			Decoction	Soaking body			
	Bones pain	L	Soak	Oral	M	12	10 (1*)
			Decoction	Oral, soaking body			
	Bones pain of pregnant women	L	Decoction	Body wash	M	1	1
	Cold	L	Soak	Oral	M	2	2
	Congo fever	L	Soak	Oral	M	1	1
	Diabetes	L	Soak	Oral	M	4	4
	Excretion of toxins from body	L	Soak	Oral	M	1	1
	Fever caused by pain in joints and muscles	L	Soak	Oral	M	1	1
	Hand and leg pain	L	Decoction, raw	Oral	M	9	7
	Infections	L	Soak	Oral	M	2	2
	Joint pain	L	Soak	Oral	M	1	1
	kidney stone	L	Soak	Oral	M	2	2
	Malaria fever	L	Soak	Oral	M	3	3
Salvia macrosiphon Boiss., Lamiaceae, Mohr danag, 054923	Abdominal pain	SE	Decoction	Oral	M	1	1
	Asthma	SE	Decoction	Oral	M	4	4
	Cataract	SE	Raw	Topical	M	5	5
	Chest infection	SE	Powder	Oral	M	1	1
	Chest pain	SE	Decoction	Oral	M	4	4
	Children's chest infection	SE	Heating, powder	Oral	M	2	2
	Children's chest pain	SE	Decoction	Oral	M	1	1
	Children's throat infection	SE	Heating, powder	Oral	M	2	2
	Children's throat pain	SE	Decoction	Oral	M	1	1
	Cough	SE	Decoction	Oral	M	1	1
	Eye infection	SE	Raw	Topical	M	3	2
			Powder	Oral, topical			
	Eye infection/ an object	SE	Powder, raw	Topical	M	7	7
	Eye irritation	SE	Powder	Oral, topical	M	2	1
	Eye pressure	SE	Powder	Oral, topical	M	2	1
	Inflammation of eye	SE	Raw	Topical	M	1	1
	Lung diseases	SE	Decoction	Oral	M	3	3
	Lung infection	SE	Decoction	Oral	M	1	1
	Nuts	SE	Powder	Edible	N	2	2
	Softness of stomach	SE	Decoction	Oral	D	1	1
	Throat pain	SE	Decoction, powder	Oral	M	3	3
	Trachoma	SE	Powder	Dermal, oral	M	2	1
Salvia mirzayanii Rech.f. & Esfand., Lamiaceae, Mor, 067622	Abdominal pain	L	Decoction, raw	Oral	M	21	19 (3*)+(2+ sugar)
			Powder	Oral, suspension			
		FL	Decoction, powder	Oral			
	Accelerating post-coma consciousness	L	Poultice	Topical	M	1	1*

Blood clots of head	L	Poultice	Topical	M	1	1*
Blood clotting	L	Poultice	Dermal	M	1	1*
Body pain	L	Poultice	Rub whole body	M	1	1*
Bones pain	L	Poultice	Rub whole body	M	1	1*
Bones pain by gunshot	L	Poultice	Dermal	M	2	2*
Brain lesions	L	Poultice	Topical	M	1	1*
Burn with boiled water	L	Poultice	Dermal	M	1	1*
Burns	L	Ashes, poultice	Dermal	M	3	3*
Children's abdominal pain	L	Decoction	Oral	M	1	1
Children's dysentery	L	Decoction	Oral	M	1	1*
Children's infection	L	Decoction	Oral	M	1	1*
Constipation	L	Decoction	Oral	M	1	1*
Diabetes	L	Decoction	Oral	M	1	1
Diarrhea	FL	Decoction, powder	Oral	M	9	8 (2*)+(1+ boiled water)
	L	Powder	Oral, suspension			
		Raw	Oral			
Digestive system disorders	L	Powder, raw	Oral	M	2	2
External skin tumor	L	Poultice	Dermal	M	1	1*
Fat disease	L	Decoction	Oral	M	3	3
Fever	L	Decoction	Oral	M	1	1
Fever by gunshot wound	L	Poultice	Dermal	M	2	2
Fever caused by pain in joints and muscles	L	Poultice	Dermal	M	1	1*
Food poisoning	FL	Decoction	Oral	M	2	2 (1*)
Infection by gunshot wound	L	Poultice	Dermal	M	2	2*
Infections	AP,L	Decoction	Oral	M	7	7 (2*)
	L	Ashes	Dermal			
Kidney infections	FL	Decoction	Oral	M	1	1*
Lung infection	L	Decoction, powder	Oral	M	2	2
Nausea	L	Powder, raw	Oral	M	5	4
Prostatic problem	L	Decoction	Oral	M	1	1*
Stomach ache	FL	Powder	Oral	M	10	10 (4*)+(1+ rock candy)
	L	Powder	Oral, suspension			
		Decoction	Oral			
Stomach diseases	FL	Powder	Oral	M	1	1
Stomach Infection	L,AP	Decoction	Oral	M	3	3
Stomach ulcers	L	Decoction	Oral	M	1	1
Swelling	L	Poultice	Dermal	M	1	1*
Urinary tract infections	FL	Decoction	Oral	M	1	1*
Vomiting	FL	Decoction, powder	Oral	M	14	12 (3*)
	L	Powder, raw				
Wound caused by crashes	L	Poultice	Dermal	M	2	2 (1*)
		Decoction	Oral			
Wounds	L	Ashes	Dermal	M	2	2
		Decoction	Oral			

	Wounds caused by gunshot	L	Poultice Decoction	Dermal Oral	M	3	3 (2*)
Salvia rhytidae Benth., Lamiaceae, Mor, 054924	Bloating	L	Decoction	Oral	M	4	4
	Chest infection	L	Decoction	Oral	M	4	4
	Cold	L	Decoction	Oral	M	11	11
	Throat infection	L	Decoction	Oral	M	2	2
	Throat pain	L	Decoction	Oral	M	2	2
Scorzonera paradoxa Fisch. & C.A.Mey. ex DC., Asteracea, Pontrok, 067624	Vegetable	AP	Cook, raw	Edible	N	38	33
Semenovia suffruticosa (Freyn & Bornm.) Manden., Apiaceae, Dibi	Livestock forage	AP	Dry	Fodder	F	8	8
Stipa hohenackeriana Trin. & Rupr., Poaceae, Shishar/ Vasht	Livestock forage	AP	Raw	Fodder	F	11	11
Suaeda aegyptiaca (Hasselq.) Zohary, Amaranthaceae, Semsor, 067630	Vegetable	L	Raw	Edible	N	32	28 (18+ yogurt)
Tamarix mascatensis Bunge, Tamaricaceae, Gaz, 054934	Accelerating post-coma consciousness	L	Poultice	Topical	M	1	1*
	Back pain	L	Vapor	Chol****	M	1	1
	Blood clots of head	L	Poultice	Topical	M	1	1*
	Blood clotting	ST	Poultice	Dermal	M	1	1*
	Body pain	L	Vapor	Chol****, inhalation	M	8	7 (1*)
	Bones pain	L	Vapor	Chol****, inhalation	M	9	7 (1*)
	Brain lesions	L	Poultice	Topical	M	1	1*
	External skin tumor	L	Poltice	Dermal	M	1	1*
	Hand and Leg pain	L	Vapor	Chol****	M	7	7
	Headache	L	Vapor	Inhalation	M	1	1*
	Heat Hizak***	ST	Ashes	Dry farming	D	1	1
	Heat Mashk**	ST	Ashes		D	1	1
	House building	ST	Raw	Construction	D	10	10
	Joint pain	L	Vapor	Chol****	M	4	4
	Paint Hizak***	R,ST	Decoction	Milk production	D	3	3
	Preparing a wooden handle for agricultural implements	ST	Raw	Agriculture	D	3	3
	Shrink the spleen	FL	Deccotion	Oral	M	1	1
	Swelling	ST	Poultice	Dermal	M	1	1*
	Truncheon for teachers	ST	Raw		O	4	4
	Wood for cooking	ST	Raw	Firewood	D	12	12
	Wound caused by crashes	L	Poultice	Dermal	M	1	1

Teucrium polium L., Lamiaceae, Kalpourag	Abdominal pain	L	Decoction, soak	Oral	M	11	10 (2+ sugar)
	Bloating	L	Decoction, soak	Oral	M	3	2
	Bones pain	L	Soak	Oral	M	1	1
	Children's abdominal pain	L	Soak	Oral	M	3	3
	Children's diarrhea	L	Decoction	Body wash	M	1	1*
	Children's food poisoning	L	Decoction	Body wash	M	1	1*
	Children's vomiting	L	Decoction	Body wash	M	1	1*
	Cooling characteristics	L	Decoction	Oral	M	2	2 (1+ sugar)
	Diabetes	L	Decoction	Oral	M	1	1
	Diarrhea	L	Decoction	Oral	M	1	1
	Dysentery	L	Deccotion	Oral	M	1	1
	External skin tumor	L	Poultice	Dermal	M	1	1*
	Fat disease	L	Decoction	Oral	M	2	2
	Fatty liver	L	Soak	Oral	M	2	2
	Food poisoning	L,FL	Decoction	Oral	M	3	2
	Hand and foot numbness	L	Poultice	Topical	M	1	1*
	Kidney pain	L,FL	Decoction	Oral	M	3	2
	Stomach ache	L	Decoction, powder, soak	Oral	M	11	11 (2*)
	Stomach Infection	L	Decoction	Oral	M	1	1
	Stomach troubles	L	Powder, soak	Oral	M	4	4 (1*)
	Wound caused by crashes	L	Poultice	Dermal	M	1	1*
Thymus vulgaris L., Lamiaceae, Ezgend/Avishan, 067633	Accelerating post-coma consciousness	L	Poultice	Topical	M	1	1*
	Asthma	L	Decoction	Oral	M	1	1*
	Bladder infection	L	Decoction	Oral	M	1	1*
	Blood clots of head	L	Poultice	Topical	M	1	1*
	Brain lesions	L	Poultice	Topical	M	1	1*
	Childbirth thirst	L	Decoction, powder	Oral, suspension	N	2	2*
	Children's pneumonia	L	Poultice	Rub whole body	M	1	1*
	Children's severe diarrhea	L	Decoction	Oral	M	1	1*
	Children's severe nausea	L	Decoction	Oral	M	1	1*
	Children's severe vomiting	L	Decoction	Oral	M	1	1*
	Children's shortness of breath	L	Decoction	Oral	M	1	1*
	Cold	L	Brewed, decoction	Oral	M	20	18 (3*) + (2+ rock candy)
	Cold – prevention	L	Decoction	Oral	M	3	3 (1*)
	Corona virus	L	Brewed, decoction	Oral	M	3	3
	Cough	L	Brewed	Oral	M	2	2
	Cough due to allergy, especially (pregnant women)	L	Decoction	Oral	M	1	1
	Diabetes	L	Powder	Oral	M	1	1*
	External skin tumor	L	Poultice	Dermal	M	1	1*
	Face masks	L	Decoction	Dermal	T	1	1
	Facial beauty in ladies/ Bokhor*****	L	Vapor	Dermal	T	1	1
	Fat disease	L	Powder	Oral	M	1	1*
	Flavor of tea	L	Decoction		N	1	1

	Gastrointestinal infection	L	Decoction	Oral	M	1	1*
	Increase immunity	L	Decoction	Oral	M	2	2
	Infections	L	Decoction, poultice	Dermal, oral	M	17	14 (3*)+(2 + rock candy)
	Internal tumors	L	Decoction	Oral	M	1	1*
	Intestinal infection	L	Decoction	Oral	M	1	1*
	Jaundice	L	Decoction	Oral	M	2	2
	Kidney infections	L	Decoction	Oral	M	2	2*
	kidney stone	L	Decoction, powder	Oral	M	2	2*
	Knee pain	L	Decoction	Oral	M	1	1*
	Liver disorder	L	Decoction	Oral	M	1	1
	Lung cleansing	L	Decoction	Oral	M	2	2 (1*)
	Lung infection	L	Decoction	Oral	M	2	2
	Lung problems	L	Brewed	Oral	M	1	1
	Lung troubles caused by cold	L	Decoction	Oral	M	2	2*
	Menstrual cramps	L	Decoction	Oral	M	2	2
	Nausea	L	Decoction	Oral	M	2	2 (1*)
	Nerve relief	L	Decoction	Oral	M	2	2
	Set Ladies monthly menstruation	L	Decoction	Oral	M	1	1*
	Severe cough	L	Poultice	Rub whole body	M	5	4 (1*)
	Stomach ache	L	Brewed, decoction Powder Decoction	Oral Suspension Oral	M	3	3 (1*)
	Tea	L	Brewed, decoction		N	8	8 (2+rock candy)
	Throat pain	L	Decoction	Oral	M	1	1*
	Urinary tract infections	L	Decoction	Oral	M	1	1*
	Vomiting	L	Decoction	Oral	M	1	1
	Wound caused by crashes	L	Poultice	Dermal	M	1	1*
	Wound disinfectant solution (as Betadine)	L	Decoction	Dermal	T	2	2
Trigonella foenum-graecum L., Fabaceae, Ambag	Abdominal pain	SE	Powder	Oral	M	1	1
	Anemia	SE	Powder	Oral	M	2	2
	Children's diarrhea	SE	Poultice Raw	Body wash Oral	M	2	2 (1*)
	Children's nausea	SE	Raw	Oral	M	1	1
	Children's vomiting	SE	Raw	Oral	M	1	1
	Diabetes	SE	Decoction, powder	Oral	M	4	4
	Diarrhea	SE	Powder	Oral	M	3	3
	Fat disease	SE	Decoction, raw	Oral	M	5	5
	Female hormonal problems	SE	Decoction	Oral	M	2	2
	Female infertility	SE	Decoction, powder	Oral	M	3	3
Verbascum gabrielae (Bornm.) Hub.-Mor., Scrophulariaceae, Mohr	Hand and leg pain	L	Squashing	Dermal	M	2	2
	Menstrual cramps	L	Powder	Oral	M	1	1

pashm, 054901	Stomach ache	L	Squashing	Oral	M	1	1
	Swelling of feet	L	Squashing	Topical	M	2	2
Withania coagulans (Stocks) Dunal, Solanaceae, Panir bad, 054949	Abdominal pain	AP,L	Deccotion	Oral	M	3	3
	Cold	AP,L	Decoction	Oral	M	9	9
	Flavor of tea	L	Raw		N	13	13
	Nerve relief	AP,L	Deccotion	Oral	M	7	7
	Stomach ache	AP,L	Decoction	Oral	M	9	9
	Stomach diseases	AP,L	Decoction	Oral	M	2	2
Ziziphora clinopodioides Lam., Lamiaceae, Porchenko, 054925	Body pain	AP	Vapor	Chol****	M	2	2
	Bones fracture	L	Squashing	Topical	M	3	3
	Cloths washing	L	Raw		T	1	1
	Diarrhea	F	Decoction	Oral	M	4	4
	Digestive system disorders	F	Decoction	Oral	M	3	3
	Hand and leg pain	AP	Vapor	Chol****	M	2	2
	Kidney infections	F	Decoction	Oral	M	1	1
	Kidney pain	F	Decoction	Oral	M	1	1 + rock candy
	kidney stone	F	Decoction	Oral	M	2	2 (1 + rock candy)
	Prevent Hizak*** rot	F	Soak	Milk production	D	4	4 + salt
	Prevent Mashk** rot	F	Soak		D	4	4 + salt
	Prostatic problem	F	Decoction, raw	Oral	M	3	3
	Stomach ache	F	Decoction	Oral	M	1	1
Ziziphora tenuior L., Lamiaceae, Porchenk Kohi, 067634	Cold	AP	Brewed	Oral	M	8	8 (1+ whey)
	Flavor of tea	AP,L	Brewed		N	9	9
	Nerve relief	AP	Brewed	Oral	M	8	8
	Stomach ache	AP	Brewed	Oral	M	5	5
Ziziphus jujuba Mill., Rhamnaceae, Konar	Hair washing	L	Squashing	Topical	T	4	4
	Headache	L	Squashing	Oral, topical	M	3	3
	Nuts	F	Raw	Edible	N	8	8
	Paint Hizak***	R	Decoction	Milk production	D	4	4
	Paint Mashk**	R	Decoction		D	4	4
Zygophyllum eurypterum Boiss. & Buhse, Zygophyllaceae, Kerich, 067627	Children's antiparasite	L	Squashing	Suppository	M	3	3
	Heat Hizak***	ST	Ashes	Milk production	D	5	5
	Heat Mashk**	ST	Ashes		D	7	7

Note: Species listed alphabetically; additional information on usage, used Plant Part (PP), preparation and administration, Use Category (UC), number of citations and number of informants; Plant Parts: AP: Aerial Parts, F: Fruit, FL: Flower, L: Leaves, O: Oil, R: Root, RE: Resin, S: Seed, ST: Stem; Use Category: C: Drugs and cigarettes, D: Domestic and charcoal, F: Hunting and fishing, H: Handicrafts, M: Medicine, N: Nutrition, O: Other, R: Ritual, T: Dental care and cosmetics. *: In a combination with other plants, **: The bag is made from animal leather and used as a refrigerator for maintaining water, ***: The bag is made from animal leather and used for the production of milk and other dairy products, also as a refrigerator for maintaining milk, ****: Traditional method of Baluch tribes for the treatments of body, joint, and any musculoskeletal pains, *****: Use the plants with the boiled water as a facial steamer for face skin beauty in women

This study reported for the first time, a large-scale study about traditional uses of plant resources in Taftan Mountain, Sistan and Baluchestan, Iran. The study points out that the study area is rich in plant resources and their local uses. Information is concentrated on elders, herbalists, and women especially in rural areas. However, many people who belong to different areas still rely on the use of plants. The young people do not show any interest in knowing and using indigenous knowledge. Obviously, knowledgeable old people will not be present for very much longer; therefore, this traditional knowledge should be collected and protected for the new generations. So far, our findings serve as a good database for other studies on the secondary compounds of the plants, i.e., new research projects on the area should be designed for the conservation of all plants and pharmacological evaluation of medicinal plants. Because access to health care in the studied area is difficult, plants still play a vital role and a great variety of medicinal plants were used by local people for the treatment of a wide range of ailments. Since the local people often collect the whole plant in a non-sustainable way, plans for the conservation and cultivation of the local flora especially in the case of medicinal plants, are needed. Therefore, further studies should take a closer look at plants collection by local people.

ACKNOWLEDGEMENTS

The authors are highly grateful to the Baluch tribes inhabiting the studied area for sharing their traditional knowledge. We especially express our sincere thanks to Barbara Ditsch and Mousa Akbarluo for their help in the identification of the plants.

REFERENCES

Abbas Q, Khan SW, Khatoon S, Hussain SA, Hassan SN, Hussain A, Qureshi R, Hussain I. 2014. Floristic biodiversity and traditional uses of medicinal plants of Haramosh valley, Central Karakoram National Park of Gilgit District, Gilgit-Baltistan. Pakistan J Biol Environ Sci 5 (6): 75-86. DOI: 10.1186/s13002-017-0172-9.

Abbas Z, Khan SM, Alam J, Khan SW, Abbasi AM. 2017. Medicinal plants used by inhabitants of the Shigar Valley, Baltistan region of Karakorum range-Pakistan. J Ethnobiol Ethnomed 13: 53.

Adnan M, Ullah I, Tariq A, Murad W, Azizullah A, Khan AL, Ali N. 2014. Ethnomedicine use in the war affected region of northwest Pakistan. J Ethnobiol Ethnomed 10: 16. DOI: 10.1186/1746-4269-10-16.

Ahmad L, Semotiuk A, Zafar M, Ahmad M, Sultana S, Liu QR, Zada MP, Abidin SZU, Yaseen G. 2015. Ethnopharmacological documentation of medicinal plants used for hypertension among the local communities of Dir Lower, Pakistan. J Ethnopharmacol 175: 138-146. DOI: 10.1016/j.jep.2015.09.014.

Ahmad M, Sultana S, Fazl-I-Hadi S, Hadda TB, Rashid S, Zafar M, Khan MA, Khan MPZ, Yaseen G. 2014. An ethnobotanical study of medicinal plants in high mountainous region of Chail valley (District Swat-Pakistan). J Ethnobiol Ethnomed 10: 36. DOI: 10.1186/1746-4269-10-36.

Ahmed N, Mahmood A, Mahmood A, Tahir SS, Bano A, Malik RN, Hassan S, Ishtiaq M. 2014. Relative importance of indigenous medicinal plants from Layyah district, Punjab Province, Pakistan. J Ethnopharmacol 155 (1): 509-523. DOI: 10.1016/j.jep.2014.05.052.

Ajaib M, Khan Q, Khan Z. 2013. A contribution to the ethnobotanical studies of some plants of Loralai District, Baluchistan. Biologia 59 (2): 323-327.

Akhani H. 2006. Flora iranica: Facts and figures and a list of publications by K.H. Rechinger on Iran and adjacent areas. Rostaniha 7 (2): 19-61.

Amiguet VT, Arnason JT, Maquin P, Cal V, Vindas S, Poveda L. 2005. A consensus ethnobotany of Q'eqchi' Maya of Southern Belize. Econ Bot 59: 29-42. DOI: 10.1663/0013-0001(2005)059[0029:ACEOTQ]2.0.CO;2.

Amiri MS, Joharchi MR. 2013. Ethnobotanical investigation of traditional medicinal plants commercialized in the markets of Mashhad, Iran. Avicenna J Phytomed 3 (3): 254-271. DOI: 10.22038/AJP.2013.487.

Amiri MS, Joharchi MR. 2016. Ethnobotanical knowledge of Apiaceae family in Iran: A review. Avicenna J Phytomed 6 (6): 621-635. DOI: 10.22038/AJP.2016.6696.

Amjad MS, Qaeem MF, Ahmad I, Khan SU, Chaudhari SK, Malik NZ, Shaheen H, Khan AM. 2017. Descriptive study of plant resources in the context of the ethnomedicinal relevance of indigenous flora; A case study from Toli Peer National Park, Azad Jammu and Kashmir, Pakistan. PLoS One 12 (2): e0171896. DOI: 10.1371/journal.pone.0171896.

Assadi M, Maassoumi AA, Khatamsaz M, Mozaffarian V. 1992-2012. Flora of Iran 1-76. Ministry of Jihad-e-Agriculture, Research Institute of Forests and Rangelands, Tehran, Iran. DOI: 10.1017/s0960428602270158. [Persian]

Begum S, AbdEIslam NM, Adnan M, Tariq A, Yasmin A, Hameed R. 2014. Ethnomedicines of highly utilized plants in the temperate Himalayan region. Afr J Tradit Complement Altern Med 11 (3):132-142. DOI: 10.4314/ajtcam.v11i3.20.

Biabangard H, Moradian A. 2008. Geology and geochemical evaluation of Taftan Volcano, Sistan and Baluchestan Province, southeast of Iran. Chin J Geochem 27: 356-369. DOI: 10.1007/s11631-008-0356-z.

Cook FEM. 1995. Economic Botany Data Collection Standard. Royal Botanic Gardens, Kew, United Kingdom.

Davis SD, Heywood VH, Hamilton AC. 1994. Centres of Plant Diversity: Vol. 1 - Europe, Africa, South West Asia and the Middle East: A Guide and Strategy for Their Conservation. IUCN Publications Unit, Cambridge.

Djamali M, Akhani H, Khoshravesh R, Andrieu-Ponel V, Ponel P, Brewer S. 2011. Application of the global bioclimatic classification to Iran: Implications for understanding the modern vegetation and biogeography. Ecol Mediterr 37 (1): 91-114. DOI: 10.3406/ecmed.2011.1350.

Dolatkhahi M, Dolatkhahi A, Bagher Nejad J. 2014. Ethnobotanical study of medicinal plants used in Arjan-Parishan protected area in Fars Province of Iran. Avicenna J Phytomed 4 (6): 402-412. DOI: 10.22038/AJP.2014.3387.

Dolatkhahi M. Nabipour I. 2013. Systematically study of medicinal plants in Bushehr Province, Southern Iran. J Herb Drug 3 (4): 209-222.

Earth Resources Observation and Science (EROS) Center, U.S. Geological Survey. https://landlook.usgs.gov/landlook/viewer.html

Ebrahimi M, Masoodipour A, Rigi M. 2015. Role of soil and topographic features in distribution of plant species (case study; Sanib Taftan watershed). Ecopersia 3 (1): 917-932.

Ebrahimi-Khusfi Z, Sardoo MS. 2021. Recent changes in physical properties of the land surface and their effects on dust events in different climatic regions of Iran. Arab J Geosci 14: 287. DOI: 10.1007/s12517-021-06664-9.

Ebrahimzadeh I. 2009. Geographical Foundations of South-East Iran. Office of Culture and Islamic Guidance, Sistan and Bloochestan, Zahedan.

Emami SA, Nadjafi F, Amine GH, Amiri MS, Khosravi MT, Nasseri M. 2012. Les espèces de plantes médicinales utilisées par les guérisseurs traditionnels dans la province de Khorasan, nord-est de l'Iran. Ethnopharmacologia 48: 48-59. [French]

Farnsworth NR, Soejarto DD. 1991. Global importance of medicinal plants. In: Akerele O, Heywood V, Synge H (eds). The Conservation of Medicinal Plants. Cambridge University Press, Cambridge. DOI: 10.1017/CBO9780511753312.005.

Farouji AE, Khodayari H. 2016. Ethnomedicinal plants of Farouj District, North Khorasan Province, Iran. J Med Herbs 7 (1): 21-36.

Ghahreman A. 1975-1999. Flora's Color of Iran (Volumes 1-20). Research Institute of Forests and Rangeland Publications, Tehran, Iran.

Ghorbani A. 2005. Studies on pharmaceutical ethnobotany in the region of Turkmen Sahra, north of Iran (Part1): General results. J Ethnopharmacol 102 (1): 58-68. DOI: 10.1016/j.jep.2005.05.035.

Giday M, Asfaw Z, Woldu Z. 2009. Medicinal plants of the Meinit ethnic group of Ethiopia: An ethnobotanical study. J Ethnopharmacol 124 (3): 513-521. DOI: 10.1016/j.jep.2009.05.009.

Hashemzade N. 2013. Statistical Yearbook of Sistan and Baluchestan Province. Deputy Governor of Planning and Employment Sistan and Baluchestan, Iran.

Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. 1998. Medicinal plants in Mexico: Healers' consensus and cultural importance. Soc Sci Med 47 (11):1859-1871. DOI: 10.1016/s0277-9536(98)00181-6.

Hopper D, Field H. 1937. Useful Plants and Drugs of Iran and Iraq. Field Museum of Natural History, Chicago. DOI: 10.5962/bhl.title.2281.

Ignacimuthu S, Ayyanar M, Sankarasivaraman K. 2006. Ethnobotanical investigations among tribes in Madurai district of Tamil Nadu, India. J Ethnobiol Ethnomed 2: 25. DOI: 10.1186/1746-4269-2-25.

Ignacimuthu S, Ayyanar M, Sankarasivaraman K. 2008. Ethnobotanical study of medicinal plants used by Paliyar tribals in Theni District of Tamil Nadu, India. Fitoterapia 79 (7-8): 562-568. DOI: 10.1016/j.fitote.2008.06.003.

Ishtiaq M, Mahmood A, Maqbool M. 2015. Indigenous knowledge of medicinal plants from Sudhanoti district (AJK), Pakistan. J Ethnopharmacol 168: 201-207. DOI: 10.1016/j.jep.2015.01.054.

Kadir MF, Bin Sayeed MS, Mia MMK. 2012. Ethnopharmacological survey of medicinal plants used by indigenous and tribal people in Rangamati, Bangladesh. J Ethnopharmacol 144 (3): 627-637. DOI: 10.1016/j.jep.2012.10.003.

Kalvandi R, Safikhani K, Najafi Gh, Babakhanlo P. 2007. Identification of medicinal plants of Hamedan province. Iran J Med Aromat Plants Res 23 (3): 350-373.

Karki M, Williams JT. 1999. Priority Species of Medicinal Plants in South Asia. International Development Research Centre, New Delhi.

Kayani S, Ahmad M, Zafar M, Sultana S, Khan MPZ, Ashraf MA, Hussain J, Yaseen G. 2014. Ethnobotanical uses of medicinal plants for respiratory disorders among the inhabitants of Gallies-Abbottabad, Northern Pakistan. J Ethnopharmacol 156: 47-60. DOI: 10.1016/j.jep.2014.08.005.

Khan I, AbdElsalam NM, Fouad H, Tariq A, Ullah R, Adnan M. 2014a. Application of ethnobotanical indices on the use of traditional medicines against common diseases. Evid Based Complement Alternat Med 2014: 635371. DOI: 10.1155/2014/635371.

Khan M, Shinwari ZK, Shah M, Musharaf S. 2014b. An ethnobotanical survey of medicinal and other useful plants of Khattak Tribe in Tehsil Karak, Khyber Pakhtunkhawa, Pakistan. Med Plant Res 4 (8): 61-74. DOI: 10.5376/mpr.2014.04.0008.

Khan MT, Khan I, Khan MI, Hussain Z, Ayub S, Khan N, Shuaib M, Khan IA. 2016. Ethnobotanical study of wild flora in the remote areas of Northern Pakistan. Wulfenia J 23 (10): 149-165.

Khan S, Jan G, Bibi H, Murad W, Ullah K, Ihsanullah. 2018. An ethnomedicinal survey of plants used in traditional medicine in arid and semi-arid zone of Bahadur Khel, district Karak, Khyber Pakhtunkhwa, Pakistan. Asian J Pharmacogn 2 (3): 41-44.

Khodayari H, Amani Sh, Amiri H. 2014. Ethnobotanical study of medicinal plants in the Northeast of Khuzestan Province: Identification and traditional uses. J Echophytochem Med Plants 8 (4): 12-26. [Persian]

Kottek M, Grieser J, Beck C, Rudolf B, Rubel F. 2006. World map of the Köppen-Geiger climate classification updated. Meteorol Z 15: 259-263. DOI: 10.1127/0941-2948/2006/0130.

Lautenschläger T, Monizi M, Pedro M, Mandombe JL, Bránquima MF, Heinze C, Neinhuis C. 2018. First large-scale ethnobotanical survey in the province of Uíge, northern Angola. J Ethnobiol Ethnomed 14 (1): 51. DOI: 10.1186/s13002-018-0238-3.

Mahishi P, Srinivasa BH, Shivanna MB. 2005. Medicinal plant wealth of local communities in some villages in Shimoga District of Karnataka, India. J Ethnopharmacol 98 (3): 307-312. DOI: 10.1016/j.jep.2005.01.035.

Maleki T, Akhani H. 2018. Ethnobotanical and ethnomedicinal studies in Baluchi tribes: A case study in Mt. Taftan, southeastern Iran. J Ethnopharmacol 217: 163-177. DOI: 10.1016/j.jep.2018.02.017.

Moghadam MR. 2018. Rangeland and Rangeland Management. University of Tehran Press, Tehran, Iran.

Mood SG. 2008. A contribution to some ethnobotanical aspects of Birjand Flora (Iran). Pak J Bot 40 (4): 1783-1791.

Mosaddegh M, Esmaeili S, Hassanpour A, Malekmohammadi M, Naghibi F. 2016. Ethnobotanical study in the highland of Alvand and Tuyserkan, Iran. Res J Pharmacogn 3 (1): 7-17.

Mosaddegh M, Naghibi F, Moazzeni H, Pirani A, Esmaeili S. 2012. Ethnobotanical survey of herbal remedies traditionally used in Kohghiluyeh va Boyer Ahmad province of Iran. J Ethnopharmacol 141 (1): 80-95. DOI: 10.1016/j.jep.2012.02.004.

Motlhanka DMT, Nthoiwa GP. 2013. Ethnobotanical survey of medicinal plants of Tswapong north, in eastern Botswana: A case of plants from Mosweu and Seolwane villages. Eur J Med Plant 3 (1): 10-24. DOI: 10.9734/EJMP/2013/1871.

Murad W, Azizullah A, Adnan M, Tariq A, Khan KU, Waheed S, Ahmad A. 2013. Ethnobotanical assessment of plant resources of Banda Daud Shah, District Karak, Pakistan. J Ethnobiol Ethnomed 9 (1): 77. DOI: 10.1186/1746-4269-9-77.

Murtem G, Chaudhry P. 2016. An ethnobotanical study of medicinal plants used by the tribes in upper Subansiri District of Arunachal Pradesh, India. Am J Ethnomed 3 (3): 35-49.

Muthu C, Ayyanar M, Raja N, Ignacimuthu S. 2006. Medicinal plants used by traditional healers in Kancheepuram District of Tamil Nadu, India. J Ethnobiol Ethnomed 2: 43. DOI: 10.1186/1746-4269-2-43.

Muthulingam P. 2015. Traditional practices of native communities and their ethnobotanical knowledge: A trivia in Wayanad, India. J Ethnobiol Tradit Med Photon 124: 993-1006.

Naghibi F, Esmaeili S, Malekmohammadi M, Hassanpour A, Mosaddegh M. 2014. Ethnobotanical survey of medicinal plants used traditionally in two villages of Hamedan, Iran. Res J Pharmacogn 1 (3): 7-14.

Naghibi F, Mosaddegh M, Mohammadi Motamed S. 2005. Labiatae family in folk medicine in Iran: From ethnobotany to pharmacology. Iran J Pharm Res 4 (2): 63-79.

Pabout H. 1979. Bioclimatic classification of Iran rangelands using rainfall and temperature data. Research Institute of Forests and Rangelands of Iran, Iran.

Pirbalouti AG, Momeni M, Bahmani M. 2012. Ethnobotanical study of medicinal plants used by kurd tribe in Dehloran and Abdanan Districts, Ilam Province, Iran. Afr J Tradit Complement Altern Med 10 (2): 368-385. DOI: 10.4314/ajtcam.v10i2.24.

Qasim M, Gulzar S, Shinwari ZK, Aziz I, Khan MA. 2010. Traditional ethnobotanical uses of halophytes from Hub, Balochistan. Pak J Bot 42 (3): 1543-1551.

Qureshi R. 2012. Medicinal flora of Hingol National Park, Balochistan. Pak J Bot 44 (2): 725-732.

Rajaei P, Mohamadi N. 2012. Ethnobotanical study of medicinal plants of Hezar Mountain allocated in South East of Iran. Iran J Pharm Res 11 (4): 1153-1167.

Rechinger KH. 1963-2015. Flora Iranica, 1-181. Akademsiche Druck- u. Verlagsanstalt und Naturhistorisches Museum Wien, Graz and Wien.

Roudi F, Azadi P, Mesgaran M. 2017. Iran's Population Dynamics and Demographic Window of Opportunity. Stanford Iran 2040 Project, Stanford University, US.

Sadeghi Z, Kuhestani K, Abdollahi V, Mahmood A. 2014. Ethnopharmacological studies of indigenous medicinal plants of Saravan region, Baluchestan, Iran. J Ethnopharmacol 153 (1): 111-118. DOI: 10.1016/j.jep.2014.01.007.

Sahoo N, Manchikanti P, Dey S. 2010. Herbal drugs: Standards and regulation. Fitoterapia 81 (6): 462-471. DOI: 10.1016/j.fitote.2010.02.001.

Sarangzai AM, Ahmed A, Laghari SK. 2013. Traditional uses of some useful medicinal plants of Ziarat District Balochistan, Pakistan. Fuuast J Biol 3 (1): 101-107.

Sharififar R, Moharam-Khani MR, Moattar RR, Babakhanloo P, Khodami M. 2014. Ethnobotanical study of medicinal plants of Joopar Mountains of Kerman Province, Iran. J Kerman Univ Med Sci 21 (1): 37-51.

Shedayi AA, Gulshan B. 2012. Ethnomedicinal uses of plant resources in Gilgit-Baltistan of Pakistan. J Med Plant Res 6 (29): 4540-4549. DOI: 10.5897/JMPR12.719.

Shokri M, Safaian N. 1993. The study of medicinal plants in Mazandaran (northern Iran). Acta Hortic 333: 165-174. DOI: 10.17660/ActaHortic.1993.333.19.

Sivasankari B, Anandharaj M, Gunasekaran P. 2014. An ethnobotanical study of indigenous knowledge on medicinal plants used by the village peoples of Thoppampatti, Dindigul district, Tamilnadu, India. J Ethnopharmacol 153 (2): 408-423. DOI: 10.1016/j.jep.2014.02.040.

Tardío J, Pardo-de-Santayana M. 2008. Cultural importance indices: A comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain)[1]. Econ Bot 62: 24-39. DOI: 10.1007/s12231-007-9004-5.

Trotter RT, Logan M. 1986. Informant consensus: A new approach for identifying potentially active medicinal plants. In: Etkin NL (eds). Plants in Indigenous Medicine and Diet. Routledge, UK. DOI: 10.4324/9781315060385-6.

Ullah M, Khan MU, Mahmood A, Malik RN, Hussain M, Wazir SM, Daud M, Shinwari ZK. 2013. An ethnobotanical survey of indigenous medicinal plants in Wana district South Waziristan agency, Pakistan. J Ethnopharmacol 150 (3): 918-924. DOI: 10.1016/j.jep.2013.09.032.

Yaseen G, Ahmad M, Sultana S, Alharrasi AS, Hussain J, Zafar M, Ur-Rehman S. 2015. Ethnobotany of medicinal plants in the Thar Desert (Sindh) of Pakistan. J Ethnopharmacol 163: 43-59. DOI: 10.1016/j.jep.2014.12.053.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 6, Number 2, November 2023
Pages: 115-126

E-ISSN: 2580-4510
DOI: 10.13057/asianjethnobiol/y060202

Ethnomedicinal knowledge used by Mullukurumbas of Nilgiris, Western Ghats, India

C. SANU[1,2], S. JEEVITH[3,♥], T.C. SHEEBA[4]

[1]Kallichal House, Munanad Post, Pandalur, The Nilgiris 643239, Tamil Nadu, India
[2]Sree Saraswathi Vivekananda Maha Vidhyalaya Matriculation School. Ayyankolly, Munnanad Post, Pandalur, The Nilgiris 643239, Tamil Nadu, India
[3]#78/1, Marie Gowder Line, Mullikorai, Udhagamandalam, The Nilgiris 643004, Tamil Nadu, India. ♥email: jeevithbotany@gmail.com
[4]Thanchora House, Pattavayal Post, Gudalur, The Nilgiris 643240, Tamil Nadu, India

Manuscript received: 31 May 2023. Revision accepted: 27 July 2023.

Abstract. *Sanu C, Jeevith S, Sheeba TC. 2023. Ethnomedicinal knowledge used by Mullukurumbas of Nilgiris, Western Ghats, India. Asian J Ethnobiol 6: 115-126.* Nilgiris is one of the biodiversity-rich areas in the Western Ghats, India, with six major groups of indigenous tribes, and Mullukuruba is one of the subtribes of Kurumbas. The present study aimed to document the ethnomedicinal knowledge among the Mullukurumba Tribe of Kallical, Cherangode Village of Nilgiris, Western Ghats. Most of the tribes in Nilgiris follow a close cultural ritual and traditional knowledge, including food and medicine. The field data were collected through interviews, observation, and documentation. The tribal people utilized 152 plant species belonging to 60 families. The life forms of the collected plants revealed that herbs constitute 53 species, followed by shrubs 44 species, trees 35 species, and climbers 20 species. Family-wise, Fabaceae dominated with 13 species, followed by Asteraceae 10 species, and Solanaceae included 8 species. The use category made by the tribal community were medicinal plants (70%), edible fruits (19%), and miscellaneous uses (11%). The plant species treat various illnesses, including piles, rheumatism, gynecological issues, dermatitis, and antidiarrheal and anti-diabetic conditions. *Argyreia cuneata* (Willd.) Ker Gawl., *Cascabela thevetia* (L.) Lippold, *Coix lacryma-jobi* L., *Ixora coccinea* L., *Gloriosa superba* L., *Melastoma malabathricum* L., and *Plumeria alba* L. were the most common plants used for rituals. Also, this study presented an updated checklist of medicinal plants used by the Mullukurumba Tribe.

Keywords: Checklist, ethnobotany, medicinal plants, Nilgiris, Pandalur

INTRODUCTION

India is one of the floristically richest regions on the planet. Since ancient times, India has been a source of medicinal plants and their products, accounting for more than 40% of the world's floristic diversity (Arinathan 2003; Vijeesh and Velumani 2011). People that depend totally or partially on wood for their livelihood reside there, and the forest is an essential component of tribal community social structures (Rajan et al. 2002; Narayanan et al. 2011). For a very long time, local populations have been quite knowledgeable about the flora and other natural resources that may be found in their immediate and adjacent environs. The herbal drugs obtained from plants are much safer, with fewer or no side effects in treating various ailments (Ayyanar and Ignacimuthu 2005; Ayyanar 2013). The tribal segment of India's population presents an interesting profile country's ethnic diversity; most of India's population comprises 427 tribal communities (Dutta and Dutta 2005). Tribes are an ecosystem of people that coexist peacefully with the environment and preserve a strong connection between the two. With more than 2,500 plant species, India has seen a rise in the study of medicinal plants and traditional knowledge in recent decades (Jain 1991). In addition, the importance of traditional treatments is extensively recognized, and ethnomedicine is considered the source of all modern medicines.

The Nilgiris District of Tamil Nadu is located at 11°10'-11°43'N and 76°14'-77°00'E, with an area of 2,565 km^2 and an elevation of 900-2,636 masl, of Western Ghats, as one of the eight hot spots of the world known for its rich biodiversity. There are 2,100 species of flowering plants endemic to Peninsular India. Among these, 818 were found in the Nilgiris and adjoining areas. The district consists of six major taluks, including Gudalur (507 km^2) and Pandalur (218 km^2) (Jeevith and Manjunath 2023). In Nilgiris, there are six major tribes, i.e., Kotas, Todas, Irulas, Kurumbas, Paniyas, and Kattunayakans (Hosagowder and Henry 1996; Rajan et al. 2003). The origin of Kurumba Tribes of the Nilgiris District is from the Wayanad District of Kerala and Gundalpet District of Karnataka, in and around Nilgiri Biosphere Reserve (Silja et al. 2008). Kurumbas are one of the very old primitive tribes of the Nilgiris (Ramachandran and Udhayavani 2013), and they are widely distributed in major taluks of the district, i.e., Coonoor, Kothagiri, Kundha, Gudalur, and Pandalur. In Kurumba Tribes, there are five sub-groups, namely Alukurumbas, Jenukurumbas, Uralikurumbas, Bettakurumbas, and Mullukurumbas (Sathyanarayanan and Nirmal 2013a).

Kallichal is a primitive village in Munanad, Pandalur Taluk, Nilgiris District of Tamil Nadu, India. The village comprises 10 colonies around the region and one of the Scheduled Tribe Mullukurumbas. The tribe is well known for their traditional hunting, owning small tracts of land, and

practicing indigenous agriculture crops, constituting (23.25%) 2,000 of the district's total population (Census 2011). They follow their traditional culture, worship their sacred grooves, and are medicinal practitioners, with fewer similarities and interests of each group (Rajan et al. 2001). The production of permanent plantation crops and spices is distinctive to these areas. Homestead farming is significant in this area, and a range of crops, including annuals and perennials, are cultivated in these modest holdings. Coconut, areca nuts, pepper, vegetables, tubers, and fruit crops, including mango and jackfruit, are among the crops. The community people have very less known of cultivation and participating cereals other than paddy, unlike Irulas, who are more experienced in agriculture and maintaining germplasm of the cereals, e.g., *Eleusine coracana* (L.) Gaertn., *Pennisetum glaucum* (L.) R.Br., *Sorghum bicolor (*L.) Moench, and *Panicum sumatrense* Roth (Arinathan et al. 2003; Saradha et al. 2017).

Several studies have contributed to recent findings of medicinal plants in the Nilgiris area during the past three decades (Rajan et al. 2003; Udayan et al. 2007; Ramachandran and Udhayavani 2013). However, the ethnobotanical and medicinal plants of Nilgiris, and Western Ghats, are yet to be revalidated. The present work is an effort to document the traditional knowledge of medicinal herbs utilized by the MulluKurumba Tribes.

MATERIALS AND METHODS

Study area

The present study area, Kallichal, is located in Cherangode Village, Munnanad Post, Pandalur Taluk of Nilgiris District, Western Ghats, India (Figure 1), Tamil Nadu, India, with a total geographical area of 2,463 hectares. The area is surrounded by tropical moist deciduous forests and patches of tropical semi-evergreen forests (Champion and Seth 1968), comprising *Vateria indica* L., *Lagerstroemia macrocarpa* Wall. ex Kurz, *Terminalia paniculate* Roth, and *Tectona grandis* L.f.. The usage of ethnobotanical and medicinal plants was obtained from experienced and traditional healers of the Mullukurumba Tribe.

Data collection

Intensive botanical exploration trips were made from April 2021 to December 2022 in the Kallichal Area of Cherangode Village. The data was collected from a questionnaire survey and personal interviews with knowledgeable inhabitants of the hamlets. We also collected published literature about the ethnic community, and recent modern techniques of the tribe were also reviewed. The plants observed from the study area were identified with the help of the regional floras and field guides. Only observation and field notes were taken in this study due to the authors' lack of access to the herbarium or preservation facilities; therefore, no specimens were collected. Plant species of vegetative, flowering, and fruiting phases were photographed for identification and future reference.

Data analysis

The plant species were analyzed with the ethnomedical value reported by the tribal practitioner and people in the village and pertinent literature. The analysis of habit was followed by Gamble and Fischer (1915-1936) and Fyson (1915). The plant species followed POWO (2023) for nomenclature updates. The photographs taken in situ are provided as figures in plates.

RESULTS AND DISCUSSION

In the present investigation, the plants used by the Mullukurumbas from the wild for their day-to-day life were gathered. A total of 152 species from 106 genera belonging to 61 families of flowering plants were studied (Table 1). Of 152 plants, 140 species are widely distributed, and 12 are cultivated. An analysis was made in the life forms of the collected plants revealed that herbs constitute 53 species (35%), followed by 44 species of shrubs (29%), 35 species of trees (23%), and 20 species of climbers (13%) (figure 2). Similarly, the dominant families are so being worked out; the families such as Fabaceae dominated with 13 species, followed by Asteraceae with 10 species, Solanaceae with 8 species, Lamiaceae and Rutaceae with 6 species each, Acanthaceae, Cucurbitaceae, Malvaceae, Moraceae, Myrtaceae Piperaceae, and Poaceae with 5 species each, Phyllanthaceae with 4 species. Amarathaceae, Apiaceae, Apocynaceae, Euphorbiaceae, Meliaceae, Oxalidaceae, and Zingiberaceae were represented by 3 species each. In contrast, Araceae, Arecaceae, Convolvulaceae, Plantaginaceae, Rhamnaceae, and Rubiaceae with 2 species each, and the rest of the families represented only one species. The complete list of species with family and uses is given in Table 1. The selected images of medicinal plants and fruits are displayed in Figures 4 and 5.

