BIODIVERSITAS
Volume 24, Number 7, July 2023
Pages: 3977-4000

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d240736

Ethnobotanical study in the underexplored species of Genus *Litsea* (Lauraceae) in Northern Thailand

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Manuscript received: 23 May 2023. Revision accepted: 21 July 2023.

Abstract. *Chaisoung N, Panyadee P, Long C, Ngernsaengsaruay C, Chaowasku T, Inta A. 2023. Ethnobotanical study in the underexplored species of Genus Litsea (Lauraceae) in Northern Thailand. Biodiversitas 24: 3977-4000.* Ethnobotanical studies offer valuable insights into medicinal plant use, but accuracy is limited by the difficulty in identifying similar species during field surveys. This study aims to investigate the Genus *Litsea* Lam. (Lauraceae) plants in Thailand, specifically focusing on underexplored species with ethnobotanical value for future utilization. The present research aims to comprehensively analyze the ethnobotanical data by comparing the results from previous ethnobotanical documents with those obtained from our field surveys. From a comprehensive review of ethnobotanical documents published from 1996-2022, the study discovered seven species of *Litsea* report to be used in Thailand. In addition, a subsequent field survey from November 2019 to December 2021 revealed that 13 species were used, with 11 of these used for medicinal purposes. The study identified seven additional species not previously documented for their medicinal uses. Among these species, *Litsea mollis* Hemsl., *Litsea glutinosa* (Lour.) C.B.Rob. and *Litsea martabanica* (Kurz) Hook.fil. have the highest use values and hold potential for future development, particularly *L. mollis* and *L. martabanica*. We also found that *Litsea* species were primarily used for treating digestive disorders. This study highlighted the importance of considering taxonomic complexities and conducting field surveys to assess plant uses accurately and can serve as a foundation for future research on these species, including their chemical analysis, biological activities, and pharmacological properties.

Keywords: Alternative medicine, aromatic plants, essential oil, ethnomedicine, Hill Tribe, Lauraceae

INTRODUCTION

People in many regions of the world have extensively explored and harvested wild plants as traditional livelihoods (Cohen 2000). Wild plants are still valuable resources for human subsistence in any part of the world, especially food and medicines. Countless plant species have been used to treat various diseases (Phumthum et al. 2018; Panyadee et al. 2019; Nguanchoo et al. 2022), especially in developing countries. These traditional medicinal plants are rich resources of pharmacological compounds, investigated and confirmed by pharmaceutical studies (Kayser 2018). Traditional knowledge is the crucial part and could be integrated into various scientific studies such as botanical exploratory (Panyadee et al. 2016; Gou et al. 2020), plant conservation and agriculture (Uprety et al. 2016; Pei et al. 2020), natural composition of food (Geng et al. 2020; Punchay et al. 2020; Jia et al. 2022; Panyadee et al. 2023;) and human health care (Kong et al. 2015; Pandey and Tripathi 2017). Investigating the traditional knowledge of plants also played an important role in developing new drugs (Getachew et al. 2022).

Approximately 300 million indigenous people live in relatively undisturbed habitats worldwide, serving as reservoirs of significant biodiversity and genetic diversity (Barsh 1999). Their livelihood depends on harvesting plant and animal species from their habitat (Bandyopadhyay 2018). Approximately 75% of indigenous people live in Asia, the most ethnically diverse region in the world (Dhir 2015). Within Asia, Thailand is a country where many ethnic groups have been established, especially in the northern part.

Akha, *Hmong*, *Karen*, *Lahu*, and *Lawa* are large populations that reside primarily in Northern Thailand. The *Karen* is a large ethnic group in Northern Thailand; they migrated from Myanmar to Thailand two hundred years ago and settled in northern and western Thailand (Phumthum and Balslev 2019; Panyadee et al. 2023). The *Akha* and *Hmong* are an ethnic group established in China and migrated to Thailand, Laos, and Vietnam. They are now widely scattered throughout Northern Thailand and live on steep mountain ridges and deep valleys, more up the mountainsides (Inta et al. 2008; Srithi et al. 2012; Phumthum et al. 2021). While the *Lahu*, part of the *Tibeto-Burman* family, has certain similarities with the *Akha*. They

resided primarily in or near Tibet and slowly migrated through China, Burma, and Thailand (Schliesinger 2000; Huai and Pei 2004). The *Lawa* has a long history in Thailand. However, their origin is unclear. Some anthropologists believe they migrated from the north along the river valley before settling in Chiang Mai District (Young 1962).

