

Medicinal plants used in traditional healthcare in Manipur: Ethnomedical insights into Urolithiasis treatment

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In the recent year in Manipur, especially among the rural communities, there is considerably high prevalence of urolithiasis, affecting approximately 22.4% of the population. Despite being this high incidence, there has been very less systematic documentation of the traditional herbal practices used by the indigenous healers to manage this condition. Therefore, the current study aimed to document and analyse the ethnomedicinal plants used in traditional practitioners for the treatment of urolithiasis in the selected rural areas of Manipur. The research was conducted over a period of six months in the five villages located in the Imphal West and Bishnupur districts of Manipur. The ethnomedicinal information was collected through semi-structured interviews with the traditional healers and knowledgeable local elders. The plant species mentioned during the interviews were noted, collected, identified taxonomically by expert taxonomist using standard botanical keys, and preserved as herbarium. The recorded data were quantitatively analysed using Frequency of Citation (FC), Relative Frequency of Citation (RFC), and Family Use Value (FUV). The study documented 15 ethnomedicinal plant species belonging to 15 different plant families. Among the documented plants, *Potentilla indica* (Andrews) Th. Wolf. was the most cited plant (RFC=0.575; FC=21.83), followed by *Plantago major* L. (RFC=0.303), *Benincasa hispida* (Thunb.) Cogn. (RFC=0.333), and *Allium odorum* L. (RFC=0.303). The leaves were most commonly used plant part, accounting for 36.84% of total preparations reported by the healers. Demographic analysis revealed that the majority of the respondents were male (75.76%), and a significant proportion were elders above 50 years of age (51.52%), indicating that the knowledge of ethnomedicine is primarily passed on orally within the older generation of the healer community. The therapeutic relevance of the documented plants may be attributed to the presence of bioactive phytochemicals such as flavonoids, terpenoids, alkaloids, and saponins, which are known to possess antioxidant, diuretic, and anti-crystallization properties.

Keywords: Ethnomedicine, Indigenous knowledge, Kidney stones, Manipur, Traditional healers, Urolithiasis

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As per WHO estimates, 80% of the world's population depends on herbal medicines as the primary form of health care. Traditional medical systems have been developed and practiced on every continent from Asia and Africa to North America and South America and demonstrate the cumulative knowledge accumulated by human beings regarding plant-based therapeutics, which has taken place over thousands of years. Despite longstanding history and cultural significance, traditional medicines are still challenged in their acceptance into modern health care delivery systems¹. Studies examine the medicinal properties of various species of plants and how they are distributed globally in local markets, demonstrating the significance of documenting TEK (Traditional Ecological Knowledge). The studies also establish

local markets as significant locations for the distribution of both cultivated and wild-harvested medicinal plant species^{2,3}. With continuous attempts to confirm traditional methods scientifically, the combination of contemporary and traditional medicine offers both potential and challenges⁴. Particularly, Indian traditional medicine has a long history and has impacted many regional healthcare systems⁵. More research, technical assistance, and initiatives to close the gap between traditional and modern therapies are required to fully realize the potential of traditional medicine^{4,5}. Here in the present context, Manipur, a Northeast state of India provides a unique example where the traditional knowledge thrives to co-exist along with the Modern practices.

If we go to look over the Global survey there is always a line blurred between the nutrition and therapy of the wild plants for human consumptions,

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even though many species serve as dual roles both as dietary supplements and medicinal use⁶⁻⁸. Local people continue to practice traditional knowledge of plant use, with many plants being used for a variety of purposes, including the treatment of diabetes and dermatological conditions⁹. This deep-rooted ethnobotanical tradition forms the basis for many local healthcare practices in the region.

Among the major health concerns in Manipur, urolithiasis (urinary stone disease) is particularly prevalent. One of the most common urological issues worldwide is urinary tract stones, which have seen substantial modification in recent years. According to medical sources, Manipur has a relatively high incidence of kidney stone illness. The epidemiology varies by diet, socioeconomic position, and region^{10,11}. After prostatic diseases and urinary tract infections, urolithiasis is the third most prevalent urinary tract disease¹². Urolithiasis has a lifetime prevalence of 7.9% in India (5.7-10.8%)¹³, and it was reported in 22.4% of Manipur's rural population¹⁴. The prevalence of urolithiasis is high in Manipur, and it is widely accepted that this illness affects a member of almost every family. The hot and humid climate, combined with certain dietary and lifestyle habits, contributes to this high incidence. The hot and muggy weather in Manipur, particularly in the summer, causes profuse perspiration, which lowers urine production. Furthermore, people generally consume only two to four glasses of water per day, which is a low amount. Fish, which is heavy in purines and can lead to the development of uric acid stones, is a staple of the traditional Manipuri diet. A Manipur study of 875 urolithiasis patients found that the disease was much more prevalent in those aged 25 to 44 (n=495, 56.7%), that most of the participants (820, 93.7%) ate fish every day, and that almost two-thirds of the study population only drank two to four glasses of water daily¹⁴. The high frequency of urolithiasis in the area is also a result of delayed diagnosis and a general lack of knowledge about kidney stone avoidance. Renal calculi, commonly known as kidney stones or urinary stones, are hard deposits inside the kidney that are composed of salts and minerals. They appear when specific chemicals in the urine become too concentrated, causing crystalline salts to form. This disorder is frequently caused by poor urine volume, which raises concentration levels, insufficient inhibitors in the urine, or excessive excretion of chemicals that form stones. Calcium oxalate makes up