Tribal people use specific plant parts and dosages to treat specific ailments. Plant products are consumed raw or taken as decoction or infusion (oral treatment) and paste (external application). Fresh leaves, roots, and stems were more frequently used compared to other parts of the plant. In the present investigation was found that various parts used by these indigenous communities were classified and inferred that leaves (45 species; 25%), fruits (39 species; 22%), whole plants (36 species; 20%), flowers (18 species; 10%), root (14 species; 8%), seeds (11 species; 6.2%), rhizome (8 species; 4.5%), stem (4 species; 2.2%), bark (2 species; 1%), and tuber (1 species; 0.6%) (Figure 3).

The plants studied concerning the kind of use made by the tribal community were medicinal plants (70%), edible fruits (19%), and miscellaneous uses (11%). Traditional healers use these medicinal plants to cure diseases: common cold, seasonal allergies, stomach ache, diarrhea, skin problems, toothache, wounds, respiratory syndromes, urinary tract infections, hemorrhoids, and venomous bites.

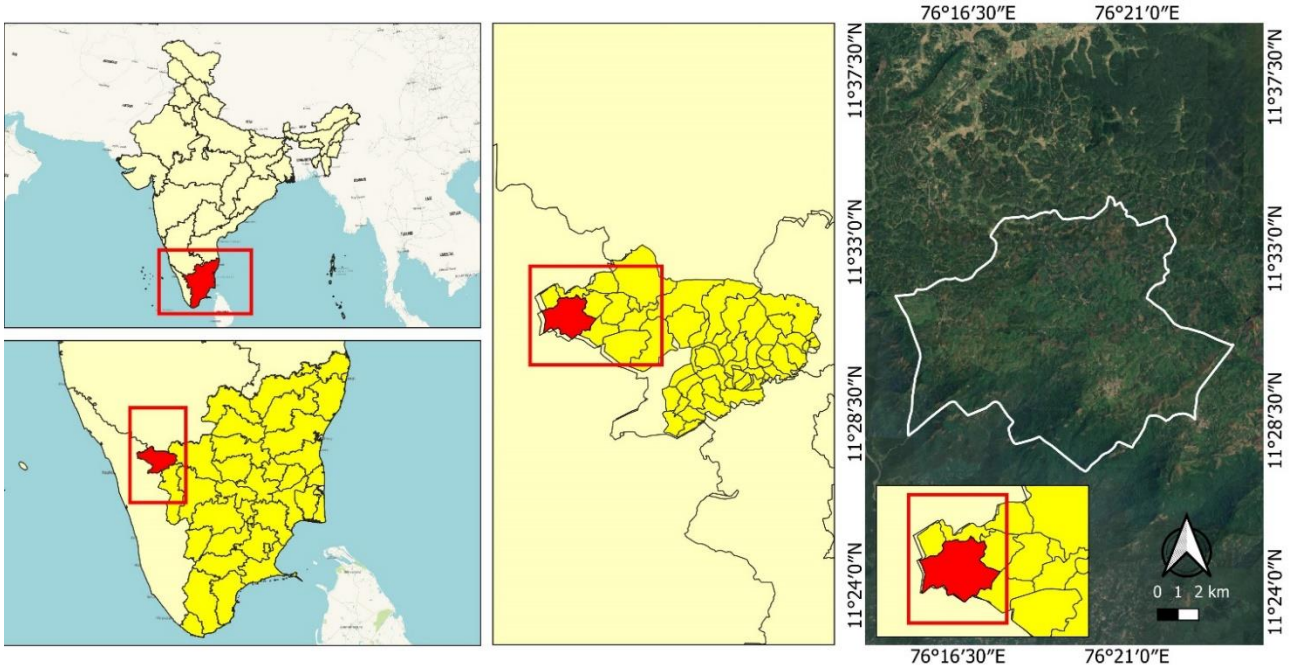

Figure 1. Map showing the Cherangode Village, Nilgiris District, Western Ghats, India

Wild and ornamental fruits are consumed raw and used as vegetables in their diet, cooked in traditional methods for daily consumption and communal ceremonies. The fruits of common plant species are wildly available and reported in the flora of Nilgiris by Fyson (1915) and Sharma et al. (1977). In addition, *Diplocyclos palmatus* (L.) C.Jeffrey, *Passiflora subpeltata* Ortega, *Persicaria chinensis* (L.) H.Gross, *Physalis peruviana* L., *Solanum torvum* Sw., *S. viarum* Dunal, *S. villosum* Mill., and *S. nigrum* L. were utilized for multiple purposes.

In this study, fruits of 20 tree species were consumed raw. Therefore leaves, fruits, and barks of *Ficus benghalensis* L., *F. racemosa* L., *Artocarpus heterophyllus* Lam., *A. hirsutus* Lam., *Morus alba* L., *Psidium guajava* L., *Syzygium cumini* (L.) Skeels, *S. jambos* (L.) Alston, *Eugenia uniflora* L., *S. aqueum* (Burm.f.) Alston, *Phyllanthus emblica* L., *Scolopia crenata* (Wight & Arn.) Clos, *Ziziphus oenopolia* (L.) Mill., *Z. rugosa* Lam., *Rhaphiolepis bibas* (Lour.) Galasso & Banfi, *Naringi crenulate* (Roxb.) Nicolson, *Morinda citrifolia* L., and *Citrus maxima* (Burm.) Merr. were utilized in many forms for their day-to-day consumption. Recently, Jeevith and Manjunath (2023) listed 171 tree species; 107 were used in traditional medicine, and 51 were used as fruit crops, in urban landscapes. Fruits of *Asparagus racemosus* Willd., *Azadirachta indica* A.Juss., *F. racemosa*, *S. cumini*, *S. jambos*, *Murraya paniculate* (L.) Jack, and *Momordica charantia* L. are well-known medicinal plants that have long been used as anti-diabetic agent (Manikandan et al. 2006).

According to Sasidharan (2004), *Artemisia nilagirica* (C.B.Clarke) Pamp. and *Globba sessiliflora* Sims are endemic to Peninsular India, followed by *Ochlandra beddomei* Gamble, and *S. aromaticum* (L.) Merr. & L.M.Perry are endemic to the southern Western Ghats. In addition, *Argyreia cuneata* (Willd.) Ker Gawl. is endemic to South India, and *Neonotonia wightii* is endemic to Western Ghats.

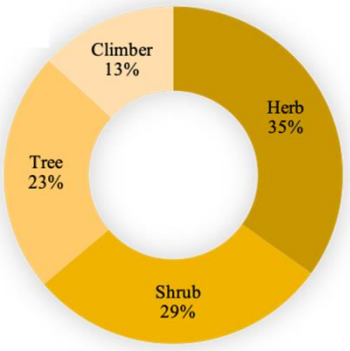

Figure 2. The analysis of habit-wise composition

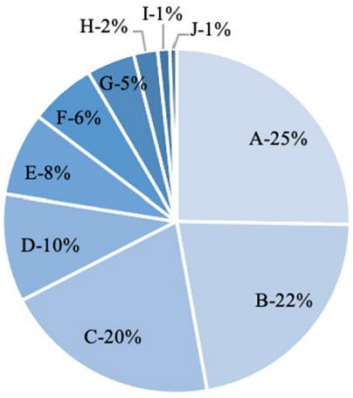

Figure 3. The utilization of plant species in the study. Note: A: Leaf, B: Fruit, C: Whole Plant, D: Flower, E: Root, F: Seed, G: Rhizome, H: Stem, I: Bark, J: Tuber

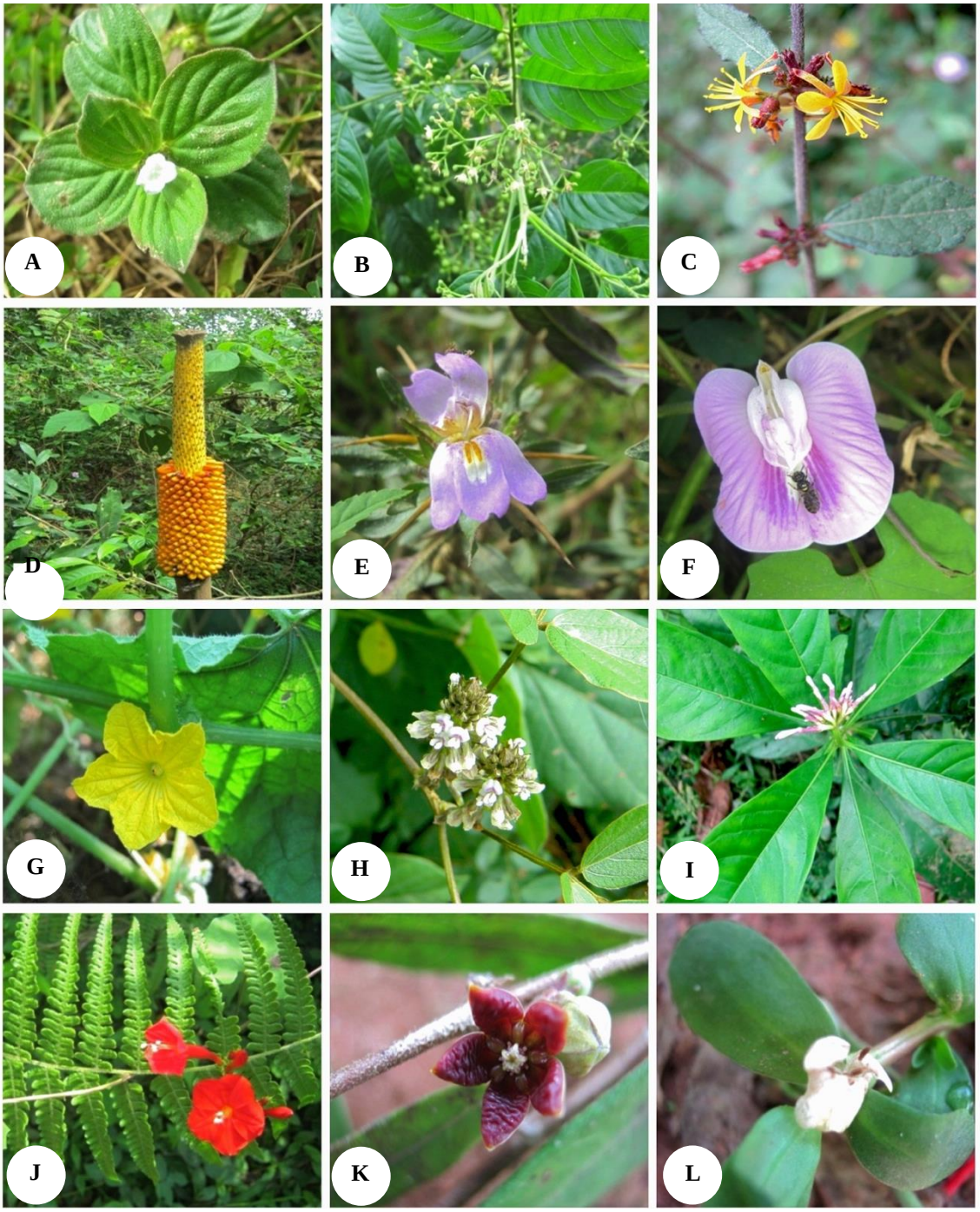

Figure 4. Selected medicinal herbs from the study area. A. *Spermacoce latifolia* Aubl., B. *Cipadessa baccifera* (Roth) Miq., C. *Triumfetta rhomboidea* Jacq., D. *Amorphophallus paeoniifolius* (Dennst.) Nicols, E. *Hygrophila schulli* (Buch-Ham.) M.R & S.M., F. *Centrosema pubescens* Benth., G. *Citrullus colocynthis* (L.) Schrad., H. *Neonotonia wightii* (Wight & Arn.) J.A.Lackey, I. *Rauvolfia serpentina* (Linn.) Benth. Ex Kurz, J. *Ipomoea hederifolia* L., K. *Hemidesmus indicus* (L.), L. *Bacopa monnieri* (L.) Wettst

In Wayanad, Kerala, Silja et al. (2008) reported that 136 plant species for traditional medicine purposes are used by the Mullu kurumas (=Mullukurumba) tribe. Similarly, medicinal plants are used for different ailments and purposes; mainly, plants are used for curing asthmatic bronchial diseases, skin diseases, urinary complaints and kidney stones, anemia, treating inflammation, dandruff control, jaundice, epilepsy, leucorrhoea, leprosy, burns and wounds, piles and constipation, abortifacient, malaria, migraine, and tuberculosis.

Similarly, Ramachandran and Udhayavani (2013) reported 123 wild edible plant species used by the ethnic community of Paniyas and Kurumbas in Pandalur and Gudalur taluk. The plant species of less known or unknown medicinal uses were reported for 36 species from these regions. Some of the species were not shown much interest by the community in Kallichal area, species such as *Acronychia pedunculata* (L.) Miq., *Amaranthus graecizans*

L., *Aporosa cardiosperma* (Gaertn.) Merr., *Bidens Pilosa* L., *Boussingaultia baselloides* Kunth., *Brassica juncea* (L.) Czern., *Bridelia retusa* (L.) A.Juss., *Caesalpinia mimosoides* Lam., *Caryota urens* L., *Cinnamomum iners* (Reinw. ex Nees & T.Nees) Blume, *Colocasia esculenta* (L.) Schott, *Diplazium esculentum* (Retz.) Sw., *Elaeagnus kologa* Schltdl., *Eryngium foetidum* L., *Hibiscus hispidissimus* Griff., *Osbeckia wynaadensis* C.B.Clarke, and *Vaccinium neilgherrense* Wight.

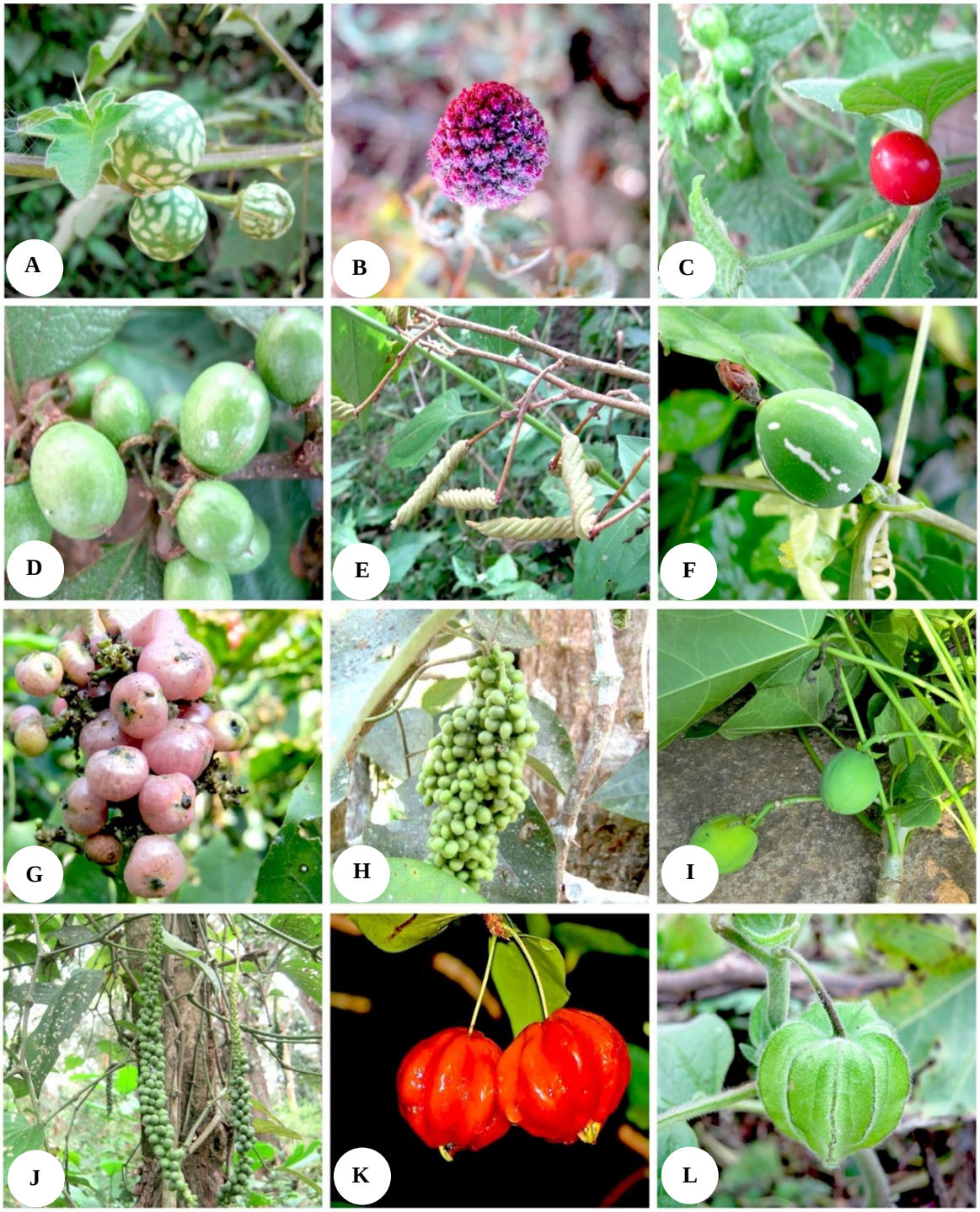

Figure 5. Some medicinal fruits from the study area. A. *Solanum viarum* Dunal, B. *Sphaeranthus indicus* L., C. *Cucumis maderaspatanus* L., D. *Ziziphus oenopolia* (L.) Mill., E. *Helicteres isora* L., F. *Diplocyclos palmatus* (L.) C.Jeffrey, G. *Glycosmis pentaphylla* (Retz.) DC., H. *Cyclea peltata* (Burm.f.) Hook.f. & Thomson, I. *Jatropha curcas* L., J. *Piper argyrophyllum* Miq., K. *Eugenia uniflora* L., L. *Physalis peruviana* L.

Table 1. List of ethnomedicinal plants used by Mullukurumbas, Nilgiris, Western Ghats, India

Family / Scientific Name	Habit	Vernacular / (Partly Used)	Mode of Preparation and Uses
Acanthaceae			
Asystasia gangetica (L.) T.Anderson	S	Upputhaliyan (whole plant)	Juice of the plant is administered to children suffering from swellings and intestinal worms.
Hygrophila auriculata (Schumach.) Heine	S	Vayalchulli (leaf, root)	Decoction of the root and leaf paste is used to stimulate sexual activity.
Justicia glauca Rottler	S	Vadamkolli (leaf)	Leaves are boiled in water and used for bathing to relieve rheumatism.
Rungia pectinata (L.) Nees	H	Kattucheera (leaf)	Leaves are used as vegetables during pregnancy period.
Thunbergia alata Bojer ex Sims	C	Kattumulla (whole plant)	A paste of the whole plant is applied for skin dryness and itching.
Agavaceae			
Agave sisalana Perrine	S	Kallichedi (leaf)	The leaf is used for making house roofs.
Amaranthaceae			
Amaranthus spinosus L.	S	Mullucheera (leaf)	The leaf paste is applied to cure burns and wounds; whole leaves are used as a vegetable.
Cyathula prostrata (L.) Blume	H	Kadaladi (whole plant	The whole plant is boiled with water for bathing to relieve rheumatic pains.
Ouret lanata (L.) Kuntze	H	Cherupoola (leaf, root)	The leaf extract expels kidney stones; the roots are grounded and taken orally to treat jaundice.
Alternanthera sessilis (L.) DC.	H	Ponnankanni cheera (leaf, stem)	The leaves and shoots are used as a vegetable.
Anacardiaceae			
Mangifera indica L.	T	Mangai (whole plant)	Fruits are eaten raw and made pickled. Leaves are used in rituals.
Annonaceae			
Annona reticulata L.	T	Seetha (whole plant)	Fruits eaten raw, leaf decoction consumed for dysentery.
Apiaceae			
Centella asiatica (L.) Urb.	H	Muthil (leaf)	Leaves are eaten raw to improve memory power.
Pimpinella heyneana (DC.) Benth. & Hook.f.	H	Kattuaymodakam (seed)	The seed extract is used to cure stomach pain
Centella asiatica (L.) Urb.	H	Vallara cheera (leaf)	Fresh leaves are consumed for wound healing and to boost neuro health.
Apocynaceae			
Cascabela thevetia (L.) Lippold	S	Arali chedi (flower)	Flowers are used for rituals.
Plumeria alba L.	T	Kadangala poovu (flower)	Flowers are used for rituals.
Asclepias curassavica L.	S	Sonipoovu (whole plant)	The whole plant is used in mesmerizing activity.
Hemidesmus indicus (L.) R.Br.	C	Nannari (root)	Fresh root extracts treat dysentery and act antidote for snake bites.
Rauvolfia serpentina (L.) Benth. ex Kurz	H	Sarpaganthum (root)	Fresh root extracts treat dysentery and act antidote for snake bites.
Araceae			
Amorphophallus paeoniifolius (Dennst.) Nicolson	S	Kattuchena (rhizome)	Corms are boiled without adding salt and eaten to cure bleeding piles.
Alocasia macrorrhizos (L.) G.Don	H	Yannacheppa (rhizome)	Rhizomes edible, used as vegetable.
Caryota urens L.	T	Kattupana (leaf)	Leaves are used to build huts.
Areca catechu L.	T	Arikka (seed)	Areca nut is chewed with beetle leaf for dyspepsia; dry leaves and wood are used to make handicrafts.
Asparagaceae			
Asparagus racemosus Willd.	C	Umicheekal (root)	Leaf paste is applied to heal foot cracks.
Asteraceae			
Acmella calva (DC.) R.K.Jansen	H	Palluvedana chedi (flower)	The flowers are eaten raw to cure toothache.
Ageratum houstonianum Mill.	H	Appala (leaf)	Leaf pastes are used for wound healing.
Artemisia nilagirica (C.B.Clarke) Pamp.	S	Malechi (leaf)	Leaf pastes are used to cure malaria.
Baccharoides anthelmintica (L.) Moench	H	Kattujeerakam (seed)	Seeds are ground with milk or water and drank to cure stomach aids.

Chromolaena odorata (L.) R.M.King & H.Rob.	S	Kammunist pacha (leaf)	Grounded leaves are applied for wound healing.
Cyanthillium cinereum (L.) H.Rob.	H	Poovamkurunnal (whole plant)	The plant extract is drunk orally for blood purification and fever and acts antidote for scorpion bites.
Eclipta prostrata (L.) L.	H	Kaiyonni (leaf, stem)	Dried leaves and stems are added into oil and used for premature grey hair.
Elephantopus scaber L.	H	Anachavitti (whole plant)	The juice of the whole plant is used to control asthmatic cough.
Sphaeranthus indicus L.	H	Adakkamani (flower)	Flower paste is used to remove skin parasites from cattle and pets.
Tithonia diversifolia (Hemsl.) A.Gray	S	Suryakanthi (flower)	Flower paste is used to remove skin parasites from cattle and pets.
Basellaceae			
Basella alba L.	H	Pasella (leaf)	Leaves are edible, used to control hemorrhoids and improve constipation.
Bignoniaceae			
Oroxylum indicum (L.) Kurz	T	Vellapathiri (whole plant)	One of the herbs in dasamoola is used for arthritis, diabetes, and respiratory diseases.
Boraginaceae			
Cynoglossum zeylanicum (Sw. ex Lehm.) Thunb. ex Brand	H	Mudichilooram (root)	Fresh root extracts are mixed in hot water and taken orally for 2-3 days against diarrhea.
Cannaceae			
Canna indica L.	S	Menthoni (rhizome)	Rhizome powder is consumed with hot water or soup as an energy booster.
Caricaceae			
Carica papaya L.	T	Pappali (leaf, fruit)	Consumption of fruit helps to control leukemia and improves eyesight; leaf decoction is used to control malarial fever.
Caryophyllaceae			
Drymaria cordata (L.) Willd. ex Schult.	H	Puliyarila (whole plant)	Juice of the whole plant is drunk to regulate digestion.
Clusiaceae			
Garcinia gummi-gutta (L.) Roxb	T	Kodampuli (fruit)	Dried fruit is used as a flavoring agent and helps with gastrointestinal ailments.
Combretaceae			
Terminalia bellirica (Gaertn.) Roxb.	T	Thannika (fruit)	Fruit powder is used for the common cold and toothache.
Commelinaceae			
Cyanotis cristata (L.) D.Don	H	Kannjai (whole plant)	Whole plant paste is applied to the forehead to cure headaches.
Convolvulaceae			
Argyreia cuneata (Willd.) Ker Gawl.	S	Kattukuzhalan poovu (flower)	Flowers are used in rituals and ceremonies.
Ipomoea hederifolia L.	C	Devathali (whole plant)	The whole plant extract is taken orally to overcome infertility.
Cucurbitaceae			
Citrullus colocynthis (L.) Schrad.	C	Attanga (fruit)	Whole fruit is cut and kept in the infected nail or finger to cure inflammations.
Cucumis maderaspatanus L.	C	Velisemattha (stem)	Young shoots are eaten raw to improve appetite.
Cucumis melo L.	C	Kattupeechinga (fruit)	Fruits are edible; used as a vegetable.
Diplocyclos palmatus (L.) C.Jeffrey	C	Kuriyankay (fruit)	Shade-dried fruits are roasted and consumed without seeds as a supplement.
Momordica charantia L.	C	Kaippa (whole plant)	Juice of the whole plant is used to control diabetes, respiratory diseases, and anemia.
Cyperaceae			
Cyperus dubius var. *dubius*	H	Muthanga (whole plant)	The whole plant is boiled in water with garlic, and the concoction is drunk to control dysentery.
Dioscoreaceae			
Dioscorea pentaphylla L.	C	Cheethukizhangu (rhizome)	Rhizomes are used as a vegetable; helps with rheumatism and arthritis problem.
Euphorbiaceae			
Jatropha curcas L.	S	Kattavanak (seed)	The oil is extracted from the seeds and mixed with coconut oil to promote hair growth.
Ricinus communis L.	S	Avanakku (root, seed)	The root powder is used in leprosy control; seed oil is used to treat liver disease.
Manihot esculenta Crantz	S	Kappakizhangu (tuber)	Tubers are cooked and eaten as the main food to enrich carbohydrates and fiber.

Fabaceae			
Cassia fistula L.	T	Kattukonna (whole plant)	Leaf paste and bark decoction are used to cure skin diseases.
Centrosema pubescens Benth.	C	Poombattapayar (whole plant)	Whole plant paste is used as an antidote for insect bites.
Crotalaria pallida Aiton	H	Kilukilukki (stem, seed)	Stem fiber is used for threading material. Ripen seeds are roasted and used as substituted for coffee.
Crotalaria prostrata Rottler ex Willd.	H	Kulukunchi (whole plant)	The whole plant paste is applied to control body itching.
Flemingia strobilifera (L.) W.T.Aiton	T	Sankuruni (root)	Root decoction is taken orally to reduce fatigue and chest pain.
Mimosa pudica L.	H	Thottavadi (root)	Root decoction is used to treat urinary disorders.
Moullava spicata (Dalzell ex Wight) Nicolson	S	Kumulmullu (flower)	Flowers are eaten raw, and paste is used as an antidote for snakebite.
Neonotonia wightii (Wight & Arn.) J.A.Lackey	C	Kattu uzhunnu (seed)	Seeds are ground with water and eaten for general health benefits.
Pseudarthria viscida (L.) Wight & Arn.	C	Kannadi (seed)	Seeds are crushed, and paste is applied to prevent pimples.
Senna tora (L.) Roxb.	H	Thakara (leaf)	Leaves are consumed as a vegetable.
Sesbania bispinosa (Jacq.) W.Wight	S	Agathi (flower, seed)	Flower extracts are used to cure leucorrhoea, and the seed paste is used to treat liver disorders.
Tadehagi triquetrum (L.) H.Ohashi	H	Kattusangupushpam (leaf)	Tender leaves are used as vegetables to regulate menstrual problem
Pterocarpus marsupium Roxb.	T	Venggamara (whole plant)	Leaf paste and latex are used for skin diseases.
Flacourtiaceae			
Scolopia crenata (Wight & Arn.) Clos	T	Challurpazham (fruit)	Ripened fruits are eaten raw.
Hypoxidaceae			
Curculigo orchioides Gaertn.	H	Nilapana (rhizome)	Rhizome paste is taken orally with milk to treat diabetes and tonsillitis.
Juglandaceae			
Juglans regia L.	T	Vallunatkotta (fruit, seed)	Fruit and seed extract is used for toothache and intestine disorders.
Lamiaceae			
Clerodendrum infortunatum L.	S	Vattaparuvelam (leaf)	Leaf extract is used for asthma, cough, diarrhea, and rheumatism.
Lantana camara L.	S	Chulli (fruit)	Ripened fruits are eaten raw.
Leucas aspera (Willd.) Link	H	Thumba (flower)	Flower extract is used to treat jaundice.
Leucas biflora (Vahl) Sm.	H	Kattuthumba (whole plant)	Oil is extracted from the whole plant and used to control itching.
Mesosphaerum suaveolens (L.) Kuntze	H	Kattuchulli (leaf, flower)	The leaves and flowers are ground and applied to the forehead to cure headaches.
Ocimum gratissimum L.	S	Kattuthulasi (whole plant)	Leaf extract is consumed to cure headaches, coughs, colds, and fever.
Lauraceae			
C*innamomum camphora* (L.) J.Presl	T	Lavanga (leaf, bark)	Used as a whole spice.
Lilliaceae			
Gloriosa superba L.	C	Onapoovu (flower)	Flowers are used in rituals and ceremonials.
Lobeliaceae			
Lobelia nicotianifolia Roth	S	Kattupukayila (leaf)	The leaf paste is used as an antiseptic agent, and the extract is used for bronchial problems.
Lythraceae			
Lawsonia inermis L.	S	Milanchi (leaf)	Dried leaf powder mixed with coconut oil and applied for premature and grey hair.
Malvaceae			
Azanza lampas (Cav.) Alef.	S	Kattuvenda (root, fruit)	Root extract and fruit juice are used to cure mouth ulcers.
Hibiscus rosa-sinensis L.	S	Chemparuthi (leaf, flower)	Leaf extract is used for hair shampoo, skin disorders, and burning sensation, mainly for children.
Sida acuta Burm.f.	H	Anakurunthotti (whole plant)	Crushed leaves are used to promote the healing of bone fractures. Dried plants are used as broomsticks.
Sida rhombifolia subsp. *alnifolia* (L.) Ugbor.	H	Vattakurunthoti (root)	Root extracts are taken orally to cure uterine disorders.
Urena lobata L.	S	Oorakam (flower)	Flower extract is used for controlling cough and healing sore throat.
Melastomataceae			
Melastoma malabathricum L.	S	Thotukarapoo (leaf, flower)	Leaf and flowers are used in rituals and sacred grooves.

Meliaceae			
Cipadessa baccifera (Roxb. ex Roth) Miq.	S	Kaippanarachi (leaf)	Leaf paste is used to arrest bleeding in cuts and wounds.
Azadirachta indica A.Juss.	T	Veppuella (whole plant)	Leaves and fruits are used for several ailments.
Melia azedarach L.	T	Kattuveppu (leaf)	Leaf decoction is used to cure malarial fever.
Menispermaceae			
Cyclea peltata (Burm.f.) Hook.f. & Thomson	C	Padakizhangu (root)	The consumption of root extract helps in purifying blood.
Mimosaceae			
Senegalia rugata (Lam.) Britton & Rose	T	Cheenikka (seed)	Seed powder is used to take baths for skin diseases.
Moraceae			
Ficus benghalensis L.	T	Peral (fruit)	Ripened fruits are eaten raw.
Ficus racemosa L.	T	Athipazham (fruit)	Ripened fruits are eaten raw.
Artocarpus heterophyllus Lam.	T	Chakka (fruit)	Ripened fruits are eaten raw.
Artocarpus hirsutus Lam.	T	Aynichaka (fruit)	Ripened fruits are eaten raw.
Morus alba L.	S	Kamblipoochedi (leaf, fruit)	Leaves are used for skin rashes, and fruits are eaten for anemia.
Moringaceae			
Moringa oleifera Lam.	T	Muringa (whole plant)	The whole plant is used as a vegetable.
Myrtaceae			
Psidium guajava L.	T	Mambazham (fruit)	Ripened fruits are eaten raw.
Syzygium cumini (L.) Skeels	T	Njaval (fruit)	Ripened fruits are eaten raw.
Syzygium jambos (L.) Alston	T	Maduranelli (fruit)	Ripened fruits are eaten raw.
Eugenia uniflora L.	T	Aranelli (fruit)	Ripened fruits are eaten raw.
Syzygium aqueum (Burm.f.) Alston	T	Chambaika (fruit)	Ripened fruits are eaten raw.
Syzygium aromaticum (L.) Merr. & L.M.Perry	T	Kirambuchedi (flower, bark)	Dried fruit is used as a whole spice.
Onagraceae			
Ludwigia perennis L.	S	Sidi (leaf)	The dried leaves are mixed with coconut oil and applied for smallpox.
Biophytum sensitivum (L.) DC.	H	Mukkuthi (whole plant)	The plant is grounded and consumed to relieve the menstrual pain; and used as an antidote for snakebite.
Oxalidaceae			
Oxalis corniculata L.	H	Pulichakeera (leaf, flower)	Leaves and fruits are edible.
Oxalis latifolia Kunth	H	Nilapulikeera (leaf, flower)	Leaves and fruits are edible.
Passifloraceae			
Passiflora subpeltata Ortega	C	Thattbotpal (fruit)	Fruits are edible and eaten raw.
Phyllanthaceae			
Phyllanthus emblica L.	T	Nelli (fruit)	Fruits are eaten raw and also pickled.
Phyllanthus reticulatus Poir.	S	Amari (leaf, stem)	Leaf paste is applied to cure the burning sensation; tender stems are used to make baskets.
Phyllanthus urinaria L.	H	Keezharnelli (whole plant)	The leaf paste is applied to the throat to cure tonsils.
Breynia androgyna (L.) Chakrab. & N.P.Balakr.	H	Peruneruri (leaf)	Used as a leafy vegetable.
Piperaceae			
Peperomia pellucida (L.) Kunth	H	Kodithutha (whole plant)	Paste of the whole plant is used to cure itching and leprosy.
Piper argyrophyllum Miq.	C	Kattukurumulaku (root)	Crushed roots are chewed and kept aside to cure toothache.
Piper umbellatum L.	S	Kattuveraku (leaf)	In the morning, leaves are ground and taken on an empty stomach to cure piles.
Piper betle L.	C	Veetilla (leaf)	Leaves chewed with areca nut as a stimulant.
Piper nigrum L.	C	Kurumulaku (fruit)	Dry fruits are used as whole spices.
Plantaginaceae			
Bacopa monnieri (L.) Wettst.	H	Brahmi (whole plant)	Whole plant extract is consumed with honey to reduce obesity and improves memory power.
Scoparia dulcis L.	H	Kalluruki (whole plant)	The whole plant is ground as a paste and consumed for expelling kidney stones.

Poaceae			
Bambusa bambos (L.) Voss	H	Mula (leaf)	Tender leaf extracts are used to cure irregular menstrual problems and used to treat spasmodic muscle contraction.
Cenchrus purpureus (Schumach.) Morrone	H	Tharippapullu (whole plant)	The whole plant is used for making house roofs.
Cynodon dactylon (L.) Pers.	H	Karkampullu (whole plant)	Whole plants are used in rituals and ceremony.
Ochlandra beddomei Gamble	H	Ooda (leaf, fruit)	Stem is used to make handcraft products and to build huts as thatching material.
Coix lacryma-jobi L.	H	Kattukotamani (whole plant)	Plants are used in rituals and ceremonies.
Polygonaceae			
Persicaria chinensis (L.) H.Gross	S	Chorathandan (fruit)	Ripened fruits and tender shoots are eaten raw.
Rhamnaceae			
Ziziphus oenopolia (L.) Mill.	T	Karingotta (fruit)	Ripened fruits are eaten raw.
Ziziphus rugosa Lam.	T	Vellakotta (fruit)	Ripened fruits are eaten raw.
Rosaceae			
Rhaphiolepis bibas (Lour.) Galasso & Banfi	T	Loqukaai (fruit)	Fruits are edible and used for refreshment.
Ixora coccinea L.	S	Thechi (flower)	Flowers are used for rituals and ceremonies.
Rubiaceae			
Spermacoce latifolia Aubl.	H	Tharthaval (whole plant)	Whole plant paste is used to cure heat boils.
Glycosmis pentaphylla (Retz.) DC.	S	Panal (root, fruit)	Root paste is mixed with goat milk and applied to the forehead to cure sinusitis; fruits are edible.
Rutaceae			
Naringi crenulata (Roxb.) Nicolson	T	Narinarakam (fruit)	Ripened fruits are eaten raw.
Ruta graveolens L.	H	Arudha (leaf)	The leaf is grounded and given to children to cure fever.
Morinda citrifolia L.	T	Nunakaai (leaf, fruit)	Leaf and fruit juice are used for body nourishment.
Murraya paniculata (L.) Jack	S	Kattukaruvepu (leaf)	Leaves paste is used for a hair pack.
Citrus maxima (Burm.) Merr.	S	Naringa (leaf, fruit)	Leaves are used as a dry spice, and fruits are used to make pickles.
Sapindaceae			
Cardiospermum halicacabum L.	C	Uzinja (whole plant)	The extract of the whole plant is used to control asthma.
Solanaceae			
Capsicum frutescens L.	S	Mulaku (leaf, fruit)	The leaf is used as a vegetable; fruit is used as a carminative.
Datura innoxia Mill.	S	Ummamkay (whole plant)	Plant extract cures cardiac disease, intestine problems, and rabies.
Physalis peruviana L.	H	Muttilpazhum (fruit)	Ripened fruits are eaten raw.
Solanum lycopersicum L.	H	Kattuthakali (whole plant)	Leaf extract controls asthma and cures eye diseases; ripened fruits are eaten.
Solanum torvum Sw.	S	Putharichunda (fruit)	Fruit powder is used to treat intestinal ulcers.
Solanum viarum Dunal	S	Kandakarichunda (fruit)	Fruit powder is used to treat asthma.
Solanum villosum Mill.	S	Ganikkachappu (leaf, fruit)	Whole plants are used as leafy vegetables, and ripened fruits are eaten raw.
Solanum nigrum L.	H	Ganikkachu (leaf, fruit)	Whole plants are used as leafy vegetables, and ripened fruits are eaten raw.
Sterculiaceae			
Helicteres isora L.	S	Valampiri idampiri (fruit)	Dried fruits are added to the coconut oil and later applied to promote hair growth.
Tiliaceae			
Triumfetta rhomboidea Jacq.	S	Oorapam (whole plant)	The whole plant is used as a broomstick.
Zingiberaceae			
Globba sessiliflora Sims	H	Malainji (rhizome)	Rhizome extract is used for gastric chest pain.
Zingiber wightianum Thwaites	H	Katuinji (rhizome)	The rhizome is used to make pickles.
Globba marantina L.	H	Kattumanja (leaf, rhizome)	Rhizome extract is used for indigestion problems.

Notes: H: Herb, S: Shrub, C: Climber, T: Tree

Therefore, medicinal plants of different ethnic communities, such as Kota, Toda, Irula, Paniya, and Kattunayak and have been reported in Nilgiris by several authors (Cyril et al. 1993; Mandal and Basu 1996; Rajan et al. 2003; Manikandan 2005; Udayan et al. 2007). Sathyanarayanan and Chandra (2013a,b) reported the occupational transformation that happened among the Alukurumbas of Nilgiris with the modern urbanization of the landscape, followed by Sejin (2019), who reported the socio-economic life of Kurumbas in Nilgiris, including culture and rituals, which they focus for many decades.

Deepak and Gopal (2014) listed 25 plant species mainly used for dermatology diseases practiced by Kurumba Tribes in Coonoor, Kotagiri, and Kundah taluks of Nilgiris. The medicinal plants locally available in and around the village are mostly used for skin rashes, burns, warts, pimples, cuts, and wounds. Saradha et al. (2017) reported 56 medicinal plants used by Kurumbas in the Chemmankarai village of Nilgiris, and the mode of medicinal plant utilization was taken generally by oral application with 58%, and external application with 41% and nasal or inhaler and steaming by 1% only.

The knowledge of wild edible plants and their potential value strongly relates to the community people for daily consumption. Most people living in rural parts of the Western Ghats have highlighted the advantages of the medicinal plants found on and around local people's homeland biodiversity. However, most popular medicinal plants are extensively dispersed and accessible in metropolitan settings, where they may be used and vigorously promoted for long-term health advantages. The present study indicates that exploring medicinal plants and their ornamental potential value in large landscapes should be designed for pharmacognosy and nanotechnology conservation in the country.

In conclusion, an updated list of the medicinal plants used among the Mullukurumba Tribe is presented in this study. In the 21st century, ethnobotany has been recognized as a separate field of natural science, and there is growing interest in investigating how people and plants interact in the natural world. Ethno-botanists can be useful in preventing the disappearing knowledge and returning it to local communities. This interrelationship has evolved over generations of experience and practices. Presently ethnobotany has become an important discipline of research and development in resource management, biodiversity conservation, and the region's socio-economic development. Therefore, best practices on propagation and preservation techniques of medicinal plants can be developed among the self-help groups with the support of the forest department and district stakeholders. In this context, it is recommended that the previous and current literature on indigenous knowledge can be patented, and further investigations on medicinal plant diversity need to be upgraded with mapping techniques for the possibility of extinction of rare or endemic species in the future.

ACKNOWLEDGEMENTS

We are grateful to R. Rajesh, a field botanist in Kallichal, India, who helped in the study. We also thank Maathan, chief of the tribal colony, for his support. The author (CS) thank the school management for their support and encouragement to complete the project. The author (SJ) thank Manjunath J, Mukthar Rahim A, and Sudandra Kumar, for their great support during the study. All authors have declared no potential conflict of interest.

REFERENCES

Arinathan V, Mohan VR, John de Britto A, Chelladurai V. 2003. Studies on food and medicinal plants of Western Ghats. J Econ Taxon Bot 27: 750-753.

Ayyanar M, Ignacimuthu S. 2005. Medicinal plants used by the tribals of Tirunelveli hills, Tamil Nadu to treat poisonous bites and skin diseases. Indian J Tradit Knowl 4 (3): 229-236. DOI: 10.4172/2167-1206.1000140.

Ayyanar M. 2013. Traditional herbal medicines for primary healthcare among indigenous people in Tamil Nadu, India. J Homeop Ayurv Med 2 (5): 1-7.

Census 2011. Census of India. Government of India, New Delhi.

Champion HG, Seth SK. 1968. A Revised Survey of the Forest Types of India. Manager of Publications, New Delhi, India.

Cyril MN, Pushparaj MS, Rajan S. 1993. Less known edible fruit - Yielding plants of Nilgiris. Anci Sci Life 12 (3&4): 363-376.

Deepak P, Gopal CV. 2014. Ethnomedicinal practices of Kurumba Tribes, Nilgiris District, Tamil Nadu, India, in treating skin disease. Glob J Res Med Plants India Med 3 (1): 8-16.

Dutta BK, Dutta PK. 2005. Potential of ethnobotanical studies in North East India: An overview. Indian J Tradit Knowl 4 (1): 7-14.

Fyson PF. 1915. The Flora of Nilgiri and Pulney Hill Tops. Superintendent, Government Press, Madras.

Gamble JS, Fischer CEC. 1915-1936. Flora of Presidency of Madras. 3 Vols. Adlard and Sons Ltd., London. DOI: 10.5962/bhl.title.21628.

Hosagowder VB, Henry AN. 1996. Ethnobotany of the tribes Irular, Kurumbar, and Paniyas of the Nilgiris in Tamil Nadu Southern India. J Econ Taxon Bot 12: 272-283.

Jain SK. 1991. Dictionary of Indian Folk Medicine and Ethnobotany. Deep Publications, New Delhi.

Jeevith S, Manjunath J. 2023. Urban trees of Nilgiris District, Tamil Nadu, India. Biod Res Conserv 69: 1-12.

Mandal SK, Basu SK. 1996. Ethnobotanical studies among some tribals of Nilgiris District, Tamil Nadu. J Econ Taxon Bot 12: 268-271.

Manikandan APN. 2005. Folk herbal medicine: A survey on the Paniya Tribes of Mundakunnu Village of the Nilgiris Hills, Southern India. Anci Sci Life 25 (1): 21-27.

Manikandan, APN, Jayendran, M, Rajasekaran CS. 2006. Study of plants used as anti-diabetic agents by the Nilgiris aborigines. Anci Sci Life 25 (3&4): 101-103.

Narayanan RMK, Mithunlal S, Sujanapal P, Anil Kumar AN, Sivadasan M, Alfarhan AH, Alatar AA. 2011. Ethnobotanically important trees and their uses by Kattunaikka tribe in Wayanad Wildlife Sanctuary, Kerala, India. J Med Plants Res 5 (4): 604-612.

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

Rajan S, Baburaj DS, Sethuraman M. 2001. Indigenous folf practices among Paniyas of Nilgiris District, Tamil Nadu, India. J Med Arom Plant Sci 23: 602-606.

Rajan S, Jayendran M, Sethuraman M. 2003. Medico-ethnobotany: A study on the Kattunayaka Tribe of Nilgiri Hills, Tamil Nadu. Nat Reme 3 (1): 68-72.

Rajan S, Sethuraman M, Mukherjee PK. 2002. Ethnobiology of the Nilgiri Hills, India. Phyto Res 16 (2): 98-116. DOI: 10.1002/ptr.1098.

Ramachandran VS, Udhayavani C. 2013. Knowledge and uses of wild edible plants by Paniyas and Kurumbas of Western Nilgiris, Tamil Nadu. Indian J Nat Prod Res 4 (4): 412-418.

Saradha M, Bharathi GD, Paulsamy S. 2017. Ethnobotanical study of knowledge and medicinal plants use by the Kurumba Tribes in Chemmankarai, Nilgiris District, Tamil Nadu. Kongunadu Res J 4 (2): 136-146. DOI: 10.26524/krj214.