Moreover, it is important to acknowledge the variability in the usage of plant species across different ethnic groups. While many species in each genus are used for various purposes, some species, like *Litsea* spp. (Lauraceae), draw interest due to their bioactive properties and distinctive chemical compounds. Ethnobotanically, many species in this genus have been used as food and medicines in many counties worldwide (Kong et al. 2015; Wang et al. 2016; Gou et al. 2020; Phumthum et al. 2021; Sahoo et al. 2023). Some species are known for anticancer activity, e.g., *Litsea glutinosa* (Lour.) C.B.Rob., *Litsea cubeba* (Lour.) Pers. (Trisonthi et al. 2014); anti-inflammatory activity, e.g., *L. cubeba* (Liao et al. 2015; Yang et al. 2018); and antioxidant activity, e.g., *L. glutinosa* and *Litsea monopetala* (Roxb. ex Baker) Pers. (Shafiq et al. 2022). It treated many ailments in China, Japan, Korea, India, Myanmar, Bangladesh, Malaysia, Indonesia, Philippines, Mexico, Guatemala, and Thailand (Mohanan et al. 2003; Wang et al. 2016).

The Genus Litsea, predominantly found in Northern Thailand, has undergone significant taxonomic revision, with 35 species now recognized (Ngearnsaengsaruay et al. 2011). However, only four species are referred to in medicinal plant uses, including *Litsea martabanica* (Kurz) Hook.fil., *Litsea punctulata* Kosterm. The *L. cubeba* and *L. monopetala* (Junsongduang et al. 2014; Phumthum and Balslev 2020). Moreover, the intraspecific morphological characteristic often remains ambiguous. For instance, *Litsea mollis* Hemsl. Is frequently misidentified as *L. cubeba* following the recent revision of *Litsea* in Thailand (Ngearnsaengsaruay et al. 2011). Additionally, some species, known as ethno-species, share the same local name. This can lead to confusion in ethnobotanical field studies and potentially affect future studies, such as chemical analysis. Furthermore, there is a risk of losing ethnobotanical data during the investigation, especially when interviewing the informants about unidentified species. Thus, this study follows the core hypothesis that gathering ethnobotanical knowledge of *Litsea* species among five ethnic groups in Northern Thailand will reveal the underexplored plant species used and enhance the potential of traditional knowledge in this genus. The underexplored species of *Litsea* may play a crucial role in the food and nutritional supplement industry and drug development shortly. However, with limited ethnobotanical data, systematic investigation is yet to be achieved. Here, this research aims to explore and analyze the ethnobotanical knowledge among five ethnic groups of the Genus Litsea and the similarity of traditional knowledge within or between ethnic groups mentioned above and to compare the medicinal plant use with the previous records for future exploitation via phytochemistry, bioactive properties, and nutrition.

MATERIALS AND METHODS

Ethnobotanical data of *Litsea* published in Thailand

The twenty-six ethnobotanical references in Thailand were explored for ethnobotanical data of *Litsea* species, including journal articles, proceedings, and scientific reports, published from 1966 to 2022 were examined. From these references, there were 92 use reports which mentioned ethnobotanical data of *Litsea* species (the full is shown in Table S2).

Gathering ethnobotanical data from fieldwork

In this study, we focused on the five largest ethnic groups in Thailand: *Karen*, *Hmong*, *Lahu*, *Lawa*, and *Akha* (Ministry of Social Development and Human Security 2002). The study focuses on diverse ethnic groups across various locations in Chiang Mai, Mae Hong Son, and Chiang Rai Districts. Twelve villages were selected, including settlements from the *Karen*, *Hmong*, *Lawa*, *Akha*, and *Lahu* ethnic groups. The selected villages present a broad range of geographical and demographic conditions, with elevation from 452 to 1,442 meters above sea level (masl) and population sizes varying from 26 to 205 households, translating to 190 to 1,790 residents per village. Established around a century ago, these communities have a long-standing tradition of transferring knowledge across generations. Rice fields and swidden fallows surround the villages. The villagers are farmers who collect non-timber forest products for food consumption and medicinal plant use. However, some people in *Hmong* and *Akha* villages have shifted their occupation to become merchants, focusing on growing cabbage, oranges, and strawberries as their main products. Their traditional religion is animism, but some have converted to Buddhism or Christianity or practiced a blend of Buddhism is to their openness. A total of twelve villages located in three districts in Northern Thailand were selected as study sites (Table 1, Figures 1 and 2) based on two criteria: (i) they have been established for at least 50 years to ensure well-established traditional knowledge, and (ii) they are located far from the hospital or clinic to minimize the effects of urbanization and alternative medicine (Table 1). The study received ethical approval from the Chiang Mai University Research Ethnic Committee, Chiang Mai University, Thailand, Code of Ethics Committees CMUREC 63/201. In each village, the key informants were chosen based on their expertise in traditional botanical knowledge and were approved by the community in each village. Furthermore, 65 key informants were recruited, with a gender split of 27 females and 38 males, and ages ranging from 30-80-year-old (Table 1).