to 70% of the total urinary stone cases, followed by calcium phosphate, uric acid, and magnesium ammonium phosphate (struvite) stones, depending on underlying causes¹⁵. Pain associated with kidney stones may include intense ureteric colic, which occurs when a stone obstructs the ureter, and loin pain, felt in the lower back or flank where the kidneys are located. Hematuria, or blood in the urine, can cause it to appear pink, red, or brown¹⁶.

From an Ayurvedic perspective, urolithiasis corresponds to "Ashmari." "Ashma" and "Ari" are the two words that make up *Ashmari*, where "Ari" means "an enemy," while "Ashma" means "a stone or gravel"¹⁷. One of the illnesses that is classified as *Asthamagada*, or difficult to treat, is *Ashmari*, a disease of the *Mutravaha Strotas*. According to Acharya Sushruta, *Ashmari* is a *Darun* (fatal) sickness, and *Basti* is considered among the *Trimarma* (three vital organs)¹⁸. It develops from an aggravated *Kapha dosha*; when *Kapha* is disturbed, it combines with urine and accumulates in the bladder, leading to stone formation, often due to irregular purification practices and unhealthy dietary or lifestyle habits¹⁹. Early indicators include fever; pain or discomfort in the bladder region; loss of taste; and difficulty with urination, along with pain in the penis, scrotum, and bladder head; overall body ache; peculiar odour in urine; and hazy or thick urine²⁰. The *Doshic* involvement includes *Vata-pradhana Tridosha*, *Dushya* as *Mutra*, *Agni Vikruti*, and *Mutravaha Strotas Dushiti*¹². Considering Manipur's high rate of urolithiasis and its rich ethnobotanical legacy, the present study aims to catalog and assess the traditional medicinal plants used to treat urinary calculi.

Materials and Methods

Study area

A comprehensive ethnobotany study was conducted in five rural areas: the villages of Meitram, Kabwokching, Phojing, Malom, and Khabi, located in the Imphal West and Bishnupur Districts of the State of Manipur. Although these villages are in two separate districts, they share common socio-cultural characteristics by virtue of being part of the Meitei community that resides in both districts and continues to practice traditional forms of health care (Maibas and Maibis, traditional healers) through traditional means of healing in both districts²¹.

In relation to correlation, both villages play host to the central valley of the state of Manipur and lie

within the state of Manipur's central valley with a combination of alluvial soil (good drainage) combined with the community's high rate of reliance on plant-based remedies for primary health care, thereby making this region an ideal candidate for a study of ethnobotany.

Data collection

A field-based ethnobotanical study was carried out in five rural villages covered under the Imphal West and Bishnupur districts: Phojing, Khabi, Kabowakching, Malom, and Konthoujam. (Fig. 1) for a duration of six months in 2024. A semi-structured interview schedule was administered to the informants to document and collect the information on the medicinal plants used in the treatment of urolithiasis by the indigenous people. The survey was conducted considering only urolithiasis treatment.

The interviews were conducted with 33 individuals within the 18-80 age group, including local healers (Maibas or Maibis) and knowledgeable village elders. Male respondents were more (approximately 76%), and more than half of them were above the age of 50 years, revealing the prevalence of traditional knowledge among the older community members. Almost half of the respondents were illiterate, whereas the remaining had varying levels of formal education, ranging from primary to higher education. The interviews were conducted in our local dialect, Meiteilon in order to ensure effective communication and for more accurate understanding. Informed consent was obtained before conducting the interview. Following the discussion, the medicinal plants were collected. Additionally, digital photography of each plant was also taken as shown in (Fig. 2).