Saradha M, Samydurai P, Jeevith S, Panneerselvam K. 2016. Traditional knowledge of cultivated cereals for their food security in rular tribe of Palamalai Hills, a part of Westen Ghats of Coimbatore, Tamil Nadu, India. Intl J Bioresour Sci 3 (1): 65-68. DOI: 10.5958/2454-9541.2016.00007.4

Sasidharan N. 2004. Biodiversity Documentation for Kerala Part 6: Flowering Plants. Kerala Forest Research Institute, Kerala.

Sathyanarayanan CR, Nirmal C. 2013a. Traditional life, livelihood and plantations: A study among the Mullu Kurumba. J Anthropol Surv India 61 (1): 595-615.

Sathyanarayanan CR, Nirmal C. 2013b. The lost landscape and livelihood: A case study of the Alu Kurumba of Nilgiris, Tamil Nadu. J Anthrol Surv India 62 (2): 821-850.

Sejin V. 2019. Socio-economic life of the Kurumbas in Nilgiris. Pramana Res J 9 (3): 61-64.

Sharma BD, Shetty BV, Vajravelu E, Kumari GR, Vivekanathan K, Chandrabose M, Swaminathan MS, Chandrasekaran R, Subbarao GV, Ellis JL, Rathakrishnan NC, Karthikeyan S, Chandrasekaran V, Srinivasan SR. 1977. Studies on the Flora of Nilgiris, Tamil Nadu. Biological Memoirs Vol.2 No. 1 & 2. International Publishers, Lucknow.

Silja VP, Varma SK, Mohanan KV. 2008. Ethnomedicinal plant knowledge of the Mullukuruma Tribe of Wayanad District, Kerala. Indian J Tradit Knowl 7 (4): 604-612.

Udayan PS, Tushar KV, George S, Balachandran I. 2007. Ethnomedicinal information from Kattunayakas Tribes of Mudumalai Wildlife Sanctuary, Nilgiris District, Tamil Nadu. Indian J Tradit Knowl 6 (4): 574-578.

Vijeesh P, Velumani K. 2011. Use of ethnomedicinal plants among Mullukuruma Tribe of Wayanad District, Western Ghats, Kerala, India. Plant Arc 2 (1): 193-200.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 6, Number 2, November 2023
Pages: 127-136

E-ISSN: 2580-4510
DOI: 10.13057/asianjethnobiol/y060203

Short Communication: Ethnobotanical study of medicinal plants used to treat livestock ailments in Dallo Manna District, Oromia State, Ethiopia

AWAL HUSSIEN GOBANA[1], HABTE TELILA[1], SUFIAN ABDO JILO[2,♥]

[1]Department of Ecotourisms and Biodiversity Conservation College of Agriculture and Natural Resources Madawalabu University. Bale, Ethiopia
[2]School of Veterinary Medicine College of Agriculture and Veterinary Medicine, Jimma University. Jimma, Ethiopia. Tel.: +251912753947,
♥email: sufianabdojilo@gmail.com

Manuscript received: 24 May 2023. Revision accepted: 12 September 2023.

Abstract. *Gobana AH, Telila H, Jilo SA. 2023. Short Communication: Ethnobotanical study of medicinal plants used to treat livestock ailments in Dallo Manna District, Oromia State, Ethiopia. Asian J Ethnobiol 6: 127-136.* Historical information on the use of medicinal plants is in danger of extinction due to changes in different parts of the world, including Ethiopia. This study aimed at the ethnobotanical analysis of medicinal plants used to treat animal diseases. Data were collected through semi-structured interviews with the selected informant sources. Analysis of ethnobotanical data used the Informant Consensus Factor (ICF), preference ranking, ranking matrix, and calculating the degree of fidelity. Dallo Manna Region was reported to have all 68 medicinal plant species used to treat veterinary diseases. The most common family is Fabaceae (7 spp.), followed by Euphorbiaceae (5 spp.), Asteraceae (5 spp.), and Solanaceae (4 spp.). The local people generally used the root, followed by leaves, seeds, and stems, to prepare drugs for treating livestock diseases. All medicine is made and used immediately; some are boiled and dried. In addition, the most common route of administration for treating animal diseases in the study area is oral, followed by topical application and nasal. The highest consensus criteria (ICF) values were recorded in ophthalmology, followed by dermatology. Most species have been reported for treating gastrointestinal disorders, followed by species for treating skin diseases and fever. Ten participants compared nine herbs used to treat veterinary diseases to determine their rankings. *Hagenia abyssinica* (Bruce) J.F.Gmel. in the first place, then this was followed by *Zingiber officinale* Roscoe and *Embelia schimperi* Vatke in third place, which achieved the highest value among traditional medicinal plants. The main threats to veterinary medicinal plants are overharvesting of available species, agricultural land expansion, and less attention to traditional medicine due to modernization.

Keywords: Dallo Manna, ethnobotany, livestock ailments, oral administration, roots

INTRODUCTION

Ethnoveterinary medicine refers to people's knowledge, skills, methods, practices, and beliefs about animal husbandry (Appelgren 2009). Ethnoveterinary knowledge has been acquired through training and traditionally transmitted orally from generation to generation. In the early 1980s, there was an interest in writing and validating ethnoveterinary practice. Since then, a lot of work has been done, many documents have been collected, and many workshops and conferences have been held. Those activities have saved ethnoveterinary knowledge from extinction: most knowledge belongs to the community's elders and is lost after death. Teaching modern culture also causes young people to feel depressed about using their ancestors' beliefs and practices. Although recent efforts have been made to expand the global use of ethnoveterinary knowledge, most information is only recorded in publications and research articles (Toyang et al. 2007). Plant resources have been an essential part of human life throughout history. After meeting their basic needs, such as nutrition and shelter, people began to search for the necessary plant drugs to treat various diseases (WHO 2001). Inadequate animal health services remain the most significant barrier to livestock production in many countries, including Ethiopia. Lack of access to services by farmers also leads to farmers using traditional veterinary medicine and traditional medicine without animal care (Kebede et al. 2014). In sub-Saharan Africa, annual losses due to disease are estimated at US$2 billion, half of which are direct deaths and the other indirect losses from reduced productivity, growth, fertility, and working capacity (De Haan and Bekure 1991). The massive loss of productive land in Africa due to African skin diseases such as trypanosomiasis and dermatophytosis limits the use of more productive animals, including hybrid cattle, improved pigs, and chickens. Trade embargoes are imposed by importing countries because highly contagious diseases create a significant economic burden, reducing trade and foreign exchange. Also, some animal diseases are zoonotic, which means that animal disease control is not only an economic but also a social and political priority. Therefore, disease control programs will continue to be essential to livestock development (Cheneau et al. 2004). According to Sofowora (1982), about 60-85% of developing countries' population must rely on traditional medicine. Traditional medicine practices also exist in China, Japan, Thailand, Pakistan, Sri Lanka, India, and Korea (Park et al. 2012). In

Ethiopia, due to its long history, plants have been used as a source of medicine for many diseases since ancient times and have become a part of traditional medicine culture (Pankhurst 1965). Traditional practices and treatments are found in oral traditions, early religious texts, and pharmacopeias that some historians estimate date back to the 15th century AD (WHO 2001). Ethiopia is home to about 6,000 species of vascular plants, probably due to its unique location and climate (IBC 2005). In this country, approximately 80% of the population and 90% of livestock are drug-dependent (IBC 2005). Ethiopian traditional medicine is often used to treat many diseases of humans and animals. Traditional healers, known by different names in different parts of the country, are important people in traditional medicine (Kassaye et al. 2006). Therefore, this research was initiated to gather information on the uses of traditional medicine from plants in local communities in the Dalo Mana District of Ethiopia for treating their livestock. This study aims to fill this gap in the documentation of traditional health practices for livestock disease, even though people living in the study area are familiar with medicinal plants to treat various animal diseases. However, the spread of agriculture and the dissatisfaction of the youth threaten medicinal plants. Therefore, indigenous knowledge of traditional medicine must be preserved through appropriate knowledge, identification of herbs used, and preparation of medicinal herbs.

MATERIALS AND METHODS

Study area

The Dallo Mana area is located in the Bale region of the Oromia State, Ethiopia and covers an area of approximately 461,665 hectares. It lies between latitudes 5˚51'N and 6˚45'N and east longitudes 39˚35'E and 40˚30'E. The altitude is from 1,314 to 1,508 meters above sea level (masl) (Figure 1).

The precipitation pattern in this area is bimodal, i.e., from mid-March to May (main rainy season) and September to October (short rainy season). The annual average temperature is 29.5˚C, and the annual average precipitation is 1,006.9 mm, which is recorded in the area (Ethiopian National Meteorology Agency 2020) (Figure 2).

The dominant vegetation in the Dallo Manna region is the African mountainous dry forest type, and the area has an ecotone of sub-African alpine and semi-desert ecosystems. Plants include podocarpus, Guinea dandelion, Thayer acacia, Senegal fruit, African cypress, large-ear croton, honeysuckle, great banyan, southern banyan, African plum, Senegalese custard apple and arabica (Frits et al. 2010)

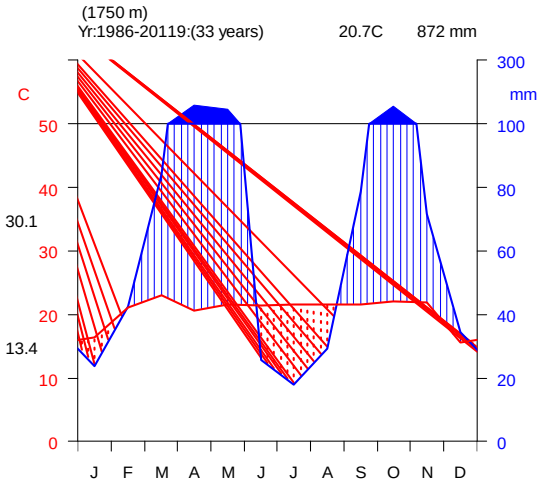

Figure 1. Clima diagram of Dallo Mana Districts, Ethiopia (National Meteorogical Agency Robe Branch)

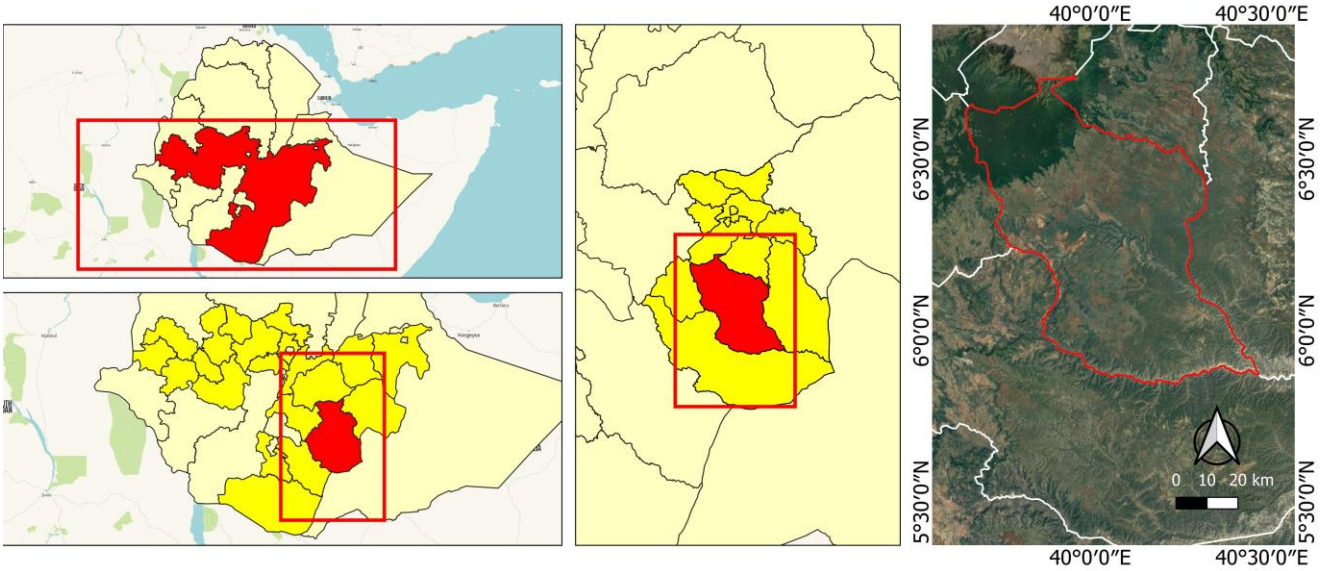

Figure 1. Map of the study area Dallo Mana District, Oromia State, Ethiopia

Sampling design

The survey was conducted from June 2021 to February 2022. The location selection is based on the recommendations of older people, local authorities, and simple access to the area. Therefore, this study was conducted in eight peasant associations from two agro-climatic zones in Dallo Manna, four of which are semi-pastoral and four dry pastoral. We selected 60 participants (41 men and 19 women) in the representative peasant associations. Following Martin (1995), participant representatives and representatives of medical professionals (main participants) in the Delo Mena Region were selected using random and purposive sampling methods, respectively. Twenty key people were deliberately selected based on the advice of knowledgeable elders, city leaders, and development representatives. The selection of key participants also depends on the narrative quality provided by the interview participants. Local healers are key workers and experts who are the guardians of local knowledge about herbs.

Ethnobotanical data collection

The data collection process (Martin 1995) was based on local knowledge of local communities about medicinal plants' health, use, conservation, and threats. The methods used in data collection are semi-structured interviews, group discussions, job training, and participant observation. Semi-structured interviews were based on a list of questions prepared in English and then translated into the language of the study area, Afaan Oromo. Interviews were conducted to cover the main points of the checklist. Meeting places and times are determined according to the interests of the participants. With the help of local guides, the morphological features and habitats of all medicinal plants in the field were determined in situ.

Data analysis

Ethnobotanical data were entered into Excel spreadsheets, analyzed using statistical data, such as percentage and frequency, and presented in tables and figures. In addition, decision preferences and comparisons were used to analyze the data (Alexiades 1996). A preference ranking was made for the five main drugs used to treat sick animals. Ten participants selected by each participating administrator participated in this exercise to determine the best herbs for veterinary use. In a joint comparison, ten participants were selected, and each partner was asked to choose the best product based on their perspective on wound healing. All possible pairs (Heinrich et al. 1998) were obtained using the n formulas (n-1)/2, where n is the number of herbs compared. The most selected items get the highest scores. Direct matrix sorting was used to compare the use of different medicinal plant species based on data collected by the participants to choose several other species from all medicinal plants.

RESULTS AND DISCUSSION

Composition of plant species used to treat animal diseases

Moreover, 68 plant species from 35 families were recorded in the area of Dallo Manna, which treated animals. The most common family is Fabaceae (7 spp.), followed by Euphorbiaceae (5 spp.), Asteraceae (5 spp.), Solanaceae (4 spp.); Three species represent Acanthaceae, Cucurbitaceae, and Rutaceae. The remaining 35 families are represented by only one species (Table 1).

Habits and habitats of plants

Shrubs were the most common habits followed by herbs, trees, and climbers. Most plants identified by traditional healers to administer the drug against livestock ailments were recorded in wild habitats, followed by agricultural fields and home gardens (Figure 3).

Part used, methods of preparation, and route of administration

Root was the most commonly used plant part to prepare remedies against livestock ailments, followed by leaf, seed, and stem (Figure 4). The medications were prepared and utilized freshly; a few were boiled and dried before use. Moreover, the most common route of administration was oral, followed by topical application and through the nose (Figure 4).

Informant consensus factor

The highest number of informants' consensus factor (ICF) values were recorded for Ophthalmological followed by dermatological. The lower informant consensus was recorded for reproductive and unclassified ones. The highest plant use citation was recorded for gastrointestinal diseases, followed by dermatological. Most of the species were reported to be used for treating gastrointestinal disorders, followed by those used to treat dermatological and febrile. The least number of species were recorded for the reproductive system and Ophthalmological disease category (Table 2).

Preference for medicinal plants

A preference ranking of five medicinal plants reported as effective for treating gastrointestinal ailments was conducted after selecting ten key participants. The participants were asked to compare the given medicinal plants based on their efficacy. The results showed that *Hagenia abyssinica* (Bruce) J.F.Gmel. scored the highest mark and ranked first, which indicates it was the most effective in treating gastrointestinal disorders, followed by *Zingiber officinale* Roscoe (Table 3).

Paired comparison

A paired comparison was made among nine plants used to treat livestock disease using ten participants to know their rank. Subsequently, *H. abyssinica* was first in rank, and then *Z. officinale*, the third in rank, was *Embelia schimperi* Vatke (Table 4).

Fidelity levels

Among the claimed traditional medicinal plants, the value of fidelity level of *H. abyssinica* was recorded as the highest, followed by *Nicotiana tabacum* L., *Phyllanthus ovalifolius* Forssk., *Ruta chalepensis* L., and *Santalum album* L. The recorded highest fidelity level value for *H. abyssinica* was found under the gastrointestinal disease category. However, the highest fidelity level value of *N. tabacum* was obtained in the category of wound management. At the same time, the highest fidelity level value of *P. ovalifolius* was for the secondary bacterial infection category (Table 5).

Direct matrix ranking on multipurpose medicinal plants

Nine commonly reported multipurpose medicinal plant species were considered in the Direct Matrix Ranking (DMR) exercise to assess their degree of threat based on their multiple-use reports. Subsequently, *H. abyssinica* was ranked first, followed by *Ekbergia capensis* Sparrm. And *Olea europaea* subsp. *cuspidata* (Wall. & G.Don) Cif. (Table 6).

Threat and conservation of medicinal plants

The primary reported threats to veterinary medicinal plants were overharvesting of available species, agricultural land expansion, and less attention to traditional medicine due to modernization. The primary threat to plants used to treat livestock diseases was mainly related to the parts used in the study area, i.e., the root. Additionally, it has been stated that the necessity for agricultural land has resulted in the loss of plant species' protected habitats. Thus, the threats were classified into direct (killing the species by uprooting through digging) and indirect (clearing significant habitats). On the other hand, some indirect conservation practices were reported in the study areas; these conserved-cultivated veterinary medicinal plants for sale, food, firewood, shade, and fences. In addition, there was a reported seasonal protection of forest patches, which were the primary reported habitats of the species.

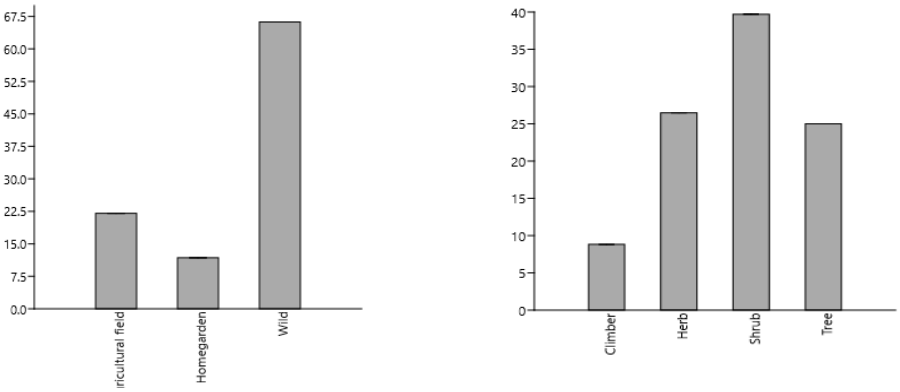

Figure 3. Habitats (A) and growth form (B) of medicinal plants

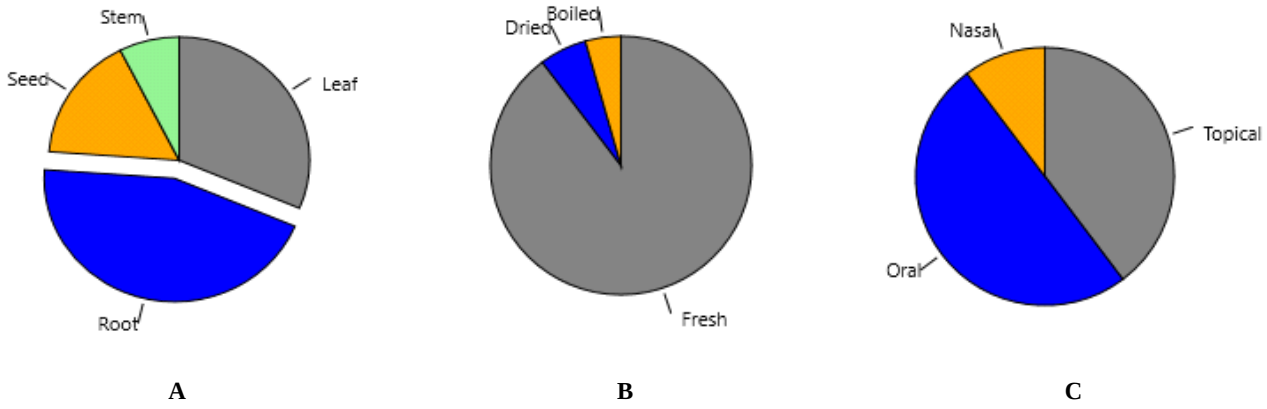

Figure 4. Pie chart showing the parts used (A), preparation (B), and routes (C) of administration

Table 1. Medicinal plant species and their family, local name, growth form, and ways drug formulation and preparation

Scientific Name	Local Name	Family	GF	Habitat	Part Used	Dosage	RA	DT	MP	RM
Acacia mellifera (Vahl) Bosc	Bilaala	Fabaceae	Tree	Wild	Stem	Fresh	Topical	Eye disease	Crushed	Ophthalmological
Albizia ummifera (J.F.Gmel.) C.A.Sm.	Burii Arbaa	Fabaceae	Shrubs	Wild	Leaf	Dried	Oral	Uterus prolapse	Boiled	Reproductive
Allium cepa L.	Kulubi	Amaryllidaceae	Herbs	Agriculture field	Leaf	Fresh	Oral	Diarrhea	Dried	Gastrointestinal
Allium sativum L	Shunkurtii	Amaryllidaceae	Herb	Agriculture field	Seed	Fresh	Nasal	Respiratory manifestations	Fresh	Respiratory
Aloe vera (L.) Burm.f. .	Hargiisaa	Asphodelaceae	Shrub	Wild	Leaf	Fresh	Oral	Gastrointestinal	Crushed	Gastrointestinal
*Balanites **pedicellaris.*** Mildbr. & Schltr	Liqimmee	Zygophyllaceae	Shrub	Wild	Root	Fresh	Nasal	Niagara	Crushed	Respiratory
Barleria acanthoides Vahl	Shishii	Acanthaceae	Herb	Wild	Root	Fresh	Topical	Dermatitis	Direct	Unclassified
Barleria eranthemoides R.Br. ex C.B.Clarke.	Shabi	Acanthaceae	Tree	Wild	Root	Fresh	Oral	Gastritis	Crushed	Gastrointestinal
Bidens pilosa L.	Chogee	Asteraceae	Herbs	Agriculture field	Leaf	Fresh	Topical	Wound management	Crushed	Febrile
Boscia angustifolia A.Rich.	Qalqalcha Allattii	Capparidaceae	Shrub	Wild	Root	Fresh	Oral	Abortion, retained placenta, muscle pain, pneumonia, joint pain, penis dysfunction	Crushed	Reproductive
Calpurina aurea (Aiton) Benth.	Cheekataa	Fabaceae	Shrubs	Wild	Leaf	Fresh	Topical	Snakebite	Crushed	Snakebite
Carica papaya L.	Papaya	Caricaceae	Herbs	Home	Seed	Fresh	Topical	Dermatitis	Crushed	Dermatitis
Cassia angustifol (Vahl)	Shorbanabii	Fabaceae	Shrubs	Wild	Leaf	Fresh	Oral	Antifever antipain	Crushed	Febrile
Catha edulis (Vahl) Forssk. ex Endl.	Chat	Celastraceae	Tree	Agriculture field	Leaf	Fresh	Oral	Pain	Boiled	Febrile
Citrillus colocyntheis L.	Harree Guugee	Cucurbitaceae	Herbs	Wild	Root	Boiled	Oral	Uterus prolapse	Dried	Reproductive
Citrus aurantifolia Del.	Loomii	Rutaceae	Tree	Wild and home	Seed	Fresh	Oral	Antihelminth, antidiarrhoeal	Crushed	Gastrointestinal
Citrus aurantium a Jaub. & Spach	Arboo	Rutaceae	Shrubs	Wild	Seed	Boiled	Topical	Dermatitis	Crushed	Dermatitis
Clematis simensis Perr. & Guill	Sariitii	Ranunculaceae	Climber	Wild	Root	Fresh	Oral	Retained placenta	Fresh	Reproductive
Clerodendrum myricoides (Hochst.) R.Br. ex Vatke	Hawaarree	Lamiaceae	Tree	Agriculture field	Root, stem, and leafe	Fresh	Topical	Footrot	Crushed	Febrile
Coffea arabica L.	Buna	Rubiaceae	Shrubs	Wild	Seed	Fresh	Topical	Wound management(burning)	Direct	Febrile
Cordia africana Lam.,	Wadeessa	Boraginaceae	Shrubs	Wild	Root	Fresh	Topical	Dermatitis	Crushed	Dermatitis
Coronopus didymu L.	Shuunfaa	Brassicaceae	Shrubs	Agriculture field	Seed	Fresh	Oral	Antihelmintic	Dried	Gastrointestinal
Croton dichogamus Pax.	Maakaftaa	Euphorbiaceae	Tree	Wild	Root	Fresh	Oral	Reproductive	Crushed	Reproductive
Croton macrostachyus Hochst. ex Delile	Bakkanniisaa	Euphorbiaceae	Tree	Wild	Root	Fresh	Oral	Reproductive	Crushed	Reproductive

Cucumis dipsaeus Ehrenb. ex Spach	Qureerraa	Cucurbitaceae	Climber	Agriculture field	Flower	Fresh	Oral	Bloating, hafraa (secondary bacterial infection), wound management	Crushed	Gastrointestinal
Cucurbita moschata (Lam.) Pior.	Buqqee	Cucurbitaceae	Climber	Agriculture field	Stem	Dried	Nasal	Respiratory manifestations	Dried	Respiratory
Cymbopogon citratus	Kormacitaa	Poaceae	Shrubs	Wild	Root	Fresh	Topical	Endoparasite	Crushed	Gastrointestinal
Cyphostemma sp. L	Laaluu	Vitaceae	Herbs	Agriculture field	Root	Fresh	Topical	Wound	Crushed	Febrile
Datura stramonium L.	Banjii	Solanaceae	Herb	Wild	Leaf	Dried	Topical	Footrot	Crushed	Nervous system
Dichrostachys cinerea L	Jirimee	Fabaceae	Herbs	Wild	Root	Fresh	Topical	Bone tb	Dried	Febrile
Ehretia cymosa Thonn.	Ulaagaa	Boraginaceae	Herbs	Wild	Leaf	Fresh	Topical	Dermatitis	Crushed	Dermititis
Embelia schimperi Vatke	Hanquu	Myrsinaceae	Herbs	Agriculture field	Seed	Fresh	Oral	Anthelmentic	Crushed	Gastrointestinal
Eucalyptus grandis W.Hill ex Maiden	Barzafi	Myrtaceae	Shrubs	Home	Root	Dried	Topical	Footrot	Dried	Febrile
Euclea racemosa L.	Mieessaa	Ebenaceae	Shrub	Wild	Root	Fresh	Topical	Eyedisaese	Mixed with water	Opthalmological
Hagenia abyssinica (Bruce) J.F.Gmel.	Heexoo	Rosaceae	Shrub	Agriculture field	Seed	Fresh	Oral	Antihelmintic	Crushed	Gastrointestinal
Jatropha curcas L	Abatalmuluug	Euphorbiaceae	Tree	Agricultural field	Seed	Fresh	Oral	gastro intestinal tract motility	Fresh	Gastrointestinal
Justicia schimperiana (Hochst. ex Nees)	Dhumuga	Acanthaceae	Tree	Wild	Leaf	Fresh	Topical	Dermatitis	Dissolved with water	Dermititis
Moringa stenopetala (Baker f.)	Miimmii	Moringaceae	Tree	Home	Leaf	Fresh	Oral	Antiamoebiasis and Giardiasis	Gastro-intestinal	
Moringa stenopetala (Baker f.) Cufod.	Mooringaa	Moringaceae	Tree	Home	Root	Fresh	Administration	Respiratory manifestations	Crushed	Respiratory
Nicotiana tabacum L.	Qorondee	Solanaceae	Shrub	Home	Leaf	Fresh	Oral	Antihelminthic wound management	Crushed	Gastrointestinal
Nigella sativa L	Absuudaa	Ranunculaceae	Herb	Home garden	Seed	Fresh	Nasal	Respiratory manifestations	Crushed	Respiratory
Ocimum lamiifolium Hochst. ex Benth	Urgoo Harree	Labiatae	Shrubs	Wild	Leaf	Fresh	Topical	Wound management	Crushed	Febrile
Olea capensis L.	Onoma	Asphodelaceae	Shrubs	Wild	Stem	Fresh	Oral	Intestinal worm	Crushed	Unclassified
Olea europaea subsp.*cuspidata* L.	Ejersa	Oleaceae	Tree	Wild	Root	Fresh	Topical	Footrot	Through dermally and orally	Nervous system
Persicaria decipiens (R.Br.) K.L.Wilson	Qorsabuutii	Polygonaceae	Shrubs	Wild	Root	Fresh	Oral	Abdominal swelling	Dried	Gastrointestinal
Phyllanthus ovalifolius Forssk.	Gurbii	Malvaceae	Shrub	Agriculture field	Root	Fresh	Oral	Anthelmintics (internal parasite), diarhoel disease, waantufaa	Crushed	Gastrointestinal
Plumbago zeylanical. L.	Dhigaajii	Plumbaginaceae	Tree	Wild	Root	Fresh	Nasal	Respiratory manifestations	Crushed	Respiratory
Polygala sphenoptera Fresen.	Harmala	Polygalaceae	Shrubs	Wild	Root	Boiled	Topical	Eye disease	Crushed	Ophthalmological
Premna schimperi Engl.	Urgeessaa	Lamiaceae	Herbs	Wild	Leaf	Fresh	Topical	Burns and wound infection	Crushed	Febrile
Pyrenacantha malvifolia Engl.	Buurii	Icacinaceae	Herbs	Wild	Stem	Fresh	Oral	Gastrointestinal	Crushed	Gastrointestinal
Rhamnus cathartica L	Awbariis	Rhamnaceae	Shrubs	Wild	Leaf	Fresh	Topical	eye disease	Crushed	Ophthalmological

Rhus vulgaris Meikle.	Daboobessaa	Anacardiaceae	Shrubs	Wild	Leaf	Fresh	Topical	burns	Crushed	Dermatitis
Rhynchosia malacotricha Harms	Jiddaa	Fabaceae	Herbs	Wild	Root	Fresh	Oral	Blackleg	Crushed	Febrile
Ricinus communis L.	Qobboo	Euphorbiaceae	Shrubs	Wild	Leaf	Fresh	Snake and ectoparasite	Crushed	Unclassified	
Ruta chalepensis L.	Xeenaddaamii	Rutaceae	Herb	Home garden	Leaf	Fresh	Oral	Abdominal pain, skin rash	Decocted	Gastrointestinal
Santalum album L.	Illamsaa	Santalaceae	Tree	Wild	Root	Fresh	Oral	Bloating, hafraa (secondary bacterial infection), wound management	Dried	Gastrointestinal
Solanecio angulatus (Vahl) C.Jeffrey	Darris(Jinniraas)	Solanaceae	Herb	Wild	Stem	Fresh	Topical	Eye disease	Crushed	Ophthalmological
Solanum incanum L.	Hiiddii	Solanaceae	Shrubs	Agriculture field	Root	Fresh	Oral	Blood clotting and internal infection	Crushed	Febrile
Stephania abyssinica (Quart.-Dill. & A.Rich.) Walp.	Baltokki	Menispermaceae	Shrub	Wild	Root	Fresh	Oral	Retained placenta, loss of milk,	Crushed	Reproductive
Tagetes minuta L.	Maxannee	Asteraceae	Tree	Agriculture field	Root	Fresh	Snake and Ectoparasite	Crushed	Unclassified	
Tamarindus indica L.	Roqaa	Fabaceae	Tree	Wild	Seed	Fresh	Oral	Intestinal worm	Crushed	Gastrointestinal
Terminalia polycarpa Engl. & Diels	Hireerrii	Combretaceae	Climber	Wild	Root	Fresh	Oral	Vaginal bleeding	Crushed	Reproductive
Terminalia spinosa North.	Hiddagabroo	Combretaceae	Shrubs	Wild	Root	Fresh	Topical	Eye disease	Crushed	Ophthalmological
Tragia cordata A.Rich.	Laalessaa	Euphorbiaceae	Climber	Wild	Root	Fresh	Oral	Unirary tract infection, external parasite	Crushed	Reproductive
Vernonia amygdalina (Delile) Sch.Bip.	Ebicha	Asteraceae	Climber	Wild	Leaf	Fresh	Oral	antihelminthic	Crushed	Gastrointestinal
Warburgia ugandensis Sprague	Beeftii	Canellaceae	Tree	Wild	Leaf	Fresh	Nasal	Respiratory manifestations	Crushed	Respiratory
Xanthium strumarium L.	Korantakatero	Asteraceae	Shrubs	Wild	Leaf	Fresh	Oral	Antifungal	Crushed	Unclassified
Zingiber officinale Roscoe	Zanjabiila	Zingiberaceae	Herb	Home garden	Root	Fresh	Oral	Antihelmentical	Dried	Gastrointestinal

Note**:** GF= growth form, RA= route of administration, DT= disease treated, MP= mechanism of preparation, and RM= medication route**.**

Table 2. The result of Informant Consensus Factors (ICF)

Category of the Disease	Number of Plant Species	Number of Informant Citations	ICF
Ophthalmological	6	18	0.82
Dermatological	9	43	0.79
Febrile	10	40	0.77
Gastro-intestinal	19	58	0.77
Snake and spider poisoning	3	12	0.73
Nervous system	5	18	0.71
Respiratory system	7	12	0.64
Reproductive system	9	5	0.5

Table 3. The results of simple preference ranking related to medicinal plants against livestock ailments

Names of Plants	Informants Labeled A to I											
	A	B	C	D	E	F	G	H	I	Total Score	Rank	A
Hagenia abyssinica	5	5	5	5	5	5	5	5	5	50	1	
Zingiber officinale	5	4	4	4	5	4	5	5	5	46	2	
Embelia schimperi	5	5	3	5	3	3	5	5	4	42	3	
Santalum album	3	3	4	3	4	3	5	5	4	35	4	
Coronopus didymu	2	4	3	5	5	3	3	4	2	32	5	

Note: Scores in the table indicate ranks given to medicinal plants based on their efficacy; the highest number (50) was given for the medicinal plant that informants thought most effective in treating diarrhea, and the lowest number (32) was given for the least-effective plant

Table 4. Results of paired comparison of medicinal plants used against livestock ailments

		1	2	3	4	5	6	7	8
1	*Hagenia abyssinica(HA)*								
2	*Zingiber officinale(ZO)*	HA							
3	*Embelia schimperi(ES)*	HA	ES						
4	*Santalum album(SA)*	HA	ES	ES					
5	*Coronopus didymu(CD)*	HA	ES	ES	CD				
6	*Vernonia amygdalina(VA)*	HA	ES	ES	VA	VO			
7	*Nicotiana tabacum(NT)*	HA	ES	ES	SA	CD	VA		
8	*Persicaria decipiens (PD)*	HA	ES	ES	SA	CD	ZO	NT	
9	*Phyllanthus ovalifolius(PO)*	HA	ES	ES	SA	CG	PO	PO	PO
	Frequency	8	7	6	3	2	1	1	1
	Rank	1	2	3	4	5	6	7	8

Notes: Paired comparison of medicinal plants to treat livestock; each plant was compared with others

Table 5. Fidelity level of five veterinary medicinal plants

Scientific Name	Therapeutic Categories	Ip	Iu	Fidelity (%)
Hagenia abyssinica	Anthelmintics (internal parasite), diarhoel disease	29	31	93.5%
Nicotiana tabacum	Anthelmintics, wound management	53	57	92.9%
Phyllanthus ovalifolius	Penile dysfunction, reproductive organ disease	19	21	90.5%
Ruta chalepensis	Abdominal pain, skin rash	19	25	76%
Santalum album	Bloating (secondary bacterial infection), wound management	12	42	28.57%

Notes: "*Ip"* is using a species for the same major purpose, and IU "Iu" is the total number of informants who mentioned the plant for any use.

Table 6. Results of direct matrix ranking

Plant Species	Uses							Total	Rank
	Agricultural Tool	Construction	Firewood	Charcoal	Fodder	Fence	Medicine		
Hagenia abyssinica	5	5	4	4	3	5	4	30	1
Ekbergia capensis	2	4	5	5	3	5	5	29	2
Olea europaea subsp. *cuspidata*	5	5	4	2	2	4	5	27	3
Terminalia Polycarpa	3	2	4	2	5	2	5	23	5
Vernonia amygdalina	4	4	4	3	2	4	4	25	4
Citrus aurantium	2	4	4	0	5	1	3	19	6
Jatropha curcas	2	2	2	0	0	5	5	16	7
Moringa stenopetala	2	2	2	0	1	4	4	15	8

Discussion

A study in the Midakegn District of West Shoa Zone, to which Ambo District belongs, revealed 60 medicinal plants to treat various livestock ailments (Kitata et al. 2017). This figure is comparable to the number of medicinal plants (68 species) documented from the Dallo Mana District that were used to manage several livestock ailments. However, the number of medicinal plants identified in the current study is significantly higher than that found in studies carried out in various districts of the three Oromia Region neighboring zones of Horro Gudurru, Jimma, and East Wollega (Tadesse et al. 2014; Yigezu et al. 2014; Birhanu and Abera 2015). There are 28 recognized medicinal plants in the East Wollega Zone (Tadesse et al. 2014); 25 medicinal plants were documented from Horro Gudurru (Birhanu and Abera 2015); and 21, 20, 19, and 14 medicinal plants were recorded from Manna, Dedo, Kersa and Seka Chekorsa districts of the Jimma Zone, respectively (Yigezu et al. 2014).

According to Tamiru et al. (2014), the study district had a greater reported number of medicinal plants than certain nearby districts or zones, which the region's abundant cattle population might explain. Due to their different sizes in terms of each family's species in Ethiopia's ora, Euphorbiaceae and Lamiaceae are thought to have contributed a more significant number of plants to the District under study's medicinal plant flora. With 209 and 184 species, respectively, Euphorbiaceae and Lamiaceae are among the biggest families in the Flora of Ethiopia and Eritrea (Gilbert 1995; Ryding 2006).

The relative abundance of these two medicinal plant families may be attributed to the abundance of certain active components in each family. The fact that herbaceous plants are more frequently used in the research district to cure ailments may be due to their greater abundance compared to other types of life, as was also noted by the study's investigators on their travels to the study area. Further ethnoveterinary investigations conducted in the Midakegn District of the West Shewa Zone (Kitata et al. 2017), as well as various districts of the Horro Gudurru (Birhanu and Abera 2015) and East Wollega (Tadesse et al. 2014) zones, also reported the widespread plants' use; there are a large variety of medicinal herbs used to treat digestive and gastrointestinal. In addition, Bacha and Taboge (2003) state that gastrointestinal ailments are among the study District's most common diseases.

Moreover, in other research done in different regions of the nation (Tadesse et al. 2014; Birhanu and Abera 2015; Kitata et al. 2017;), the leaf was the most employed plant part in the formulation of treatments. Making treatments from such plant parts is significantly simpler and quicker, which may explain why leaves are used more frequently. The majority of remedies in the study district were made by crushing, a practice that is also popular throughout the nation (Belayneh et al. 2012; Yirga et al. 2012; Teklay 2015; Usmane et al. 2016; Bekele et al. 2018).

Crushing is frequently used in creating treatments, which may have something to do with its simplicity. Most remedies in the study district are made from fresh plant materials. Fresh materials were also mentioned in other studies carried out in various regions of Ethiopia (Birhanu and Abera 2015; Lulekal et al. 2013; Usmane et al. 2016; Bekele et al. 2018). The increased usage of fresh ingredients in manufacturing remedies may imply that most necessary plant parts are available nearby throughout the year. Water frequently used as a diluent in the study district may be connected to its ability to dissolve various active chemicals. Furthermore, most remedies that were administered orally could be attributed to the common gastrointestinal tract ailments in the study District. In addition, a study reveals that gastrointestinal ailments are among the top animal health problems in the same study District (Bacha and Taboge 2003).

The main disease categories with high ICF values in the study district were ophthalmological, dermatological, febrile, and gastrointestinal ailments. As a result, medicinal plants used to treat these disease categories could be considered good candidates for further pharmacological evaluation because they are promoted to have higher potency than those used to treat disease categories with low ICF values (Heinrich et al. 1998).

According to reports from previous studies carried out around the nation (Giday et al. 2013; Birhanu and Abera 2015; Usmane et al. 2016; Bekele et al. 2018), the majority of the allegedly medicinal plants in the study district were discovered to be uncultivated plants. Therefore, the country's continuous deforestation and habitat degradation, and most medicinal plants being taken from the wild, implies a severe threat to their existence.

The study district's older and younger people had different levels of knowledge of medicinal plants, which

may indicate a need for more with information transmission between generations. That may be connected to the younger generation's lack of interest in utilizing traditional medicine due to acculturation. Studies conducted in other parts of the country have shown that older people are more informed about medicinal plants than younger people (Gedif and Hahn 2003; Lulekal et al. 2013).

REFERENCES

Alexiades M. 1996. Collecting ethnobotanical data: An introduction to basic concepts and techniques. In: Alexiades MN (eds). Selected Guideline for Ethnobotanical Research: A Field Manual. Botanical Garden, New York.

Appelgren LE . 2009. Veterinary drugs: yesterday, today and tomorrow. J Vet Pharmacol Ther 32: 7-10.

Bacha D, Taboge E. 2003. Enset Production in West Shewa Zone. Research Report No 49. EARO, Addis Ababa. https://www.researchgate.net/publication/281149222

Bekele F, Lulu D, Goshu D, Addisu R. 2018. Survey of ethno-veterinary medicinal plants at Dale Sadi Districts of Oromia Regional State, Western Ethiopia. J Nat Sci Res 8 (19): 2225-0921.

Belayneh A, Asfaw Z, Demissew S, Bussa F. 2012. Medicinal plants potential and use by pastoral and agropastoral communities in Erer Valley of Babile Woreda, Eastern Ethiopia. J Ethnobiol Ethnomed 8 (42): 12-16. DOI: 10.51227/ojafr.2020.22.

Birhanu T, Abera D. 2015. Survey of ethno-veterinary medicinal plants at selected Horro Gudurru Districts, Western Ethiopia. Afr J Plant Sci 9 (3): 185-192. DOI: 10.5897/AJPS2014.1229.

Cheneau Y, El Idrissi AH, Ward D. 2004. An assessment of the strengths and weaknesses of current veterinary systems in the developing world', Revue scientiiue et technique. Rev Off Int Épizoot 23 (1): 351-359. DOI: 10.20506/rst.23.1.1489.

De Haan C, Bekure S. 1991. Animal Health Services in Sub-Saharan Africa: Initial Experiences with New Approaches. The World Bank, Wahington DC.

Ethiopian National Meteorology Agency (ENMA). 2020. Weather Report. http://www.ethiomet.gov.et/

Frits I, Demissew S, van Breugel P. 2010. Atlas of the Potential Vegetation of Ethiopia. Royal Danish Academy of Sciences and Letters, Copenhagen.

Gedif T, Hahn H. 2003. The use of medicinal plants in self-care in rural central Ethiopia. J Ethnopharmacol 87 (2-3): 155-161. DOI: 10.1016/S0378-8741(03)00109-0.

Giday M, Teklehaymanot T. 2013. Ethnobotanical study of plants used in management of livestock health problems by Afar people of Ada'ar District, Afar Regional State, Ethiopia. J Ethnobiol Ethnomed 9 (8): 1-10. DOI: 10.1186/1746-4269-9-8.

Gilbert MG. 1995. Euphorbiaceae. In: Edwards S, Tadesse M, Hedberg I (eds). Flora of Ethiopia and Eritrea. Volume 2, Part 2: Canellaceae to Euphorbiaceae. National Herbarium, Addis Ababa.

Heinrich MA, Ankli B, Frei C, Weimann, O Sticher. 1998. Medicinal plants in Mexico: healers' consensus and cultural importance. Soc Sci Med 47 (11): 1859-1871. DOI: 10.1016/s0277-9536(98)00181-6.

IBC. 2005. National Biodiversity Strategy and Action plan. Addis Ababa Ethiopia. http://www.fao.org/pgrfa-gpa-archive/eth/Reports/Third Report.pdf.

Kassaye K, A Amberbir, B Getachew, Y Mussema. 2006. A historical overview of traditional medicine practices and policy in Ethiopia. Ethio J Heal Dev 20 (2): 127-134. DOI: 10.4314/ejhd.v20i2.10023.

Kebede H, Melaku A, Kebede E. 2014. Constraints in animal health service delivery and sustainable improvement alternaties in North Gondar, Ethiopia. Onderstepoort J Vet Res 81 (1): 1-10. DOI: 10.4102/ojvr.v81i1.713.

Kitata G, Abdeta D, Amante M. 2017. Ethnoknowledge of plants used in veterinary practices in Midakegn district, west Showa of Oromia region, Ethiopia. J Med Plants Stud 5 (5): 282-288.

Lulekal E, Asfaw Z, Kelbessa E, van Damme P. 2013. Ethnomedicinal study of plants used for human ailments in Ankober District, North Shewa Zone, Amhara Region. J Ethnobiol Ethnomed 9 (63): 1-13 DOI: 10.1186/1746-4269-9-63.

Martin G. 1995. Ethnobotany: A Method Manual. A "People and Plants" Conservation anual. Champman and Hall, London. DOI: 10.1007/978-1-4615-2496-0_2.

Pankhurst R. 1965. A historical examination of traditional Ethiopian medicine and surgery. Ethiop Med J 3: 157-172.

Park HL, HS Lee, BC Shin. 2012. Traditional medicine in China, Korea, and Japan: A brief introduction and comparison. Evid-Based Complement Alternat Med 9: 1-9. DOI: 10.1155/2012/429103.