The ethnobotanical data were collected for two years, from November 2019 to December 2021. The process began by showing pictures of different *Litsea* species to the key informants, who were then asked about their vernacular names, usage, and species recognition. Then, they were requested to accompany the research team to collect the voucher specimens. Further ethnobotanical field surveys were conducted in each study village with the key informant(s), during which any encountered *Litsea* species

were asked about their vernacular name and traditional uses—the usefulness of the plant, plant part used, mode of preparation, and routes of administration through snowball sampling method and semi-structured interviews (Cotton 1996) (full list of questionnaires is shown in Table S1).

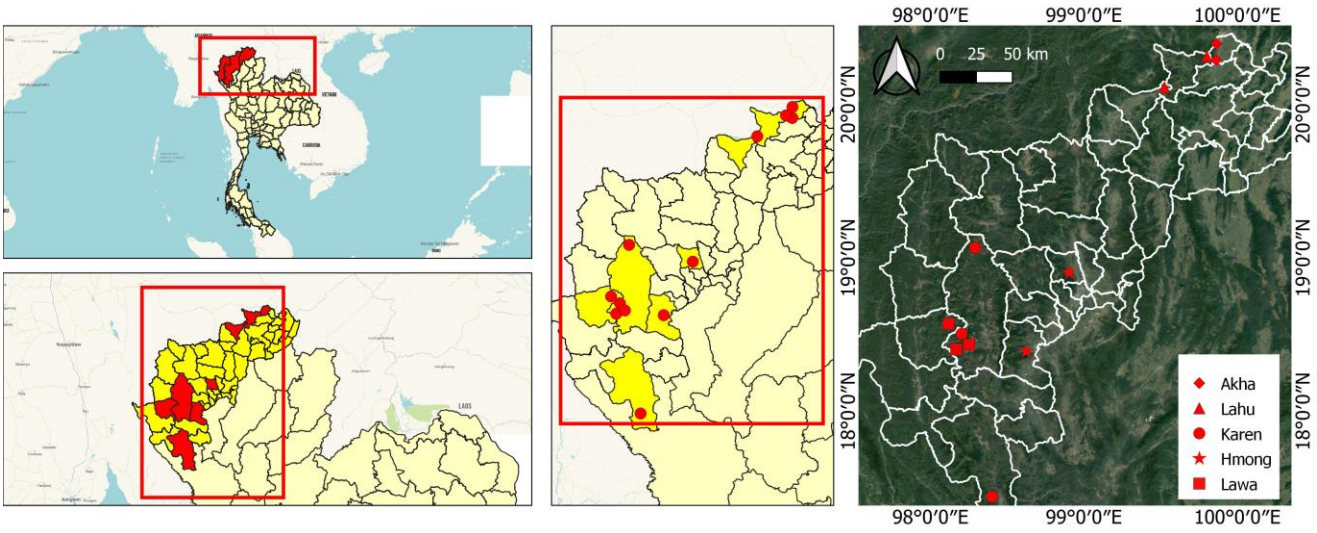

Figure 1. The locations of study villages (Thailand) where the ethnobotanical studies on *Litsea* were conducted

Figure 2. A. Interviewing and collecting; B. Ethnic groups, villages, and their lifestyle: B1. *Akha*, B2. *Hmong*, B3. *Karen*, B4. *Lahu*, B5. *Lawa*

Table 1. Baseline information of twelve villages where the ethnobotanical studies on *Litsea* were conducted