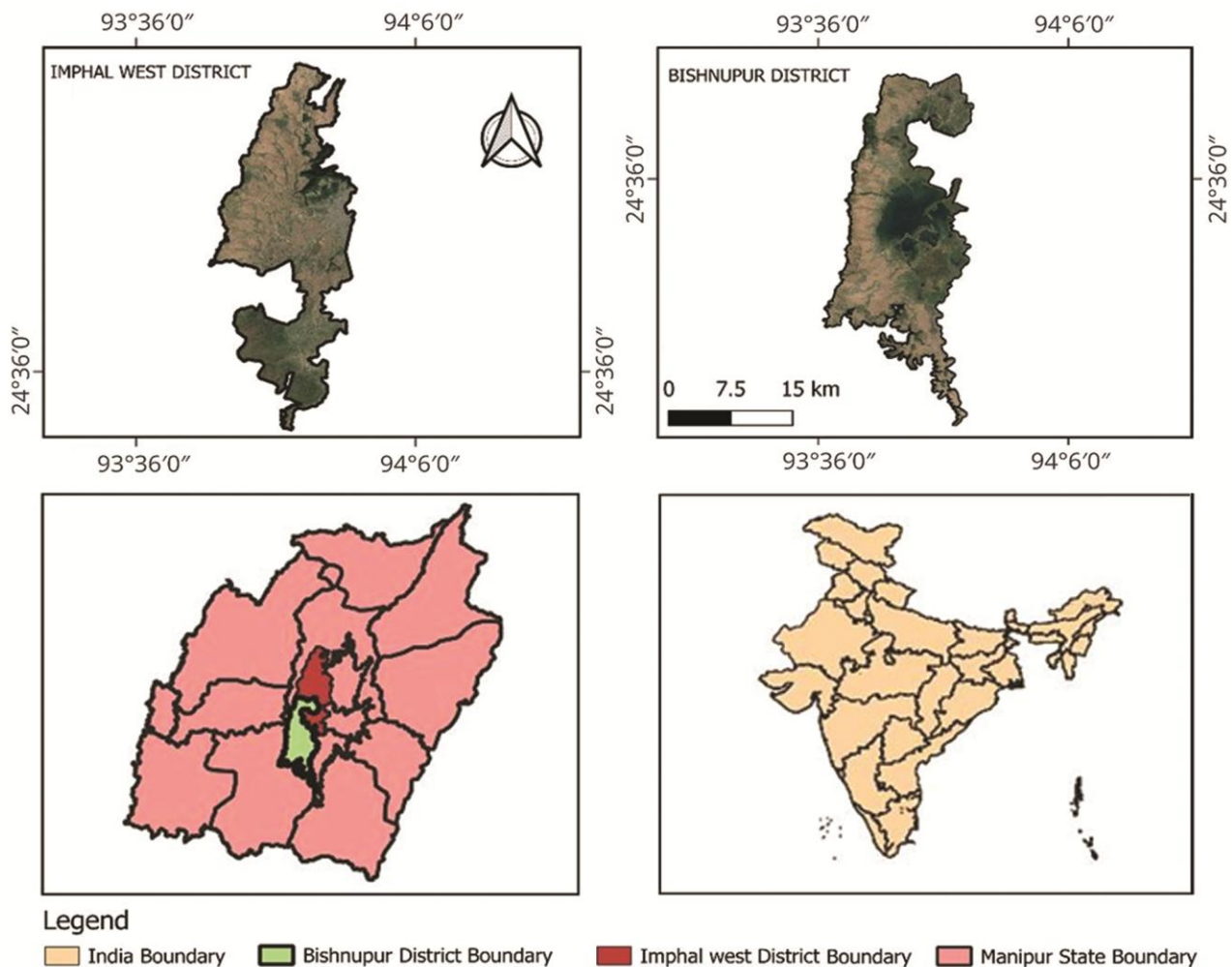


Fig. 1 — Location of study area: Imphal West district (a), Bishnupur district (b), Manipur map (c), India map (d) (created by the author using QGIS Software 4.0.0).

Identification of the ethnomedicinal plant

Plant specimens from the field were taken to Manipur International University, where they were identified and authenticated with the help of a taxonomist (Botany Department) using multiple resources such as regional floras, like the Flora of Assam and the Flora of Manipur. The final taxonomic authentication was done by comparing the specimens collected with verifiable images and/or specimens in the herbarium records held by the Botanical Survey of India [BSI]. Voucher specimens were deposited in the herbarium at the Department of Dravyaguna Vigyan, Parul Institute of Ayurved, Parul University, Vadodara, Gujarat, with corresponding accession numbers (PIA/DU/2024/01 to PIA/DU/2024/15) for future reference as shown in (Fig. 3).

Data analysis

The study area was mapped using QGIS software. Parameters such as Frequency of Citation (FC), Relative Frequency of Citation (RFC), and Family Use Value (FUV) were also calculated for

determining the importance of each plant use in the treatment of urolithiasis as shown in (Table 1).

Frequency of citation

The number of informants mentioning a specific plant species (n) divided by the total number of informants interviewed (N) X 100 is how FC is computed. Citation Frequency (FC%) = $(n/N) \times 100$, where N is the total number of informants questioned for the study and n is the number of informants mentioning a specific plant species²².