Ryding O. 2006. Lamiaceae. In: Hedberg I, Kelbessa E, Edwards S, Demissew S, Persson E (eds). Flora of Ethiopia and Eritrea. Volume 5: Gentianaceae to Cyclocheilaceae. The National Herbarium, Addis Ababa. DOI: 10.1007/s00606-010-0270-9.

Sofowora. 1982. Medicinal Plants and Traditional Medicine in Africa. John Wiley & Sons, New York.

Tadesse B, Mulugeta G, Fikadu G, Sultan A. 2014. Survey on Ethno-veterinary medicinal plants in selected woredas of East Wollega Zone, Western Ethiopia. J Biol Agric Healthcare 4 (17): 97-105.

Tamiru F, Dagmawit A, Askale G, Solomon S, Morka D, Waktole T. 2014. Prevalence of ectoparasite infestation in chicken in and around Ambo town, Ethiopia. J Vet Sci Tech 5: 4. DOI: 10.4172/2157-7579.1000189.

Teklay A. 2015. Traditional medicinal plants for ethnoveterinary medicine used in Kilte Awulaelo District, Tigray Region, Northern Ethiopia. Adv Med Plant Res 3 (4): 137-150.

Toyang NJ, Wanyama J, Nuwanyakpa M, Django S. 2007. Ethnoveterinary Medicine. A Practical Approach to the Treatment of Cattle Diseases in Sub-Saharan Africa. Agromisa Foundation and CTA, Wageningen.

Usmane A, Birhanu T, Redwan M, Sado E, Abera D. 2016. Survey of ethno-veterinary medicinal plants at selected districts of Harari Regional State, Eastern Ethiopia. Ethiop Vet J 20 (1): 1-22. DOI: 10.4314/evj.v20i1.1.

World Health Organization (WHO). 2001. Legal Status of Traditional Medicine and Complementary/Alternative Medicine: A Worldwide Review, WHO, Geneva.

Yigezu Y, Berihun D, Yenet W. 2014. Ethnoveterinary medicines in four districts of Jimma zone, Ethiopia: Cross sectional survey for plant species and mode of use. BMC Vet Res 10: 76. DOI: 10.1186/1746-6148-10-76.

Yirga G, Teferi M, Brhane G, Amare S. 2012. Plants used in ethnoveterinary practices in Medebay-Zana District, Northern Ethiopia. J Med Plants Res 6 (3): 433-438. DOI: 10.5897/JMPR11.1133.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 6, Number 2, November 2023
Pages: 138-144

E-ISSN: 2580-4510
DOI: 10.13057/asianjethnobiol/y060204

Ethnobotanical study of medicinal plants in Ogotun-Ekiti, Ekiti State, Nigeria

ADEOLA KILASHO[1,♥], MOLAWA ABDULLAHI KOLADE[1], JAMES OLUBORODE[2], VINCENT JACKSON[2], SAMUEL AFOLABI[2]

[1]Department of Social and Environmental Forestry, University of Ibadan. Ibadan, Nigeria. Tel.: +2348034032684, ♥email: kilashodavid@gmail.com
[2]Department of Forest Production and Products, University of Ibadan. Ibadan, Nigeria

Manuscript received: 10 July 2023. Revision accepted: 6 October 2023.

Abstract. *Kilasho A, Kolade MA, Oluborode J, Jackson V, Afolabi S. 2023. Ethnobotanical study of medicinal plants in Ogotun-Ekiti, Ekiti State, Nigeria. Asian J Ethnobiol 6: 138-144.* The essential role of medicinal plants in maintaining human health demonstrates the necessity for appropriate knowledge and documentation of their significance and application. The aim of this study is to thoroughly and methodically record the ethnobotanical knowledge of medicinal plants by local community in Ogotun-Ekiti, Nigeria. The data was collected using both interview method and a structured questionnaire. Respondents were chosen based on their experience, related job and deep understanding of the usage of herbal medicines. According to the findings of the research, 81 medicinal plant species from 40 families and 78 genera were identified and documented. The study also revealed that trees make up 58% of all plants, shrubs make up 27%, herbs make up to 10%. Furthermore, leaves (57%) were the most plant parts used in treating several ailments followed by bark (21%), root (10%) and the seeds (8%) as the least used plant parts. Plants from the Malvaceae family (9 species) were recorded to be the most available in the study area, followed by the Fabaceae family (7 species), Moraceae and Asteraceae (each with 5 species) and three species each from Anarcadiaceae, Combreteaceae, Poaceae, Sapotaceae, Curcurbiataceae, Rutaceae, Solanaceae and Lamiaceae. Some of the frequent illnesses treated with medicinal plants in the study region include: malaria, urinary tract infection, diarrhoea, diabetes amongst others. This study concluded that ethnobotanical survey is crucial for assessing current knowledge and serving as a baseline for future analyses of changes in knowledge and usage. These will thereby give the use of medicinal plants more national and global recognition.

Keywords: Herbal medicine, human health, indigenous knowledge, medicinal plants

INTRODUCTION

Nature provides humans with diverse important and highly valued plant species (Oluborode et al. 2022). As raw materials for various products, plants play a great role in contributing to sustainable livelihood and maintaining social stability of communities. Not only essential to delivering various ecological functions, many plant species are also important for daily uses of societies, including as a source of food-building materials as well as for medicinal purposes since many traditional medications are mostly used plant resources (Ma et al. 2021).

The medicinal plant is any plant with therapeutic, symptomatic, or health-promoting qualities. The word "medicinal plants" also describes several plant species used in herbalism, some of which have medicinal qualities. The development of human cultures around the world has been significantly influenced by medicinal plants (Hassan 2012). The history of using medicinal plants to treat illnesses dates back to the beginning of human civilisation. In many societies around the world, traditional medication that uses medicinal plants has been practiced for thousands of years, making them the oldest type of therapy.

Traditional medicine is becoming increasingly popular worldwide (Kumar et al. 2013). This is due to its use to be the superior, safer and more cost-effective method of treating several ailments. Poverty, a lack of healthcare services and the exorbitant cost of conventional pharmaceuticals all contribute to a strong reliance on medicinal plants (Agbor and Nidoo 2015). A study by Vandana et al. (2021) affirmed the use of medicinal plants as the as the primary source for treating and curing a wide range of significant illnesses. This rate is higher in developing countries, where up to 90% of the total population relies on medicinal plants to help their primary healthcare needs (Adewale and Oduyemi 2014). However, the recent rapid depletion of medicinal plants and other natural resources due to urbanization, population growth, modern agriculture and medical technology amongst others has led to significant loss of traditional knowledge connected to local medicine and ethnic medicine (Chen 2021; Jia et al. 2022). Many of these ancient practices of medicinal plants have either been mostly forgotten or are no longer practiced as a result of inadequate recording (Gruyal et al. 2014). This is due to the fact that most traditional healers keep scant records and their knowledge is passed down, primarily verbally, from generation to generation. Therefore, increased efforts are needed to document ethno-medical data on medicinal plants because of the revival of interest in the use and importance of medicinal plants by many developing countries.

One effort to document the uses of plants for medication is through the study of ethnobotany. Ethnobotany mostly used a linguistics approach to identify

the language when writing down plant names with accurate phonetics and etymology (Mohanty et al. 2018). The recording of knowledge or information about conventional herbal treatments is an important step toward ensuring sustainable management of medicinal plants. Additionally, it will provide enough details on the value of various plant species, how to use them effectively, and how to aid in the search for novel therapeutics. Herbal medicines are now recognized as a feasible and affordable source of alternative medicine with lower side effects. With the emergence of new ailments and the demand for affordable pharmaceuticals, the documentation of therapeutic plants claimed by local communities is critical since it will open up a plethora of chances for the discovery and enhancement of novel and affordable plant-based therapies (Orillaneda and Acero 2023).

This study intends to catalogue medicinal plants specifically used by local population in Ogotun-Ekiti, Ekiti State, Nigeria to treat several ailments. The study offers crucial details on the ethnobotanical resources and local customs relating to the use of medicinal plants in the study area, information that may be helpful for the sustainable management, use, and utilization of these priceless resources. To the best of our knowledge, no formal ethnobotanical research has been conducted in these regions. Additionally, some of these local people depend on this traditional medical knowledge as a source of income. The research area, Ogotun-Ekiti, is a rural area with little healthcare services, which forces the locals to only use traditional medicines.

MATERIALS AND METHODS

Study area

The study was carried out in Ogotun-Ekiti, Ekiti State, Nigeria (Figure 1). Geographically, it is located at 7030'0''N and 500'0''E. Ogotun has a tropical climate with an annual rainfall of 1613 mm and average temperature of 24.60C. One of the three major towns that make up Ekiti State's South West Local Government Area is Ogotun-Ekiti. Its southern and eastern borders, both in Osun, are Ikeji Ile and Ikeji, respectively. This community lies on the border between the states of Ekiti and Osun.

Data collection procedure

Data collection of medicinal plant inventory was done between March 2022 and November 2022. A participatory research approach, which is mostly used for ethnobotanical research, was adopted for this research. Interview and questionnaire methods were used to collect ethnobotanical data from a small group of people in the study area. Verbal prior informed consent was acquired and the goals of the study were briefly explained to respondents who agreed to interviews in order to ensure reliability and reproducibility. Respondents were selected and asked several questions, including information about the informant's profile (age and gender); occupation and source of income; respondent's knowledge of plants and their uses; and information on the use of medicinal plants for disease treatment.

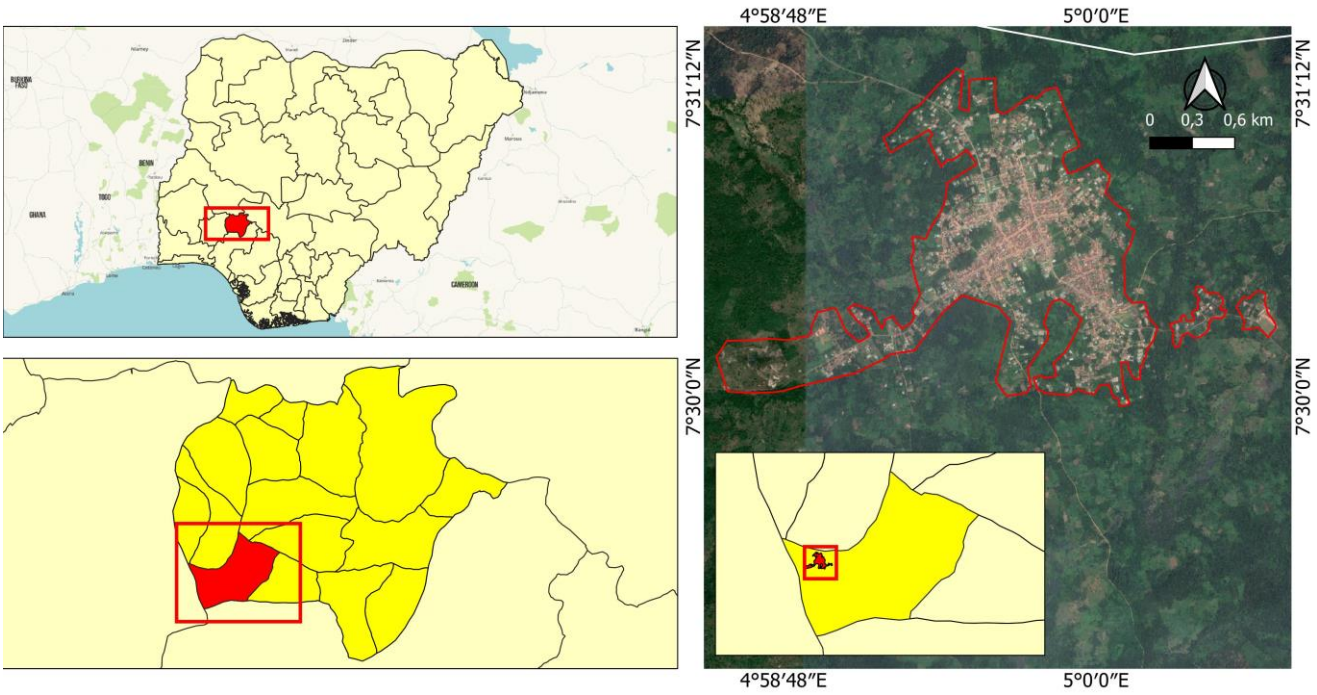

Figure 1. Map of the study area in Ogotun-Ekiti, Ekiti Southwest District, Ekiti State, Nigeria

A total number of 74 respondents were selected for this study. The selection was based on their profession and understanding of the usage of herbal treatments. The interviews were all conducted in the local language, i.e., Yoruba. Some of the plants near the neighbourhood were cultivated and shown to the respondents to identify while some respondents volunteered to go into the field with the scientists to identify the plant species that weren't close to neighbourhood or accessible to them. The informants' ages ranged from 40 to 80 years.

The data and information gathered during the interview were compared and confirmed using reviews of readily available records from the existing diverse floras, literature and available plant databases like www.theplantist.org,www.sciencedirect.org and www.tropicos.com. Comparisons were also made with the herbarium specimens on hand at the Forestry Research Institute of Nigeria, Ibadan, Nigeria. The results obtained were arranged in alphabetical order using their scientific names followed by their local names, family, usage of the plant parts and classification.

Data analysis

To analyse and summarize data on medicinal plants, their uses, and other related information, descriptive statistical approaches such as percentages were employed. The frequency of citation was determined using the formula below:

$$Frequency\ of\ citation = \frac{Number\ of\ citations\ x\ 100}{Total\ number\ of\ citation)}$$

RESULTS AND DISCUSSIONS

Respondents' characteristics

There were 74 respondents, of which 65% were male while 35% were female. Respondents from the age group 60 years and above were the most dominant (62%), followed by respondents between the ages of 50-60 (27%). For occupation, 41% of the respondents were herbalists, 35% were herbs sellers, 20% were farmers, while the least percentage were artisans (4%).

Diversity of medicinal plants identified

The study identified and documented 81 plant species from 40 families and 78 genera, with the most widely used plants in the study area were obtained from tree species (58%), followed by herbaceous species (27%), shrubs (13%) and others (2%) (Figure 2). Furthermore, plants from the Malvaceae family have the highest number of species with 9 species, followed by the Fabaceae family (7 species), Moraceae and Asteraceae (each with 5 species) and three species each from Anarcadiaceae, Combreteaceae, Poaceae, Sapotaceae, Curcurbiataceae, Rutaceae, Solanaceae and Lamiaceae.

Plants parts used

According to the data obtained in the study area, leaves (57%) were the most used plant parts in treating several ailments, followed by bark (21%), and roots (10%), while seeds/fruits were the least used plant parts (8%). In some cases, the whole plants are used (1%) (Figure 3).

Discussion

The study identified and documented 81 medicinal plant species from 40 families and 78 genera with the most widely used plants in the study area were obtained from tree species (58%) followed by herbaceous species (27%), shrubs (13%) and others (2%). The findings, however, contradict with the report of Hong et al. (2015), who indicated that most medicinal plants are sourced from herbaceous plants, in part because forests have been degraded and it takes less time and effort to extract plant material from medicinal herbs.

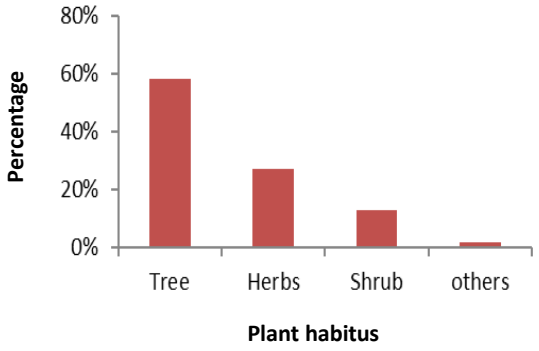

Figure 2. Percentage of plants habitus for medicinal uses the study area in Ogotun-Ekiti, Ekiti State, Nigeria

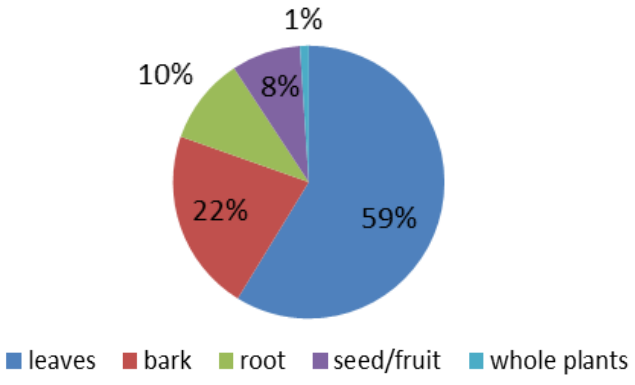

Figure 3. Percentage of plant parts used for medicinal uses the study area in Ogotun-Ekiti, Ekiti State, Nigeria

Table 1. List of medicinal plants found in Ogotun-Ekiti, Ekiti state, Nigeria

Scientific name	Common name	Family	Uses	Plant Parts Used	Habitus	Frequency of Citation
Abrus precatarious	Roasary pea, Oju ologbo (Yor)	Fabaceae	Jaundice, tumors	leaves	Herbs	5
Acanthospermum hispidum	Dagunro (yor), star burr	Asteraceae	Fever, skin ailments	Leaves	Herbs	12
Adasonia digitata	Baobab	Malvaceae	Gastro-intestine disorder	Leaves, bark, flower	Tree	8
Afromomum melegueta	Atare (yor)	Zingiberaceae	Sore throat, congestion	Fruits	Herb	10
Ageratum conyzoides	Imi-esu (yor), goat weed	Asteraceae	Ear defects, fever	Leaves	Herb	5
Albizia lebbeck	Frywood, sisris	Fabaceae	Eye injury, lung problems	leaves, bark	Tree	18
Aloe vera	Aloe, Ahon-Erin (yor)	Asphodelaceae	Wound, oral, skin infection	Leaves	Herbs	15
Anacardium occidentale	Cashew	Anacardiaceae	Diabetes,malaria	Leaves, bark, fruit	Tree	4
Anogeissus schimperi	Ayin (yor)	Combretaceae	Hypertension, leprosy	Leaves, bark	Tree	5
Annona muricata	Soursop	Annonaceae	Inflammation, anti-oxidants	Leaves, bark, fruits	Tree	6
Artocarpus altilis	Bread fruit	Moraceae	Toothache, diabetes	Fruits, leaves, bark	Tree	5
Azadirachta indica	Neem, Dongayaro (yor)	Meliaceae	Malaria, contraceptive, typhoid	Leaves, bark, seed	Tree	4
Blighia sapida	Isin (yor)	Sapindaceae	Epilepsy, headache	Fruit, leaves, bark	Tree	8
Bryophyllum pinnatum	Abamoda (yor)	Crassulaceae	Cough, asthma	Leaves	Herb	7
Calotropis procera	Bomubomu (yor)	Apocynaceae	Hallucination, insomnia	Leaves, fruit	Shrub	2
Camellia sinensis	Yerepe (yor), bush tea	Theaceae	Heart diseases, dementia	Leaves	Shrub	15
Carica papaya	pawpaw	Caricaceae	Male infertility	Fruit, leaves, root	Tree	6
Cassia fistula	Igi kasia (yor)	Fabaceae	Purgatives	Leaves, bark	Tree	4
Ceiba pentandra	Araba (yor), silk cotton tree	Bombacaceae	Leprosy, diabetes, constipation	Leaves, bark	Tree	6
Chromolaena odorata	Akintola (yor)	Asteraceae	Skin infection, burn, wound	Leaves	Shrub	8
Chrysophyllum albidum	Agbalumo (yor), African star apple	Sapotaceae	Malaria, yellow fever, diarrhoea	Fruits, seed, leaves and bark	Tree	11
Cissus populnea	Epa ikun (yor)	Amplidaceae	Sore breast, indigestion	Leaves, bark	Tree	5
Citrullus colocynthis	Egusi (yor)	Cucurbitaceae	Tumors, ulcer, sexual transmitted infection	Fruit, seed	Herbs	6
Citrus aurantiifolia	Lime	Rutaceae	Hypertension, diabetes	Fruits, leaves, bark	Tree	9
Citrus paradise	Grape	Rutaceace	Detoxification, heart diseases	Fruit, leaves, bark	Tree	4
Citrus sinensis	Orange	Rutaceace	Malaria, appetizer	Fruit, leaves, bark	Tree	11
Cocos nucifera	Coconut	Arecaceae	Sexual transmitted infection, urinary tract infection	Fruits, leaves	Tree	18
Cola millenii	Obi edun (yor)	Sterculiaceae	Ringworm, scabies	Fruit, leaves, bark	Tree	21
Cola nitida	Kolanut, Obi (yor)	Malvaceae	Depression, male sexual enhancer	Fruit, leaves, bark	Tree	5
Corchorus olitorius	Jute leaf, ewedu (yor)	Malvaceae	Female fertility, ulcer	Leaves, seeds	Herb	5
Costus afer	Ginger lily	Costaceae	Asthma, cough	Leaves	Shrub	7
Datura metel	Devil's trumpet, gegemu (yor)	Solanaceae	Oral infection, insomnia	Leaves, fruits,	Shrub	5
Elaeis guineensis	Oil palm tree	Arecaceae	Headache, pain, rheumatism	Fruit, leaves	Tree	8
Eleusine indica	Paragis	Poaceae	Malaria, diabetes	Leaves	Herb	6
Euphorbia Hirta	Emile (yor), Asthma herb	Euphorbiaceae	Dysentery, jaundice, tumors	Leaves	Herb	8
Ficus exasperate	Ewe Ipin (yor)	Moraceae	Leprosy, eye sore, ring worm	Bark, leaves	Tree	4
Ficus thoningii	Igi odan (yor)	Moraceae	Diarrhoea, utis, diabetes, malaria	Leaves, bark	Tree	11
Garcinia Kola	Bitter kola, Orogbo (yor)	Clusiaceae	Cough, throat infections	Fruit, leaves, bark	Tree	8
Gmelina arborea	Melina (yor), Malay beechwood	Lamiaceae	Pile, ulcer, fever	Oil, leaves, bark	Tree	4

Gliricidia sepium	Agunmaniye (yor)	Fabaceae	Antimicrobial, antibacterial	Leaves, bark	Tree	6
Gossypium arboretum	Cotton plant, ewe owu (yor)	Malvaceae	Oral infection, headache, ear ache	Seed, root leaves	Tree	5
Irvingia gabonensis	Oro (yor), African mango	Irvingiaceae	Diabetes, weight loss	Fruit, leaves, bark	Tree	7
Jatropha curcas	Physic nut, Barbados nut,	Euphorbiaceae	Malaria, oral infection	Oil, bark, leaves	Shrub	6
Justicia carnea	Ewe eye (yor)	Acanthaceae	Anaemia, diabetes	Leaves, stem	Herb	7
Lannea taraxalifolia	Yanrin (yor)	Asteraceae	Antioxidant, anticancer	Leaves	Herb	6
Lagenaria breviflora	Tagiri (yor)	Cucurbitaceae	Chickenpox, measles	Fruit, seed, leaves	Climber	6
Mangifera indica	Mango	Anarcadiaceae	Malaria, diabetes, obesity	Fruit, leaves, bark	Tree	4
Mansonia altisima	African walnut, Asala (yor)	Malvaceae	Leprosy, tuberculosis	Fruit, leaves, bark	Tree	5
Mentha piperita	Mint leaf	Lamiaceae	Stomach ache, fever, nasal congestion	Leaves	Herb	6
Mimosa pudica	Patanmo (yor)	Mimosaceae	Fevers, piles, jaundice, leprosy	Leaves	Shrub	5
Milicia excelsa	Iroko (yor)	Moraceae	Cough, fever, backache	Leaves, bark	Tree	4
Momordica charantia	Ejirin (yor), Bitter gourd leaf	Cucurbitaceae	Pile, back pain, skin and hair care	Leaves, fruits	Herb	11
Morinda lucida	Brimstone tree, Oruwo (yor)	Rubiaceae	Diabetes, jaundice, typhoid,	Leaves, bark	Tree	7
Moringa olifera	Moringa, drum stick	Moringaceae	Detoxification, constipation	Seed, fruit bark	Tree	4
Nauclea diddericchii	Opepe	Rubiaceae	Gonorrhoea, dental care	Leaves, bark	Tree	3
Newbouldia leavis	Akoko (yor)	Bignoniaceae	Epilepsy, wound	Leaves, bark	Tree	4
Nicotiana tabacum	Taba (yor)	Solanaceae	Swelling, skin problem	Leaves, seed	Herbs	7
Ocimum gratissimum	Scent leaf	Lamiaceae	Diarrhoea, dysentery, pile	Leaves, stem	Shrub	3
Parkia biglobosa	African locust beans, Iru (yor)	Fabaceae	Malaria, diabetes	Fruit, leaves, bark	Tree	11
Parquentina nigrescens	Ewe ogbo (yor)	Periplocaceae	Blood pressure	Leaves	Herb	8
Pennisetum purpureum	Elephant grass	Poaceae	Pain reliever, sexual transmitted infection	Leaves	Herb	3
Psidium guajava	Guava	Myrtaceae	Malaria, diabetes	Fruit, leaves, bark	Tree	4
Rauvolfia vomitoria	Asofeyeje (yor), swizzle stick	Apocynaceae	Diabetes, arthritis leprosy	leaves	Shrub	4
Senna alata	Asunwo	Fabaceae	Typhoid, diabetes	Leaves	Shrub	5
Sida acuta	Oshopotu (yor)	Malvaceae	Stomache, diaphoretic and antipyretic	Leaves, roots	Shrub	3
Solanum melongena	Egg plant	Solanaceae	Kidney infection, liver disorder	Leaves, fruit	Shrub	7
Spondias mombin	Iyeye (yor), hog plum	Anarcadiaceae	Rashes, diabetes	Leaves, fruit, bark	Tree	20
Synsepalum dulcificum	Miracle tree	Sapotaceae	Cancer, sexual transmitted infection	Leaves, bark	Tree	15
Talinum triangulare	Water leaf, Gure (yor)	Talinaceae	Constipation, pile	Leaves	Herb	23
Tectona grandis	Teak	Lamiaceae	Constipation, leprosy, pile	Leaves, bark	Tree	20
Terminalia catappa	Tropical almond tree	Combretaceae	Sickle cell disorder, eye problem	Fruit, leaves, bark	Tree	5
Terminalia ivoriensis	Afara	Combreteceae	Voice loss, sexual transmitted infection	Leaves, bark	Tree	7
Terminalia superba	African limba wood	Combreteceae	Female infertility, diabetes	Leaves, bark	Tree	8
Tetrapleura tetraptera	Aidan (yor)	Fabaceae	Stis, reproductive disorders	Fruit, leaves, bark	Tree	11
Theobroma cacao	Cocoa	Malvaceae	Skin care, constipation	Fruits, bark, leaves	Tree	16
Tithonia diversifolia	Sunflower, sepeleba (yor)	Asteraceae	Malaria, typhoid	Leaves, stem	Shrub	13
Treculia africana	African bread fruit	Moraceae	Cough, rashes	Leaves, fruit bark	Tree	9
Triplochyton scleroxylon	Obeche, African whitewood	Malvaceae	Edemas, painkiller	Leaves bark	Tree	12
Vernonia amygdalina	Bitter leaf, ewuro (yor)	Malvaceae	Malaria, pile	Leaves bark	Shrub	18
Vitellaria paradoxa	Shea butter	Sapotaceae	Skin care, pain reliever	Fruit, leaves	Tree	8
Zingiber officinale	Ginger	Zingiberaceae	Pain reliever, lung disease	Roots, rhizome	Herb	13

Note: (Yor) indicated the language spoken by the respondents (Yoruba language)

Furthermore, the study also showed that leaves (57%) were the most used plant parts in treating several ailments, followed by stem bark (21%) roots (10%), while seed/fruits were the least used plant parts (8%). In some cases, the whole plants are used. Because of their high availability, medicinal potency, and presence of active components, leaves are widely used in the treatment of a variety of diseases. According to Ghorbani (2005), the reason for the widespread use of leaves is that they are active in photosynthesis, which results in the production of secondary metabolites in higher concentrations than other parts of the plant, and these metabolites are actively implicated in remedial activity. This contradicts with the findings of Mesfin et al. (2009) and Kefalew et al. (2015), who found that roots were extensively used plant parts. The widespread use of roots in herbal medicine is discouraged due to the negative effects on plant growth, development, and availability. Respondents also supported the use of bark due to its strong regeneration potential and active phytochemical components.

The local/indigenous names of the plants helped the responders recognize them. Due to variations in environmental conditions, site quality, socioeconomic status, and traditional knowledge systems, medicinal plant species diversity and availability vary from one area to another (Pradhan et al. 2020).

These plants are mostly used to treat a variety of common illnesses, including typhoid, malaria, gastric ulcers, fever, infections, sexually transmitted diseases, cough, bronchitis, asthma, birth control, sleeplessness, toothaches, wounds, and skin conditions (Table 1). The following plants are frequently used by local traditional healers to cure a variety of illnesses: *Anacardium occidentale*, *Azadirachta indica*, *Calotropis procera*, *Bambusa vulgaris*, *Chromolaena odorata*, *Corchorus olitorius*, *Carica papaya*, *Mangifera indica* and *Citrus sinensis*. Informants reported a lack of regularity in the amount and dosage of medications they took. Among the informants, there was no clear standard of measurement or unit of measurement.

The study also discovered that single medicinal plants can be utilized to treat a variety of disorders, which may be related to the existence of many phytochemical ingredients. For instance, *Ficus thonnqii* is utilized in the treatment of many diseases, such as malaria, urinary tract infections, diarrhea and diabetes (Table1). Furthermore, it was also discovered during the study that a single illness could be cured by more than one medicinal plant. More than 15 medicinal plants were recorded to be potent in the treatment of diabetes mellitus. In most cases, the use of single medicinal plant is used to treat an ailment. However, it is believed by the respondents that combination of various plants with might contain different or same phytochemical constituents have proven to be more effective and efficient. For instance, the utilization of *C. sinensis* leaves in combination with the bark of *M. indica* and the leaves of *Psidium guajava* is said to be more effective in the treatment of malaria when compared to using either plant singly.

It is claimed that a multi-herbal treatment has greater therapeutic ability than a single plant (Teklehaymanot and Giday 2007; Shanmugam et al. 2020). The frequent usage of several plant products and other materials among traditional healers could be due to synergistic interactions (Giday et al. 2010). Rivera et al. (2013) also reported that the use of mixture therapies based on various plants and components of single and mixed species was shown to increase the effectiveness of the therapy due to additive or synergistic effects of the combination.

The respondents also said that the majority of medicines were prepared using fresh plant ingredients. They believe that fresh plant portions contain more active chemical components than dried plant parts. The usage of fresh materials may be an attempt to avoid the loss of volatile oils, the concentration of which may decrease after drying. This is consistent with the findings of Kassa et al. (2020), who indicated that preference for fresh plant parts is related to the efficacy of medicinal plants in treating ailments when compared to dried portions. However, Moa et al. (2013) observed that the drawback of using fresh plant parts is that frequent collecting, notably during dry seasons, may endanger the plants because local people made little effort in keeping dried plant material for later use.

The study urges immediate attention to and sustainable use of the medicinal plants found in the study region. The responders confirmed the worrisome rate of biodiversity loss in the region. Numerous reasons, including ever-rising population, urbanization, habitat loss, overuse, deforestation, inadequate conservation strategies, and unsustainable management, may contribute to the falling rate of medicinal plant biodiversity.

In conclusion, this study described and clarified various medicinal plants along with their therapeutic purposes used by local community in Ogotun-Ekiti, Ekiti State, Nigeria. This is crucial for assessing current knowledge and serving as a baseline for future analyses of changes in knowledge and usage. This record may contribute to greater acceptance of the use and preservation of indigenous traditional knowledge. The traditional method of transferring ethnobotanical knowledge through word of mouth has failed since the knowledge of how to use therapeutic plants is in danger of disappearing. Ethnobotanical understanding of medicinal plants and how indigenous cultures use them is beneficial for the preservation of traditional knowledge and biodiversity, as well as for advancing community healthcare and maybe aiding in the creation of new drugs.

Ethnobotanical research is essential to understand the social, cultural, and economic factors influencing attitudes and behaviours towards health and illness as well as to learn about the types of diseases and health issues that are prevalent among locals of a particular location. Therefore, it is essential to preserve the taxa as well as document the significant ethnobotanical knowledge. This survey can provide as a springboard for further academic investigation towards developing new plant-based medicines for the market. The study recommended that more research should be done in order to examine a wider variety of herbal plants

with various therapeutic characteristics. A more concentrated effort is also seen to be required for prospecting and studying the medicinal plants that are so crucial to developing countries healthcare systems.

ACKNOWLEDGEMENTS

The author wishes to thank all the respondents, local leaders and the government institutions who shared the information. There is no competing interest. Before the interviews, the study participants provided verbal agreement, and all data were acquired using their verbal approvals. This study was not supported by any funding agencies.

REFERENCES

Adewale OO, Oduyemi OI. 2014. Oral administration of leaf extracts of *Momordica charantia* affects reproductive hormones of adult female Wistar rats. Asian Pac J Trop Biomed 4 (1): S521-524. DOI: 10.12980/APJYB.4.2014C939.

Agbor MS, Naidoo S. 2015. Ethnomedicinal plants used by traditional healers to treat oral health problems in Cameroon. Evid-based Complement Alternat Med 2015: 649832 DOI: 10.1155/2015/649832.

Chen N. 2021. A study on traditional knowledge related to biodiversity of Uyghur people in Xinjiang. Minzu Univers 2021. DOI: 10.27667/d.cnki.gzymu.2021.000134.

Ghorbani A. 2005. Studies on pharmaceutical ethnobotany in Turkmen Sahra North of Iran (Part 1): General results. J Ethnopharmacol 102: 58-68. DOI: 10.1016/j.jep.2005.05.035.

Giday M, Asfan Z, Wolduh Z. 2010. Medicinal plants of the Meinit group of Ethiopia –an ethnobotanical study. J Ethnopharmacol 124 (2):153-523. DOI: 10.1016/j.jep.2009.05.009.

Gruyal AG, Roasario RD, Palmes ND. 2014. Ethno medicinal plants used by residents in Northern Surigao del Sur, Philippines. Nat Prod Chem Res 2: 140. DOI: 10.4172/2329-6839.1000140.

Hassan BAR. 2012. Medicinal plants (importance and uses). Pharm Anal Acta 3: e139. DOI: 10.4172/2153-2453.

Hong L, Guo Z, Huang K, Wei S, Liu B, Meng S, Long C. 2015. Ethnobotanical study on medicinal plants used by Maonan people in China. J Ethnobiol Ethnomed 11: 32. DOI: 10.1186/s13002-015-0019-1.

Jia XH, Zhao YX, Zhu YY, Zeng X, Liang XH, Xie J, Wu FM. 2022. Ethnobotany of wild edible plants in multiethnic areas of the Gansu-Ningxia-Inner Mongolia junction zone. J Ethnobiol Ethnomed 18: 53. DOI: 10.1186/s13002-022-00549-1.

Kassa Z, Asfaw Z, Demissew S. 2020. An ethnobotanical study of medicinal plants in Sheka Zone of Southern Nations Nationalities and People Regional State, Ethiopia. J Ethnobiol Ethnomed 16: 7. DOI: 10.1186/s13002-020-0358-4.

Kefalew A, Asfaw Z, Kelbessa E. 2015. Ethnobotany of medicinal plants in Ada'a District, East Shewa zone of Oromia regional state, Ethiopia. J Ethnobiol Ethnomed 11: 25. DOI: 10.1186/s13002-015-0014-6.

Kumar G, Jalaluddin MD, Rout P, Mohanty R, Dileep CL. 2013. Emerging trends of herbal care in dentistry. J Clin Diag Res 7 (8): 1827-1829. DOI: 10.7086/JCDR/2013/6339.3282.

Ma L, Zhang M, Zhao R, Wang D, Ma Y, Li A. 2021. Plant natural products: Promising resources for cancer chemoprevention. Molecules 26 (4): 933. DOI: 10.3390/molecules2604033.

Mesfin F, Demissew S, Teklehaymanot T. 2009. An ethnobotanical study of medicinal plants in Wonago Woreda, SNNPR, Ethiopia. J Ethnobiol Ethnomed 5: 28. DOI: 10.1186/1746-4269-5-28.

Moa M, Zemede A, Ensermu K, Abebe B, Bizuneh W. 2013. An ethnobotanical study of medicinal plants in Wayu Tuka District, East Welega Zone of Oromia Regional State, West Ethiopia. J Ethnobiol Ethnomed 9: 68. DOI: 10.1186/1746-4269-9-68.

Mohanty M, Behera SK, Dash S, Leelaveni A. 2018. Documentation of medicinal plants from the undivided area of Puri District, Odisha, India. Eur J Med Plants 25 (1): 1-12. DOI: 10.9734/EJMP/2018/43170.

Oluborode JO, Kilasho AR, Adebiyi WA. 2022. Comparative effect of cow dung and poultry manure on the growth of *Khaya senegalensis* (desr.) seedlings. Preprints 2022: 2022070183. DOI: 10.20944/preprints202207.0183.v1.

Orillaneda KNP, Acero LH. 2023. Ethnomedicinal plants used By middle-aged residents in San Antonio, Tandag City, Surigao Del Sur, Philippines. Intl J Bioinform Biosci 13: 1. Doi: 10.5121/ijbb.2023.13106.

Pradhan R, Manohar KA, Vineeta, Sarkar BC, Bhat JA, Shukla G, Chakravarty S. 2020. Ecosystem services of urban green sites: A case study of eastern Himalayan Foothills. Trees For People 2020: 100029. DOI: 10.1016/j/tfp.2020.100029.

Rivera J, Loya AM, Ceballos R. 2013. Use of herbal medicines and implications for conventional drug theraphy medical sciences. Alternat Integr Med 2: 2-6. DOI: 10.4172/2327-5162.1000130.

Shanmugam S, Jeyaprabakaran G, Rajendran K. 2020. Medicinal trees from home gardens of urban areas in, Madurai District of Tamil Nadu, Southern India. Asian J Ethnobiol 3 (1): 10-15. DOI: 10.13057/asianjethnobiol/y030102.

Teklehaymanot T, Giday M. 2007. Ethnobotanical study of medicinal plants used by people in Zegie Peninsula, Northwestern Ethiopia. J Ethnobiol Ethnomed 3: 1-12. DOI: 10.1186/1746-4269-3-12.

Vandana, Lather R, Tallapragada S, Singh G. 2021. Medicinal and aromatic plants: "Natural bio-chemicals and medicine factories". Intl J Agric Sci 17 (2): 691-698. DOI: 10.15740/HAS/IJAS/17.2/691-698.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 6, Number 2, November 2023
Pages: 145-152

E-ISSN: 2580-4510
DOI: 10.13057/asianjethnobiol/y060205

Short Communication: Ethnobotanical survey of medicinal plants for wound-healing in Dir Upper District, Pakistan

JAWADULLAH[1,2,♥], NAVEED AKHTAR[1]

[1]Department of Botany, Islamia College Peshawar. Jamrud Road, Peshawar 25120, Khyber Pakhtunkhwa, Pakistan.
Tel.: +92-91-9222036, ♥email: jawadullah401@gmail.com
[2]Depatment of Plant Sciences, Faculty of Biological Sciences, Quaid-i-Azam University. Islamabad 45320, Pakistan

Manuscript received: 2 October 2023. Revision accepted: 3 November 2023.

Abstract. *Jawadullah, Akhtar N. 2023. Short Communication: Ethnobotanical survey of medicinal plants for wound-healing in Dir Upper District, Pakistan. Asian J Ethnobiol 6: 145-152.* Medicinal plants have been used since ancient time by communities as an alternative to the synthetic medicine, which have adverse side effects and is not available to every individual. This study reports medicinal plants used for wound-healing by the local peoples in Dir Upper District, northern area of Pakistan. A semi-structured questionnaire was used to collect ethnomedicinal data by interviewing 50 informants of different ages (25 to 90 years old). Plant samples were collected as herbarium to be identified in the laboratory. The result shows a total of 20 plant species, each belonging to different families, were used for wound-healing. The majority of growth forms of such plants were herbs (35%) and trees (35%), followed by shrubs (25%) and climbers (5%). The plant parts used for healing were leaves of the plant (45%), followed by plant bark (10%), whole plant (10%), plant roots (10%), fruit peel (5%), gum (5%), bulb (5%), rhizome (5%) and latex (5%). Furthermore, external applications were more common than oral consumption to promote wound-healing. *Berberis lycium* Royle, *Curcuma longa* L. and *Punica protopunica* Balf.fil. were the most cited species used to heal wounds. This study revealed that there is an array of plant biodiversity among Pakistanis for the purpose of wound-healing. This is a result of the socioeconomic status and limited access to modern health services and their preference for folk medicine. Further studies should be planned to create an online database for a collection of therapeutic medicinal plants and their traditional healing potentials.

Keywords: Dir Upper, medicinal plants, pharmacological characteristics, species, wound-healing

INTRODUCTION

Plants have various roles in human life. Throughout history, humans have been using about 40,000-100,000 plant species for various purposes, accounting for only 5% of the total global flora. Among them, 30,000 plant species have been used as source of food and 7000 species have been cultivated for other purposes. However, due to green revolution, most of these species are substituted with high yielding varieties (Guzo et al. 2023). People have also been using medicinal plants to treat various ailments. According to World Health Organization (WHO), about 80% of the world population depends on the medicinal plants to cure various types of diseases (Tahir et al. 2023). One type of ailments that are frequently cured with medicinal plants is wound.

Wound is defined as a break in the skin epithelium or cellular and anatomical breakage in the living tissue continuity (Alam et al. 2011). In terms of location, there are two types of wounds, i.e., external wounds and internal wounds. The external wound is related to the damage to skin or upper layer of the body that may be caused due to the puncture, penetrating or incised wounds. In internal wound, the skin remains intact while the underlying tissue is damaged to a varying degree (Handoo 2006). Based on the cause, wounds can be classified as: (i) acute wound, which is caused by cuts or surgical incision; (ii) closed wound, in which blood leaks out from vessels but remains inside which form bruises; (iii) open wound, in which blood escapes from the vessels and clearly visible; (iv) incised wound, which is caused by a sharp object but no loss of tissue; (v) tear wound, in which loss of tissue occurs; (vi) puncture wound, which is caused by needle or nail and chances of infections are there; (vii) abrasive wound, which is caused due to sliding on rough surface and induces abrasion (Sharma et al. 2021). Cutaneous wound forms due to the damage of skin structure as a result of burns, surgery or injuries, which results in tissue damage (Xu et al. 2023).

Wounds are a serious problem for healthcare sector to be treated well and on time. Untreated wounds become worsen due to an unhealthy lifestyle. Wound infection is the major cause of wound complications and occurs due to a favorable environment for the microbes. Therefore, wound-healing should be done in order to maintain the epithelial barrier (Zulkefli et al. 2023). An estimated cost of 25 billion USD is being spent annually for chronic wound treatment. This cost increases day by day due to the expensive healthcare. Skin tissues help the body to protect itself from external harmful agents (Marques et al. 2023).

Due to the series of adverse effects of synthetic therapeutic agents, medicinal plants are being recommended because they have been used since ancient times (Budovsky

et al. 2015). Natural and bioactive compounds present in plants can act as antibacterial and anti-fungal properties, which fasten the wound-healing process. Various research shows that herbal extracts have antioxidant properties that promote wound-healing (Yazarlu et al. 2021). It is being assumed that ingredients from plants have few side-effects and non-toxic compared with synthetic therapeutic agents. Wound care using medicinal plants involves debridement and disinfection to provide a suitable environment for healing process (Oguntibeju 2019). Extracted natural compounds from plants help in various stages of wounds healing process. These plants have anti-inflammatory action and anti-fungal activities (Criollo-Mendoza et al. 2023).

Different studies have reported that for centuries African and Asian people traditionally have used medicinal plants. These people have an Indigenous Knowledge System (IKS) in their cultural practices, including the use of medicinal plants by traditional healers, which are believed to have healing properties (Cheikhyoussef et al. 2011). Nowadays, these plants have been scientifically investigated to have tremendous importance in the healing activity of wounds (Ayyanar and Ignacimuthu 2009). Currently, most researchers are attracted to natural compounds of medicinal plants due to promising results of these plants in patients and curing wounds (Monika et al. 2022). The major characteristic of these plants is they have blood-clotting properties (Bhardwaj and Gakhar 2005). Naturally derived substances are being used in the wound-healing process, because they have cell synthesis modulation, anti-inflammatory and antioxidant properties.

This study aimed to report medicinal plants used for wound-healing by the local peoples in Dir Upper District, northern area of Pakistan. In this study area, research has already been done regarding a general ethnobotanical study on medicinal plants but has yet to be done on the local plants specifically used for wound-healing. During this research, several trips were made to collect data on the wild and cultivated medicinal plants locally used for wound-healing. We expected the results of this study might help the people not to lose this precious knowledge and the researchers to work on the identified medicinal species of plants further to procure the actual ingredients that are helpful in wound-healing process.

MATERIALS AND METHODS

Study area and period

This study was carried out in Dir Upper District, Khyber-Pakhtunkhwa (Kp), Pakistan (Figure 1). The district is spread over 3,699 square kilometers. It is situated at Latitude 35º06’51” N and Longitude 72º01’59” E. Geographically, it is bounded by Chitral District to the northern side, by Bajaur and Afghanistan to the western side, by Dir Lower District to the southern side and by Swat District to eastern side. The climate of Dir Upper is cold and damp and is visited by the monsoon in July and August. The mountains are usually covered with snow and receive heavy snowfall in December, January and February. The average rainfall in the district is 700 mm and the temperature varies from -6°C to 38°C. Farming, trade and overseas work are the main occupations of the people. Dir Upper is very diverse in flora, having almost all types of plants. Due to rapid climate change and many other hazards, the flora remains not the same as it was before but still has diversity in its way. Most of its population are Yusufzai, Swati, Sahibzadgan and Roghani (Muhammad et al. 2014; Khan et al. 2015). Data was collected in 2020 between April and August.