Villages*	**KTN**	**PSC**	**SDS**	**MSM**	**PK**	**BH**	**OP**	**MH**	**Phi**	**PHm**	**Phi**	**WD**
Elevation (m asl)	1,442	1,200	1,320	1,016	1,381	1,003	1,109	976	986	598	986	452
District	Omkoi	Galayani Vadhana	Mae Chaem	Mae Rim	Chom Thong	Mae Chaem	Mae Sariang	Mae Chaem	Mae Sai	Mae Sai	Mae Sai	Mae Ai
District	Chiang Mai	Chiang Mai	Chiang Mai	Chiang Mai	Chiang Mai	Chiang Mai	Mae Hong Son	Chiang Mai	Chiang Rai	Chiang Rai	Chiang Rai	Chiang Mai
Internasional.of households in the studied area	26	172	72	205	151	68	35	59	164	115	57	52
No.of population	190	633	392	1,750	944	369	203	250	590	563	275	325
Vegetation**	LMF	LMF	LMF	LMF	LMF	LMF	LMF	LMF	LMF	MDF	LMF	MDF
Age of village (years)	>100	>100	~70	>100	>100	>100	>100	>100	>100	>100	>100	>100
Age of informant	~40-70	~50-80	~35-75	~55-65	~55-70	~50-80	~50-80	~50-65	~50-60	~50-70	~55-60	~50-65
Number of key informants Male	2	2	2	3	1	5	4	5	4	4	3	3
Female	3	3	3	2	4	5	1	0	1	1	2	2
Occupation	Farmer	Farmer	Farmer	Gardener	Gardener	Farmer	Farmer	Farmer	Gardener	Gardener	Gardener	Farmer
Religion	Buddhism and Christianity	Buddhism and Christianity	Buddhism and Christianity	Buddhism and Christianity	Buddhism and Christianity	Buddhism and Christianity	Buddhism and Christianity	Buddhism and Christianity	Buddhism and Christianity	Buddhism and Christianity	Buddhism and Christianity	Buddhism and Christianity
Km from the hospital (dirt road)	100	2.9	48.7	29.3	24.4	21.8	85.2	46.5	17.6	8.4	17.6	19.1
Number of found used species	2	1	4	10	8	6	4	3	2	2	7	6
Number of medicinal species	2	1	4	9	8	4	4	3	2	2	6	5
% medicinal/total 13 species	15.38	7.69	30.77	69.23	61.54	30.77	30.77	23.08	15.38	15.38	46.15	15.38

Note: *Village Name: Khun Tuen Noi (KTN), Pa Son Wat Chan (PSC), Sedosa (SDS), Mae Sa Mai (MSM), Pa Kluay (PK), Ban Ho (BH), Om Phay (OP), Muet Hlong (MH), Pha Hi (PHi), Pha Hme (PHm), and Wang Din (WD) **vegetation: Lower Montane Forest (LMF) and Mixed Deciduous Forest (MDF)

Identification and categorization

The plant samples were first photographed and collected for further identification. Therefore, to ensure the accuracy of the collected information, the photos and samples were again shown to the key informants. Plant samples were identified at the species level using two main taxonomic literature, i.e., The Flora of China (Brach and Hong 2006) and the revision of the Genus Litsea in Thailand (Ngearnsaengsaruay et al. 2011). The plant specimens were deposited at Queen Sirikit Botanic Garden Herbarium (QBG) and Chiang Mai University Herbarium (CMUB), Thailand.

Organization of ethnobotanical data of *Litsea* published and this study

All plant uses reported by all informants were classified into primary use categories following Economic Botany Data Collection Standards (Cook 1995). However, the categories of food and food additives were combined as food because they added this species as the main ingredient in food for a specific odor. Medicinal uses were classified into secondary categories according to thInternasionalal Classification of Primary Care, Third Edition (ICPC-3) (van Boven and Napel 2021). The used parts of the plant were classified into the bark, flowers, fruits, leaves, roots, whole plant, and other parts. Methods of preparation and routes of administration were classified into burning, crushing, decoction, eating as food, and pounding.

Data analysis

The ethnobotanical data from the previous study

The significant differences in use records among different categories and other variables were analyzed by a Chi-square and F test with $\alpha = 0.05$. This analysis was performed by SPSS software, version 28.