Relative frequency of citation

RFC, which is based on the ratio of the total number of respondents who mentioned using a specific individual plant species (named FC) to the total number of respondents who took part in the survey (N), was used to ascertain the significance of a certain plant species among respondents²³. RFC can be computed using the following formula:

$$RFC = FC/N$$

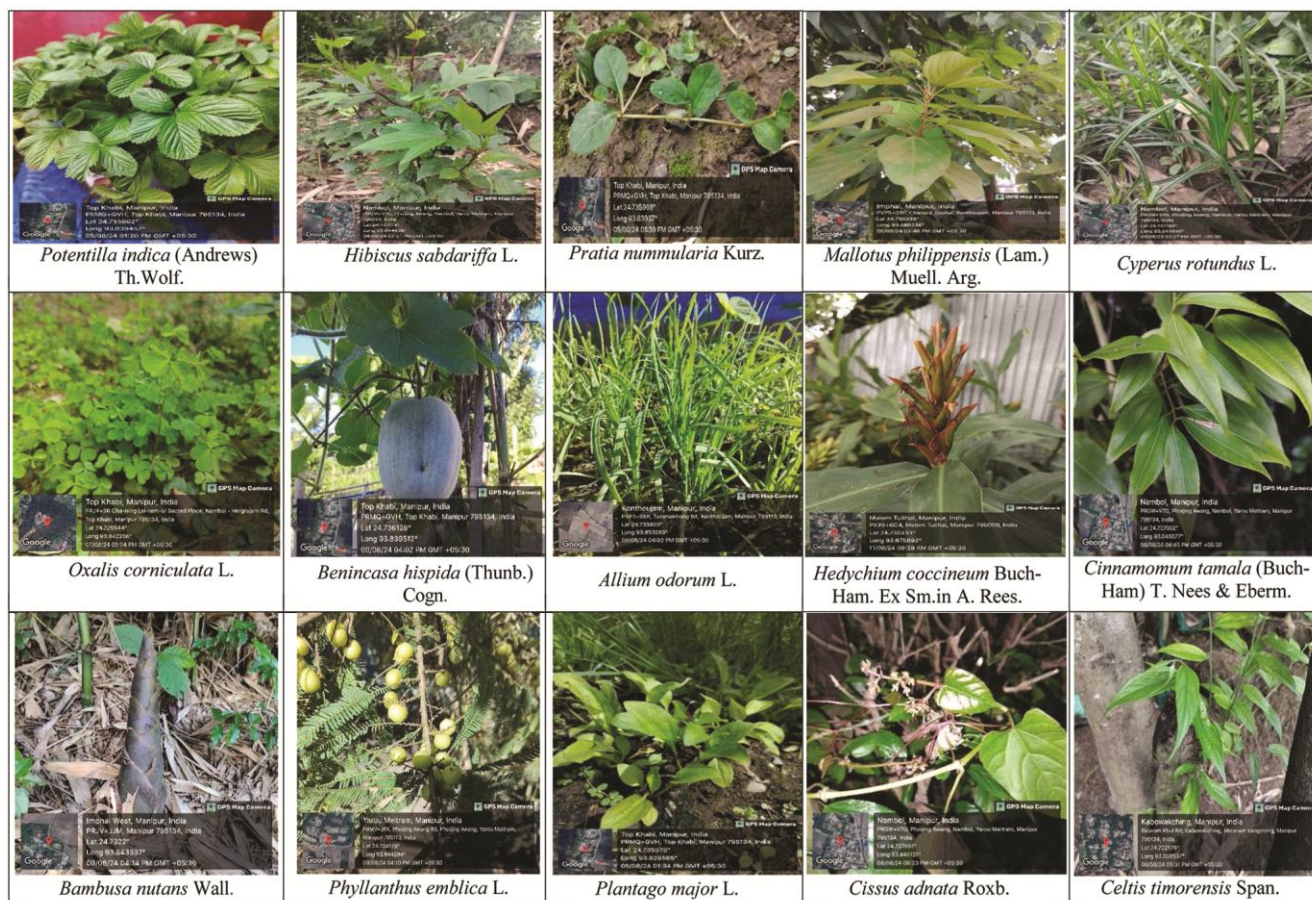


Fig. 2 — Medicinal plants used as LHTs for urolithiasis

Family use value

A numerical indicator that establishes the relative significance of plant families in a community. It is the

proportion of plant use reports to all informant survey responses for specific plant²⁴.