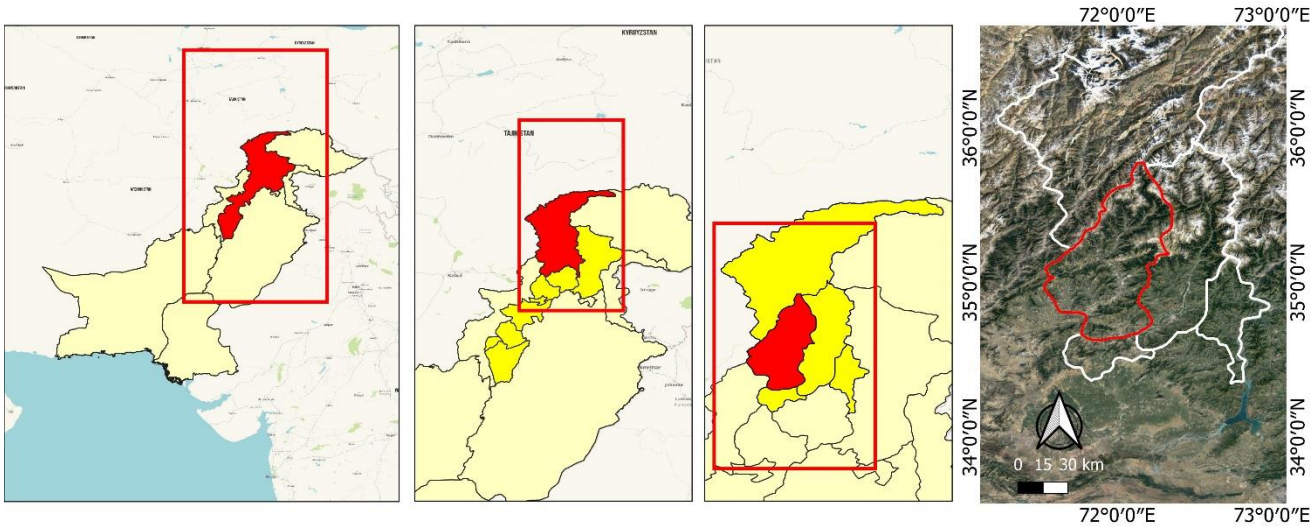

Figure 1. Map of study area in Dir Upper District, Pakistan

Ethnomedicinal data collection

Ethnomedicinal information was collected from local inhabitants and traditional healers in Dir Upper District using interview method. Respondents were randomly selected whoever wanted to share this precious knowledge. A total of 50 respondents of different ages (25 to 90 years old), sex and traditional knowledge were interviewed, with all respondents being free to state obtained from elders. No specific permits were required for this study data collection, as the researcher was also an inhabitant of the same area. However, most of the people were older, so prior to the data collection, they were briefed about the importance and their role in this data collection.

A semi-structured questionnaire was used to gather their knowledge related to a particular plant, including mode of administration (oral, apply on wound), type of wound in which that particular plant is used (abrasion, burn, cut and pimple), plant part used (leaf, stem, root, bark etc.), mode of preparation (powder form, extract or fresh plant part) and local name of the plant.

Plant samples collection

The natural habitat of the medicinal plants locally used for wound-healing was visited accompanied by the local inhabitants and identified their location where they have naturally grown. The information related to the plant was taken as a semi-structured questionnaire. For the plant collection, preparation, preservation, drying and ethnomedicinal uses, a standard method was observed. The plant's correct nomenclature was arranged alphabetically. The samples were dried in shade and mounted on a herbarium sheet. The pictures were taken from the plant while still in their natural habitat. Plants botanical names were confirmed by a botanist in the Faculty of Botany, Islamia College Peshawar. The dried samples were taken and deposited in the herbarium of Islamia College Peshawar. Some additional information was also collected, like altitude of the area where that plant was growing, latitude and longitude with the help of an App (accurate altimeter).

RESULTS AND DISCUSSION

Twenty plant species, each belonging to different families, were specifically used for wound-healing directly and some indirectly in the studied area (Figure 2, Table 1). Among the documented species, 16 were wild, while 4 were cultivated in the local area or other areas. Among the species, the most commonly used was *Berberis lycium*. Pharmacological studies showed that *B. lycium* has antimicrobial and wound-healing properties (Bukhari and Ali 2022). A study by Neto et al. (2020) in the Brazilian Cerrado showed that 29 plant species belonging to 18 families were traditionally used and have pharmacological features to heal wounds, with major used families were Bignoniaceae, Fabaceae, Asteraceae and Euphorbiaceae.

Plant parts used as a recipe to heal wounds were in this order, i.e., leaves (10), roots (2), bark (2), whole plant (2), rhizome (1), bulb (1), latex (1) and gum (1) (Figure 3). This result aligns with the study on tribal people in southern India, which also found leaves as the most frequent part of the plant. Most herbal remedies are prepared and applied externally (Ayyanar and Ignacimuthu 2009). Mobale et al. (2023) reported that plants and their parts used for wounds healing activity were in this order: trees (38%) and shrubs (28%) were the most used life forms, while the leaves (48%) and bark (38%) were the most parts of the plant that were exploited.

There were three main preparation methods applied, namely powder, paste and decoction, but some other forms, like fresh leaves, pulp, latex and gum, were also in use (Table 1). The preparation concentration could have been more quantitatively measured as it depended on the wound condition. Most of the injuries cured by these plants were pimples, as they are very common wounds in local areas and too dangerous to be uncured. Because most peoples take it non-serious and does not have the facilities, local plants are very important in this regard, as they are easily accessible to everyone and free of cost.

An ethnopharmacological study conducted in Dogonland revealed 73 plant species used to heal wounds, with mostly the information obtained from traditional healers (Inngjerdingen et al. 2004). Another ethnobotanical survey was also conducted in Tamil Nadu, Kancheepuram, to reveal native plants used for wound-healing during (Muthu et al. 2006). In Bangladesh, the local healers of Santal tribe in Dinajpur District used 16 plant species belonging to 14 families to treat cuts, diabetes, fever, respiratory issues, skin problems and wounds (Azad et al. 2014). Ethnobotanical study in the Balkan Peninsula identified 128 plant species used for wound-healing through external application in the form of an infusion, tinctures, oils, decoction, syrups, balms, ointment and direct to the skin (Jarić et al. 2018). Through clinic surveys and interviews with rural dwellers and traditional healers, Grierson and Afolayan (1999) documented different plants used for wound-healing in Eastern Cape Province, South Africa. An ethnobotanical survey was carried out in Iran to record plant species used by the inhabitants of the area, especially in the rural areas, for wounds healing (Pirbalouti et al. 2010).

Medicinal plants used to heal wounds include the scales of *Allium cepa* warmed with oils of *Brassica campestris* and crushed, applied on the wound externally. The *A. cepa*, commonly known as onion, is proven to have antioxidant, anti-diabetic, anti-thrombotic, anti-hypertensive, hypoglycemic, and antihyperlipidemic activity (Alam et al. 2011). In current study, the most cited plant species were *B. lycium* and *Curcuma longa*, followed by *Punica protopunica* and *Aloe vera*. Leaf pulp of *A. vera* is applied on bleeding wounds, the dried bark of *B. lycium* is sprinkled on injured parts and a paste of *Dodonaea viscosa* leaves is applied externally on wounds as germicide (Abbasi et al. 2010). The *A. vera* has been used by Egyptians, Asians, Romans and Americans for over 5000 years. It has bioactive compounds like saponins, acetones, phytol etc., which act as antimicrobial agents and can act as first-line treatment for burns, ulcers, and wounds (Shedoeva et al. 2019).

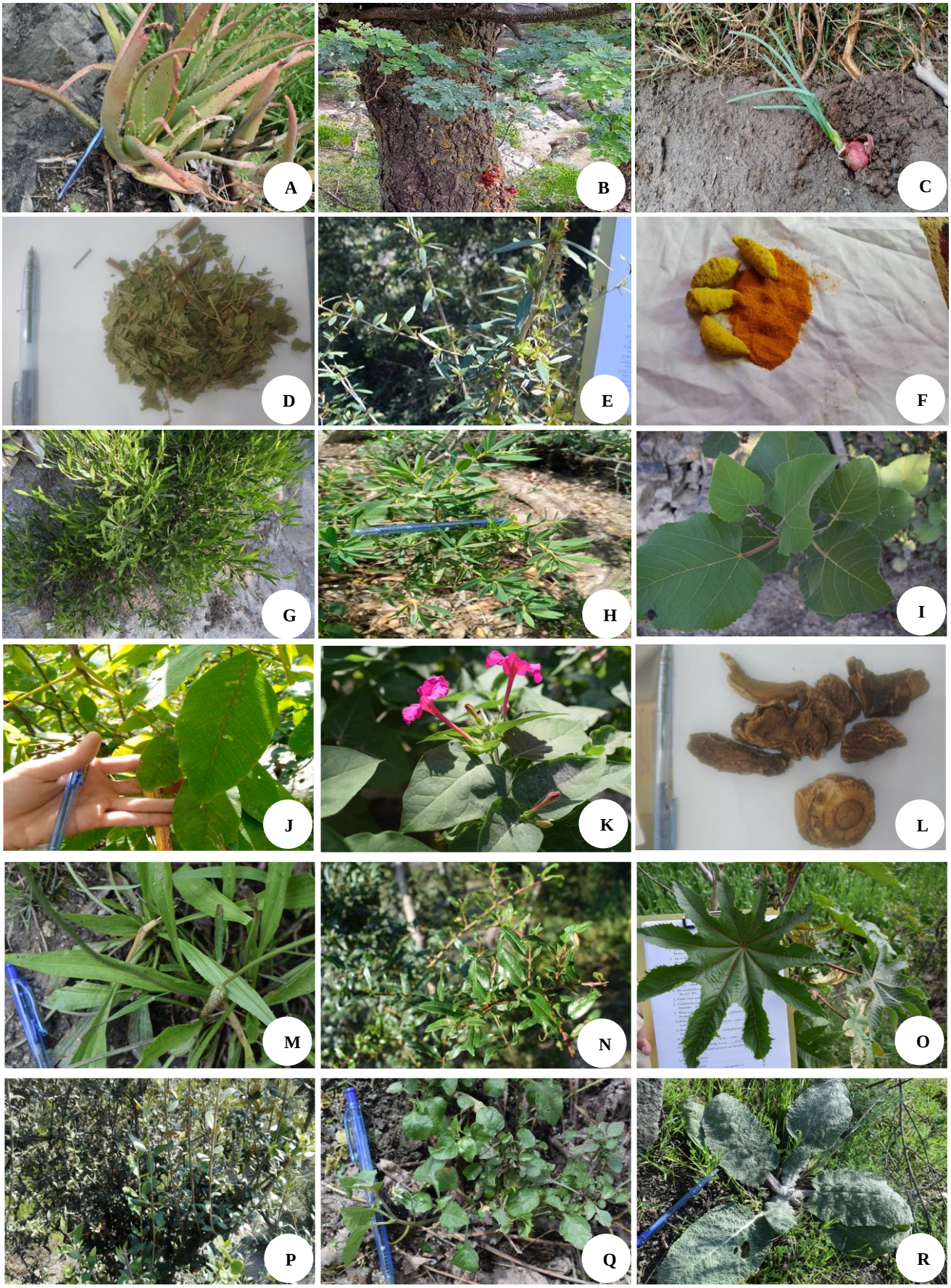
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R

Figure 2. Plant species used to heal wounds in Dir Upper District, Pakistan. A. *Aloe vera*, B. *Acacia modesta*, C. *Allium cepa*, D. *Azadirachta indica*, E. *Berberis lycium*, F. *Curcuma longa*, G. *Dodonaea viscosa*, H. *Daphne mucronata*, I. *Ficus carica*, J. *Juglans regia*, K. *Mirabilis jalapa*, L. *Olea ferruginea*, M. *Plantago lanceolata*, N. *Punica protopunica*, O. *Ricinus communis*, P. *Rheum emodi*, Q. *Solanum nigrum*, R. *Salvia moorcroftiana*, S. *Tamarix aphylla*, T. *Vitis vinifera*

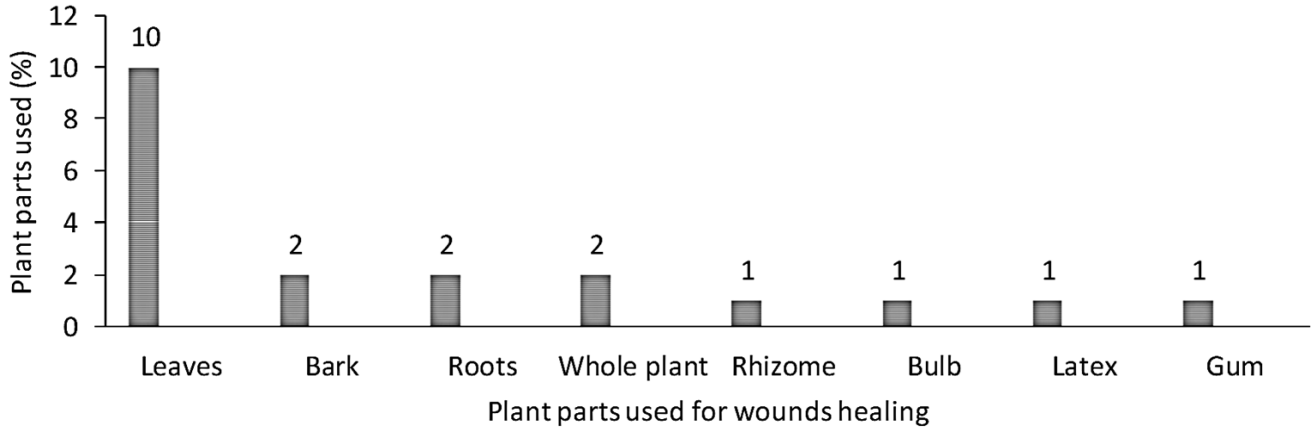

Figure 3. Plant parts used in wound-healing in Dir Upper District, Pakistan

Curcuma longa, commonly known as turmeric, has been reported to contain anti-fungal, anti-bacterial and anti-inflammatory activities. Rhizomes are the parts used. It also contains protein, fats, vitamins (A, B, C, etc.) all of which have a very important role in wound-healing and regeneration. The *D. viscosa* was reported to have anti-ulcer, anti-inflammatory, anti-fungal and anti-bacterial activities (Venkatesh et al. 2008). While *A. vera*, *C. longa* and pomegranate have already been reported to have wounds healing activity (Albahri et al. 2023), to our knowledge, present use of *Acacia modesta*, *D. viscosa*, *Daphne mucronata*, *Ficus carica*, *Juglans regia*, *Mirabilis jalapa*, *Olea ferruginea*, *Plantago lanceolata*, *P. protopunica*, *Ricinus communis*, *Solanum nigrum*, *Salvia moorcroftiana* and *Vitis vinifera* to cure wounds were rarely reported before from any other part of Pakistan.

For new antiseptic and insecticidal medicine this survey gathered information to screen out biological activities of identified valuable plants. The medicinal plants and polyphenolic compounds have therapeutic potential to cure wounds, and can develop new drugs (Mssillou et al. 2022). Future research can be directed to test their biological activities against infectious organisms in order to set up a scientific ground for the searching of new active compounds.

This present study showed that for treatment of primary healthcare, the inhabitants depend on medicinal plants greatly. Due to lack of interest among young generation to carry on this traditional way of healthcare, this traditional knowledge is diminishing day by day as traditional healers remained very few in number. Traditional knowledge of various plant has been acquired from decades of trial and error by local communities of different localities. With respect to time, they have transferred this precious knowledge from generation to generation by oral tradition (Birhan et al. 2023). A study by Bhattarai (1997) in Nepal revealed wound-healing properties of 42 plant species from 40 genera and 23 families used for the treatment of wounds and injuries. This knowledge of remedies by using plants is based on their ancestral and personal knowledge still used and maintained in the rural localities. Ethnobotanical study by Kumar et al. (2007) documented indigenous knowledge of plants used for wound treatment and cuts by the tribal and folklore practices prevailing in India.

Table 1. Medicinal plant species used to heal wounds in Dir Upper District, Pakistan

Botanical name	Family	Local name	Wound heals	Plant part used	Preparation mode	Administration mode	Altitude (m)	Growth form	Plant status	Frequency	Frequency of plants cited	Habitat
Aloe vera	Asphodelaceae	Zuqam	Pimple and cut	Leaves	Fresh plant part	Apply on wound	1006	Herb	Cultivated	Rare	40 resp. (80%)	Arid areas
Acacia modesta	Fabaceae	Palosa	Erector spinae injury	Gum	Fresh or mix with oils and cooked	Oral	1006	Tree	Indigenous	Common	25 resp. (50%)	Woodland
Allium cepa	Amaryllidaceae	Piaz	Pimple	Bulb	Fresh plant part	Warm the bulb and add to wound	937	Annual	Cultivated	common	30 resp. (60%)	Arable
Azadirachta indica	Meliaceae	Neem	Internal wound	Leaves	Extract	Oral or apply externally	1402	Tree	Alien	Scattered	23 resp. (46%)	Woodland
Berberis lycium	Berberidaceae	Koare	Abrasion	Roots	Fodder form	Oral or apply on wounds	1433	Shrub	Indigenous	Rare	48 resp. (96%)	Woodland
Curcuma longa	Zingiberaceae	Kurkaman	Cut and abrasion	Rhizome	Paste (warmed with oils)	Bandage on wound	916	Herb	Alien	Rare	48 resp. (96%)	Arable
Dodonaea viscosa	Sapindaceae	Ghwaraske	Abrasion	Leaves	Fresh plant part	Apply wounds	998	Shrub	Indigenous	Common	20 resp. (40%)	Arid areas
Daphne mucronata	Thymelaeaceae	Neghone	Abrasion	Branch	Extract	Wash the lesion with the extract	1027	Shrub	Indigenous	Common	10 resp. (20%)	Woodland
Ficus carica	Moraceae	Inzar	Sliver wound	Branch	Latex	Intrusion in sliver wound	968	Tree	Indigenous	Rare	18 resp. (36%)	Arable
Juglans regia	Juglandaceae	Ghuz	Gingivitis	Root bark / leaves	Fresh plant part	Rubbing gums with fresh plant	966	Tree	Cultivated	Rare	22 resp. (44%)	Arable
Mirabilis jalapa	Nyctaginaceae	Mazegar goale	Pimple	Leaves	Fresh plant part	Add on to the pimple	1009	Herb	Cultivated	Scattered	12 resp. (24%)	Arable
Olea ferruginea	Oleaceae	Khona	Oral infection	Leaves	Fresh plant part	Mastication	968	Tree	Indigenous	Common	32 resp. (64%)	Woodland
Plantago lanceolata	Plantaginaceae	Ghwajaby	Pimple	Leaves or whole plant	Fresh plant	Add on to the wound	968	Perennial	Indigenous	Scattered	21 resp. (42%)	Wetland
Punica protopunica	Lythraceae	Nangore	Uti	Fruit peel	Fodder form	Oral	969	Tree	Indigenous	Common	45 resp. (90%)	Woodland
Ricinus communis	Euphorbiaceae	Harhanda	Pimple	Leaves	Fresh plant part	Add on to the pimple	1013	Shrub	Established Alien	Scattered	27 resp. (54%)	Ruderal
Rheum emodi	Polygonaceae	Chotyal	Internal wound	Root	Fodder form	Oral	1463	Perennial	Cultivated	Scattered	7 resp. (14%)	Arable
Solanum nigrum	Solanaceae	Karmachu	Pimple	Leaves	Fresh plant part	Add on to the Pimple	968	Annual	Indigenous	Common	41 resp. (82%)	Ruderal
Salvia moorcroftiana	Lamiaceae	Kharkhwag	Abrasion	Leaves	Fresh plant part	Add on to the wound	1263	Perennial	Indigenous	Scattered	30 resp. (60%)	Ruderal
Tamarix aphylla	Tamaricaceae	Ghaz	Burn (antibiotic)	Bark	Fodder mixed with oils	Paste on wound	1448	Tree	Alien	Rare	9 resp. (18%)	Woodland
Vitis vinifera	Vitaceae	Koar	Pimple	leaves	Fresh plant part	Add on to the wound	937	Perennial climber	Cultivated	Rare	25 resp. (50%)	Arable

Note: resp.: respondents

In conclusion, the Dir Upper District area is rich in plant diversity, and its local inhabitants benefit by using it to heal wounds. Due to socioeconomic and limited access to modern health facilities, local people in this area prefer to use medicinal plants, as it is cheap and has little or no known side effects. In this study, a total of 20 plant species were identified to have the ability to cure various types of wounds. Types of wounds that these plants could cure include pimples, cuts, abrasions and internal infections. The growth forms of medicinal plants were mostly herbs and trees, followed by shrubs and climbers. The parts used for healing were dominated by leaves, followed by bark, whole plant, roots, fruit peel, gum, bulb, rhizome and latex. The plants were easy to access and free of cost. External applications were more common than oral consumption to heal wounds. This study revealed that there is an array of plant biodiversity among Pakistanis for the purpose of wound-healing. The younger generation is reluctant to carry on this practice of using herbal plants, and because of this, in the near future, there is a high risk of losing this vibrant knowledge that the elders maintain. Therefore, we recommend setting up an online database to bring to eminence this incredible traditional knowledge of medicinal plants for therapeutic purposes and healing wounds.

REFERENCES

Abbasi AM, Khan MA, Ahmad M, Zafar M, Jahan S, Sultana S. 2010. Ethnopharmacological application of medicinal plants to cure skin diseases and in folk cosmetics among the tribal communities of North-West Frontier Province, Pakistan. J Ethnopharmacol 128 (2): 322-335. DOI: 10.1016/j.jep.2010.01.052.

Alam G, Singh MP, Singh A. 2011. Wound-healing potential of some medicinal plants. Intl J Pharm Sci Rev Res 9 (1): 136-145.

Albahri G, Badran A, Hijazi A, Daou A, Baydoun E, Nasser M, Merah O. 2023. The therapeutic wound-healing bioactivities of various medicinal plants. Life 13 (2): 317. DOI: 10.3390/life13020317.

Ayyanar M, Ignacimuthu S. 2009. Herbal medicines for wound-healing among tribal people in Southern India: Ethnobotanical and scientific evidences. Intl J Appl Res Nat Prod 2 (3): 29-42.

Azad AK, Mahmud MR, Parvin A, Chakrabortty A, Akter F, Moury SI, Akter S, Rahmatullah M. 2014. Medicinal plants of a Santal tribal healer in Dinajpur District, Bangladesh. World J Pharm Pharmaceut Sci 3 (10): 1597-1606.

Bhardwaj S, Gakhar SK. 2005. Ethnomedicinal plants used by the tribals of Mizoram to cure cuts & wounds. Indian J Tradit Knowl 4 (1): 75-80.

Bhattarai NK. 1997. Traditional herbal medicines used to treat wounds and injuries in Nepal. Trop Doct 27 (1): 43-47. DOI: 10.1177/00494755970270S114.

Birhan YS, Kitaw SL, Alemayehu YA, Mengesha NM. 2023. Medicinal plants with traditional healthcare importance to manage human and livestock ailments in Enemay District, Amhara Region, Ethiopia. Acta Ecologica Sinica 43 (2): 382-399. DOI: 10.1016/j.chnaes.2022.05.004.

Budovsky A, Yarmolinsky L, Ben-habat S. 2015. Effect of medicinal plants on wound-healing. Wound Repair Regen 23 (2): 171-183. DOI: 10.1111/wrr.12274.

Bukhari SMF, Ali G. 2022. An overview of ethnobotany of *Berberis lycium* Royle in Pakistan. In: Öztürk M, Khan SM, Altay V, Efe R, Egamberdieva D, Khassanov FO (eds). Biodiversity, Conservation and Sustainability in Asia: Volume 2: Prospects and Challenges in South and Middle Asia. Springer, Cham. DOI: 10.1007/978-3-030-73943-0.

Cheikhyoussef A, Shapi M, Matengu K, Ashekele HM. 2011. Ethnobotanical study of indigenous knowledge on medicinal plant use by traditional healers in Oshikoto region, Namibia. J Ethnobiol Ethnomed 7 (1): 10. DOI: 10.1186/1746-4269-7-10.

Criollo-Mendoza MS, Contreras-Angulo LA, Leyva-López N, Gutiérrez-Grijalva EP, Jiménez-Ortega LA, Heredia JB. 2023. Wound-healing properties of natural products: Mechanisms of action. Molecules 28 (2): 598. DOI: 10.3390/molecules28020598.

Grierson DS, Afolayan AJ. 1999. An ethnobotanical study of plants used for the treatment of wounds in the Eastern Cape, South Africa. J Ethnopharm 67 (3): 327-332. DOI: 10.1016/S0378-8741(99)00082-3.

Guzo S, Lulekal E, Nemomissa S. 2023. Ethnobotanical study of underutilized wild edible plants and threats to their long-term existence in Midakegn District, West Shewa Zone, Central Ethiopia. J Ethnobiol Ethnomed 19 (1): 30. DOI: 10. 1186/s13002-023-00601-8.

Handoo S. 2006. A survey of plants used for wound-healings in animals. Vet Scan 1 (1): 3-9. DOI: 10.1186/1751-0147-1-3.

Inngjerdingen K, Nergård CS, Diallo D, Mounkoro PP, Paulsen BS. 2004. An ethnopharmacological survey of plants used for wound-healing in Dogonland, Mali, West Africa. J Ethnopharmacol 92 (2-3): 233-244. DOI: 10.1016 /j. jep. 2004.02.021.

Jarić S, Kostić O, Mataruga Z, Pavlović D, Pavlović M, Mitrović M, Pavlović P. 2018. Traditional wound-healing plants used in the Balkan region (Southeast Europe). J Ethnopharmacol 211: 311-328. DOI: 10.1016/j.jep.2017.09.018.

Khan IA, Din MMU, Hussain S, Akbar R, Saeed M, Farid A, Fayaz W, Shah RA. 2015. A study of mosquito fauna of District Upper Dir, Khyber Pakhtunkhwa-Pakistan. J Entomol Zool Stud 3 (5): 455-458.

Kumar B, Vijayakumar M, Govindarajan R, Pushpangadan P. 2007. Ethnopharmacological approaches to wound-healing—exploring medicinal plants of India. J Ethnopharmacol 114 (2): 103-113. DOI: 10.1016/j.jep.2007.08.010.

Marques MP, Mendonça L, Neves BG, Varela C, Oliveira P, Cabral C. 2023. Exploring Iberian Peninsula Lamiaceae as potential therapeutic approaches in wound-healing. Pharmaceuticals 16 (3): 347. DOI: 10.3390/ph16030347.

Mobale MM, Ngbolua KTNJP, Djamba AM, Jeannine EM, Mawunu M, Ashande CM, Mpiana PT. 2023. Survey on wound-healing plants traditionally used by the bambenga pygmy indigenous peoples of Dongo Sector (South Ubangi Province) in the Democratic Republic of The Congo. Egypt Acad J Biol Sci 14 (1): 29-42. DOI: 10.21608/EAJBSH.2023.287751.

Monika P, Chandraprabha MN, Rangarajan A, Waiker PV, Chidambara Murthy KN. 2022. Challenges in healing wound: Role of complementary and alternative medicine. Front Nutr 8: 791899. DOI: 10.3389/fnut.2021.791899.

Mssillou I, Bakour M, Slighoua M, Laaroussi H, Saghrouchni H, Amrati FEZ, Lyoussi B, Derwich E. 2022. Investigation on wound-healing effect of Mediterranean medicinal plants and some related phenolic compounds: A review. J Ethnopharmacol 298: 115663. DOI: 10.1016/j.jep.2022.115663.

Muhammad I, Hasan Z, Ullah S, Ullah W, Ullah H. 2014. A preliminary survey of fish fauna of river Panjkora at District Upper Dir, Khyber Pakhtunkhwa Pakistan. J Biodivers Environ Sci 5 (1): 362-368.

Muthu C, Ayyanar M, Raja N, Ignacimuthu S. 2006. Medicinal plants used by traditional healers in Kancheepuram District of Tamil Nadu, India. J Ethnobiol Ethnomed 2 (1): 43. DOI: 10.1186/1746-4269-2-43.

Neto JAR, Tarôco BRP, dos Santos HB, Thomé RG, Wolfram E, Ribeiro RIMDA. 2020. Using the plants of Brazilian Cerrado for wound-healing: From traditional use to scientific approach. J Ethnopharmacol 260: 112547. DOI: 10.1016/j.jep.2020.112547.

Oguntibeju OO. 2019. Medicinal plants and their effects on diabetic wound-healing. Vet World 12 (5): 653-663. DOI: 10.14202/vetworld.2019.653-663.

Pirbalouti AG, Koohpayeh A, Karimi I. 2010. The wound-healing activity of flower extracts of *Punica granatum* and *Achillea kellalensis* in Wistar rats. Acta Pol Pharm 67 (1): 107-10.

Sharma A, Khanna S, Kaur G, Singh I. 2021. Medicinal plants and their components for wound-healing applications. Future J Pharm Sci 7 (1): 1-13. DOI: 10.1186/s43094-021-00202-w.

Shedoeva A, Leavesley D, Upton Z, Fan C. 2019. Wound-healing and the use of medicinal plants. Evid Based Complement Alternat Med 2019: 2684108. DOI: 10.1155/2019/2684108.

Tahir M, Asnake H, Beyene T, Van Damme P, Mohammed A. 2023. Ethnobotanical study of medicinal plants in Asagirt District, Northeastern Ethiopia. Trop Med Health 51 (1): 1-13. DOI: 10.1186/s41182-023-00493-0.

Venkatesh S, Reddy YR, Ramesh M, Swamy MM, Mahadevan N, Suresh B. 2008. Pharmacognostical studies on *Dodonaea viscosa* leaves. Afr J Pharm Pharmacol 2 (4): 083-088.

Xu Z, Dong M, Yin S, Dong J, Zhang M, Tian R, Min W, Zeng L, Qiao H, Chen J. 2023. Why traditional herbal medicine promotes wound-

healing: Research from immune response, wound microbiome to controlled delivery. Adv Drug Deliver Rev 195: 114764. DOI: 10.1016/j.addr.2023.114764.

Yazarlu O, Iranshahi M, Kashani HRK, Reshadat S, Habtemariam S, Iranshahy M, Hasanpour M. 2021. Perspective on the application of medicinal plants and natural products in wound-healing: A mechanistic review. Pharmacol Res 174: 105841. DOI: 10.1016/j.phrs.2021.105841.

Zulkefli N, Che Zahari CNM, Sayuti NH, Kamarudin AA, Saad N, Hamezah HS, Bunawan H, Baharum SN, Mediani A, Ahmed QU, Ismail AFH, Sarian MN. 2023. Flavonoids as potential wound-healing molecules: Emphasis on pathways perspective. Int J Mol Sci 24 (5): 4607. DOI: 10.3390/ijms24054607.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 6, Number 2, November 2023
Pages: 153-160

E-ISSN: 2580-4510
DOI: 10.13057/asianjethnobiol/y060206

Species diversity of socio-economic importance in the Kebe Block Forest, Cameroon: Local perceptions and conservation implications

SOREL LEOCADIE INIMBOCK[1,2,♥], CÉDRIC DJOMO CHIMI[3,4], ARLENDE FLORE NGOMENI[3], CHRISTIAN YAYA ENAMBA[1], YOLLANDE GUIAWA POUOMOGNE[1], ROSE GUSUA CASPA[4], DIANE CHRISTELLE TSEMO[1], ELVIS CHENANG NGUEGUIM[1], GUILLAINE YONGA[1], PANY NOUTANEWO[4], CHRISTIAN ALAIN MISSE[1], WILLIAM ALAIN MALA[2]

[1]Institute of Agricultural Research for the Development (IRAD). B.P. 203, Bertoua, Cameroon. Tel: +237-696700046, ♥email: sorelinimbock@yahoo.fr
[2]Department of Plant Biology, University of Yaounde 1. B.P. 812, Yaounde, Cameroon
[3]Institute of Agricultural Research for the Development (IRAD). B.P. 161, Yokadouma, Cameroon
[4]Conservation and Sustainable Natural Resources Management Network (CSNRM-Net). Yaoundé, Cameroon

Manuscript received: 9 August 2023. Revision accepted: 17 November 2023.

Abstract. *Inimbock SL, Chimi CD, Ngomeni AF, Enamba CY, Pouomogne YG, Caspa RG, Tsemo DC, Ngueguim EC, Yonga G, Noutanewo P, Misse CA, Mala WA. 2023. Species diversity of socio-economic importance in the Kebe Block Forest, Cameroon: Local perceptions and conservation implications. Asian J Ethnobiol 6: 153-160.* Forest areas dedicated to research and education, such as the Kebe Block Forest (KBF), Cameroon, have a high plant diversity, some of which are of socio-economic importance to local populations. Knowing that the objectives of the KBF are well defined, this study aimed to identify forest plant species of socio-economic importance to the local populations living around the KBF. Also, this study aimed to propose strategies that reconcile the local population's well-being and the preservation of the KBF. Given the high dependence of local communities on the forest, a socio-economic survey was carried out in 51 households. Therefore, 40 species of socio-economic importance were found, and six products and services, namely food, medicinal products, raw materials for handicrafts, edible caterpillar species, timber, and income generating, were identified. For 86% of the local people, the availability of these plant species has decreased significantly compared to 10 years ago; the main causes identified were illegal logging (32%) and agriculture (21%). According to occurrence frequency citation, *Baillonella toxisperma* Pierre (65%), *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill. (38%), and *Ricinodendron heudelotii* (Baill.) Heckel (30%) were identified as the flagship socio-economic plant species that local people would like to introduce into their farms to ensure their sustainability. Identifying plant species of socio-economic importance, their availability, and their threats provides substantial information that could help the authorities manage the KBF to plan conservation activities better, considering the local population's well-being.

Keywords: Availability, east Cameroon, Kebe Block Forest, local perception, socio-economic importance, sustainability

Abbreviations: IRAD: Institute of Agricultural Research for Development, KBF: Kebe Block Forest

INTRODUCTION

Cameroon's Forest expanse is known for its ecosystems' variability and high plant diversity (Onana 2018). These ecosystems are an essential source of goods and services for the population's well-being (Leakey et al. 2022). Indeed, they are a source of livelihood (food, timber, medicine and raw material) and support service to thousands of people living in and around the forests, who use them for their daily well-being (Inimbock et al. 2021; Chimi et al. 2022; Leakey et al. 2022; Ayoub et al. 2023; Chimi et al. 2023). The local population strongly depends on forest resources, while the availability of these natural resources is decreasing, and forest areas are shrinking (Zekeng et al. 2019). The main causes are converting forest areas into agricultural land, overexploitation, poor harvesting techniques and timber exploitation (Zekeng et al. 2019; Chimi et al. 2022). Like several other African countries, Cameroon has based its conservation policy on strategies to promote the conservation of its forest area, such as protected areas.

Cameroon's commitment to this vital requirement has created several protected areas, such as National parks. By 2021, the Ministry in charge of Cameroon's forests, in partnership with the World Resource Institute (WRI), designated more than 4.7 million hectares of its land as protected areas. In this context, for example, the Deng-Deng National Park in the East region of Cameroon was created under Decree No. 2010/0482/PM of 18/03/2010. This forest area, belonging to the Congolese domain (Letouzey 1985), is one of the richest in terms of biodiversity in Cameroon (Kabelong et al. 2018). It hosts a forest reserved for research and education, known as the Kebe Block Forest (KBF), managed by the Institute of Agricultural Research for Development (IRAD), especially the IRAD Belabo antenna. Like protected areas, these forests dedicated to teaching and research are, according to the forestry law, areas where all logging activities are prohibited. Unfortunately, the KBF is a victim of extensive human activity, impacting its future and achieving its basic objectives (Tchingsabe et al. 2016). This is also confirmed by the study of Chimi et al. (2023), who showed that KBF

provides 19 provisioning services to riparian people that include firewood, timber, caterpillars, mushrooms, snails, insects (termites and grasshoppers), *djansang* and *andok*, amend, liana, Marantaceae leaves, hazelnut, honey, *okok* (*Gnetum* spp.), livestock feed (pasture), medicinal plants, wine palm, river fishes and snakes. However, even if these services imply several plant species, information about the diversity of socio-economic plant importance for the local population needs to be more understood.

The objective of the Belabo research Antenna is to develop appropriate silvicultural tools for sustainable forest management in the east region of Cameroon, as recommended by Debroux (1998), who points out the urgent need to take practical measures to ensure the protection and sustainability of forest species. Given that population encroachment into the KBF has left the forest area considerably degraded (Tchingsabe et al. 2016), making it difficult for the KBF to achieve its set objectives, particular attention must be paid to reconciling the well-being of the local population with biodiversity conservation goals. Moreover, considering that one of IRAD's missions is to carry out actions in favor of the well-being of the local population and the conservation and sustainable management of biodiversity. The study aims to identify forest plant species of socio-economic importance to the local population to provide substantial information that could help IRAD support the local people in their conservation strategies. This will ensure that the resources of the KBF are preserved, thus attaining the objectives of its creation, and would be part of win-win solutions.

MATERIALS AND METHODS

Study area

This study was carried out from June to August 2022 in the villages adjacent to the Kebe Block Forest (KBF), located in the Belabo Sub-Division, Lom and Djerem Division of the East region of Cameroon (Figure 1). This block has a classified surface area of 3,689 ha under the joint supervision of the University of Dschang and the Belabo IRAD Research Antenna, which was set up in 1972. The average altitude of the study area varies between 600 to 800 m and is characterized by a few hills. The climate in this area is Guinea-Equatorial, with four seasons of unequal duration (a long dry season from mid-October to mid-March, a short dry season from July to August, and a long rainy season from mid-March to June, and a short rainy season from September to mid-October. The average rainfall is 1,600 mm/year, and the average annual temperature fluctuates from 23°C to 25°C. The hydrographic network is very dense and characterized by several tributaries. The soils are essentially ferritic, sandy-clay, or silty-clay, generally found on the plains, with lateritic cuirasses in places and some hydrographic soils found mainly in marshy areas and flood plains. The vegetation comprises phytogeographical units falling into two subsets: the Guinea-Sudanese with its different savannah facies and the semi-deciduous forest (Letouzey 1985). The main activities are logging, agriculture, hunting, and collecting non-timber forest products (NTFPs).

Data collection

Data were collected in five villages (Biombi, Yebi, Yanda, Ebaka, and Essandjane) of the seven villages bordering the KBF, Cameroon. These villages were selected based on their proximity to the boundaries of the KBF. The methodological approach used for data collection consisted of administering a questionnaire to the heads of households in the target villages, with or without other members of the household present. These people were selected based on the duration of their stay in the locality (the more time you spend in a village, the greater your knowledge of the socio-economic species (Ngoukwa et al. 2023), their dependence on forest products, and their hospitality.

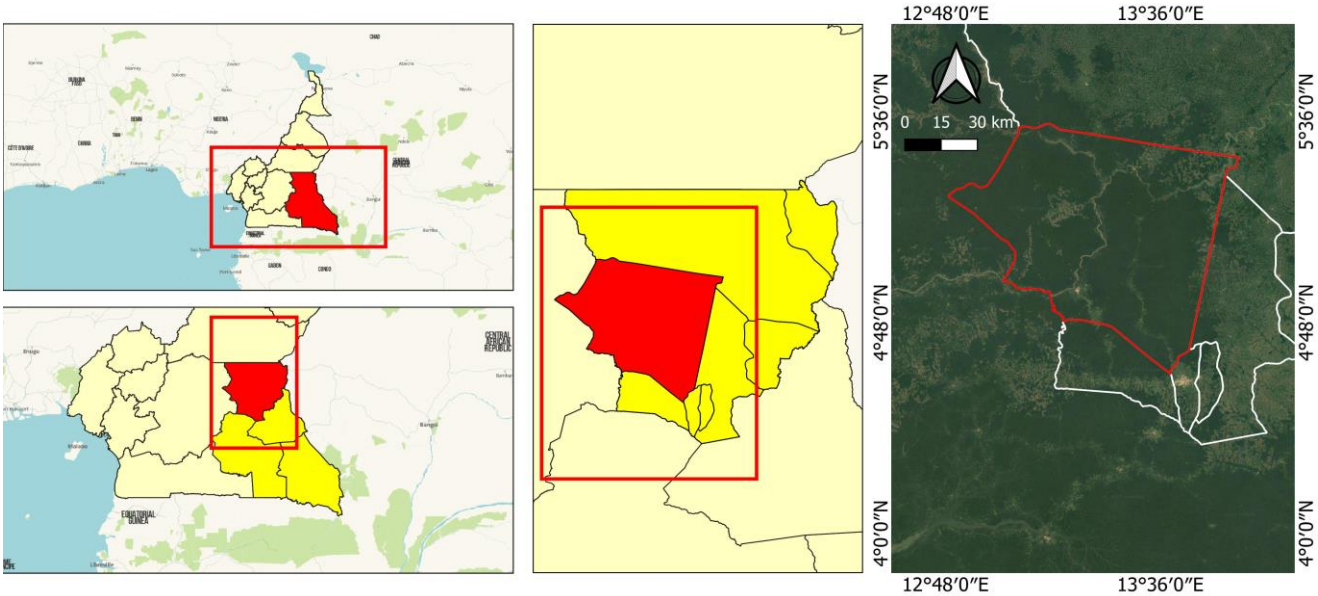

Figure 1. Study area in Kebe Block Forest, in the Belabo Sub-Division, Lom and Djerem Division of the East of Cameroon

Given the language barrier, a translator (local language to French and vice versa) was recruited to facilitate the administration of the questionnaire. The questions essentially concerned the forest species of importance to them, their uses, the harvesting methods, the plant parts collected, approximate walking distance from their villages to the resource collection points and the degree of importance value The botanical forms of each plant species listed were identified through literature reviews (Onana and Mezili 2018). Information on the perception of local people concerning the level of threats and availability of these natural resources in the villages was also collected. Notably, out of the 60 households retained for this study in the five target villages (Chimi et al. 2023), 51 heads of household were surveyed (representing 85% of all households living in the KBF).

Data analysis

The collected data were encoded in a Microsoft Excel spreadsheet, and descriptive analyses based on the frequency of quotations (%) obtained were calculated to assess local populations' perceptions of socio-economic plant species. On the other hand, local people of each species' occurrence frequency citation (in percentage %) was done to appreciate the number of species according to different parts used, harvesting techniques, distance, consumption level, and then the socio-economic interest of these species.

RESULTS AND DISCUSSION

Diversity of species of socio-economic importance to local people in the periphery of the Kebe Block Forest

Surveys of local people living near the KBF reveal that all respondents (100%) rely on resources derived from the forest for their well-being, given the socio-economic potential that these forest species provide. A total of 40 plant species of socio-economic importance to local people were identified (Table 1). According to their forms, 81% are trees, 1% is shrubs, 10% herbaceous plants and 8% liana.

These plant species provide people with goods and services such as food, traditional medicine, handicrafts, timber, raw materials for handicrafts, and edible caterpillars found on some specific tree species. For the six services identified (food, traditional medicine, handicrafts, timber, caterpillars, and income generating (products collected for sale), four plant species were identified as providing four services each (representing 10% of the total species identified); 17 provide three services each (43%); 10 provide two services each (25%), and only nine plant species provide a single service each (23%) (Table 1).

The population traveled from less than 1 to nearly 25 km (distance from the village) to collect forest products from the plant species identified. For 73% of these species, riparian people traveled 10 or less than 10 km to collect these resources. These consist essentially of plant parts such as bark, seeds, fruit, flowers, leaves, and roots for both food and traditional medicine; timber, raw material for handicrafts (rattan, petioles from the palms of *Raphia* sp.); palm wine, caterpillars from certain forest tree species such as *Entandrophragma* spp. (Table 1). For most plant species (23%), the parts collected are bark and trunk; for 18% and 13%, fruit and trunk caterpillars are collected, respectively. Leaves, trunk and bark-fruit are collected by 8% of plant species. The bark is collected for 5% of these plant species. The others are represented by 3% of plant species each; these include bark-chenille-trunk, bark-fruit-leaves, bark-fruit-sap, bark-sap, flowers and leaves-sap.

The methods used to collect these plant species depend on the services provided: picking off the leaves (medicinal), tree felling (timber and in some cases for edible caterpillars), picking (seeds, fruits and caterpillars: food and raw material), and debarking (bark: medicinal). It should be noted that several collection methods are applied for some plant species depending on the part collected (Table 1). We found that for 8% of these plant species, the harvesting method consists of Picking leaves and debarking-felling each. For harvesting methods like debarking, felling, picking-felling and picking leaves-debarking, they are represented by 3% of plant species each. Debarking-picking, debarking-picking leaves, picking, picking-picking-leaves and picking-debarking-dealing are represented by 2% of plant species. Debarking-picking-felling, debarking-picking, leave-picking, felling-picking, picking, picking leaves-picking represented each 1%. It should also be noted that woody forest resources provide local residents with the fuelwood they need for cooking. However, there is no specific choice of woody species for this service.

According to the perception of local people concerning the socio-economic importance of the plant species, only those of 29 plant species were provided (73%), and they still need to provide information concerning the socio-economic importance of 11 plant species. However, for these 29 plant species where information was provided, 55% of respondents think that their economic value is low despite their interest in these plant species, 21% think it is medium, and 24% think it is high. According to the consumption level perception of local people, we found that 53% have a low consumption; 28% a moderate consumption and 20% a high consumption. For each plant species, the economic value and consumption level provided were mentioned in Table 1.

Availability of plant species of socio-economic importance in the zone

Nearly 86% of household respondents perceived a decrease in the availability of plant species of socio-economic importance compared to 10 years ago. However, 11% and 3% thought these species had remained constant and increased. On the question of which plant species they are interested in, even though they have become rare in the area, 29 forest plant species were identified. The frequency of occurrence (%) of these plant species according to the respondents (indicating the socio-economic importance of the plant species despite the decline in their densities) is shown in Figure 2. *Baillonella toxisperma, Triplochiton scleroxylon, Entandrophragma cylindricum,* and *Milicia*

excelsa were the plant species most frequently cited by households as having a high economic potential, although they are disappearing in the area.

When asked whether local people would like to introduce forest plant species into their plots (fields, plantations, home gardens and cocoa agroforest, 100% of respondents expressed an interest in introducing forest plant species of their choice into their plots if the plants were available and accessible to them. In their opinion, the selected plant species to be introduced is a function of these plant species' socio-economic importance. Figure 3 shows, in order of relative frequency of occurrence, the 28 flagship plant species in which people have shown an interest. The *B. toxisperma* (65%), *Irvingia gabonensis* (38%), *Ricinodendron heudelotii* (30%), and *E. cylindricum*, (24%) were selected because they preferred of more frequently exceed 20%.

Factors affecting the availability of these plant species

Several factors have been identified as being the cause of the decline or even scarcity of plant species of socio-economic importance. Figure 4 shows the various causes, and it can be seen that the main anthropogenic causes are illegal logging (32%) and agriculture (21%). High market demand and domestic and medicinal needs were also mentioned to a lesser extent, below 5% each.