The medicinal plant used in this study

Based on the information gathered through interviews, a use report was shown to specific informants to confirm the plant use. Therefore, several use reports of a species being used to treat various diseases by the same informant were noted. Then, the use reports in this study refer to a specific genus, *Litsea*, among five ethnic groups in Northern Thai“and. A sin”le "use report" was considered for each time utilized (Amiguet et al. 2005; Inta et al. 2008). For example, the leaf of plant A was used to treat cough, while the root was used to treat diarrhea, then both of them were noted as two-use reports. However, if the leaf and roots of plant A were boiled together to treat cough, we counted them as a one-use report.

Moreover, the frequency distribution of the usefulness of *Litsea* species among different ethnic groups was visualized by the ethnobotanyR package in the R program.

Furthermore, the medicinal plant data were analyzed by ethnobotanical indices, i.e., Use Value (UV) and Relative Frequency of Citation (RFC). These indices evaluated the knowledge relationship between cultures and determined the relative importance of certain plant species to various societies (Gazzaneo et al. 2005). The chi-square and F test with a 0.05 significance level was used to assess the variations in use reports between the categories and other variables. The calculation was conducted by SPSS software, version 28.0.

RFC method

This citation is calculated for evaluating the species known by most informants (Tardío and Pardo-De-Santayana 2008). It was calculated as follows:

$$RCF = FC/N$$

Where: *FC* is the number of informants who mention the traditional use of plant species, and *N* is the total number of informants. The value of RFC ranges from 0 to 1. When the value of 0 indicates that any informants did not use the species, 1 means that all informants mention the use of the species.

UV method

According to the informants, UV indices were calculated to find the plant that most use reports mentioned.

$$UV = \Sigma Ui/\Sigma N$$

Where: *Ui* is the number of species mentioned in use reports by each informant, and *N* is the total number of informants in each ethnic group (Oliver and Alwyn 1993).

Venn diagram

The similarity of the medicinal plants used among five ethnic groups was tested using the ggVennDiagram package in R (Heinrich et al. 2018; Gao et al. 2021).

RESULTS AND DISCUSSION

Exploration of traditional uses of *Litsea* spp. in Thailand

A comprehensive review of 26 ethnobotanical research conducted between 1996 and 2022 in 35 villages from 4 districts in Northern Thailand revealed 373 use reports (all references were referred to in Table S2.). The study included seven ethnic groups: *Hmong*, *H'tin*, *Karen*, *Lahu*, *Lawa*, *Lisu*, *Tai Lue*, and *Tai Yuan*. Seven species were documented, i.e. *Litsea beusekomii* Kosterm., *L. cubeba*, *L. glutinosa*, *Litsea lancifolia* (Roxb. ex Nees) Fern. -Vill., *L. martabanica*, *L. monopetala* and *L. punctulata*. Among these species, *L. cubeba* and *L. glutinosa* had the highest use reports, contributing to 53% and 17% of the total use report, respectif is tishe full list is shown in Table S2).

The use report of *Litsea* species from the reviewed references was categorized into four groups: food, material, medicine, and social use. The highest reported usage was medicinal (39%), followed by material (29%), food (26%), and social use (6%). A chi-square test was used to assess the statistical significance of these percentage differences, yielding a result of $P=0.57$, $\alpha=0.05$ (Figure 3A; full list in Table S2). The frequently used species for medicine were *L. cubeba* (75%), *L. monopetala* (11%), and *L. glutinosa* (6%). The percentage of *L. cubeba* is 71% of the total use

reports commonly used for food. The *L. glutinosa* (48%) was commonly used as material. The *L. cubeba* (60%) and *L. punctulata* (40%) were used for social use (Figure 3A, the full list is shown in Table S2).

Four species of *Litsea* were used as food. The *L. cubeba* was cultivated for fresh fruit consumption and was popular among *Karen* and *Lawa* groups (Yawut 2001; Tangtragoon 2006; Kamwong 2010). Dry fruits were also prepared for non-fruiting seasons (Pongamornkul and Muangyen 2013). The *L. glutinosa* fruits were eaten without preparation among the *Karen* community in some villages of Nan District, Northern Thailand (Srithi 2012). Fresh leaves of *L. martabanica* and *L. monopetala* were also used as food among *Karen* and *Lawa* groups (Junsongduang 2014) (Figure 3, the full list is shown in Table S2). Five of seven species were used with different plant parts for medicinal purposes. For example, an aqueous decoction of *L. cubeba* fruits was used to treat diarrhea (Inta and Pongamornkul 2015), and it is bark decoction to treat fever (Tangjitman 2014). Bathing with the decoction of *L. monopetala* was used to treat menstrual problems, while its root poultices were used to treat skin injury (Junsongduang 2014) (Figure 3, the full list is shown in Table S2).