$$FUV = UVS/NS$$



Fig. 3 — Herbarium of the collected medicinal plant

Table 1 — Data analysis for quantitative indices

Botanical name	Local name	Family	No. of cited species	Data analysis		
				FUV	RFC	FC
<i>Potentilla indica</i> (Andrews) Th. Wolf.	Heirongkaklaba	Rosaceae	19	21.84	0.576	21.84
<i>Hibiscus sabdariffa</i> L.	Silotsougri	Malvaceae	7	8.04	0.212	8.04
<i>Pratia nummularia</i> Kurz.	Kihomman	Campanulaceae	3	3.44	0.090	3.44
<i>Oxalis corniculata</i> L.	Yensil	Oxalidaceae	5	5.74	0.151	5.74
<i>Benincasa hispida</i> (Thunb.) Cogn.	Torobot	Cucurbitaceae	11	12.64	0.333	12.64
<i>Allium odorum</i> L.	Yenam nakuppi Maroi nakuppi	Alliaceae	10	11.49	0.303	11.49
<i>Bambusa nutans</i> Wall.	Ootang	Poaceae	1	1.14	0.030	1.14
<i>Phyllanthus emblica</i> L.	Heikru	Phyllanthaceae	9	0.167	0.272	10.34
<i>Plantago major</i> L.	Yempat	Plantaginaceae	12	13.76	0.364	13.79
<i>Mallotus philippensis</i> (Lam.) Muell. Arg.	Ureiom laba	Euphorbiaceae	2	2.29	0.060	2.29
<i>Cyperus rotundus</i> L.	Shembang kaothum	Cyperaceae	1	1.14	0.030	1.14
<i>Cissus adnata</i> Roxb.	Kongouyen	Vitaceae	1	1.14	0.030	1.14
<i>Celtis timorensis</i> Span.	Heikreng	Ulmaceae	1	1.14	0.030	1.14
<i>Cinnamomum tamala</i> (Buch.-Ham.) T. Nees & Eberm	Tezpat	Lauraceae	1	1.14	0.030	1.14
<i>Hedychium coccineum</i> Buch.-Ham. ex Sm. in A. Rees.	Takhellei Angangba	Zingiberaceae	4	4.59	0.121	4.59

Result

Demography of the respondents

A total of 33 respondents participated in the present ethnobotanical study, representing diverse demographic backgrounds. The demographic characteristics of the respondents are presented in (Table 2). Of the 33 respondents in the current study, 8 (24.24%) were female and 25 (75.76%) were male. Respondents were classified into three groups according to their respective ages, with 15.15% of respondents being between 18 and 30, 33.33% being between 30 and 50, and 51.52% being aged above 50. The majority of respondents (above 50 years) indicate that much of the traditional medicinal knowledge associated with urolithiasis is maintained within the elderly population of the community. For the level of education, the classification of respondents includes four categories: Illiterate (48.48%), Primary (27.27%), Secondary (15.15%), and Higher (9.09%). The respondent's education level indicates that indigenous healing practices are supported within society's non-formally/illiterate educated individuals, which is a hallmark of oral tradition of knowledge transmission being passed down through generations.

Medicinal plants used in the treatment of urolithiasis

The collected medicinal plants are listed with their local name, botanical name, family name, part used, and method of preparation along with the dosage in Table 3. 15 Medicinal plant species belonging to 15 families were identified, one plant species belonging to each family: Euphorbiaceae, Rosaceae, Malvaceae, Campanulaceae, Oxalidaceae, Cucurbitaceae, Alliaceae, Poaceae, Phyllanthaceae, Plantaginaceae, Euphorbiaceae, Cyperaceae, Vitaceae, Ulmaceae, Lauraceae, and Zingiberaceae as shown in (Fig. 4).

Medicinal plant part use

All the different plant parts, including leaves, seeds, bark, fruits, roots, calyx, whole plant etc. are

Table 2 — Demographic characteristics of the respondents participating in the ethnomedicinal survey

Factor	Respondent	Number of respondents	Percentage (%)
Gender	Male	25	75.76%
	Female	8	24.24%
Age	18-30	5	15.15%
	30-50	11	33.33%
	>50	17	51.52%
Education	Illiterate	16	48.48%
	Primary	9	27.27%
	Secondary	5	15.15%
	Higher	3	9.09%

being used by the practitioners. And as shown in table 3, all the plant parts are effective. In the current study, 36.84% of the overall usage consisted of leaves, making it the most commonly used plant's part. The whole plant (15.79%) and fruits (10.53%) were next in line (Fig 5). Additional plant parts, including the calyx, shoot, roots, bark, rhizome, and stem, each received one citation and accounted for 5.26% of the total use. The predominance of leaves suggests their accessibility, ease of preparation, and likely abundance of active phytoconstituents such as flavonoids and alkaloids²⁵.

Ethnobotanical quantitative indices

Potentilla indica (Andrews) Th. Wolf had the highest FUV of 21.83, indicating that informants frequently used it and that it was widely utilized, followed by *Benincasa hispida* (Thunb.) Cogn. (12.64), *Allium odorum* L. (11.49), and *Plantago major* L. (13.76). The strong therapeutic importance of these plants in the regional traditional healthcare system is reflected in these values. However, a few taxa, including *Cinnamomum tamala* (Buch.-Ham.) T. Nees & Eberm, *Bambusa nutans* Wall., *Cyperus rotundus* L., *Cissus adnata* Roxb., and *Celtis*