Discussion

The survey results identified 40 plant species with socio-economic importance for the local people living along the KBF. The various uses to which these species are put are mainly for food, medicinal purposes, and timber. Ingram et al. (2010) showed that priority species in countries of Central Africa such as Cameroon, the Democratic Republic of Congo, and the Central African Republic have multiple uses, mainly for food, medicine, and fuel. However, the people who make up the population of the KBF are not specific in the plant species used as an energy source, which is why this service in terms of plant diversity was not directly considered in this study.

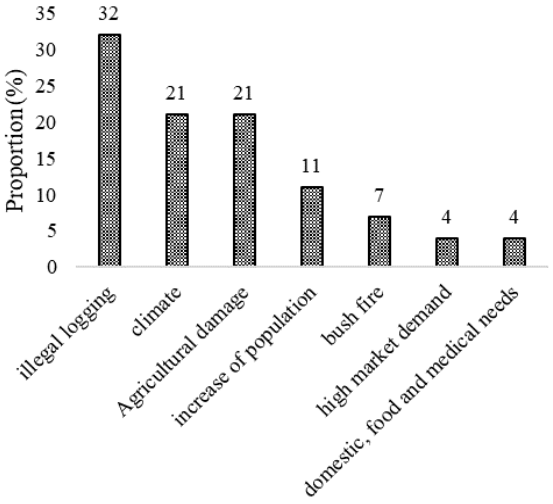

Figure 4. Factors explaining the reduction in plant species in and around the Kebe block forest

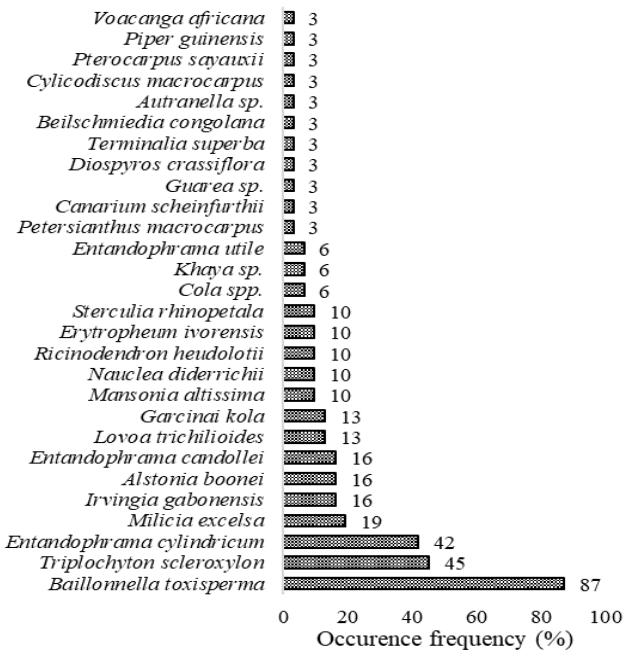

Figure 2. List of plant species that have become rare in the area

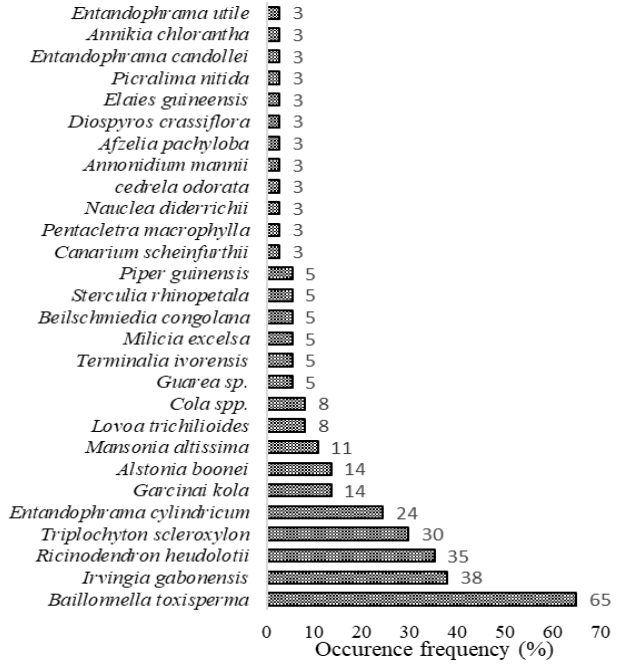

Figure 3. Plant species whose populations are interested in introducing into their plots or fields by frequency of occurrence

Table 1. List of forest plant species of socio-economic value to local populations around the KBF for their multi-use value

Common/Vernacular Names	Scientific Names (Plants)	Socio-economic Value/ Use						Part Used	Harvesting Method	Consumption Level (+++, ++, +)	Collection Distance (km)	Economic Importance
		Fo	Me	Ti	Cra	Ct	In					
Liana												
Bamboo	*Bambusa* spp.				X			Le	PickLe	+	Less than 5	Low
Rattan	*Calamus* spp.				X			Tr	Fel	+	5 to 10	Low
	Eremosphata spp.				x			Tr	Fel	+	5 to 10	Low
	Lacosperma spp.				x			Tr	Fel	+	5 to 10	Low
Ndonkol	*Piper guineense*	x					x	Fr	PickLe	++	3 to 8	Average
Herbaceous												
Atanga	*Aframomum* spp.	X	x				x	Fr	PickLe	++	3 to 8	Low
Ba'a	*Elaeis guineensis* Jacq.	X	x		x		x	Le, Sa	PickLe	+++	1 to 6	Strong
Junc leaves	*Marantochloa cordifolia* (K. Schum.) Koechlin	x					x	Le	PickLe	+++	5 to 15	Strong
	Raphia sp.				x			Le	PickLe	+	variable	Low
Trees												
Ikouk	*Alstonia boonei* De Wild.		X	x			x	Ba, Tr	Deb, Fel	+++	Up to 8	Low
Pol	*Annickia chlorantha* (Oliv.) Setten & Maas		x					Ba	Deb	+	5 to 8	
Corossol wild	*Anonidium mannii* (Oliv.) Engl. & Diels	x	x				x	Ba, Fr	Deb, Pick	++	3 to 8	Low
Moabi	*Baillonella toxisperma* Pierre	x	x					Fr, Se, Tr	Fell, pick	++	5 to 25	Strong
Kanda	*Beilschmiedia congolana* Engl. Ex Stapf	x					x	Fr	Deb	+++	1 to 3	
Ayele	*Canarium schweinfurthii* Engl.	X	x	x			x	Ba, Tr	Pick, Fel	++	Up to 5	
fromagier	*Ceiba pentandra* (L.) Gaertn.	X						Flo	Pick	+	less than 5	
Cola/Baa/Goro	*Cola* spp.	X	x				x	Ba, Fr	Deb, PickLe, Pick	++	up to 5	Low
Okan	*Cylicodiscus gabunensis* Harms		x	x			x	Ba, Tr	Deb, Fel	+	5 to 6	
Sapelii/tiama/kossipo	*Entandrophragma* spp.		X	x		x	x	Ba, Cart, Tr	Pick, Deb, Fel	+++	5 to 15	Average
Tali	*Erythrophleum ivoreense* A. Chev.		x	x			x	Ba, Tr	Deb, Fel	+		Low
Yieul/bitter cola	*Garcinia kola* Heckel	x	x					Ba, Fr	Deb, Pick	+++	2 to 8	
Bosse	*Guarea* spp.		x	x			x	Ba, Tr	Deb, Fel	+	5 to 7	Low
Adok	*Irvingia gobonensis* Baill. ex Lanen.	x	x	x			x	Fr	Pick	+++	1 to 15	Strong
Bete	*Mansonia altissima* A. Chevalier			x		x	x	Cart, Tr	Pick, PickLe	+	5 to 8	Average
Iroko	*Milicia excelsa* (Welw.) C.C. Berg		x	x			x	Ba, Tr	Deb, Fel	++	5 to 10	Low
Monkeys pineapple	*Myrianthus arboreus* Beauv.	x	x				x	Ba, Sa	Deb, PickLe	+	1 to 9	Low
Iza/bilinga	*Nauclea diderrichii* (De Wild. & T.Durand) Merrill		x				x	Ba, Fr, Tr	Deb, Pick, Fel	+	Up to10	Low
Ibai	*Pentaclethra macrophylla* De Wild. & T.Durand	x						Fr	PickLe	+		Low
Abale	*Petersianthus macrocarpus* (P.Beauv.) Liben			x		x	x	Cart, Tr	PickLe, Pick	+		Average
Ibam	*Picralima nitida* (Stapf) Th. & H. Durand		x					Ba, Fr, Le	Deb, PickLe	+	5 to 15	Low
Dabéma	*Piptadeniastrum africanum* (Hook.f.) Brenan		x	x			x	Ba, Tr	Deb, Fel	++	1 to 8	
Faux padouk	*Pterocarpus milbradii* Harms			x		x	x	Cart, Tr	Pick, PickLe	+		Average
Padouk	*Pterocarpus soyauxii* Taub.		x	x			x	Ba, Tr	Deb, Fel	+		

Ilumba	*Pycnanthus angolensis* (Welw.) Exell		x	x		x	Ba, Tr	Deb, Fel	+		
Izol/djanssang	*Ricinodendron heudelotii* (Baill.) Heckel	x				x	Fr	Pick	+++	2 to 8	Strong
Nkannang	*Sterculia rhinopetala* K. Schum.			x			Tr	Fel	+		
Frake	*Terminalia superba* Engl. & Diels			x		x	Tr	Fel	+		Low
Ayous	*Triplochiton scleroxylon* K. Schum.			x	x	x	Cart, Tr	Pick, Fel	++	2 to 15	Strong
Ayous	*Triplochiton scleroxylon* K. Schum.			x	x	x	Cart, Tr	Pick, Fel	+	less than 8	Average
Amvout	*Trichoscypha acuminata* Engl.	x				x	Fr	PickLe	++	5 to 9	Low
Shurbs											
Gomde	*Rauvolfia vomitoria* Afzel.		x				Ba	Deb	+	1 to 5	
Voacanga	*Voacanga africana* Stapf ex Scott-Elliot		x			x	Ba, Fr, Sa	PickLe, Deb	++	1 to 9	Strong

Note: Socio-economic value: Al: Food, Me: Medicinal, Ti: Timber, Cra: Craft, Ct: Tree host caterpillar, In: Incomes. Part used: Fr: Fruits, St: Stem, le: Leaves, Flo: Flower, Se: Seeds, Cart: Caterpillars, Tr: Trunk, Ba: Bark, Sa: Sap. Harvesting methods: PickLe: Picking leaves, fel: Felling, Pick: Picking, Deb: Debarking. Consumption level perception: +++: Highly consumed, +++: Moderate consumption, +: Low consumption

Similar results relating to the potential diversity of plant species of interest and the multi-use of these species have been found by several authors who have conducted studies among rural populations in African tropical forests (e.g., Madountsap et al. 2019; Ngansop et al. 2019; Bosanza et al. 2021; Inimbock et al. 2021; Chimi et al. 2022; Ayoub et al. 2023; Ji et al. 2023). These authors noted, for example, the extensive use of bark from forest trees in the Eastern region by local people to treat certain diseases. This is the case, for example, of the uses of the bark of *I. gabonensis, Beilschmiedia congolana, Canarium schweinfurthii, Alstonia boonei, Annickia chlorantha, Anonidium mannii, Voacanga africana, R. heudelotii, Allanblackia floribunda* and *Antrocaryon klaineanum*, which were also identified as part of this study.

From a food service provision point of view, Chimi et al. (2022) showed the strong dependence of local populations on forest supply services, particularly those of food value. Indeed, forest dwellers are heavily dependent on forest resources for their day-to-day well-being because, in addition to the food resources that these provide, they are also an important income source since the resources they collect are not only intended for consumption but also to a large extent, for sale. For this reason, in the context of this study, economic value (sale) was considered forest utility for the populations. From our surveys, we found that the annual income from the sale of some specific forest products could vary from 20,000 XFA (33 USD) to nearly 200,000 XFA (330 USD) and 50,000 to 200,000 XFA (82 to 330 USD), respectively, for *I. gabonensis* and *R. heudelotii.* Ngome (2006) obtained similar results in the forest zone of Cameroon. In the case of caterpillar, which is one of the main ingredients in the diet of local people, as shown by several authors concerning the unit of NTFP marketing measurement (Ngome 2006; Ngansop et al. 2019), they used "kumbo" of two liters unit of NTFP marketing measurement and the price of one "kumbo" of caterpillar varied between 500 (0.82 USD) and 2000 XFA (3.3 USD) for an annual income of 20,000 to 50,000 XFA (33 to 82 USD). This price variation is attributable to the seasonal nature of the resource. During the period of caterpillar abundance, i.e., July-August, caterpillars are plentiful and less expensive. In periods of scarcity, those who have collected and preserved them, resell them at a higher price, hence the price fluctuations observed in the area for this resource. Ngome (2006) and Ngansop et al. (2019) obtained the same trends for several other NTFPs in forest areas. On the other hand, caterpillars resources are becoming increasingly scarce due to the decreasing density of their host tree species in the forest environment and, above all, because some people cut down trees to collect these caterpillars (unsustainable management). This poor management contributes to a reduction in the density of individuals of the target plant species. This reduction in the density of individuals of interest would also be due to poor notching methods for collecting bark because when it is not sustainable, the tree dies (Ngansop et al. 2019).

The KBF belongs to the semi-deciduous forests, which are generally very rich from a floristic point of view (Kabelong et al. 2018). This site is surrounded by several forest management units and the Belabo communal forest, where several timber species are exploited (Temgoua et al. 2020), many of which have been identified by local people of the KBF. This could be the reason for the existence of illegal logging in the area, as local people are generally looking for timber for the construction of various tools, particularly for building houses and furniture (Chimi et al. 2023), and as a source of income (sale), even though it is illegal in the area and generally avoiding state control and monitoring (Cerutti and Tacconi 2006). According to the results of this study, logging is more pronounced in the area for plant species such as *B. toxisperma, A. boonei*, *M. excelsa, Sterculia rhinopetala, E. cylindricum, T. scleroxylon, Terminalia superba*, *Pterocarpus* sp., and *Nauclea diderrichii*. Removing these species impacts the conservation process, which is the mission of the KBF. In addition, the reduction of seed trees reduces their regeneration potential. This justifies the perception of a decrease in the abundance of these species compared to 10 years ago, as mentioned by nearly 86% of those surveyed. Guedje (2002) showed that removing non-timber forest products by felling or sawing reduces the forest's productive potential. Moreover, from the point of view of debarking, Guedje (2002) also showed that the commercial exploitation of *Garcinia lucida* bark consists of completely debarking the standing tree, thus causing its death and a sharp reduction in its density.

Two main factors cause deforestation and forest degradation in Cameroon. The first is slash-and-burn agriculture, responsible for 80-95% of forest cover loss (Cerutti and Tacconi 2006). Slash-and-burn farming is one of the crucial farming practices around the KBF, and as it continues to expand, it has even encroached on areas set aside for research and education. It is time for measures that meet the needs of the various stakeholders to be considered. To this end, the recommendations made to IRAD from the study include setting up buffer zones, which are located between the classified KBF and the local population areas. These areas could be used for domestication programs for flagship plant species identified by the local people so that they can obtain these services in these areas without entering the classified/protected forest. Similarly, local people should be supported in domesticating these forest species by making seedlings available, setting up nurseries with their help, and supporting local people in tree planting. In addition, with the intensification of sensitized actions done by IRAD around the KBF, local people should change their mentality by applying sustainable harvest methods and avoiding hindering the ecological balance of this forest. Therefore, it maintains its character, continuously fulfilling its purpose of research and education as its vision envisages. Better still, the inactivity of people in the forest will encourage the natural regeneration of this site and even appreciation of the ecological dynamics.

In conclusion, this study made it possible to identify 40 forest plant species of socio-economic importance to the local populations of the KBF, which are a source of food, timber, medicinal products, caterpillars, handicrafts, and income generators. However, local people's perception of

their current forest availability shows a decrease in these resources compared to 10 years ago, mainly due to uncontrolled logging and agriculture (expansion of agricultural land at the expense of forests). However, given their economic value, local people have shown great interest in several forest tree species, from which the goods and services collected not only provide them with food, raw materials and medicinal services, but also represent an essential source of income for them. They have expressed an interest in planting these plant species in their areas or fields if they were allowed to plant them. As a research and education site, it is therefore recommended to IRAD that measures be taken to preserve this site's mission. Knowing that its intervention is also aimed at the well-being of the local population, implementing a strategy to develop the buffer zone into domestication areas for the identified flagship species would be beneficial, coupled with providing seedlings to local people and support in their planting. In this way, we can ensure the local population's well-being and the resource's sustainability for the benefit of future generations.

ACKNOWLEDGEMENTS

We thank IRAD for financial support through its Public Investment Budget (PIB) 2019 funding. Many thanks also to the people of the study villages for their hospitality and willingness to answer the questions that formed the basis of our research.

REFERENCES

Ayoub M, Saeed S, Ahmed A, Ahmed M. 2023. Ethnobotanical survey and utilization of medicinal and food plants of Panjgur, Balochistan, Pakistan. Asian J Ethnobiol 6 (1): 26-35. DOI: 10.13057/asianjethnobiol/y060104.

Bosanza J, Zwave A, Mongeke M, Bobuya PN, Mukiza J, Koto-Te-Nyiwa JPN. 2021. Inventaire des essences forestières utiles de la réserve de Bayenga dans le secteur de Dongo (Province du Sud-Ubangui) en République Democratique du Congo. Rev Mar Sci Agrom Vet 9 (1): 102-108.

Cerutti PO, Tacconi L. 2006. Forests, Illegality and Livelihoods in Cameroon. Working paper 35. CIFOR, Bogor.

Chimi DC, Enamba YC, Ngansop TM, Inimbock SL, Ntonmen YAF, Ngoukwa G, Christelle TTD, Noutanewo P, Messie SND, Nyong PA, Ngueguim CE, Kabelong BLPR, Misse AC, Zapfack L. 2023. Local population perspectives of the ecosystem services provided by the Kebe Block Forest in the east region of Cameroon. Forestist 73 (2): 191-196. DOI: 10.5152/forestist.2022.22054.

Chimi DC, Inimbock SL, Kabelong BLPR et al. 2022. Availability of medicinal forest plant species used as adjuvant in COVID-19 treatment in the periphery of the Deng-Deng Forest, Cameroon. J Med Plants Stud 10 (1): 98-106. DOI: 10.22271/plants.2022.v10.i1b.1367.

Debroux L. 1998. L'aménagement des forêts tropicales fondé sur la gestion des populations d'arbres: l'exemple du Moabi (*Baillonella toxisperma* Pierre) dans la forêt du Dja. Cameroun. [Thèse de Doctorat]. Faculté Universitaire des Sciences Agronomiques de Gembloux, Belgique.

Guedje N. 2002. La gestion des populations d'arbres comme outil pour une exploitation durable des produits forestiers non ligneux: l'exemple de *Garcinia lucida* (Sud Cameroun). [PhD Thesis]. Université Libre de Bruxelles, Bruxelles. [Belgique]

Ingram V, Tieguhong V, Nkamgnia EM, Eyebe JP, Ngawe M. 2010. The Bamboo Production to Consumption System in Cameroon. CIFOR, Bogor. DOI: 10.17528/cifor/003312.

Inimbock SL, Chimi DC, Enamba YC, Tsemo TDC, Somnjom ED, Mounmenie KH, Bogne TLV, Noudem JC, Nanfack TCL, Misse AC. 2021. Contribution to traditional knowledge used for the prevention and healing of the Covid-19 symptoms by local people of Deng-Deng massif forest Cameroon. Intl J Curr Res Biosci Plant Biol 8 (7): 7-16. DOI: 10.20546/ijcrbp.2021.807.002.

Ji A, Hamid A, Andrabi HAS. 2023. Ethnomedicinal knowledge of the rural communities of Gulmarg, Jammu and Kashmir, India. Asian J Ethnobiol 6 (1): 58-64. DOI: 10.13057/asianjethnobiol/y060107.

Kabelong BLPR, Zapfack L, Weladji R et al. 2018. Floristic diversity and carbon stocks in the periphery of Deng Deng National Park, Eastern Cameroon. J For Res 31: 989-1003. DOI: 10.1007/s11676-018-0839-7.

Leakey RRB, Avana TML, Awazi NP, Assogbadjo AE, Mabhaudhi T, Hendre PS, Degrande A, Hlahla S, Manda L. 2022. The future of food: Domestication and commercialization of indigenous food crops in Africa over the third decade (2012-2021). Sustainability 14 (4): 2355. DOI: 10.3390/su14042355.

Letouzey R. 1985. Notice de la carte phytogéographique du Cameroun au 1/500000. Institut de la carte international de la végétation, Toulouse, France.

Madountsap TN, Zapfack L, Chimi DC, Kabelong BLP, Forbi PF, Tsopmejio TI, Tajeukem VC, Ntonmen YAF, Tabue MRB, Nasang JM. 2019. Carbon storage potential of cacao agroforestry systems of different age and management intensity. Clim Dev 11 (7): 543-554. DOI: 10.1080/1756 5529.2018.1456895

Ngansop M, Sonwa D, Fongnzossie E, Elvire HB, Preasious FF, Oishi T, Bernard-Aloys N. 2019. Identification of Main Non-Timber Forest Products and Related Stakeholders in its Value Chain in the Gribe Village of Southeastern Cameroon. ASC-TUFS Working Papers, Kyoto University, Japan.

Ngome TP. 2006. Etude sur la gestion durable des PFNL au Cameroun. Rapport Projet UICN ITTO, CFC, Cameroun.

Ngoukwa G, Chimi DC, Kabelong BLPR, Moses BL, Zekeng JC, Ntonmen YAF, Tabue MRB, Lekeufack A, Tchonang DLB, Nana NJJ, Mounmemi KH, Bawou ARM., Atabong PA, Tsopmejio TI, Djoukang NV, Nbendah P, Nana NNE, Zapfack L. 2023. Perception and adaptation strategies of forest dwellers to climate variability in the tropical rainforest in eastern Cameroon: The case of the inhabitants of the Belabo-Diang Communal Forest. Heliyon 9: e15544. DOI: 10.1016/j.heliyon.2023e15544.

Onana JM, Mezili P. 2018. Recueil des noms des plantes en langues ethniques du Cameroun. Edition Université Européenne.

Onana JM. 2018. Cartographie des écosystèmes du Cameroun. Intl J Biol Chem Sci 12 (2): 940-957. DOI: 10.4314/ijbcs.v12i2.25.

Tchingsabe O, Ngomeni AF, Mapongmetsem PM, Bekwake NA, Noutcheu R, Dibong SD, Tchatat M, Fawa G. 2016. Valorization of non-timber forest products in Mayo-Rey (North Cameroon). J Appl Biosci 108: 10491-10499. DOI: 10.4314/jab.v108i1.2.

Temgoua LF, Solefack MCM, Awazi NP, Tadjo P. 2020. Floristic diversity and exploitable potential of commercial timber species in the Cobaba community forest in Eastern Cameroon: implications for forest management. For Sci Technol 16 (2): 56-67. DOI: 10.1080/21580103.2020.1750493.

Zekeng JC, Sebego R, Mphinyane WN, Mpalo M, Nayak D, Fobane JL, Onana JM, Funwi FP, Mbolo MMA. 2019. Land use and land cover changes in Doume Communal Forest in eastern Cameroon: Implications for conservation and sustainable management. Model Earth Syst Environ 5 (4): 1801-1814. DOI: 0.1007/s40808-019-00637-4.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 6, Number 2, November 2023
Pages: 161-170

E-ISSN: 2580-4510
DOI: 10.13057/asianjethnobiol/y060207

An ethnobotanical study of aromatic medicinal plants of Swat Valley, Pakistan

SHUJAT ALI[1,♥], MEHMOODA MUNAZIR[2], HASSAN SHER[1], RAHMATULLAH QURESHI[3], MUHAMMAD AKRAM[4]

[1]Independent Researcher. Swat, KP, Pakistan. ♥email: alishujat119@gmail.com, shujatbotnay@gmail.com
[2]Department of Botany, Government College Women University. Kutchehry Road, Sialkot, Pakistan
[3]Department of Botany, Pir Mehr Ali Shah-Arid Agriculture University. Rawalpindi, Pakistan
[4]Department of Eastern Medicine and Surgery, Government College University Faisalabad. Lahore District, Punjab, Pakistan

Manuscript received: 20 October 2023. Revision accepted: 29 November 2023.

Abstract. *Ali S, Munazir M, Sher H, Qureshi R, Akram M. 2023. An ethnobotanical study of aromatic medicinal plants of Swat Valley, Pakistan. Asian J Ethnobiol 6: 161-170.* Plants play a key role in local medicines and are a source of income, as in the case of Swat, Pakistan, which is rich in medicinal plants coupled with rich in the practice of traditional knowledge and diverse cultures. So, the present study aimed to record the cultural uses of aromatic medicinal plants commonly used as medicines by herbalists from remote areas in Swat Valley. The survey was carried out in 2021 and 2023 using a semi-structured questionnaire with a total of 106 people were interviewed. A total of 33 aromatic medicinal plant species belonging to 30 genera and 14 families were identified and recorded. Lamiaceae was the most commonly used plant family (33%), followed by Apiaceae (18%), Rutaceae (9%), Zingiberaceae (6%), and Myrtaceae (6%). Herbs were commonly used for herbal recipes with 23 species (69%), followed by shrubs (12%), trees (15%), and climbers (3%). Shoots and leaves (30%) were the most commonly used parts of the plants, followed by fruits (18%), seeds (15%), bulbs (6%), rhizomes, bark, and needles (3%). In terms of mode of application, powder was the most common mode (42%), followed by dried (30%), infusions (27%), decoctions (24%), crushing (6%), and heating (3%). The highest Relative Frequency of Citation (RFC) was *Skimmia laureola* with 0.84, while *Anisomeles indica* had the lowest RFC (0.13). In terms of Fidelity Level (FL), *Zingiber officinale* had the highest FL (83%), while *Sium latifolium* had the lowest FL (13%). The recorded aromatic medicinal plants are mostly used to treat stomach problems. It has also been observed that elderly people are more knowledgeable than younger ones. Therefore, the present study suggests that these plants should be screened for new compounds linked to their reported use in the development of new therapeutics.

Keywords: Aromatic plants, cultural use, ethnopharmacological profile, Swat Valley, therapeutic agents

INTRODUCTION

Since the beginning of human history, plants and humans have had a close and devoted link, not only ecologically but also socio-culturally. For centuries, medicinal and aromatic plants have been used as ingredients for food, flavor, clothing and medicine. Generally, plants with high medicinal and aromatic values have history of use as a source of cheap and effective therapies for several diseases (Salganik and Heckathorn 2004; Qureshi et al. 2016). The custom and tradition of using medicinal plants to treat ailments have always been an essential part of many cultures and can be traced back 7,000 years (Goodman and Ghafoor 1992). For example, the Sumerian clay tablet, a 4000-year-old medical script, documents the most primitive known plant remedies for numerous diseases (Ali et al. 2018). Many of the medications used in today's healthcare systems are derived from plants and were, for the most part, inspired by their traditional uses (Farnsworth and Soejarto 1991; Newman and Cragg 2012).

The number of plant species globally is estimated between 350,000 and 400,000 species in which a great number of them are utilized to treat various diseases (Bussmann et al. 2007; Paton et al. 2008; Abbasi et al. 2010). According to the World Health Organization (WHO), herbal medicines constitute the major source of healthcare for 80% of the world's population in third-world nations (World Health Organization 2003). The trade in aromatic and medicinal plants has a global market worth US$60 billion (Hamilton 2006). Due to the growing trend and popularity of herbal medications, its value is anticipated to significantly increase by the year 2050 (Lange 1997; Al-Quran 2008; Khan et al. 2011).

In Pakistan, due to the vast cultural acceptance and economic potential of materials made from plants, major scientific and commercial trends have been seen during the past few decades (Sher et al. 2014; 2015) including medicine derived from plants. Due to a lack of access to contemporary pharmacopeia, the rural population relies more on a range of traditional herbal medicines (Khan et al. 2012). Nonetheless, there is a great spectrum and variation in the traditional knowledge on the ethnobotanical uses of medicinal plants across local communities in Pakistan. The difference in how traditional medicine is practiced can be attributed to a number of elements, such as community culture, history, attitudes, and philosophies (Šavikin et al. 2013). Over time, knowledge on how to make handmade traditional herbal remedies is typically passed down from one generation to another (Mahmood et al. 2011a,b).

Pakistan has remarkable natural resources, ethnic composition, and ancient civilizations, with a multiplicity of climates, environmental zones, and geographical areas that are gifted with a variety of medicinal plants (Yaseen et al. 2015). It has a great diversity of flowering plants described to occur in different parts of the country. About 6000 species of flowering plants have so far been recognized and familiarized in Pakistan (Ahmad et al. 2014a,b; Nasir and Ali 1971-1999). Among them, more than 10% (600-700 plant species) have medicinal purposes (Akhtar et al. 2013) of which 400-600 species are used in traditional health care (Shinwari and Qaiser 2011).

The great diversity of medicinal plants in Pakistan is due to its climatic conditions, ecological zones, and topography (Sher et al. 2010). There are about 350 traditional herbal preparations used to treat numerous infectious diseases throughout Pakistan (Ahmad and Husain 2008). One of the unique ecological zones in Pakistan is Swat Valley which is an arid region located in high mountainous area. Medicinal plants from the arid area are well known for their nutritional and therapeutic potential. Swat contains a massive diversity of phyto-ecological and agro-climatic combinations, supporting the presence of a huge variety of natural resources. Therefore, the present study is aimed to documents aromatic plants from Swat and their ethnomedicinal use. The current study will provide baseline information on the documented aromatic plants for further study in order to examine their pharmacology and photochemistry to encourage cultural diversity and sustainable use of these aromatic plant resources in the area.

MATERIALS AND METHODS

Study area

The present study was conducted in the district of Swat, Pakistan, which lies on the mountain ranges of the Hindu Kush Himalaya and Karakoram. Swat District is located around 190 km to the northeast of the provincial capital of Peshawar (Sher et al. 2017). It is known for its beautiful scenery, encompassing river, fertile lowlands, and extreme altitude gradients to some of the highest mountains in the world. Swat contains five ecological zones: alpine, subalpine, moist temperate, dry temperate, and subtropical (Sher et al. 2017). It is separated from Afghanistan by the Hindu Kush mountain range and harbors the highest peak of the range, Tirich Mir, at 7708 meters. The cool climate of the Swat District and its topography give rise to rich alpine and subalpine ecological zones that are especially important for sourcing medicinal and aromatic plants (Sher et al. 2017). Pakistan's Swat region is the highest in elevation with 980 meters above sea level are on average. The region experiences four distinct seasons: spring, summer, winter, and autumn. The district's upper reaches, including Kohistan, experience bitterly cold winters and are perpetually covered in snow. Temperatures can practically exceed 41°C in the summer on the lower plains, which are dry and hot. As a result, the district's lower areas rarely experience snowfall (Ali 2023). Two monsoon cycles are present in both the upper and lower portions of the region. While the second takes place in the summer, the first happens in the winter. While the upper Swat is covered in dense pine forests, the lower Swat contains vegetation, including dry bushes and deciduous trees (Ali 2023). During the Gandhara culture, which lasted until the tenth century, the area was a significant early Buddhist center; later, the Swat region largely converted to Islam (Niaz 2007). Nearly 90% of the locals are Pashtun, with the Yusufzai tribe being the most prevalent (Niaz 2007).

Field interview methods

The study was conducted in remote areas of the district through semi-structured ethnomedicinal interviews with residents between 2021 and 2023. There were 106 people interviewed in total (90 men and 16 women). The interviewees were mostly elderly and ranged in age from 25 to 85. Due to the areas' diversity of ethnic groups, ethno-medicinal research has a certain degree of representativeness. The Yousuzai and Gujars were the two primary ethnic groups, and they had a considerable understanding of the study of ethnic medicine. Interviews took place in parks, markets, and fields. Furthermore, since all of these sites were public rather than private, no specific consents were required. After defining the study's goal, a thorough series of questions pertaining to plant therapeutic practices was put out, and at least twice as many people with extensive understanding of medicinal plants were questioned. The information was verified by neighborhood hakims (a practitioner of herbal medicine) or herbalists and cross-referenced with material that was already published. A questionnaire was used to document every meeting with local people and was kept on file for future use. Microsoft Office 2013 was used to import the information and data on aromatic medicinal plants for statistical analysis. The interview questions included native plant names (vernacular names), ailments for which the plants were used, the sections of the plants used, and preparation and administration procedures in an effort to empathetically describe the customary practices of therapeutic plants. The study went into the field with the interview subjects to gather samples of the plants they were told about. The entire collection of plants has not yet been added to any organization’s herbarium.

Voucher specimen collection

We gathered voucher specimens in 2021-2023 to better represent and safeguard the aromatic medicinal plants obtained in the region. Under the guidance of locals and herbalists with extensive knowledge of these aromatic therapeutic plants, voucher specimens were gathered and prepared. A total of 33 aromatic plants used as medicine in the area were gathered. In the field, the plants were collected and ready for herbarium preservation. The Flora of Pakistan was used to identify the collected plants. With the related field data, a thorough checklist for the region was created. From Tropicos (https://www.tropicos.org/home), accepted plant names were obtained.

Data analysis

The data collected were analyzed statistically using various quantitative indices: Fidelity Level (FL) and Relative Frequency of Citation (RFC).

Fidelity Level (FL)

Fidelity Level (FL) index was calculated using the formula described by Friedman et al. (1986) to determine the most preferred species used in the treatment of a particular ailment as more than one plant species are used in the treatment in the same category:

$$FL = Np/N \times 100$$

Where: Np is the number of informants mentioned the usage of the plant for a specific diseases and N is the total number of informants mentioned the species for any diseases. High FL value shows high frequency of usage of the plant species for cure of a specific diseases category by the informants of the study area.

Relative Frequency of Citation (RFC)

RFC is of the most utilized plant taxon by the native people (Tardío and Pardo-de-Santayana 2008). It was determined using the formula:

$$RFC = FC/N$$

Where ($0 < RFC < 1$), FC is the number of informants citing a useful species and N is the total number of informants in the survey.

RESULTS AND DISCUSSION

Sociodemographic profile of local informants

Humans have been utilizing plants for a very long time to meet a variety of everyday needs and to maintain life forms. It includes plants with medicinal uses as alternatives to synthetic medications developed by native people from place to place. Due to the presence of temperate climates in its upper portions, Swat District has a high diversity of plants. According to the demographic profile, only 15% of informants were women, and 85% of men were interviewed for the medicinal and aromatic plants of the area. Due to cultural and religious restrictions, fewer women than men were interviewed since women would not be willing to engage and share expertise with the male interviewers. Over 79% of older adults (those over 40) were more knowledgeable about folk medicinal treatments than people in their middle years (aged under 40). Since the young have a limited desire for such traditional practices due to the alteration of their way of life and culture, the elders are typically the ones who are given the crucial native information about aromatic plants. Farmers made up 50% of the informants, followed by Shaponkeys (shepherds) (16%), healers (14%), laborers (8%), shopkeepers (6%), and teachers (5%). Out of 106 people, 35% were illiterate 20% had completed their higher education 13% had completed their secondary education 13% had finished middle school 12% were still in elementary school, and 9% had completed their higher education. According to the ethnic breakdown, Yousufzai made up 41% of the population, Gujjars 23%, Kohistani 14%, Mula 11%, Mians 9%, and Parachas 6%, as indicated in Table 1. Pashto and Gujjaro were the languages most commonly used.

Biological information and medicinal uses of plants

The present study was carried out to document aromatic medicinal plants from a highly floristic and culture-rich district of Swat, Pakistan. A total of 33 aromatic medicinal plant species from 30 genera and 14 families were documented. Lamiaceae had the highest percentage of total species utilized by the locals with 33% (11 species), followed by Apiaceae (18%) or six species, Rutaceae (9%) or three species, Zingiberaceae (6%) and Myrtaceae (6%) contained two species each. In total, 72% of known aromatic medicinal species belong to these five families as shown in Figure 1. The remaining species are from nine other families, each of which has one species. Herbs (69%) predominated the group with 23 species, followed by shrubs (12%), trees (15%), and climbers (3%) as shown in Figure 2. Based on field observation, various species that were collected in the Swat District were found to be easily collected and to be used therapeutically. The trend of medicinal plants is passing through generations.

Table 1. Demographic profile of the informants

Age	10–20 years 1 (1%)	20–30 years 05 (5%)	30–40 years 16 (15%)	40–50 years 23 (21%)	50–60 years 43 (41%)	Above 60 years 18 (17%)	Total 106	% 100%
Qualification	Illiterate 38 (35%)	Primary 12 (11%)	Middle 13 (12%)	Secondary 13 (12%)	Higher secondary 20 (19%)	Higher education 10 (9%)	Total 106	% 100%
Profession	Farmers 53 (50%)	Shepherds17 (16%)	Hakims 15 (14%)	Teachers 5 (5%)	Shopkeeper 7 (6%)	Laborers 9 (8%)	Total 106	% 100%
Ethnic	Yousufzai 41 (39%)	Gujjar's 23 (22%)	Mians 10 (9%)	Parachas 6 (5%)	Mula 11 (10%)	Kohistani 15 (14%)	Total 106	% 100%

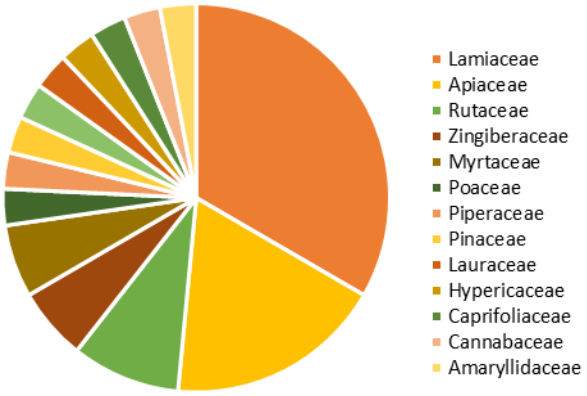

Figure 1. Family of aromatic plants used as medicines

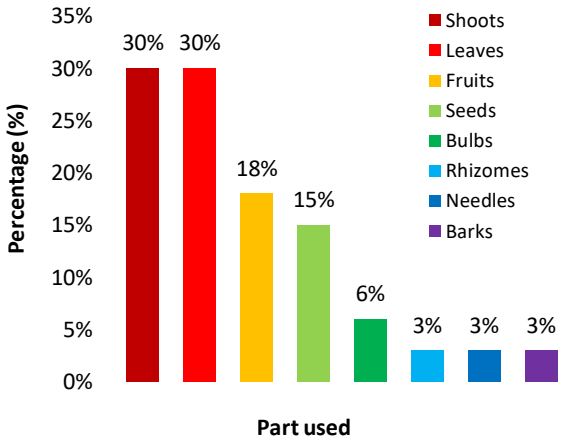

Figure 3. Parts of plants are used to cure different diseases

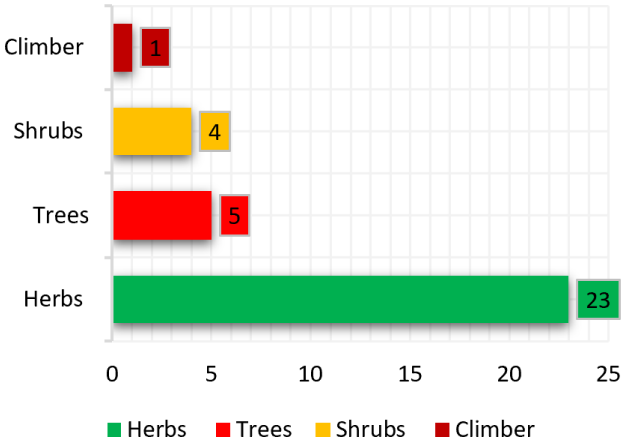

Figure 2. Life form of the usable plants

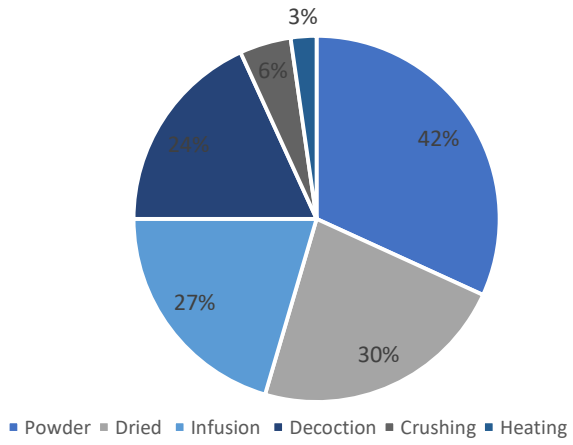

Figure 4. Method of preparation of herbal recipes

Plant parts and mode of preparation

Native people of the district Swat claimed that certain or several components of the local plants were used in herbal remedies. It is also important to note that different plant parts may be used to cure different ailments or that a specific plant part may be needed to cure a certain condition. For this reason, it is crucial to list the plant component along with the diseases it treats. However, we gathered information from 106 reports of 33 species using a variety of nine plant parts as shown in Table 3. Shoots and leaves (30%) were the most commonly used parts of the plants, followed by the fruits (18%), seeds (15%), bulb (6%), rhizome, bark, and needle (3%), respectively as shown in Figure 3. Additionally, for three species, two or more parts are used in the treatment and curing of diseases, with different parts employed for different effects. For example, the seed of *Ocimum basilicum* is used for fever and headaches, while the leaves are used for constipation, and the flower is used for fragrances as shown in Table 3. Based on the above findings, we can safely draw the conclusion that different parts of the plant exhibit different functions. The results of the study revealed that powder was the most common mode of preparing aromatic medicinal plants, accounting for 42% of the recorded preparations, followed by dried (30%), infusions (27%), decoctions (24%), crushing (6%), and heating (3%) as shown in Figure 4. Therefore, there are several methods for the preparation of aromatic medicinal plants used in the area. However, different methods present different efficiencies, and the most appropriate preparation method should be chosen.

Disorders treated

Based on this survey, the collected aromatic plants are broadly used in local traditional medicine to treat gastrointestinal disorders, fever, dysentery, impotency, cough, asthma, wounds, depression, antipathies, cancer, TB, and diabetes as shown in Table 3. Commonly, local people combine two or more aromatic medicinal plants to treat a particular ailment. In this survey, most of the identified aromatic medicinal plants can be employed as both medicine and flavor agents. The local population used these plants to maintain good health in the long term. Some aromatic medicinal plants can be made into healthcare products, such as herbal teas and medicinal juices, which contribute to

health through therapies or prevention. Furthermore, some people cultivate aromatic vegetables and plants with certain characteristics that are conducive to supplying the body with necessary nutrients and particular trace elements. In our survey, plants such as *Coriandrum sativum, Zingiber officinale, Elettaria cardamomum, Zanthoxylum armatum, Cymbopogon citratus, Allium sativum, Mentha spicata,* etc. were cultivated as vegetables, flavouring agents, and for medicinal purposes. The *M. spicata* was grown for flavor and stomach disorders; *C. sativum* as a vegetable and for cough and weakness; *Z. officinale* for spices, stomach, and cough; *E. cardamomum* for stomachic, vomiting, and asthma; and highly used as tea flavor; *C. citratus* for weight loss and tea flavor; *A. sativum* for antioxidants and to promote male impotency; and highly used as food flavor and *M. spicata* used for stomach, cough and toothache, while high used as flavor for chutney. According to the results of our study, the most common methods of application are oral and external. According to the present study, about 97% of aromatic plants can be used as oral medicines, whereas only one plant, *Cannabis sativa*, was reported to be employed only as an externally applied drug. Under some circumstances, oral and external treatments can better cure disease. These plants have anti-inflammatory and anti-bacterial functions. There were many aromatic plants identified during this survey that present unique characteristics and play specific roles in the medical community.

Uses for other purposes

Aromatic plants have been commonly used as flavors for foods, tea substitutes, spices, candies, honeybees, fragrances, juices, and chutneys. In the current study, among the 33 of aromatic plant species recorded, a total of 29 plants were used for other purposes, such as 12 plants used as flavor agents, six used as substitutes for tea, six used for spices, two used for candies, two visited by honeybees, two species burned to protect from evil eyes, and one species used as juice. However, the use of aromatic plants was high in the area, particularly in remote areas. They collected some species from the wild, and some were cultivated in the area for their own use, such as *Allium cepa, M. spicata,* and *C. sativum,* which were cultivated in the area for different uses, such as salads and making different recipes. The *Z. officinale* was grown for use as a flavor in recipes and spices. The *Z. armatum* and *Z. alatum* were collected from the wild for use as flavor for chutney; *C. citratus* was cultivated for use as a flavoring agent for tea; and some were also collected from the wild as tea substitutes, such as *Abies pindrow, Mentha arvensis, Origanum vulgare,* and *Clinopodium umbrosum. Sium latifolium* was collected from the wild as a flavoring agent for sag; *Mentha sylvestris* was collected from wild to cook with maize cobs as a flavoring agent; *O. basilicum* was grown as a flavoring agent and for better fragrances, *Syzygium aromaticum* and *Piper nigrum* were grown as sources of spice. The present study concluded that aromatic plants are highly used and have high demand in the area. Therefore, locals collected them from the wild or cultivated areas for different purposes.

Marketing value of aromatic plants in the area

The present study revealed that people in the area cultivated some aromatic species for marketing purposes. Among them were *M. spicata, C. sativum, Foeniculum vulgare, Z. officinale, A. sativum, P. nigrum, E. cardamomum, S. aromaticum,* and *C. citratus,* which were cultivated as sources of income. The highest price rate was found in *C. citratus,* followed by *S. aromaticum, F. vulgare, E. cardamomum,* as shown in Table 2. Local people used these plants as source of income, mainly herb healer involved in the marketing of these plants.

Quantitative value of plant use

Quantitative ethnobotany is particularly interested in quantifying the importance of plants to a community. In our survey, we used the Relative Frequency of Citation (RFC) with resulting value ranged from 0.13 to 0.84. The RFC demonstrated how people frequently reported various ailments on plants. RFC was used to gauge a species' popularity within its native habitat. *Skimmia laureola* had the greatest RFC value (0.84), followed by *Z. officinale* (0.82), *C. sativa* (0.80), *Mentha longifolia* (0.77), *M. spicata* (0.73), *E. cardamomum* (0.71), and *P. nigrum* (0.68). Table 3 showed that *Anisomeles indica* had the lowest RFC (0.13), followed by *S. latifolium* (0.14), *Isodon rugosus* (0.15), and *Calamintha debilis* (0.16) as shown in Table 3.