Two species were used for social use, with branches of *L. cubeba* and the bark of *L. punctulata* used to decorate doors to ward off spirits (Kaewsangsai 2016; Kantasrila 2016). All seven species were used as material, including stems used for construction and flue, and leaves of *L. glutinosa* popularly used as a liquid used for washing hair (shampoo) (Songsangchun 2001; Panyadee 2010; Muangyen 2013) (Figure 3, the full list is shown in Table S2).

Use categories of *Litsea* species from the field study

A total of 373 use reports belonging to 13 *Litsea* species were found in our field study. The most frequently used species was *L. mollis* (26%), significantly different from other species (Chi-square test: P=0.00, $\alpha = 0.05$). Other species in decreasing order of use reports were *L. cubeba* (25%), *L. martabanica* (18%), and *L. glutinosa* (12%). The use reports were categorized into four categories, with medicine (77.9%) being the most preferred and significantly different from other categories (Chi-square test: P=0.00, $\alpha = 0.05$), followed by food (20.2%), material use (e.g., constructing the fence, producing shampoo, and making wrapping material) (1.4%), and social use (0.5%) (Figure 3B, the full list is shown in Table S3).

The frequently used species for medicine were *L. cubeba* (24%), *L. martabanica* (22%), *L. mollis* (22%), and *L. glutinosa* (12%). The commonly used species for food were *L. mollis* and *L. cubeba*, contributing to 43% and 27% of the total use reports, respectively. The *L. cubeba* (80%) and *L. martabanica* (20%) were used as materials. Only *L. martabanica* was used for social use (Figure 3B, the full list in Table S3).

***Litsea*: Medicinal uses and preparations**

Moreover, 289 medicinal use reports were obtained from the ethnobotanical investigation (Table 2; Figure 4). The investigation identified eleven species, including *L. beusekomii*, *L. cubeba*, *Litsea elliptica* Blume, *L. glutinosa*, *Litsea khasyana* Meisn., *Litsea laeta* (Nees) Trimen, *L. lancifolia*, *L. martabanica*, *L. mollis*, *L. monopetala*, and *Litsea semecarpifolia* (Nees) Hook.fil.

According to ICPC3, the medicinal use of *Litsea* species recorded during the ethnobotanical field surveys were categorized into eight systems: groups of general disorders (6 species, 36 use reports), digestive system (9 species, 96 use reports), ear (1 species, 6 use reports), circulatory system (1 species, 6 use reports), musculoskeletal system (6 species, 35 use reports), respiratory system (7 species, 31 use reports), skin (6 species, 68 use reports), endocrine, metabolic, and nutritional system (3 species, 4 use reports), and pregnancy and childbearing (2 species, 7 use reports) (Table 2, Figure 4).

Figure 4 presents an alluvial plot illustrating the use of reports of *Litsea* spp. across medicinal categories and ethnic groups. In this plot, the thickness of the lines indicates the volume of use reports. Thicker lines correspond to higher numbers of use reports, while thinner lines represent lower numbers. The colors are used to represent different entities.

Each ethnic group is associated with a distinct color: *Hmong* (pink), *Lahu* (lavender), *Karen* (light purple), *Lawa* (light blue), and *Akha* (rose). The *Hmong* group had the highest use reports, followed by *Lahu*, *Karen*, *Lawa*, and *Akha*. The total reports 11 species; only *L. Laeta* (ice blue color) was not mentioned by the *Hmong*, while *L. beusekomii* (rose color), *L. Khasyana* (light blue color), and *L. semecarpifolia* (lime color) were reported just only by the *Hmong* (Figure 4, Table 2).