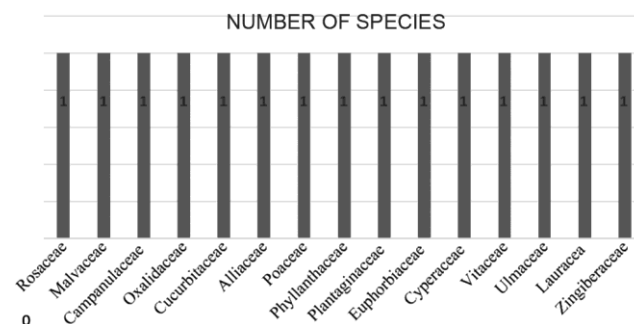


Fig. 4 — Family distribution of the medicinal plants

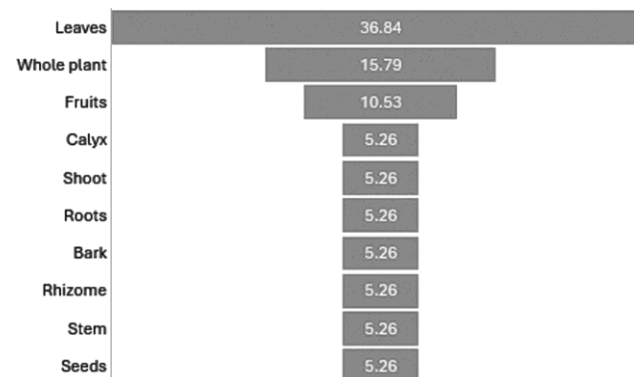


Fig. 5 — Percentage of medicinal plant part used for the treatment of urolithiasis

timorensis Span., had the lowest FUV of 1.14, suggesting that they are not as commonly used to treat urolithiasis.

Relative Frequency of Citation Score (RFC)

P. indica (Andrews) Th. Wolf had the highest RFC rating, at 0.575, indicating that a significant number of informants had cited it. Following it were *B. hispida* (Thunb.) Cogn. (0.333), *A. odorum* L. (0.303), and *Plantago major* L. (0.363), all of which were highly prized for their therapeutic qualities. On the other hand, species like *C. tamala* (Buch.-Ham.) T. Nees & Eberm., *B. nutans* Wall., *C. rotundus* L., *C. adnata* Roxb., and *C. timorensis* Span received the

lowest score (0.030), suggesting that very few people cited them. Frequency of Citation (FC)

P. indica (Andrews) Th. Wolf once again distinguished itself with the highest FCS of 21.83, which was in close alignment with the FUV trends. High FCS values were also shown by *P. major* L. (13.76), *B. hispida* (Thunb.) Cogn. (12.64), and *A. odorum* L. (11.49), highlighting their significance in the ethnomedical treatment of urolithiasis. The lowest FCS values, 1.14, were displayed by *B. nutans* Wall., *C. rotundus* L., *C. adnata* Roxb., *C. timorensis* Span., and *C. tamala* (Buch.-Ham.) T. Nees & Eberm., indicating their comparatively small relevance in conventional treatment methods for this ailment.

Table 3 — Drugs with Botanical name, Family name, Part used and its method of preparation and dosage

Sl. No	Local Name	Botanical Name	Family Name	Part used	Method of preparation and dosage
1.	Heirongkaklaba	<i>Potentilla indica</i> (Andrews) Th. Wolf	Rosaceae	Leaves	Leaves are boiled with sugar candy and drink 4 glasses before and after food.
				Vegetative part	The plant's vegetative portion is boiled with sugar and used to treat stone cases and urinary tract issues
2	Silotsougri	<i>Hibiscus sabdariffa</i> L.	Malvaceae	Calyx	Mix 3gm of dried calyx with 1 glass hot water and drink it after meals twice a day
3	Kihomman	<i>Pratia nummularia</i> Kurz	Campanulaceae	Whole plant	Boil the whole plant with 10 g sugar candy and reduce the decoction to 1-3 of it and drink 4-5 times a day in morning, afternoon, evening and night
4	Yensil	<i>Oxalis corniculata</i> L.	Oxalidaceae	Leaves or Whole plant	A pinch of the indigenous Manipuri salt is added to the boiling leaves. As an alternative, 100 mL of juice of roasted plant (wrapped in banana leaf) with local salt is taken twice a day
5	Torobot	<i>Benincasa hispida</i> (Thunb.) Cogn.	Cucurbitaceae	Fruit	Boil the fruits with sugar candy and consume.
6	Yenamnakuppi	<i>Allium odorum</i> L.	Alliaceae	Leaves	250gm of leaves boiled with 1L of water adding sugar candy and drink 1 tea glass daily till cure.
7	Maroi nakuppi Ootang	<i>Bambusa nutans</i> Wall.	Poaceae	Bamboo shoot	For seven days, cut 250 g of shoots into slices, boil them in one liter of water and drink half of tea glass everyday
8	Heikru	<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Fruits	Mix extracted juice (250 mL) with 250 mL lime water and take 4 spoons orally twice daily for 7 days.
9	Yempat	<i>Plantago major</i> L.	Plantaginaceae	Root	The root is boiled, and the decoction is used as diuretic.
10	Ureirom laba	<i>Mallotus philippensis</i> (Lam.) Muell. Arg.	Euphorbiaceae	Bark	The bark is boiled with sugar, and the decoction is given in urinary tract stone problem.
11	Shembang kaothum	<i>Cyperus rotundus</i> L.	Cyperaceae	Whole plant	The whole plant is boiled, and the decoction is used in urinary trouble.
12	Kongouyen	<i>Cissus adnata</i> Roxb.	Vitaceae	Leaves	Leaves are boiled and decoction is given in urinary problem due to stone.
13	Heikreng	<i>Celtis timorensis</i> Span.	Ulmaceae	Leaves	To the decoction of leaves add 10 g sugar candy and drink 4-5 glasses daily.
14	Tezpat & Heikreng	<i>Cinnamomum tamala</i> (Buch.-Ham.) T. Nees & Eberm	Lauraceae	Leaves	5 g of each plant's leaves should be boiled with 1 L of water, one teaspoon of sugar added, and one tea glass was consumed twice a day for 10 days.
		<i>Celtis timorensis</i> Span.	Ulmaceae	Leaves	
15	Takhellei Angangba	<i>Hedychium coccineum</i> Buch-Ham. ex Sm. in A. Rees.	Zingiberaceae	Rhizome Stem	Boil the rhizome, add 10 g sugar candy and drink 4-5 glasses daily. The stem of the plant (10 g) boiled with 1 L of water and consumed half tea glass daily.