Table 2. Marketing value of aromatic medicinal plants used in Swat District, Pakistan

Plant Species	Marketing Form	Part Sold	Bundle	Gram	Price (PKR)	Price (USD)
Mentha spicata	Fresh/dried	Shoot	1	100g	20/40	0.069/0.13
Coriandrum sativum	Fresh/dried	Leaves/seed	1	100g	20/90	0.069/0.3
Foeniculum vulgare	Dried	Seed	-	100g	200	0.69
Zingiber officinale	Fresh/dried	Bulb	-	100g	80	0.27
Allium sativum	Fresh	Bulb/leaves	-	100g	25/80	0.87
Piper nigrum	Dried	Fruit	-	100g	150	0.52
Elettaria cardamomum	Dried	Fruit	-	100g	160	0.55
Syzygium aromaticum	Dried	Fruit	-	100g	400	1.38
Cymbopogon citratus	Fresh/dried	Leaves	-	100g	500	1.73

Table 3. List of aromatic plant use as medicine in Swat Valley, Pakistan

Plants/Voucher Number	Family	Habitat	Part used	Form of Use	Form/Method of Use	Other uses	RFC	FL
Allium cepa L. SMHR-001	Amaryllidaceae	Herb	Bulb	Direct eating/infusion	Eating its bulb as antioxidant, used for fever and treat male impotency	Used in food as flavor	0.66	60
Coriandrum sativum L. SMHR-002	Apiaceae	Herb	Leaves/seed	Dried/infusion	Dried seed in chicken soup or infusion highly effective in cough and weakness	Leaves used as flavor for foods	0.56	50
Carum carvi L. SMRH-003	Apiaceae	Herb	Seeds	Fresh/dried	Power used for dyspepsia	Used in spices	0.51	46
Foeniculum vulgare Mill. SMHR-004	Apiaceae	Herb	Seed	Dried/decoction	Seed with water or decoction of seed used for stomachic	Seed used as flavor in candies	0.72	55
Mentha sylvestris L. SMHR-005	Apiaceae	Herb	Shoot	Dried/infusion	Powder taken with water is used for gastric problems	Cooked with maize cobs as flavoring agent	0.21	45
Plectranthus rugosus Wall. ex Benth. SMHR-006	Apiaceae	Herb	Leaves	Dried/infusion	Powder taken with water or infusion is used for internal inflammations	Honeybee species	0.38	40
Sium latifolium SMHR-007	Apiaceae	Herb	Shoot	Fresh	-	Shoot used as flavor in sag and seed used in spices	0.14	13
Cannabis sativa L. SMHR-008	Cannabaceae	Herb	Leaves	Dried/heated	Keep heated leaves in fracture for relief of pain and its smokes inhale for asthma	Dry leaves burning to protect from evil eyes	0.80	64
Valeriana jatamansi Jones. SMHR-009	Caprifoliaceae	Herb	Rhizome	Crushed/decoction	Used as antioxidant and carminative	-	0.20	35
Hypericum perforatum L. SMHR-010	Hypericaceae	Herb	Shoot	Powder/fresh	Tea of the plant use for anxiety, stomachache and depression	-	0.29	45
Anisomeles indica (L.) Kuntze. SMHR-011	Lamiaceae	Herb	Shoot	Powder	Powder taken with water is effective for allergies	-	0.13	43
Calamintha debilis (Bunge) Benth SMHR-012	Lamiaceae	Herb	Shoot	Powder/infusion	Powder taken with water or infusion used for stomach disorders	-	0.16	41
Clinopodium umbrosum (M.Bieb.) Kuntze SMHR-013	Lamiaceae	Herb	Shoot	Powder	Powder taken with water is used for wounds	Herbal tea	0.21	40
Isodon rugosus (Wall. ex Benth.) Codd SMHR-014	Lamiaceae	Shrub	Leaves	Powder/decoction	Decoction or powder used for stomach disorder	Honeybee	0.15	44
Mentha longifolia (L.) L. SMHR-015	Lamiaceae	Herb	Shoot	Powder/infusion	Powder taken with water or use of decoction used for belly pain, gas and stomachic	Flavoring agent	0.77	73
Mentha spicata L. SMHR-016	Lamiaceae	Herb	Shoot	Powder/infusion	Powder taken with water or shoot directly eaten is used for stomachic and leaves keep in teeth to relieve pain	Flavor agent	0.73	65

Micromeria biflora (Buch.-Ham. ex D.Don) Benth. SMHR-017	Lamiaceae	Herb	Leaves	Powder	Powder with water used for healing and fever	Pot herb	0.28	33
Ocimum basilicum L. SMHR-018	Lamiaceae	Herb	Leaves/seed	Seed powder	Seed powder with water used for fever and leaves used for constipation	Fragrance and flavor	0.35	54
Origanum vulgare L. SMHR-019	Lamiaceae	Herb	Seed	Powder	Powder with water used for fever and stomachic	Seed used in tea	0.25	20
Thymus linearis Benth. SMHR-020	Lamiaceae	Herb	Shoot	Powder	Powder with water used Fever	Herbal tea	0.6	61
Thymus serphyllum L. SMHR-021	Lamiaceae	Shrub	Leaves	Decoction	Plants is anticancer properties	Herbal tea	0.50	57
Cinnamomum verum J.Presl SMHR-022	Lauraceae	Tree	Bark	-	Stem used as tooth brash	Used in spices	0.42	63
Syzygium aromaticum (L.) Merr. & L.M.Perry SMHR-023	Myrtaceae	Tree	Fruit	Dried/decoction	Powder with water or decoction and chewing is effective for stomachache, fever, and TB.	Used in curries and spices	0.59	71
Myrtus communis L. SMHR-024	Myteraceae	Shrub	Leaves/Fruits	Decoction	Decoction or making tea from leaves effective in cough	Extract juice used as drink	0.5	56
Mentha arvensis L. SMHR-025	Lamiaceae	Herb	Leaves	Infusion	Infusion and making tea from its leaves are effective in ulcer and other internal inflammation	Herbal tea	0.22	26
Abies pindrow (Royle ex D.Don) Royle SMHR-026	Pinaceae	Tree	Needle	Decoction	Decoction or making tea from it effective in asthma	Tea substituent	0.63	50
Piper nigrum L. SMHR-027	Piperaceae	Climber	Fruits	Powder	Powder in chicken soup used for cough and improvement of eye vision	Fruit used as spice and flavor in foods	0.68	65
Cymbopogon citratus (DC.) Stapf SMHR-028	Poaceae	Herb	Shoot	Dried/infusion	Making tea from leaves used for weight lose	Flavoring agent/herbal tea	0.53	64
Skimmia Laureola Franch. SMHR-029	Rutaceae	Shrub	Leaves	Dried/decoction	Powder with water used for stomachic and diabetes	Leaves smoke used against evil eyes	0.84	77
Zanthoxylum alatum Roxb. SMHR-030	Rutaceae	Tree	Fruits	Powder	Powder taken with water effective for stomachic	Flavor for chutney	0.41	30
Zanthoxylum armatum DC. SMHR-031	Rutaceae	Tree	Fruits	Powder	Powder taken with water for stomach and fever	Used as flavor for chutney	0.64	57
Elettaria cardamomum (L.) Maton SMHR-032	Zingiberaceae	Herb	Fruit	Dried	Chewing dried fruits help in stomachic, vomiting and asthma	Tea flavor	0.71	54
Zingiber officinale Roscoe SMHR-033	Zingiberaceae	Herb	Bulb	Crushed	Crushed bulb used for stomach and making tea from it used for cough	Used as flavor for foods and also used in spice	0.82	83

In term of Fidelity Level (FL), no species had value of 100%. The *Z. officinale* had the highest FL value (83%), followed by *S. laureola* (77%), *M. longifolia* (71%), and *S. aromaticum* (71%), which are used to treat stomach, cough, diabetes, fever, and tuberculosis. The plants which are used to treat fever, stomachaches, and inflammation have lower FL such as *S. latifolium* (13%), followed by *O. vulgare* (20%), *M. sylvestris* (21%) and *M. arvensis* (26%) as shown in Table 3. However, as many 18 species have a strong tendency to be used for stomach and related illnesses, followed by fever (7 species), cough (4 species), asthma and pain (3 species), inflammations (2 species), weakness (1 species), cancer (1 species), antioxidants (1 species), impotency (1 species), depression (1 species), allergies (1 species), wounds (1 species), TB (1 species), eye (1 species), and diabetes (1 species).

Discussion

The topography in Swat District provides ideal physical condition for the growth and maintenance of several highly valuable medicinal and aromatic plants (Sher et al. 2014). Since around 5000 BC, aromatic plants, commonly referred to as herbs and spices, have been utilized in the Middle-east to enhance the flavor and scent of food as well as for preservation and therapeutic purposes (Piccaglia et al. 1993; Chang 2000; Li et al. 2006). According to the World Health Organization (WHO), approximately 80% of the world's population, particularly in developing countries, still relies on plant-produced medications for their healthcare (Collins 2006; Gurib-Fakim 2006). Their use is still widespread today. Aromatic plants, their extracts, and their essential oils have been studied among these natural supplements due to their advantages over antibiotics as growth boosters. They are generally accepted as safe (GRAS) and residue-free (Varel 2002; Windisch et al. 2009; Brenes and Roura 2010).

In the present study, a total of 33 aromatic plant species used as medicines and a source of income were documented in Swat District. Our study suggested that *C. sativum* is used for cough and weakness and also highly used as spices for food; *M. spicata* is used to cure stomachic and toothache; *Micromeria biflora* is used for healing fever; *S. aromaticum* is used for stomachache, fever, and TB; *A. cepa* is used as an antioxidant and for fever; *Z. officinale* is used for stomachache and cough; and *E. cardamomum* is used for stomachic, vomiting, and asthma. Hence, our result showed some differences from the study by Akhtar et al. (2013) and Ali et al. (2018). The *C. sativa* was mentioned by Iqbal and Hamayun (2004), Hussain et al. (2006), Ali et al. (2011), and Bibi et al. (2014), as a narcotic, anodyne, and tonic, while our study reported it as painkiller and use against evil eyes. Bibi et al. (2014) mentioned *A. cepa* for pimples and skin infections from Baluchistan, while our study reported it is used as an antioxidant agent and used for snake bites. *Plectranthus rugosus* was mentioned by Hussain et al. (2006) as an antiseptic that cures toothaches, while our study mentioned it for internal inflammation. Iqbal and Hamayun (2004) reported *C. sativum* for piles, secretion of gastric juices, and a fruit decoction is given in colic, seeds create appetite, while our study suggested it is effective in cough and weakness. Iqbal and Hamayun (2004) reported *A. cepa* as a diuretic, aphrodisiac, expectorant, antiseptic, and for tobacco poisoning, while our study suggested it as an antioxidant, for fever, and to treat snake bites. The *M. spicata* is used as a stimulant, carminative, and stomach and toothache*; M. sylvestris* is used for stomach; *Valeriana jatamansi* is used as an antioxidant and carminative, so the findings of this study support this (Iqbal and Hamayun 2004). Gulzar et al. (2019) reported similar uses for *C. sativa, M. longifolia, Z. armatum,* and *M. biflora* from the Malakand district. Ahmad et al. (2011) mentioned similar reports for *F. vulgare*, *M. longifolia,* and *Z. armatum* from the Tehsil Kabal Swat, while both studies found different uses of *O. basilicum.* Khan et al. (2015a,b) mentioned similar uses for *Z. armatum* and different uses for *P. rugosus.* Shah et al. (2016) mentioned *A. cepa* and *C. sativum,* while our study disagreed with them in cases of use, while similar studies mentioned *F. vulgare*. Nabi et al. (2013) mentioned *A. cepa* as a source of food but did not mention any medicinal uses, while for *M. longifolia* and *C. sativa,* similar uses were mentioned, while different uses were mentioned for *Coriaundrum sativum, S. aromaticum,* and *F. vulgare.* Ali et al. (2023) reported similar uses for *A. cepa, M. longifolia, O. basilicum,* and *F. vulgare*, while different for *Cuminum cyminum,* and *P. rugosus.* Akhtar et al. (2013) mentioned *Hypericum perforatum* as a diuretic, stimulant, and analgesic, as well as *O. vulgare* used as diuretic, against toothache and earache, while our study revealed that *H. perforatum* is used for anxiety, stomach, and depression, and *O. vulgare* is used for fever and stomachic. Our study revealed that *Clinopodium debile* and *I. rugosus* is used for stomach disorders, while Ahmad et al. (2015) mentioned *C. debile* as forage and for healing wounds and *I. rugosus* is an antipyretic and an antidiarrheal. The present study is in line with Ali et al. (2018) in the case of *Thymus linearis.* The present study reported that *A. indica* is effective for allergies, but there was no report of this study from Swat.

Some aromatic medicinal plants have high demand in local markets. So, in the present study, we also documented the marketing value of selected plants. It was observed throughout the survey that residents of the study region not only cultivated or harvested aromatic herbs for medical uses but also used them as a source of income. Therefore, a total of nine plants were sold in local markets. Our findings are consistent with similar reports of medicinal plant used as a source of income in Swat (Hussain et al. 1995; Sher et al. 2004; Begum et al. 2005). While it was noted that only local healers are involved in the collection of medicinal plants, Sher et al. (2015) stated that superior economic outcomes can be reached from the harvesting of wild medicinal plants as opposed to the traditional cash crop. A number of therapeutic herbs from local marketplaces are also supplemented by them. Local people in remote locations of the study region significantly benefited economically from using forest products. Different communities in Pakistan's northern mountains that rely on wild resources have discovered similar benefits (Sher 2002; Hamayun et al. 2003; Islam et al. 2006; Shinwari et al. 2006; Ahmad et al. 2014a). Crops can aid in the economic development of a region in particular and the nation as a whole (Sher et al.

2014). According to the current study, the city of Mingora is the center for the commerce and gathering of numerous valuable medicinal and aromatic plants. According to (Rashid et al. 2011), the bulk of marketable medicinal plants is gathered in Pakistan's northern regions, particularly the Swat District. In order to supplement their meager income and meet their fundamental necessities in rural life, people are forced to pick medicinal plants and sell them at extremely low prices to middlemen, especially in mountainous areas (Nwafor et al. 2021). The most common medicinal recipe preparation was in powder form, as observed in this study. A similar result was also obtained by (Akhtar et al. 2013). While our results are different from those of Fallah et al. (2006), because they reported that most people used medicinal plants in processed form, some used as paste form, and a few uses used in powder form, shoot was the dominant part used in herbal remedies. In this regard, our observations disagree with those of Cakilcioglu and Turkoglu (2010), Akhtar et al. (2013), Ahmad et al. (2014b), and Bano et al. (2014) because the said leaf a dominant part of herbal recipes, because they focused on whole medicinal plants; while the present study is based focused on aromatic plants.

The present study was the first documentation from the Swat District reporting aromatic medicinal plants from the area. Some plants in the current study had similar uses to those found in the literature while others had different uses. Therefore, there is a need to scientifically validate the ethnomedicinal uses of the documented plants.

In conclusion, this study is the first ever to document information on aromatic plants used in traditional medicinal practice in Swat District, suggesting that the region is home to a large number of aromatic plants. There were 33 aromatic plant species that belonged to 14 families used by the locals for medicinal purposes. The quantitative analysis determined the importance of the medicinal plants in the target area. Therefore, Swat is a place where local medicinal plants have a variety of applications, and a multifaceted medical healthcare delivery system has been established here. However, there is still a paucity of physiotherapeutic support for several of the local traditional remedies. To investigate the potential of aromatic plants, it is therefore required to analyze the chemical components and pharmacological properties of some medicines.

ACKNOWLEDGEMENTS

We present our sincere gratitude for the enthusiasm of the local people interviewed in this study. We appreciate that they helped the present research to be completed in a satisfactory way, contributing to laying the foundation for further studies in the Swat District, Pakistan. SA conducted the field work, SA and MM conceived and designed the research, interpreted results and wrote the manuscript. HS identified the collected plants. HS, MA, and RQ reviewed the article and given their output. All the authors read, reviewed and approved the manuscript. The authors declare that they have no conflict of interest.

REFERENCES

Abbasi AM, Khan MA, Ahmad M, Zafar M, Jahan S, Sultana S. 2010. Ethnopharmacological application of medicinal plants to cure skin diseases and in folk cosmetics among the tribal communities of North-West Frontier Province, Pakistan. J Ethnopharm 128 (2): 322-335. DOI: 10.1016/2010.01.052.

Ahmad I, Ibrar M, Ali N. 2011. Ethnobotanical study of tehsil kabal, Swat District, KPK, Pakistan. J Bot 2011: 368572. DOI: 10.1155/2011/368572.

Ahmad I, Jan S, Begum A, Wali S. 2015. Taxonomic diversity and ethnobotanical characteristics of the family Lamiaceae of Swat, Khyber Pakhtunkhwa, Pakistan. Pure Appl Biol 4 (4): 465-470. DOI: 10.19045/bspab.2015.44003.

Ahmad M, Sultana S, Fazl-i-Hadi S, Ben Hadda T, Rashid S, Zafar M, Yaseen G. 2014a. An ethnobotanical study of medicinal plants in high mountainous region of Chail Valley (District Swat-Pakistan). J Ethnobiol Ethnomed 10: 1-18. DOI: 10.1186/1746-4269-10-36.

Ahmad S, Waris HM, Alam K, Anjum S, Mukhtar M. 2014b. Ethnobotanical studies of plant resources of Cholistan desert, Pakistan. Intl J Sci Res 3 (6): 1782-1788.

Ahmad SS, Husain SZ. 2008. Ethno medicinal survey of plants from salt range (Kallar Kahar) of Pakistan. Paki J Bot 40 (3): 1005-1011.

Akhtar N, Rashid A, Murad W, Bergmeier E. 2013. Diversity and use of ethno-medicinal plants in the region of Swat, North Pakistan. J Ethnobiol Ethnomed (9): 1-14. DOI: 10.1186/1746-4269-9-25.

Ali H, Sannai J, Sher H, Rashid A. 2011. Ethnobotanical profile of some plant resources in Malam Jabba valley of Swat, Pakistan. J Med Plant Res 5 (18): 4676-4687.

Ali K, Khan N, Rahman IU, Khan W, Ali M, Uddin N, Nisar M. 2018. The ethnobotanical domain of the Swat Valley, Pakistan. J Ethnobiol Ethnomed (14): 1-15. DOI: 10.1186/s13002-018-0237-4.

Ali M, Khan T, Fatima K, Ali QUA, Ovais M, Khalil AT, Idrees M. 2018. Selected hepatoprotective herbal medicines: Evidence from ethnomedicinal applications, animal models, and possible mechanism of actions. Phytothe Res 32 (2): 199-215. DOI: 10.1002/ptr.5957.

Ali S, Sayed AS, Saeed RF, Iqbal J, Ijaz S, Munazir M. 2023. Ethnomedicinal plant use value in Lower Swat, Pakistan. Ethnobot Res Appl 25: 1-22. DOI: 10.32859/era.25.13.1-16.

Ali S. 2023. A study on different plant species of the Rosaceae family and their ethnobotanical uses among the local communities at Swat District, Pakistan. Ethnobot Res Appl 25: 1-16. DOI: 10.32859/era.25.23.1-22.

Al-Quran S. 2008. Taxonomical and pharmacological survey of therapeutic plants in Jordan. J Nat Prod 1 (1) 10-26.

Bano A, Ahmad M, Hadda TB, Saboor A, Sultana S, Zafar M, Ashraf MA. 2014. Quantitative ethnomedicinal study of plants used in the skardu valley at high altitude of Karakoram-Himalayan range, Pakistan. J Ethnobiol Ethnomed 10 (1): 1-18. DOI: 10.1186/1746-4269-10-43.

Begum HA, Jan MM, Hussain F. 2005. Ethnobotanical studies on some plants of Dehri-julagram Malakand agency, Pakistan. Intl J Biol Biotech 2: 597-602.

Bibi T, Ahmad M, Tareen RB, Tareen NM, Jabeen R, Rehman SU, Yaseen G. 2014. Ethnobotany of medicinal plants in district Mastung of Balochistan province-Pakistan. J Ethnopharm 157: 79-89. DOI: 10.1016/j.jep.2014.08.042.

Brenes A, Roura E. 2010. Essential oils in poultry nutrition: Main effects and modes of action. Anim Feed Sci Technol 158 (1-2): 1-14. DOI: 10.1016/2010.03.007.

Bussmann RW, Sharon D, Vandebroek I, Jones A, Revene Z. 2007. Health for sale: The medicinal plant markets in Trujillo and Chiclayo, Northern Peru. J Ethnobiol Ethnomed 3 (1): 37. DOI: 10.1186/1746-4269-3-37.

Cakilcioglu U, Turkoglu I. 2010. An ethnobotanical survey of medicinal plants in Sivrice (Elazığ-Turkey). J Ethnopharm 132 (1): 165-175. DOI: 10.1016/j.jep.2010.08.017.

Chang J. 2000. Medicinal herbs: drugs or dietary supplements. Biochem Pharmacol 59 (3): 211-219. DOI: 10.1016/s0006-2952(99)00243-9.

Collins C, Fryer M, Grosso A. 2006. Plant uptake of non-ionic organic chemicals. Environ Sci Technol 40 (1): 45-52. DOI: 101021/0508166.

Fallah H, Fakhrzadeh H, Larijani B, Shikh Samani A. 2006. Review of anti-diabetic medicinal plant used in traditional medicine. J Med Plants 5 (S2): 1-8.

Farnsworth NR, Soejarto DD. 1991. Global importance of medicinal plants. Conserv Med Plants 26: 25-51. DOI: 10.1017/CBO9780511753312.005.

Friedman J, Yaniv Z, Dafni A, Palewitch D. 1986. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. J Ethnopharm 16 (2-3): 275-287. DOI: 10.1016/0378-8741(86)90094-2.

Goodman SM, Ghafoor A. 1992. The Ethnobotany of Southern Balochistan, Pakistan: With Particular Reference to Medicinal Plants. Publication/field Museum of Natural History, Fieldiana, USA. DOI: 10.5962/bhl.title.2542.

Gulzar H, Hazrat A, Gulzar K, Ali F, Khan N, Nisar M, Ullah A. 2019. Medicinal plants and their traditional uses in thana Village, District Malakand, Khyber Pakhtunkhwa, Pakistan. Intl J Endorsing Health Sci Res 7 (1): 11-21. DOI: 10.29052/IJEHSR.v7.i1.2019.11-21.

Gurib-Fakim A. 2006. Medicinal plants: Traditions of yesterday and drugs of tomorrow. Mol Aspects Med 27 (1): 1-93. DOI: 10.1016/j.mam.2005.07.008.

Hamayun M, Khan MA, Begum S. 2003. Marketing of medicinal plants of Utror-Gabral valleys, Swat, Pakistan. Ethnobot Leafl 2003: 1.

Hamilton A. 2006. Medicinal plant conservation in the Himalaya: Lessons from the field. 3rd Global Botanic Gardens Congress 2006: 1-4.

Hussain F, Islam M, Zaman A. 2006. Ethnobotanical profile of plants of Shawar Valley, District Swat, Pakistan. Intl J Biol Biotechnol 3 (2): 301-7.

Hussain F, Khaliq A, Durrani MJ. 1995. Ethnobotanical Studies of Some Plants of Dabargai Hills, Swat. Proceeding of First Training Workshop on Ethnobotany and Its Application to Conservation. National Herbarium/PASA/PARC. Islamabad, Pakistan.

Iqbal I, Hamayun M. 2004. Studies on the traditional uses of plants of Malam Jabba valley, District Swat, Pakistan. Ethnobot Leafl 2004: 1.

Islam M, Ahmad H, Rashid A, Razzaq A, Akhtar N, Khan I. 2006. Weeds and medicinal plants of Shawar Valley, District Swat. Pak J Weed Sci Res 12 (1-2): 83-86.

Khan AA, Ali F, Ihsan M, Hayat K, Nabi G. 2015a. Ethnobotanical study of the medicinal plants of Tehsil Charbagh, District Swat, Khyber Pakhtunkhwa, Pakistan. Am Eur J Agric Environ Sci 15: 1464-1474.

Khan K, Kunz R, Kleijnen J, Antes G. 2011. Systematic Reviews to Support Evidence-Based Medicine. CRC Press, Florida. DOI: 10.1201/b13411.

Khan MA, Khan MA, Hussain M. 2012. Ethno veterinary medicinal uses of plants of Poonch Valley Azad Kashmir. Pak J Weed Sci Res 18: 4.

Khan SM, Din NU, Sohail IU, Rahman FI, Iqbal Z, Ali Z. 2015b. Ethnobotanical study of some medicinal plants of Tehsil Kabal, District Swat, KP, Pakistan. Med Aroma Plants 4 (189): 2167-0412. DOI: 10.1155/2011/368572.

Lange D. 1997, Untersuchungen zum Heilpflanzenmarkt in Deutschland, Bundesamt für Naturschutz, Bonn, Germany.

Li S, Long C, Liu F, Lee S, Guo Q, Li R, Liu Y. 2006. Herbs for medicinal baths among the traditional Yao communities of China. J Ethnopharm 108 (1): 59-67. DOI: 10.1016/j.jep.2006.04.014.

Mahmood A, Mahmood A, Shaheen H, Qureshi RA, Sangi Y, Gilani SA. 2011a. Ethno medicinal survey of plants from District Bhimber Azad Jammu and Kashmir, Pakistan. J Med Plants Res 5 (11): 2348-2360.

Mahmood A, Malik RN, Shinwari ZK, Mahmood AQEEL. 2011b. Ethnobotanical survey of plants from Neelum, Azad Jammu and Kashmir, Pakistan. Pak J Bot 43 (1): 105-110.

Nabi G, Rab A, Sajidm M, Abbas SJ, Ali I. 2013. Influence of curing methods and storage conditions on post-harvest quality of onion bulbs. Pak J Bot 45 (2): 455-460.

Nasir E and Ali SI. 1971-1999. Flora of West Pakistan. Department of Botany, University of Karachi, Karachi, Pakistan.

Newman DJ, Cragg GM. 2012. Natural products as sources of new drugs over the 30 years from 1981 to 2010. J Nat Prod 75 (3): 311-335. DOI: 10.1021/np200906s.

Niaz MY. 2007. Pakistan: A Global Studies Handbook. ABC-CLIO, Santa Barbara, Calif.

Nwafor I, Nwafor C, Manduna I. 2021. Constraints to cultivation of medicinal plants by smallholder farmers in South Africa. Horticulturae 7 (12): 531. DOI: 10.3390/horticulturae7120531.

Paton AJ, Brummitt NA, Govaerts R, Harman K, Hinchcliffe S, Allkin R, Lughadha EMN. 2008. Towards Target 1 of the Global Strategy for Plant Conservation: A working list of all known plant species - Progress and prospects. Taxon 57 (2): 602-611. DOI: 10.2307/25066027.

Piccaglia R, Marotti M, Giovanelli E, Deans SG, Eaglesham E. 1993. Antibacterial and antioxidant properties of Mediterranean aromatic plants. Indust Crops Prod 2 (1): 47-50. DOI: 101016/0926-6690(93)90010-7.

Qureshi R, Ghazanfar SA, Obied H, Vasileva V, Tariq MA. 2016. Ethnobotany: A living science for alleviating human suffering. Evid-Based Complement Alternat Med 2016: 9641692. DOI: 10.1155/2016/9641692.

Rashid A, Swati MF, Sher H, Al-Yemeni MN. 2011. Phytoecological valuation with detail floristic appraisal of the vegetation arround Malam Jabba, Swat, Pakistan. Asian Pac J Trop Biomed 1 (16): 461-467. DOI: 10.1016/S2221-1691(11)60101-9.

Salganik MJ, Heckathorn DD. 2004. Sampling and estimation in hidden populations using respondent-driven sampling. Sociol Methodol 34 (1): 193-240. DOI: 10.1111/j.0081-1750.2004.0015.

Šavikin K, Zdunić G, Menković N, Živković J, Ćujić N, Tereščenko M, Bigović D. 2013. Ethnobotanical study on traditional use of medicinal plants in South-Western Serbia, Zlatibor District. J Ethnopharm 146 (3): 803-810. DOI: 10.1016/j.jep.2013.02.006.

Shah SA, Shah NA, Ullah S, Alam MM, Badshah H, Ullah S, Mumtaz AS. 2016. Documenting the indigenous knowledge on medicinal flora from communities residing near Swat River (Suvastu) and in high mountainous areas in Swat Pakistan. J Ethnopharm 182: 67-79. DOI: 10.1016/j.jep.2016.02.008.

Sher H, Aldosari A, Ali A, de Boer HJ. 2014. Economic benefits of high value medicinal plants to Pakistani communities: an analysis of current practice and potential. J Ethnobiol Ethnomed 10: 1-16. DOI: 10.1186/1746-4269-10-71.

Sher H, Aldosari A, Ali A, de Boer HJ. 2015. Indigenous knowledge of folk medicines among tribal minorities in Khyber Pakhtunkhwa, northwestern Pakistan. J Ethnopharm 166: 157-167. DOI: 10.1016/j.jep.2015.03.022.

Sher H, Al-Yemeni MN, Masrahi YS, Shah AH. 2010. Ethnomedicinal and ethnoecological evaluation of *Salvadora persica* L.: A threatened medicinal plant in Arabian Peninsula. J Med Plant Res 4 (12): 1209-1215. DOI: 10.5897/JMPR10.230.

Sher H, Barkworth ME, de Boer HJ. 2017. Medicinal and aromatic plant cultivation in the Swat Valley, North-western Pakistan, for economic development and biodiversity conservation. Genet Resour Crop Evol 64: 237-245. DOI: 10.1007/s10722-015-0346-z.

Sher H, Hussain F, Mulk S, Ibrar M. 2004. Ethnoveternary plants of Shawar Valley, District Swat Pakistan. Pak J Plants Sci 10 (1): 35-40.

Sher H. 2002. "Some Medicinal and Economic Plants of Mahodand, Utror, Gabral Valleys (District Swat), Gabur, Begusht, Valleys (District Chitral)." Technical Report Prepared for Pakistan Mountain Areas Conservation project. IUCN-Pakistan.

Shinwari ZK, Qaiser M. 2011. Efforts on conservation and sustainable use of medicinal plants of Pakistan. Pak J Bot 43 (1): 5-10.

Shinwari ZK, Rehman M, Watanabe T and Yoshikawa Y. 2006. Medicinal and Aromatic Plants of Pakistan (A Pictorial Guide). Kohat University of Science and Technology, Kohat, Pakistan.

Tardío J, Pardo-de-Santayana M. 2008. Cultural importance indices: A comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Econom Bot 62: 24-39. DOI: 10.1007/s12231-007-9004-5.

Varel VH. 2002. Livestock manure odor abatement with plant-derived oils and nitrogen conservation with urease inhibitors: A review. J Anim Sci 80 (E-suppl_2): E1-E7. DOI: 10.2527/animalsci2002.80E-Suppl_2E1x.

Windisch W, Rohrer ELISABETH, Schedle K. 2009. Phytogenic Feed Additives to Young Piglets and Poultry: Mechanisms and Application. Nottingham University Press, Nottingham, UK.

World Health Organization. 2003. The World Health Report*:* 2003*:* Shaping The Future. World Health Organization.

Yaseen G, Ahmad M, Sultana S, Alharrasi AS, Hussain J, Zafar M. 2015. Ethnobotany of medicinal plants in the Thar Desert (Sindh) of Pakistan. J Ethnopharm 163: 43-59. DOI: 10.1016/j.jep.2014.12.053.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 6, Number 2, November 2023
Pages: 171-181

E-ISSN: 2580-4510
DOI: 10.13057/asianjethnobiol/y060208

Ethnobotany of medicinal plants in homegarden of Menoreh Karst Area, Purworejo District, Indonesia

IGUSTITA[1], LAYYINATUSSYIFA A'YUNI FATIKHA[1], LUNA ASTIKASARI[1], DIAN KUSUMA[1], RACHEL SANISCARA NUGRAHENI[1], BEBI SYLVIA MURYANTO[1], DAFI AL ANSHORY[2], SYAMSUL HIDAYAT[3], PUGUH SUJARTA[4], AHMAD YASA[5], DARLINA MD NAIM[6], AHMAD DWI SETYAWAN[1,7,♥]

[1]Department of Environmental Science, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57126, Central Java, Indonesia. Tel./fax.: +62-271-663375, ♥email: volatileoils@gmail.com
[2]Indonesia Ethnobiology Society, Research Center for Ecology and Ethnobiology, National Research and Innovation Agency. Jl. Ir. H. Juanda No. 18, Bogor 16122, West Java, Indonesia
[3]Research Center for Plant Conservation, Botanic Garden and Forestry, National Research and Innovation Agency. Jl. Ir. H. Juanda No. 13, Bogor 16122, West Java, Indonesia
[4]Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Cenderawasih. Jl. Kambolker Perumnas III, Jayapura 99224, Papua, Indonesia
[5]Faculty of Medicines, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57 126, Central Java, Indonesia
[6]School of Biological Sciences, Universiti Sains Malaysia. 11800 Pulau Pinang, Malaysia
[7]Biodiversity Research Group, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57 126, Central Java, Indonesia

Manuscript received: 28 December 2022. Revision accepted: 30 November 2023.

Abstract. *Igustita, Fatikha LA, Astikasari L, Kusuma D, Nugraheni RS, Muryanto BS, Anshory DA, Hidayat S, Yasa A, Naim DM, Setyawan AD. 2023. Ethnobotany of medicinal plants in homegarden of Menoreh Karst Area, Purworejo District, Indonesia. Asian J Ethnobiol 6: 171-181.* Many medicinal plants can grow in karst areas, one of which is found in the Menoreh karst mountain area, southern of Central Java, Indonesia. Therefore, this research was conducted to determine the diversity and utilization of medicinal plants in the homegarden of the Menoreh Karst area, i.e. Donorejo Village, Purworejo District, Indonesia. The data was collected from plant inventory and interview activities. The plant inventory is carried out through direct house-to-house surveys to observe existing plants and then record and document each species of plant, while interviews were conducted primarily to determine its use as a medicinal ingredient. 46 respondents (households) were interviewed, mostly farmers (47.8%). The result showed that there were 55 species of plants from 34 families used to treat various diseases, such as wounds, digestive disorders, diarrhea, cold/flu, hypertension, etc. The most commonly treated disease is wounds (7 species). The plants commonly used were ginger, turmeric, and vanilla, while the mostly plant family used was Zingiberaceae (7 species and 1 variety). The tree (36%) and shrub (31%) were the most plant habitus used, and the leaves (49%) were the most part used. Most medicinal plants were boiled and then drunk. Almost all species used was cultivated plant (90%). Knowledge about medicinal plants passed down from generation to generation, through trial processes by ancestors, was still maintained. This research shows that homegardens are very important for public health, because of the diversity of plants and the diversity of diseases they can treat.

Keywords: Ethnobotany, homegarden, karst, medicinal plants, Menoreh

INTRODUCTION

Karst is a landscape with unique characteristics due to the karstification process in carbonate rock and limestone from water (Pertiwi et al. 2020), with an attractive morphology affecting available resources (Salawangi et al. 2021). The soil composition in the karst area is built from limestone fragments with low nutrients but high calcium and magnesium content, which results in the uniqueness of plants in the karst area (Suhendar et al. 2018). This uniqueness makes this area potentially have many underground water sources (Suprayogi et al. 2019) and a provider of plant diversity. The soil formation rate controls changes in the diversity of plant species in karst areas and soil moisture (Zhang et al. 2022), while mid and low-latitude karst areas are controlled by human intervention (Zhao et al. 2020). The Menoreh Karst Mountains are connected through three districts in Indonesia: Purworejo, Kulon Progo, and Magelang. The soils of the three districts combine limestone mountains lined up and covered by forests. The existence of forests with underground and surface river systems is a useful carrying capacity as a habitat for organisms and supports species diversity. Biodiversity in karst areas provides economic, ecological, educational, and cultural functions (Septiasari et al. 2021).

A home garden is a traditional house garden where land management combines various useful plants, livestock, and fisheries (Purnomo et al. 2019). The community grows various useful plants to fulfill their needs, including food, ornamental, and medicinal plants. According to Hong and Zimmerer (2022), the plants that dominate in their presence in the yard are food and medicinal plants. Utilization of the house's yard applies the concept of an agroecosystem where people grow plants to benefit from the surrounding environment. Apart from fulfilling daily needs, planting plants in the yard also helps to conserve natural resources (Naigaga et al. 2020). Geologically, parts of Donorejo Village, Kaligesing Sub-District, Indonesia are around the

Menoreh Mountains, part of the Jonggrangan Formation. The area around this formation used to have a cave community settlement with the Menoreh Mountains Area, primarily used as mixed gardens, rice fields, dry fields, and settlements (Kurniawan and Sadali 2018). The local community takes advantage of the condition of this area to grow various plants in their yards. Mudawaroch and Zulfanita (2020) report that this area was mountainous, with the most cultivated forest, including mangosteens and empon-empon.

Plants are still used as medicine to cure various diseases (Harefa 2020). The use of these plants is included in the category of ethnobotany with the specification of medicinal plants or ethnobotany medicine. Ethnobotany medicine introduces natural resources in an area using the traditions and traditional knowledge of the local community to determine interactions between the community and the surrounding environment, especially those related to plants as medicine (Najib 2020). People believe medicinal plants are useful for curing diseases but have few side effects. The community have obtained plants as medicine from the forest or plants them in their yards (Mulyani et al. 2020). Several medicinal plants that have been reported include *Mahkota Dewa,* used for its fruit as a fever remedy (Puspita et al. 2020), and *Ciplukan* (*Physalis angulata* L.), which affects flu healing, pharyngitis, coughs, respiratory disorders, mumps, high blood pressure, and diabetes (Tajidan et al. 2020). Community knowledge about medicinal plants needs to be documented so the data can develop to advance to other expertise. Various medicinal research has been developed modernly, where basic knowledge is obtained from traditional knowledge in the community. The benefits of medicinal plants could be one of the breakthroughs in drug discovery for previously unknown diseases. It is proven by research using medicinal plants for COVID-19 (Benarba and Pandiella 2020). Based on the existing phenomena, it is necessary to conduct similar research to benefit from using plants around. Thus, this research aims to determine the utilization and diversity of various medicinal plants in the home garden of the Menoreh Karst Area located in Donorejo Village, Purworejo, Indonesia.

MATERIALS AND METHODS

Study area

The research was held in Donorejo Village, Kaligesing Sub-district, Purworejo District, Central Java Province, Indonesia (Figure 1). The boundary of Donorejo Village to the north is Tlogoguwo Village, to the south is Jatirejo Village, to the west is Kaligono Village, and to the east is Kulon Progo District, Yogyakarta. The astronomical location of Donorejo Village is 7°46’24” S, 110°06’55” E with a regional structure in the form of a plateau with an altitude of 800 meters above sea level. Donorejo Village is part of the Menoreh Karst Mountains, which has endokarst in the caves and epikarst in the form of tower-type karst hills.

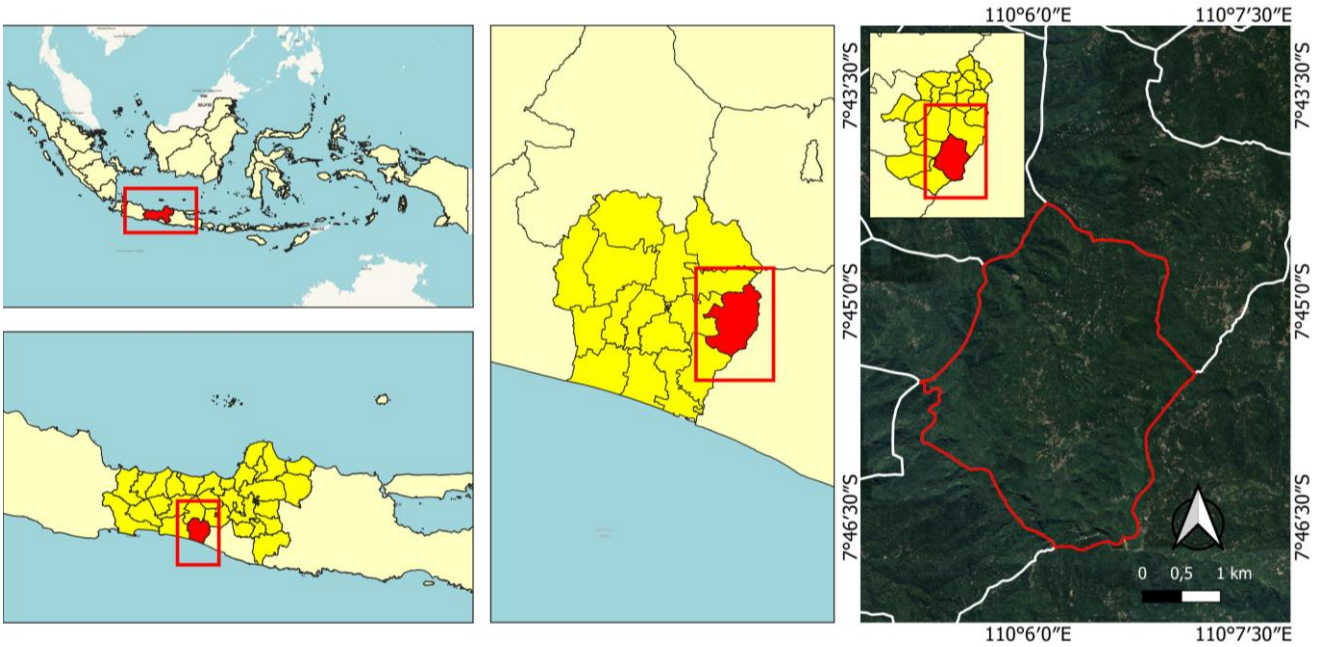

Figure 1. Map of the study area in Donorejo Village, Kaligesing Sub-district, Purworejo District, Central Java Province, Indonesia

Data collection and analysis

The data collected in this research was primary data derived from plant surveys and interview activities. Surveys were conducted to determine the diversity of medicinal plants, while interviews with a semi-structured system were conducted primarily to determine their use as medicinal ingredients, as well as local diversity and names. The interview technique applied was snowball sampling, with the target of the first informant being the Village Head (*Kepala Desa*) with 45 supporting respondents (*warga*) (each respondent representing one household), therefore 46 respondents were interviewed. The snowball sampling technique led researchers to find other respondents based on information provided by previous respondents (Siregar et al. 2021). Plant diversity was carried out through direct surveys from house-to-house to observe the presence of medicinal plants in homegarden (house's yard). Plants are recorded and documented for each species that grows in the community's homegarden for further identification using POWO (Plants of the World Online, https://powo.science.kew.org/).

Furthermore, research data was analyzed using qualitative methods (Andina et al. 2020) to explain the diversity of medicinal plants used in the community. The data shown as the results of this study are local plant names, scientific names, family groups, species, parts of plants used, properties, and consumption manner presented with a descriptive approach provided with tables and graphs and descriptive results.

RESULTS AND DISCUSSION

Respondent characteristic

In this study, 46 respondents (each representing one household) were found, with the oldest respondent aged 86-95 years (1 respondent) and the youngest respondent aged from 15 to 25 years (2 respondents). Young respondents (15-25 years) rarely use traditional medicine because technological advances have made healthcare facilities more modern and sophisticated (Naz et al. 2022). The majority of the gender of informants were women, with a total of 31 female informants (67.4%); it happens because a woman generally knows more about medicinal plants. On average, women often deal with home gardens and household needs such as kitchen needs, so they know about the benefits and efficacy of the medicinal plants used. However, the presence of male respondents also cannot be ruled out as being ignorant of medicinal plants. Several male respondents have knowledge of medicinal plants in their yards because they have experience using these plants to treat health.

Table 1 shows that the education level of the majority of respondents is in elementary school, with a percentage of 52.1%. It shows that the number of community education graduates in the Donorejo Village community is relatively low (Abidin 2019). According to Has et al. (2020), the large number of village people who have their last education at the elementary school level is affected by limitations in terms of facilities, infrastructure, and accessibility. The education level can affect respondents' knowledge regarding medicinal plant utilization. The interviews show respondents with a higher education level, such as universities, will provide more data on medicinal plants and their utilization. In this case, respondents with an education level up to elementary school will provide data on medicinal plants based only on their experience. They need some examples of medicinal plants and their benefits to name medicinal plants in their yards. Following Kusuma and Maida's (2022) research, the level of education attained affects the capabilities possessed, where the higher the educational attainment, the wider the mindset held will be. However, according to Utami et al. (2019), the level of education does not significantly affect knowledge about medicinal plants because their knowledge is obtained from ancestors.

Based on the research data (Table 1), it is known that most of the respondents are farmers, with a total of 47.8% (22 people). Therefore, farmers' contribution to using medicinal plants as an alternative to preserving medicinal plants is better (Utami et al. 2019). Apart from farmers, the majority of respondents work as housewives (41.3%), laborers (2.2%), village officials (2.2%), traders (4.3%), and students (2.2%).

Table 1. Respondent Characteristics of Donorejo Village, Kaligesing Sub-district, Purworejo District, Central Java Province, Indonesia

Variable	Count	Percentage
Age		
15-25	2	4,3%
26-35	9	19,6%
36-45	11	24%
46-55	12	26%
56-65	7	15,3%
66-75	2	4,3%
76-85	2	4,3%
86-95	1	2,2%
Gender		
Male	15	32,6%
Female	31	67,4%
Education		
Elementary	24	52,1%
Junior High School	10	21,7%
Senior High School	11	24,0%
University	1	2,2%
Profession		
Housewive	19	41,3%
Laborer	1	2,2%
Village official	1	2,2%
Farmer	22	47,8%
Trader	2	4,3%
Student	1	2,2%

Medicinal plant cultivation

Based on the interviews, we observed that 90% or 50 medicinal plant species found in the Donorejo village were plants that residents deliberately planted, while 10% or 5 other plants were naturally grown in the homegardens (Figure 2). As we know, Javanese *jamu* mostly used cultivated plants and not wild plants. The local community deliberately plants medicinal plants found in Donorejo Village because besides being ornamental plants for their yards, medicinal plants are also very beneficial for health and cooking spices (Pratiwi et al. 2018). Furthermore, according to Probowati et al. (2022), medicinal plants in homegarden can be used for emergencies and increase the body's immunity. Moreover, a homegarden, as the land around the house, has clear boundaries and ownership; this land has the potential to produce valuable crops. In addition to the garden aesthetic and production benefits, vegetable and medicinal plants support the medical needs of family members. These gardens also reap additional benefits; we follow a green lifestyle by planting gardens; we can start from home to overcome global warming trends.

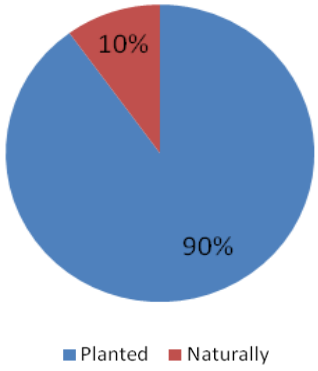

Figure 2. Comparison of medicinal plants planted and naturally in Donorejo Village, Purworejo, Indonesia

Diversity of medicinal plants

Based on surveys and interviews, there are 55 species of medicinal plant consisting of 34 families in Donorejo homegardens (Table 2). This result is higher than Nahdi and Kurniawan (2019) that found 46 species from 26 families in the homegarden's karst area of Planjan and Giricahyo Villages in Gunung Kidul District, and Ammar et al. (2021) that found 51 species from 29 families in the homegarden's karst area of Bungur and Tulakan Villages, Pacitan District, but lower than Agustina et al. (2022) that found 59 species from 32 families in homegarden of Tasikmadu, Prigi, and Karanggandu Villages, Trenggalek District which is a coastal karst area.

The most used medicinal plant family are Zingiberaceae (8 species) (Figure 3), including *Curcuma aeruginosa* (*temu ireng*), *C. heyneana* (*temu kuning*), *C. longa* (*kunir*, turmeric), *C. xanthorrhiza* (*temu lawak*), *Kaempferia galanga* (*kencur*, galangal), *Wurfbainia compacta* (*kapulaga*), *Zingiber montanum* (*bangle*), *Z. officinale* (*jahe*, ginger), and *Z. officinale* var. rubrum (*jahe merah*, red ginger) (Table 2). Zingiberaceae is also the most common homegarden medicinal plant found in the following studies. Ammar et al. (2021) found 6 species in Bungur and Tulakan (Pacitan), Nahdi and Kurniawan (2019) found 8 species in Planjan and Giricahyo (Gunung Kidul), even Agustina et al. (2022) found 12 species in Tasikmadu, Prigi, and Karanggandu (Trenggalek).

According to Rukmana and Zulkarnain (2022), Zingiberaceae is widely used as a food and medicinal plant worldwide. Members of this family are very popular herbs in many traditional medicinal systems, especially ginger rhizome. This plant has a long history of ethnobotanical use due to the antimicrobial properties derived from essential oils of rhizomes (Shahrajabian et al. 2019). For example, galangal, turmeric and ginger have been used extensively for decades; and are still used for traditional and medicinal purposes today, with easy access and low costs, allowing more people to benefit from this plant.

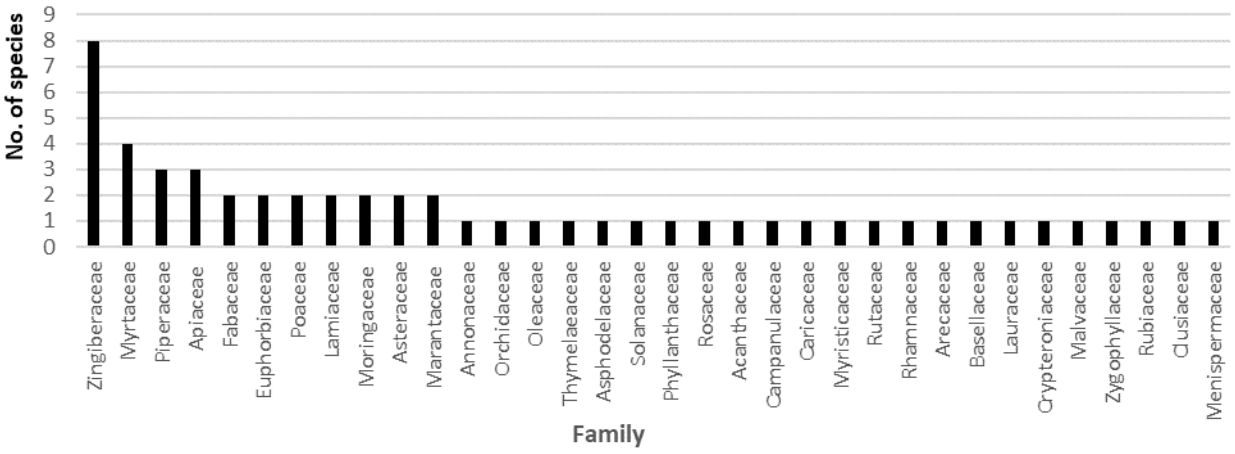

Figure 3. The plant family is used as a medicinal plant by the people of Donorejo Village, Kaligesing Sub-district, Purworejo District, Central Java Province, Indonesia

Table 2. Plants used as medicinal plants by people in Donorejo Village, Purworejo, Indonesia

Family	Scientific name	Local name	Growth form	Part used	Preparation	Application methods	Disease
Acanthaceae	*Strobilanthes crispa* L.	*Kenci beling*	Shrub	Leaves	Boiled	Drink	To help shed kidney stones
Annonaceae	*Annona muricata* L.	*Sirsak*	Tree	Leaves	Boiled	Drink	Cancer medicine
Apiaceae	*Carum carvi* L.	*Jinten*	Shrub	Leaves	Boiled	Drink	Body health
Apiaceae	*Centella asiatica* (L.) Urb.	*Pacul gowing*	Shrub	Leaves	Boiled and then mashed, smoothed	Pasted; rubbed	To reduce joint and bone inflammation, relieve fever, and toothache medicine.
Apiaceae	*Foeniculum vulgare* Mill.	*Adas*	Shrub	Leaves	Pounded	Smeared	Fever
Arecaceae	*Cocos nucifera* L.	*Kelapa*	Tree	Stem	-	Smeared	Wound medicine
Asphodelaceae	*Aloe vera* (L.) Burm. F.	*Lidah buaya*	Shrub	Sap	The sap is taken	Smeared	For medicine for fall scars
Asteraceae	*Ageratum conyzoides* L.	*Bandotan*	Shrub	Leaves	Crushed or boiled	Smeared on the wound	Diabetes medication and treating wounds
Asteraceae	*Gynura procumbens* (Lour.) Merr.	*Sambung nyawa*	Tree	Leaves	Boiled	Drink	Blood sugar medication
Basellaceae	*Anredera cordifolia* (Ten.) Steenis	*Binahong*	Climber	Leaves	Pounded	Smeared	Wound medicine
Campanulaceae	*Hippobroma longiflora* (L.) G. Don	*Bunga sandi*	Shrub	Leaves	Crush the dry leaves, then pour in the water	Dropped into the eye	Eye health and cataract eye medication
Caricaceae	*Carica papaya* L.	*Pepaya*	Tree	Leaves	Boiled	Drink	Stomachic
Clusiaceae	*Garcinia mangostana* L.	*Manggis*	Tree	Rind	Boiled	Drink	Medicine for diarrhea and intestinal infections
Crypteroniaceae	*Loranthus* L.	*Benalu*	Climber	Leaves	Boiled	Drink	Cancer and cyst medicine
Euphorbiaceae	*Euphorbia tithymaloides* L.	*Tulangan*	Tree	Stem	Boiled	Drink	Bone medicine
Euphorbiaceae	*Ricinus communis* L.	*Jarak tintir*	Tree	Sap	Apply directly to wound	Smeared	Wound medicine
Fabaceae	*Clitoria ternatea* L.	*Telang*	Climber	Flower	Dried then brewed	Drink	Increase blood circulation in the head, over-come hair loss, maintain a healthy scalp, and reduce the appearance of gray hair
Fabaceae	*Erythrina variegata* L.	*Dadap*	Tree	Leaves	Boiled	Drink	To reduce joint and bone inflammation
Fabaceae	*Mimosa pudica* L.	*Putri malu*	Shrub	Leaves	Boiled	Drink	Treating baby shock
Lamiaceae	*Coleus scutellarioides* (L.) Benth.	*Iler*	Shrub	Leaves	Boiled	Drink	Pregnant women
Lamiaceae	*Orthosiphon stamineus* Benth	*Sungut kucing*	Shrub	Leaves and Flower	Boiled	Drink	High blood pressure
Lauraceae	*Persea americana* Mill.	*Alpukat*	Tree	Leaves	Brewed	Drink	Hypertension
Malvaceae	*Hibiscus rosa-sinensis* L.	*Bunga sepatu*	Tree	Flower	Mixed with oranges	Drink	Weight loss drug
Marantaceae	*Maranta arundinacea* L.	*Garut*	Herbaceous	Tuber	Made flour	Eat	Stomachic
Menispermaceae	*Tinospora cordifolia* (Willd.) Miers	*Brotowali*	Climber	All parts	Cut into small pieces, mixed with other medicinal plants, then boiled	Drink	Lowers blood sugar levels
Moringaceae	*Moringa oleifera* Lam.	*Kelor*	Tree	Leaves	Boiled	Drink	For supplements, hypertension
Myristicaceae	*Myristica fragrans* Houtt.	*Pala*	Tree	Fruit	Boiled	Drink	Cold medicine
Myrtaceae	*Psidium guajava* L.	*Jambu biji*	Tree	Leaves	Mashed	Eat	Diarrhea medicine
Myrtaceae	*Syzgium aromaticum* (L.) Merr. & Perry	*Cengkeh*	Tree	Fruit	Made into herbal medicine	Drink	Diarrhea medicine and nauseous
Myrtaceae	*Syzygium aqueum* (Burm. F.) Alston	*Jambu air*	Tree	Leaves	Boiled	Drink	Ulcer medicine and diarrhea medicine
Myrtaceae	*Syzygium polyanthum* (Wight) Walp.	*Salam*	Shrub	Leaves	Boiled	Drink	Uric acid medication

Oleaceae	*Jasminum sambac* (L.) Aiton	*Melati*	Shrub	Flower	Brewed	Drink	Cough medicine
Orchidaceae	*Vanilla planifolia* Andrews	*Vanili*	Climber	Sap	-	Spotted or rubbed directly into the wound	Wound medicine
Phyllanthaceae	*Breynia androgyna* (L.) Chakrab. & N.P.Balakr.	*Katuk*	Tree	Leaves	Made vegetables	Eat	Pregnant women
Piperaceae	*Peperomia pellucida* (L.) Kunth	*Sirih cina*	Shrub	All parts	Grind it, take the juice, mix it with honey. For acne medicine, pure it	Drink and attach to wound	Reduce high fever and treat acne
Piperaceae	*Piper betle* L.	*Sirih*	Climber	Leaves	Boiled with water	Bathing	Feminine cleanser
Piperaceae	*Piper cubeba* L.fil.	*Kemukus*	Climber	Leaves	Boiled	Drink	Aches and pains medicine
Poaceae	*Chrysopogon zizanioides* (L.) Roberty	*Akar wangi*	Shrub	Root	Boiled	Drink	Treat rheumatic diseases and increase stamina
Poaceae	*Cymbopogon nardus* L. Rendle	*Sereh*	Herbaceous	Stem	Boiled	Bathing	Itching and massage
Rhamnaceae	*Ziziphus mauritiana* Lam.	*Bidara*	Tree	Leaves	Boiled	Rubbed into the wound	Wound medicine
Rosaceae	*Rosa x hybrida* Schleich. Ex W.D.J.Koch & Ziz	*Mawar*	Shrub	Flower and Leaves	Flowers and leaves are brewed using water and sugar	Drink	Cough medicine
Rubiaceae	*Morinda citrifolia* L.	*Mengkudu*	Tree	Leaves and Fruit	Boiled; brewed; blended	Drink	Hypertension
Rutaceae	*Citrus* × *aurantiifolia* (Christm.) Swingle	*Jeruk nipis*	Tree	Fruit	Brewed	Drink	Cold medicine
Solanaceae	*Physalis angulata* L.	*Ciplukan*	Shrub	All parts	Boiled	Drink; eat immediately	Gout and heart disease
Thymelaeaceae	*Phaleria macrocarpa* (Scheff) Boerl.	*Mahkota dewa*	Tree	Fruit	Dried then brewed	Drink	For itching
Zingiberaceae	*Curcuma aeruginosa* Roxb.	*Temu ireng*	Herbaceous	Tuber	Boiled	Drink	To treat worms and increase appetite
Zingiberaceae	*Curcuma heyneana* Valeton & Zijp	*Temu kuning*	Herbaceous	Tuber	Grated tuber	Smeared on the wound	Treating peeling wounds
Zingiberaceae	*Curcuma longa* L.	*Kunir*	Herbaceous	Tuber	Herbal medicine	Drink	*Padaran* (stomach ache medicine)
Zingiberaceae	*Curcuma xanthorrhiza* D.Dietr	*Temu lawak*	Herbaceous	Tuber	Herbal medicine	Drink	To increase appetite and for cancer
Zingiberaceae	*Kaempferia galanga* L.	*Kencur*	Herbaceous	Tuber	Crushed and then mixed with rice	Bandaged to the wound	Sprain medicine, cough medicine, and health medicine
Zingiberaceae	*Wurfbainia compacta* (Sol. Ex Maton) Skornick. & A.D.Poulsen	*Kapulaga*	Herbaceous	Fruit	Made into herbal medicine	Drink	Cold medicine
Zingiberaceae	*Zingiber montanum* (J.Koenig) Link ex A.Dietr	*Bangle*	Herbaceous	Leaves	Boiled	Drink	Convulsion medicine
Zingiberaceae	*Zingiber officinale* Roscoe	*Jahe*	Herbaceous	Tuber	Crushed, boiled with water, then filtered	Drink	Cold medicine
Zingiberaceae	*Zingiber officinale* var rubrum	*Jahe merah*	Herbaceous	Tuber	Boiled	Drink	Cold medicine (influenza)
Zygophyllaceae	*Tribulus terrestris* L.	*Sigar polo*	Shrub	Leaves	Boiled	Drink	Medicine for headache

The Donorejo Village people use medicinal plants, namely ginger (*Zingiber officinale*), which can be used in several ways as an ingredient in traditional medicines, culinary seasonings, and drinks. In Indonesia, ginger is divided into three varieties, i.e.: red ginger (*merah*, berem), big ginger (*gajah*, *badak*), and spicy little ginger (*sunti*, *emprit*). Ginger is an herbal medicine because its essential oils contain active ingredients such as curcumin, camphor, limonin, borneol, eucalyptol, and gingerol, which effectively treat and prevent various diseases (Setyawan 2002). Donorejo Village people usually use the ginger plant to treat colds, nausea, and body aches due to the flu. Ginger can reduce nausea (Li et al. 2019) and is known to have active anti-inflammatory, antioxidant (Aryanta 2019), and antibacterial compounds (Mao et al. 2019). Ginger also relieves body aches because it has an active anti-inflammatory compound namely gingerol (Balmaseda et al. 2020).

Furthermore, there is the turmeric plant (*Curcuma longa*), which the local community usually uses to treat inflammatory diseases. It helps increase endurance and relieve pain, which is useful for reducing menstrual pain. Turmeric is used in various manners, such as health care, cooking, and beauty. The yellow flesh of the turmeric plant is caused by curcumin, a bioactive component of secondary metabolites in turmeric. Curcumin has enormous therapeutic activity and potential, including anti-inflammatory, biological antioxidant, anticancer, antimutagenic, anti-coagulant, fertility, antidiabetic, antibacterial, antifungal, antiprotozoal, antiviral, antifibrotic, antivenom, antiulcer, antihypertensive, and hypocholesterolemia (Kusbiantoro 2018: Ansari et al. 2020: Srivastava et al. 2022).

On the other hand, lemongrass (*Cymbopogon nardus*), included in Poaceae, is usually used by the community to treat itching on the body and is often mixed with massage oil. This plant can manufacture essential oils because the parenchyma contains oil cells (glands). According to Murni and Rustin (2020) lemongrass contains citronellal, citronellol and geraniol. Moreover, lemongrass oil compounds in piperitone contain active anti-inflammatory, antioxidant, and antimicrobial compounds that can prevent microbial oxidation and decay (Mukarram et al. 2021), are aromatic (smelling pleasant), and have therapeutic properties. Many people use lemongrass for sore throats, headaches, colitis, stomach ulcers, gargles, colds, stomachaches, diarrhea, coughs, and salves for rheumatism and eczema.

Another plant, *jarak tintir* or jatropha (*Ricinus communis*), is often used by the local community to heal wounds, and the plant part used is the sap. According to Zaetun (2018), this Euphorbiaceae plant is commonly the main ingredient in traditional medicine for the *Labuapi* community from North Lombok, Indonesia, including seeds, roots, fruit, leaves, and sap. The sap produced from the jatropha plant is also widely used as an additional ingredient to treat skin wounds. This plant effectively accelerates wound healing (Bawotong et al. 2020) and helps blood clot due to its flavonoid content (Kujawska and Hirschmann 2022). Several studies have proven that this plant has antibacterial (Ivan et al. 2019) and anti-dengue compounds for the treatment of dengue fever (Yuniyanti et al. 2022).

The residents deliberately plant the medicinal plants *kapulaga* or cardamom (*Wurfbainia compacta*) and *vanili* or vanilla (*Vanilla planifolia*) for personal use and economic potential (Figure 4). *Kapulaga* is a spice generally used to add aroma and flavor to dishes. The part of *kapulaga* used for treatment is the fruit, where the fruit is processed and can be used as herbal medicine to treat colds. According to Yunitasari (2018), *kapulaga* seeds also help lower blood sugar levels. It is because *kapulaga* seeds contain compounds that have the potential to antidiabetics, namely phenolic compounds and flavonoids. In addition, it contains fat, protein, calcium oxalate, and citric acid, which have diuretic ingredients. Many studies show flavonoids have pharmacological effects such as protecting the heart, anti-oxidation, and diuresis (Husna et al. 2021).

On the other hand, besides being a flavor enhancer for food, *vanili* can also treat wounds. This plant contains ethanol (Sarak et al. 2021), which can play a role in wound healing because it has anti-inflammatory and antimicrobial properties. According to Costantini et al. (2021), a study of anti-inflammatory activity showed that *vanili* at higher doses was effective in the early phase of inflammation, which could be hypothesized due to the histamine and serotonin release inhibition responsible for the initial phase of inflammation; therefore, *vanili* shows its effectiveness by inhibiting histamine release. In addition, the antinociceptive effect of *vanili* is also important in wound healing by reducing pain or soreness (Ueno et al. 2019).

Growth form

The habitus of medicinal plants used by the people of Donorejo include climbers, trees, shrubs, and herbaceous (Figure 5). Plants with a tree habitus of 36%, followed by Shrubs with a percentage of 31%, herbs with 20%, and climber with 13%. Several trees found in Donorejo Village that can be used as medicinal plants include nutmeg, clove, avocado, noni, and coconut, with various benefits for treatment and are still often used. In addition, the local community often uses several shrub plants, including *iler* (*Coleus scutellarioides*), *adas* (*Foeniculum vulgare*), and *jinten* (*Carum carvi*), while herbaceous plants such as ginger, turmeric, *temulawak*, and vines such as *telang* (*Clitoria ternatea*), *benalu* (*Loranthus* sp.), and *binahong* (*Anredera cordifolia*). Not all medicinal plants used by residents come from homegardens, but some come from forest or forest gardens (agroforests) or even from the market. This result is different from Ammar et al. (2021) which states that the most commonly found habitat is bushes (35%), while according to Agustina et al. (2022), the most commonly found habitat is herbaceous (37%). This indicates that there is a tendency for differences in plant use at the three research locations.

Figure 4. A. *Vanili* plant (*Vanilla planifolia*) and B. *Kapulaga* plant (*Wurfbainia compacta*)

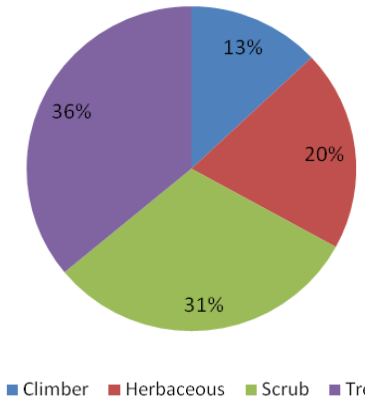

Figure 5. Medicinal plant habitus in Donorejo Village, Purworejo, Indonesia

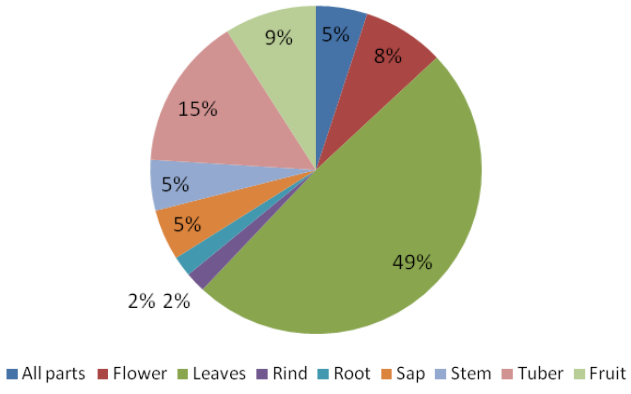

Figure 6. Parts of medicinal plants used in Donorejo Village, Purworejo, Indonesia

Part used, preparation and application methods

The plant part used for medicinal purposes varies depending on the species of plant to be used. In this study, the plant part commonly used for treatment is the leaf (49%) (Figure 6). This finding is in line with Ammar et al. (2021)(67% leaf) and Agustina et al. (2022)(46% leaf). Qasrin et al. (2020) reported that leaves are part of a medicinal plant that the Malays tribe in Sumatra island often uses in the Riau province because they contain beneficial substances compared to other plant parts. The leaves become medicinal because they are the plant part used for photosynthesis and have many valuable substances (Nurchayati and As'ari 2021). In addition, the leaves are one of the plants' easiest parts to use because they are easily accessible and will not cause death while picking. According to Helmina and Hidayah (2021), researching in Kampung Padang, Sukamara District, also stated that leaves are part of the medicinal plant that is often used because it has many benefits and is one of the easiest parts of the plant to process.

The local people of Donorejo Village utilized medicinal plants in various ways; most processed medicinal plants are boiled and then drunk. It is in line with research conducted in Kutalanggeng and Kutamaneuh Villages, Tegalwaru Sub-district, Karawang, which reported that 70% of medicinal plants were used by drinking because, according to the village community, drinking was the most effective way, boiling the medicinal plants was carried out before making medicinal plants as a drink (Gunarti et al. 2021). According to research by Haziki et al. (2021), medicinal plants processed by boiling are also conducted by people in the Setapuk Kecil Village, Singkawang, West Kalimantan and Pagar Ruyung Village, Lahat, South Sumatra (Rizal et al. 2021). Qasrin et al. (2020) also reported that the public believes medicinal plants that are processed by boiling to kill bacteria that live on these plants; most people will prefer to use medicinal plants by drinking. Therefore, most medicinal plants are processed by boiling with water, and the boiled water can be consumed directly as a drink.

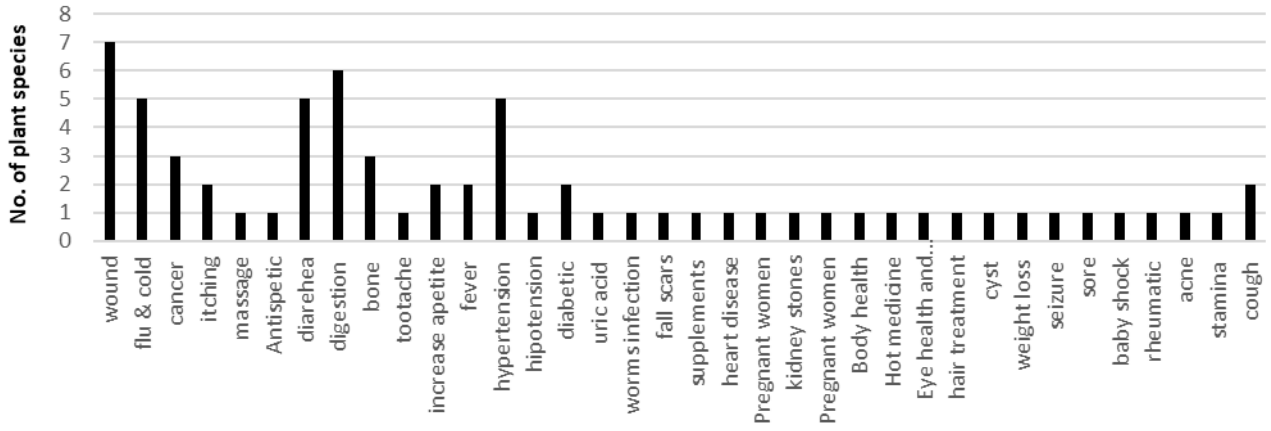

Figure 7. Disease treated using plants in Donorejo Village, Purworejo, Indonesia

An example of a medicinal plant processed by boiling is all parts of *ciplukan* plant (*P. angulata*) (roots, stems, trees, and fruit). This plant is processed by boiling the plant parts for use, and then the boiled water is consumed directly as a drink. In addition, the *ciplukan* fruit is also directly consumed for treatment like diabetes mellitus since the fruit contains antidiabetic activity (Raju and Estari 2015). Similar research was conducted by Afriyeni and Surya (2019), in which the *ciplukan* plant contains flavonoids and phenolic compounds, which are potential antioxidants. On the other hand, *kapulaga* (*W. compacta*) is also used by Donorejo Village people to cure colds; the fruit part will be processed as herbal medicine. Husna et al. (2021) also revealed that *kapulaga* fruit is used for fever, anti-asthma, stomach ulcers, antibacterial, deodorizing, and influenza. Apart from these plants is a *vanili* (*V. planifolia*), which the Donorejo Village people use to treat wounds. The part used is sap, which will be applied directly to the wound.

Diseases treated

People's knowledge about using plants as medicine has been passed down from generation to generation and is still maintained. People believe their traditional knowledge about medicinal plants has gone through a lengthy trial process by their ancestors. So, people still use these plants as medicine without any harmful effects as long as they are not consumed excessively. Several types of cured diseases also often occur in the surrounding community. The illness often treated using medicinal plants by the people around the Menoreh karst is wound (Figure 7). In healing wounds, 7 plants were used, namely *R. communis*, *V. planifolia*, *Ziziphus mauritiana*, *Cocos nucifera*, *Anredera cordifolia*, *Ageratum conyzoides*, and *Curcuma heyneana*. Some other diseases that are cured with many plants are cold/flu (6 species), diarrhoea (5 species), digestive disorders (5 species), and hypertension (5 species). The use of medicinal plants (or their derivatives) as wound medicine is well known, for example, Shedoeva et al. (2019) state 36 species are used for wound healing, Farahpour (2019) states 25 species, Albari et al. (2023) state 13 species. Many of these medicinal plants can be planted in the homegarden.

In conclusion, in the karst area of Donorejo Village, a wide variety of medicinal plant diversity has been identified, with 55 species belonging to 34 families. These medicinal plants include ginger, *jarak tintir*, *kapulaga*, and vanilla. The identification shows that the medicinal plant families' dominance in Donorejo Village is Zingiberaceae. Rural communities widely use the Zingiberaceae family as medicinal, where these medicinal plants include ginger and turmeric. In addition, the plant part mostly used as medicinal is the leaf because the leaf is a plant part that is relatively easy to process. The Donorejo Village people generally process plant parts used as medicinal by boiling them, and then the boiled water is consumed directly for drinking. Moreover, medicinal plants have been used to treat various diseases, such as wounds, digestive disorders, diarrhea, cold/flu, and hypertension.

ACKNOWLEDGEMENTS

The authors thank the people of Donorejo Village, Purworejo, Indonesia, for their knowledge and willingness to become resource persons in this research.

REFERENCES

Abidin Z. 2019. Pemanfaatan tanaman obat dalam mengatasi keluhan kesehatan pada kelompok tani tebu Jatiroto Lumajang. Indones J Health Sci 11 (1): 9-21. DOI: 10.32528/ijhs.v11i1.2233. [Indonesian]

Afriyeni H, Surya S. 2019. Efektivitas antihiperkolesterolemia ekstrak etanol dari bagian batang dan buah tumbuhan *Ciplukan* (*Physalis angulata* L.) pada tikus putih hiperkolesterolemia. Jurnal Farmasi Higea 11 (1): 49-61. DOI: 10.52689/higea.v11i1.211. [Indonesian]

Agustina N, Hutauruk TJW, Sulistyaningrum N, Yudhanto SM, Liza N, Kusumaningrum L, Sugiyarto, Yasa A, Saensouk S, Naim DMD, Setyawan AD. 2022. Diversity of the medicinal plant in homegarden of local communities in the coastal area of Prigi Bay, Trenggalek, East Java, Indonesia. Biodiversitas 23: 6302-6312. DOI: 10.13057/biodiv/d231226

Albahri G, Badran A, Hijazi A, Daou A, Baydoun E, Nasser M, Merah O. 2023. The therapeutic wound healing bioactivities of various medicinal plants. Life (Basel) 13(2): 317. DOI: 10.3390/life13020317

Ammar LA, Kurniawati B, Anggorowati D, Cahyaningsih AP, Setyawan AD.2021. Ethnobotanical study of the medicinal plant used by local communities in karst area of Pacitan District, East Java, Indonesia. Intl J Trop Drylands 5: 84-93. DOI: 10.13057/tropdrylands/t050205.

Andina AN, Barokah S, Wulandari OAD, Girsang AA, Afifah RAN. 2020. Strategi pengembangan ekowisata hutan mangrove Pandansari Kabupaten Brebes untuk mengurangi kemiskinan. Syntax Literate: Jurnal Ilmiah Indonesia 5 (7): 251-261. DOI: 10.36418/syntax-literate.v5i7.1457. [Indonesian]

Ansari S, Jilani S, Abbasi H, Hashimi A, Ahmed Y, Khatoon R, Rifas AL. 2020. *Curcuma longa*: A treasure of medicinal properties. Cell Med 10 (2): 9.1-9.7. DOI: 10.5667/CellMed.2020.0009.

Aryanta IWR. 2019. Manfaat jahe untuk kesehatan. Widya Kesehatan 1 (2): 39-43. DOI: 10.32795/widyakesehatan.v1i2.463. [Indonesian]

Balmaseda DD, Vega ID, Larrosa M, Juan AFS, Issaly N, Pérez DM, Burgos S, Quintana MS, Gonzalez C, Bas A, Roller M, Ruiz MP. 2020. Effect of a blend of *Zingiber officinale* Roscoe and *Bixa orellana* L. herbal supplement on the recovery of delayed-onset muscle soreness induced by unaccustomed eccentric resistance training: A randomized, triple-blind, placebo-controlled trial. Front Physiol 11: 826. DOI: 10.3389/fphys.2020.00826.

Bawotong RA, Queljoe ED, Mpila DA. 2020. Uji efektivitas salep ekstrak daun jarak pagar (*Jatropha curcas* L.) terhadap penyembuhan luka sayat pada tikus putih jantan galur wistar (*Rattus norvegicus*). Pharmacon 9 (2): 284-293. DOI: 10.35799/pha.9.2020.29283.

Benarba B, A Pandiella. 2020. Medicinal plants as source of active molecules against Covid 19. Front Pharmacol 11 (1189): 1-16. DOI: 10.3389/fphar.2020.01189.

Costantini E, Sinjari B, Falasca K, Reale M, Caputi S, Jagarlapodii S, Murmura G. 2021. Assessment of the vanillin anti-inflammatory and regenerative potentials in inflamed primary human gingival fibroblast. Mediat Inflamm 2021: 5562340. DOI: 10.1155/2021/5562340.

Farahpour MZ. 2019. Medicinal plants in wound healing. In: Dogan KH (ed.) Wound Healing-Current Perspectives. IntechOpen, London. DOI: 10.5772/intechopen.80215

Gunarti NS, Fikayuniar L, Hidayat N. 2021. Studi etnobotani tumbuhan obat di Desa Kutalanggeng dan Kutamaneuh Kecamatan Tegalwaru Kabupaten Karawang Jawa Barat. Majalah Farmasetika 6 (1): 14-23. DOI: 10.24198/mfarmasetika.v6i0.36668. [Indonesian]

Harefa D. 2020. Pemanfaatan hasil tanaman sebagai Tanaman Obat Keluarga (TOGA). Madani Indones J Civil Soc 2 (2): 28-36. DOI: 10.35970/madani.v2i2.233. [Indonesian]

Has DH, Zuhud EAM, Hikmat A. 2020. Etnobotani obat pada masyarakat suku penguluh di KPHP Limau Unit VII Hulu Sarolangun, Jambi. Media Konservasi 25 (1): 73-80. DOI: 10.29244/medkon.25.1.73-80. [Indonesian]

Haziki, Syamswisna, Wahyuni ES. 2021. Studi etnobotani tumbuhan obat tradisional oleh masyarakat di Kelurahan Setapuk Kecil Singkawang. Biocelebes 15 (1): 76-86. DOI: 10.22487/bioceb.v15i1.15471. [Indonesian]

Helmina S, Hidayah Y. 2021. Kajian etnobotani tumbuhan obat tradisional oleh masyarakat Kampung Padang Kecamatan Sukamara Kabupaten Sukamara. Jurnal Pendidikan Hayati 7 (1): 20-28. [Indonesian]

Hong Y, Zimmerer KS. 2022. Useful plants from the wild to home garden: An analysis of home garden ethnobotany in context of habitat conversion and land use change in Jeju, South Korea. J Ethnobiol 42 (3): 1-21. DOI: 10.2993/0278-0771-42.3.6.

Husna N, Handayani R, Zakiah N, Aulianshah V. 2021. Efek diuretik ekstrak etanol *Kapulaga* (*Amomum compactum*) pada mencit (*Mus musculus*) jantan. Jurnal Ilmiah Simplisia 1 (2): 112-118. [Indonesian]

Ivan I, Sudigdoadi S, Kartamihardja AHS. 2019. Antibacterial effect of *Jatropha multifida* L. leaf infusion towards *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Althea Med J 6 (2): 95-99. DOI: 10.15850/amj.v6n2.1622.

Kujawska M, Hirschmann GS. 2022. The use of medicinal plants by Paraguayan migrants in the Atlantic Forest of Misiones, Argentina, is based on Guarani tradition, colonial, and current plant knowledge. J Ethnopharmacol 283: 114702. DOI: 10.1016/j.jep.2021.114702.

Kurniawan A, Sadali MI. 2018. Keistimewaan Lingkungan Daerah Istimewa Yogyakarta. Universitas Gajah Mada Press, Yogyakarta. [Indonesian]

Kusbiantoro D. 2018. Pemanfaatan kandungan metabolit sekunder pada tanaman kunyit dalam mendukung peningkatan pendapatan masyarakat. Kultivasi 17 (1): 544-549. DOI: 10.24198/kultivasi.v17i1.15669. [Indonesian]

Kusuma PO, Maida S. 2022. Hubungan karakteristik dengan pengetahuan masyarakat mengenai pemanfaatan TOGA di Kelurahan Cileungsi Kidul. Jurnal Kefarmasian 9: 10-19. DOI: 10.56319/bhj.v9i1.24. [Indonesian]

Li H, Liu Y, Luo D, Ma Y, Zhang J, Li M, Yao L, Shi X, Liu X, Yang K. 2019. Ginger for health care: An overview of systematic reviews. Complement Ther Med 45: 114-123. DOI: 10.1016/j.ctim.2019.06.002.

Mao QQ, Xu XY, Cao SY, Gan RY, Corke H, Beta T, Li H.B. 2019. Bioactive compounds and bioactivities of ginger (*Zingiber officinale* Roscoe). Foods 8 (6): 185-206. DOI: 0.3390/foods8060185.

Mudawaroch RE, Zulfanita. 2020. Evaluasi pelatihan pembuatan jamu ternak fermentasi. Jurnal Masyarakat Mandiri 4 (5): 930-939. DOI: 10.31764/jmm.v4i5.3066. [Indonesian]

Mukarram M, Sadaf C, Mo AK, Palmiro P. 2021. Lemongrass essential oil components with antimicrobial and anticancer activities. Antioxidants (Basel) 11 (1): 20. DOI: 10.3390/antiox11010020.

Mulyani Y, Sumarna R, Patonah. 2020. Kajian etnofarmakologi pemanfaatan tanaman obat oleh masyarakat di Kecamatan Dawuan Kabupaten Subang Provinsi Jawa Barat. Jurnal Farmasi Galenika 6 (1): 37-54. DOI: 10.22487/j24428744.2020.v6.i1.13572. [Indonesian]

Murni M, Rustin L. 2020. Karakteristik kandungan minyak atsiri tanaman sereh wangi (*Cymbopogon nardus* L.). Prosiding Seminar Nasional Biologi 6 (1): 227-231. DOI: 10.24252/psb.v6i1.15835. [Indonesian]

Nahdi MS, Kurniawan AP. 2019. Ethnobotanical studyof medicinal plants inkarst environment in Gunung Kidul, Yogyakarta, Indonesia. Nusantara Biosci 11: 133-141. DOI: 10.13057/nusbiosci/n110204.

Naigaga H, Joseph S, Ablye N, Godfrey S, Mame SM, Kandioura N. 2020. Ethnobotanical knowledge of home garden plant species and its effect on home garden plant diversity in Thies region of Senegal. Environ Dev Sustain 23: 7524-7536. DOI: 10.1007/s10668-020-00930-8.

Najib NN. 2020. Kajian etnobotani masyarakat sekitar Kawasan Taman Nasional Bantimurung Bulusaraung. Journal TABARO 4 (1): 1-8. DOI: 10.35914/tabaro.v4i1.352. [Indonesian]

Naz A, Amjad MS, Umair M, Altaf M, Ni J. 2022. Medicinal plants used as therapeutic medicine in the Himalayan region of Azad Jammu and Kashmir. South Afr J Bot 150: 194-216. DOI: 10.1016/j.sajb.2022.07.007.

Nurchayati N, As'ari H. 2021. Studi inventarisasi ragam tanaman obat keluarga di Dusun Umbulrejo Desa Bagorejo Kecamatan Srono Kabupaten Banyuwangi. Biosense 4 (1): 1-10. DOI: 10.36526/biosense.v4i01.1426. [Indonesian]

Pertiwi W, Bahri S, Rokhim S, Firdhausi NF. 2020. Keanekaragaman dan kemerataan jenis *Collembola* gua di Kawasan Karst Malang Selatan. Biotropic J Trop Biol 4 (2): 134-139. DOI: 10.29080/biotropic.2020.4.2.134-139. [Indonesian]

Pratiwi R, Saputri FA, Nuwarda RF. 2018. Tingkat pengetahuan dan penggunaan obat tradisional di masyarakat: Studi pendahuluan pada masyarakat di Desa Hegarmanah, Jatinangor, Sumedang. Dharmakarya 7 (2): 97-100. DOI: 10.24198/dharmakarya.v7i2.19295. [Indonesian]

Probowati W, Fuad GT, Sunartiyah. 2022. Tangguh hadapi Covid-19 dengan budidaya tanaman obat keluarga di Desa Margomulyo, Seyegan, Sleman. PengabdianMu Jurnal Ilmiah Pengabdian kepada Masyarakat 7 (1): 245-251. DOI: 10.33084/pengabdianmu.v7iSpecial-1.2692. [Indonesian]

Purnomo, Batoro J, Hakim A. 2019. Ethnobotany home garden in Puspa Jagad Tourism ecology area. J Indones Tour Dev Stud 7 (1): 50-55. DOI: 10.21776/ub.jitode.2019.07.01.08.

Puspita D, Notosoedarmo S, Fauzi MR. 2020. Studi etnobotani di Kawasan Karst Bukit Bulan untuk mendukung studi arkeologi. J Nat Resour Environ Manag 10 (2): 270-283. DOI: 10.29244/jpsl.10.2.270-283. [Indonesian]

Qasrin U, Setiawan A, Yulianti, Bintoro A. 2020. Studi etnobotani tumbuhan berkhasiat obat yang dimanfaatkan masyarakat suku Melayu Kabupaten Lingga Kepulauan Riau. Jurnal Belantara 3 (2): 139-152. DOI: 10.29303/jbl.v3i2.507. [Indonesian]

Raju P, Estari M. 2015. Antidiabetic activity of compound isolated from *Physalis angulata* fruit extract in alloxan-induced diabetic rats. Am J Sci Med Res 1 (1): 40-43. DOI: 10.17812/ajsmr2015111.

Rizal S, Kartika T, Septia GA. 2021. Studi etnobotani tumbuhan obat di Desa Pagar Ruyung Kecamatan Kota Agung Kabupaten Lahat Sumatera Selatan. Sainmatika Jurnal Ilmiah Matematika dan Ilmu Pengetahuan Alam 18 (2): 222-230. DOI: 10.31851/sainmatika.v18i2.6618. [Indonesian]

Rukmana R, Zulkarnain. 2022. Etnobotani tanaman obat famili Zingiberaceae sebagai bahan herbal untuk kesehatan di masa pandemi Covid 19. Media Informasi Sains dan Teknologi 16 (1): 74-80. DOI: 10.24252/teknosains.v16i1.25970. [Indonesian]

Salawangi R, Arif AKD, Djainal H. 2021. Studi geomorfologi kawasan bentang alam karst di Desa Sagea Kecamatan Weda Utara Kabupaten Halmahera Tengah. Jurnal Teknik 14 (2): 77-81. [Indonesian]

Sarak AS, Dawane JS, Pandi VA. 2021. Experimental evaluation of anti-inflammatory effect of ethanolic extract of *Vanilla planifolia* seeds in Wistar rats. Natl J Physiol Pharm Pharmacol 12 (7): 937-942. DOI: 10.5455/njppp.2022.12.12433202107122021.

Septiasari A, Balgis M, Lathifah MN, Hanugroho PD, Setyawan AD. 2021. Identification and potential of vascular plants in the karst ecosystem of Somopuro Cave, Pacitan, East Java, Indonesia. Intl J Trop Drylands 5: 75-83. DOI: 10.13057/tropdrylands/t050204.

Setyawan AD. 2002. Keragaman varietas jahe (*Zingiber officinale* Rosc.) berdasarkan kandungan kimia minyak atsiri. BioSMART. 4 (2): 48-54. [Indonesian]

Shahrajabian MH, Wenli S, Qi C. 2019. Clinical aspects and healyh benefits of ginger (*Zingiber officinale*) in both traditional Chinese medicine and modern industry. Acta Agric Scand 69 (6) : 546-556. DOI: 10.1080/09064710.2019.1606930.

Shedoeva A, Leavesley D, Upton Z, Fan C. 2019. Healing and the use of medicinal plants. Evid-Based Compl Altern Med 2019: 2684108. DOI: 10.1155/2019/2684108

Siregar MRA, Perawati S, Andriani L. 2021. Etnofarmakognosi pada Suku Anak Dalam di Desa Hajran Kecamatan Bathin Xxiv Kabupaten Batanghari. J Healthc Technol Med 6 (1): 215-220.

Srivastava BBL, Ripanda AS, Mwanga HM. 2022. Ethnomedicinal, phytochemistry and antiviral potential of turmeric (*Curcuma longa*). Compounds 2 (3): 200-221. DOI: 10.3390/compounds2030017.

Suhendar AS, Yani E, Widodo P. 2018. Analisis vegetasi kawasan karst Gombong Selatan Kebumen Jawa Tengah. Scr Biol 5 (1): 37-40. DOI: 10.20884/1.sb.2018.5.1.639. [Indonesian]

Suprayogi TD, Nengse S, Hakim A. 2019. Analisis kualitas air sungai bawah tanah Gua Ngerong, Kecamatan Rengel, Tuban. Jurnal Teknik Lingkungan 5 (1): 45-53. DOI: 10.29080/alard.v5i1.748. [Indonesian]

Tajidan, Sahidu A, Suparmin. 2020. Penyuluhan pemanfaatan buah *Ciplukan* sebagai bahan makanan sehat melalui metode jaga jarak fisik akibat wabah Covid 19. Jurnal Gama Ngabdi 2 (2): 139-146. DOI: 10.29303/jgn.v2i2.85. [Indonesian]

Ueno H, Shimada A, Suemitsu S, Murakami S, Kitamura N, Wani K, Takahasi Y, Matsumoto Y, Okamoto M, Fujiwara Y, Ishihara I. 2019. Comprehensive behavioral study of the effects of vanillin inhalation in mice. Biomed Pharmacother 115: 108879. DOI: 10.1016/j.biopha.2019.108879.

Utami RD, Zuhud EAM, Hikmat A. 2019. Medicinal ethnobotany and potential of medicine plants of Anak Rawa ethnic at The Penyengat Village Sungai Apit Siak Riau. Media Konservasi 24 (1): 40-51. DOI: 10.29244/medkon.24.1.40-51. [Indonesian]

Yunitasari N. 2018. Pemanfaatan daun pandan wangi, jahe, dan biji *Kapulaga* sebagai minuman teh untuk obat herbal antidiabetes. UNES J Sci Technol Res 3 (2): 197-203. [Indonesian]

Yuniyanti MM, Nugrahaningsih DA, Wahyuningsih MSH. 2022. Phytochemical screening and antidengue activity of *Jatropha multifida* extract against DENV-2. Majalah Obat Tradisional 27 (1): 75-82. DOI: 10.22146/mot.73368.

Zaetun S. 2018. Daya hambat getah tanaman *Jarak Tintir* (*Jatropha multifida* Linn) terhadap proses penyembuhan luka di tinjau dari hasil pemeriksaan Cloting TIME. Jurnal Kesehatan Prima 8 (2): 1308-1315. DOI: 10.32807/jkp.v8i2.52. [Indonesian]

Zhang S, Baia X, Zhao C, Tan Q, Luo G, Caoa Y, Deng Y, Lia Q, Li C, Wua L, Wang J, Chen F, Xi H, Ran C, Liu M. 2022. Limitations of soil moisture and formation rate on vegetation growth in karst areas. Sci Total Environ 810 (1): 151209. DOI: 10.1016/j.scitotenv.2021.151209.

Zhao S, Pereira P, Wu X, Zhou J, Cao J, Zhang W. 2020. Global karst vegetation regime and its response to climate change and human activities. Ecol Indic 113: 110-121. DOI: 10.1016/j.ecolind.2020.106208.