The findings imply that Manipur uses a small but significant collection of medicinal plants to treat urolithiasis. The most often suggested and reliable plant for therapeutic purposes was *P. indica* (Andrews) Th. Wolf. The widespread usage of leaf-based preparations points to a sustainable approach to both collecting and utilization. These findings emphasized the long history of ethnomedicinal in Manipur and its potential to aid in future research and drug development.

Discussion

The nature and inhabitants of Manipur have always coexisted in harmony. The people have always respected and relied on their environment and resources to provide health care. In many rural areas of Manipur, people still heavily rely on traditional medicine to treat urolithiasis and many other health problems. Many plants described in this paper exemplify this dual use as they are used as both foods and medicines. This food-medicine overlap indicates a close relationship between traditional medicine and food and suggests that knowledge about medicinal plants has been preserved by community elders and traditional healers. All species described contain a wide variety of phytochemicals that provide numerous pharmacological activities, such as diuresis; inhibition of crystal nucleation and aggregation; and increased urinary excretion of material that causes urolithiasis, which contributes to its management and prevention²⁶⁻³⁵. Results from this study illuminate the ethnomedicine of Manipur and its ongoing utility to rural healthcare systems; urolithiasis continues to be a prevalent health issue in this area, as indicated by past research and individual interviews. There is an urgent need for options to treat urolithiasis that are inexpensive, culturally acceptable, and available nearby. Traditional medicine; specifically, the use of plants, serves as an important component of continuing care and treatment in rural populations, alongside modern healthcare practices, by providing an opportunity to use locally sourced, indigenous pharmaceutical products. This study has identified 15 plant species within 15 distinct families utilized in the treatment of urolithiasis. The heterogeneity of the plants identified reinforces both the high degree of biodiversity within Manipur and the cultural importance of medicinal plant use within indigenous traditions. Relationships between local flora and traditional medicine practices are exemplified in

various ethnobotanical and ethnoveterinary studies of many indigenous communities globally^{36,37}. The results also highlight the ongoing reliance of rural communities upon their local plants for sustaining both animal and human health. The species *B. hispida* (Thunb.) Cogn., *P. major* L., and *Potentilla indica* (Andrews) Th. Wolf were the most frequently referenced by respondents, indicating they are widely available and have strong cultural beliefs about their medicinal value to treat urolithiasis. The high frequency of citation (FC), relative frequency of citation (RFC), and family use value (FUV) support the importance of these plants in the traditional health care system of this region. When examining plant parts used, leaves were used more often than all other plant parts combined (36.84%). This may partially be attributed to a variety of reasons, including that leaves contain a higher concentration of active compounds than other plant parts, as well as being readily available and easiest to collect^{38,39}. Leaves contain a plethora of bioactive compounds that have been shown to possess diuretic, antioxidant, and anti-inflammatory properties, these compounds may prevent stone formation in addition to promoting general urinary tract health. Other plant parts have also been reported as components of traditional remedies, providing evidence of practitioners' empirical observations regarding which parts provide therapeutic properties. Urolithiasis and associated health behaviours appear to be influenced by both environmental and cultural factors in Manipur. Manipur's climate is hot and humid; therefore, many traditional dietary habits include high consumption of fish (which contains purines) that can lead to elevated uric acid levels. In addition, some populations in Manipur tend to have low water intake, which could also predispose individuals to uric acid stones^{10,14}. Therefore, the continuation of using traditional remedies aimed at providing urinary balance and preventing stone formation could be partly based on these environmental and lifestyle factors. According to Ayurveda, disruptions in the Kapha dosha and buildup of lithogenic materials in the urinary tract are linked to urolithiasis. Concentrated and acidic urine contributes to crystal precipitation and clustering, leading to stone development. To help restore normal physiological balance, traditional herbal therapies have been used to purge fluid from the body; decrease inflammation; and dissolve or expel urinary calculi. Therefore, herbal remedies could play an important

supporting role in treating kidney stones through more traditional/formal medical means. Many traditional medical books and ethnographic surveys demonstrate a wide variety of plants used for urinary disorder symptoms from North America and Europe, but there is a lack of scientific research on their safety and effectiveness. Both *C. tamala* (Buch-Ham.) T. Nees & Eberm. and *C. adnata* Roxb. were reported by only a few informants; suggesting limited use in particular community members, or possible decline in usage over time. Preserving traditional knowledge by documenting and scientifically proving lesser-known species helps facilitate the integration of ethnomedicine into modern healthcare systems. Several phytochemical and pharmacological studies have established that documented plants traditionally used for treatment contain bioactive compounds, including: alkaloids, flavonoids, terpenoids, and phenolic compounds; all of which possess diuretic, antioxidant, anti-inflammatory, and anti-crystallization properties²⁶⁻³⁵. For example, *Hibiscus sabdariffa* L. has been shown to inhibit calcium oxalate crystal deposition and enhance uric acid excretion. Likewise, *Pratia nummularia* Kurz and *C. rotundus* L. have considerable potential to prevent kidney stone formation. *Oxalis corniculata* L. and *B. hispida* (Thunb.) Cogn. also exhibited inhibition of crystal nucleation and growth^{28,29}. In addition, terpenoid-rich extracts of *Plantago major* L. were found to decrease the size and surface area of calcium oxalate crystals³⁰. Other supporting species with diuretic, antioxidant, and anti-crystallization activity include *C. adnata* Roxb., *A. odorum* L., *P. indica* the capability of traditional plant-based medicine to help maintain renal health, as well as decrease the risk of urinary stones^{31-35,39-43}. Unlike most studies which often do not offer any details about preparations frequently used in traditional medicine, this investigation provides some insight into the use of sugar (*sharkara*) as an adjuvant ingredient. Sugar is defined in Ayurvedic pharmacology as having *Madhura Rasa* (sweetness) and *Sheeta Virya* (cool) attributes, thereby providing mild diuretic and *Pitta* pacification benefits⁴⁴. Adding sugar to herbal compounding helps relieve burning during urination, increase urinary output, improve taste, and encourage patient compliance. Thus, we believe sugar will probably act synergistically with the medicinal plant components to enhance therapeutic efficacy.

Overall, this study has demonstrated the very large store of ethno-medicine maintained by alternative

health practitioners (healers) and within rural areas in Manipur. The scientific documentation and validation of these practices will allow for the translation of centuries-old indigenous cultural ideas into evidence-based, easily accessible, and culturally-respectful healthcare systems for the treatment of urolithiasis and other related urinary disorders.

Conclusion

This research recorded 15 medicinal plants of 15 separate plant families in Manipur, reflecting the great variety of traditional approaches towards managing urolithiasis as demonstrated through indigenous Manipur people's knowledge regarding the medicinal use of plants. The number of different plant taxa listed indicates that local persons have an extensive reliance on their native plants for healing. The most frequently mentioned plants, *Potentilla indica* (Andrews) Th. Wolf and *Plantago major* L., also demonstrate the importance of these two species for providing health services through a traditional system and their significance in the cultural context of local health care. These results reflect continued dependence on traditional herbal medicine by rural populations, with leaves being identified as the primary part used. The majority of these traditional herbal practitioners believe the most potent active ingredient(s) in plants reside in the leaves, thus creating their preference to utilize this plant part due to its availability and ease of gathering. The extensive use of these traditional herbal remedies exemplifies the extensive amount of empirical knowledge, compiled over generations of experience and observation by indigenous peoples. There are many medicinal benefits associated with these plants, providing much opportunity to examine them further using pharmacological, toxicological, and clinical methods to validate their safety and effectiveness. Continued development of the scientific literature documenting the medicinal potential of these plant species will be critical for their rational integration into modern health care systems. Additionally, expanding the number of available, affordable, and culturally appropriate treatment modalities will keep with the goals and values of the indigenous people of Manipur.

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Author Contributions

JL: Data collection, research design, data analysis, manuscript preparation. AJ: manuscript supervision. SJD: Data collection and data analysis. PKS Verification and identification of the recorded plants. All the author has approved the manuscript.

Conflict of Interest

There was no conflict of interest.

Ethical Statements

Prior informed consent: Verbal informed consent was obtained prior to the survey. The study was conducted in accordance with the Code of Ethics of the International Society of Ethnobiology.

Data Availability

The data will be provided by the corresponding author upon request.

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