However, many species were used among ethnic groups, with abundant use reports for treatments of the same symptoms. The primary system categories were the Digestive System (DS) and Skin (SN). Ethnic groups, including *Akha*, *Hmong*, *Karen*, and *Lahu*, used species such as *L. cubeba*, *L. elliptica*, *L. glutinosa*, etc., to treat Digestive System (DS) ailments. Moreover, the most frequently reported species used were *L. cubeba* (pink color), *L. glutinosa* (light purple), and *L. martabanica* (aqua color). Furthermore, the species used to treat skin ailments (SN) was predominantly used in all ethnic groups. We found seven species, including *L. cubeba* (pink color), *L. elliptica* (lavender color), *L. glutinosa* (light purple), *L. martabanica* (aqua color), *L. mollis* (green color), and *L. monopetala* (light green color) was used to treat symptoms in these groups. The *L. cubeba* (pink color) and *L. mollis* (green color) were highlighted as the species with the highest use reports among ethnic groups.

Parts of plants used

The fruit was the most frequently used plant part for medicinal purposes, with 33% of all use reports. This was followed by leaf (24%), root (19%), bark (11%), whole plant (6%), flower (3%), and other parts (5%) (Figure 5). The fruits were the preferred plant part used in most medicinal categories, except for ear and endocrine, metabolic, and nutritional system. The leaves were used to

treat digestive system disorders and skin issues, while the root and bark were used for the musculoskeletal system. In addition, the flowers were used for a single treatment in the respiratory system (Figure 5).

Preparation and administration

Regarding the preparation and administration of *Litsea* species, various methods were utilized (Figure 5). The decoction was the most widely used preparation method, accounting for 66% of the total use reports, especially for the root (35%) and leaf (28%) parts. Other preparations included pounded (18%), eaten as food (10%), crushed (4%), and burned (2%). The fruits were used in all preparation methods except for squeezing for ear drops, in which bark was the only part used in this method (Figure 5).

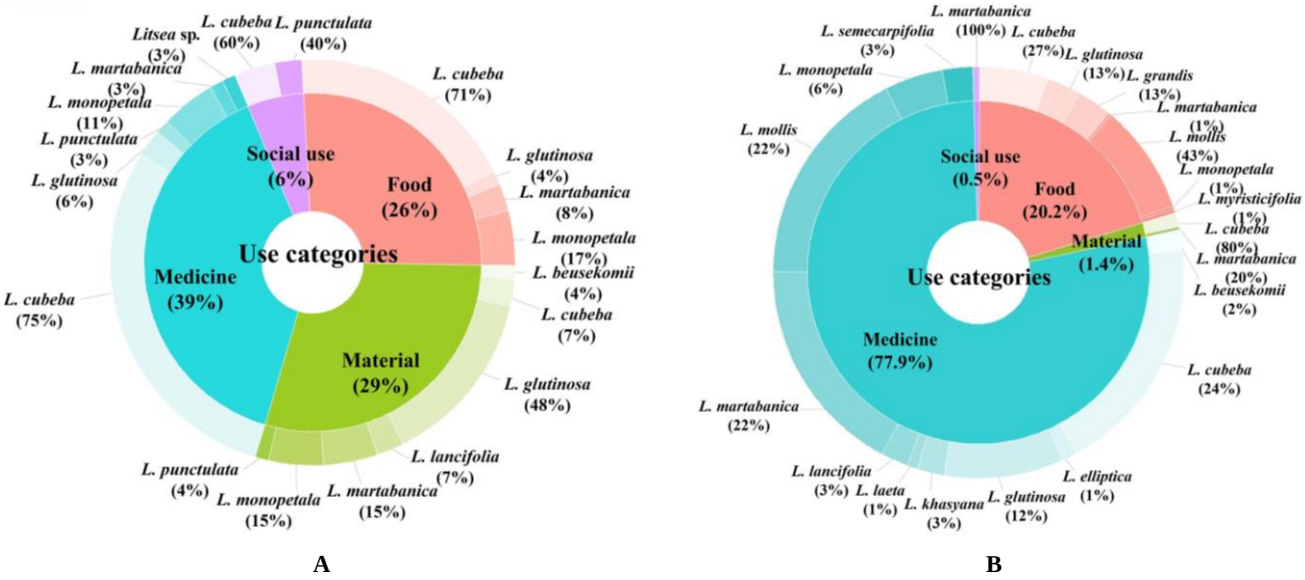

Figure 3. A comparison of the proportion of use reports of *Litsea* species in different use categories and species: A. The use reports compiled ethnobotanical references published from 1996 and 2022, B. Our investigation

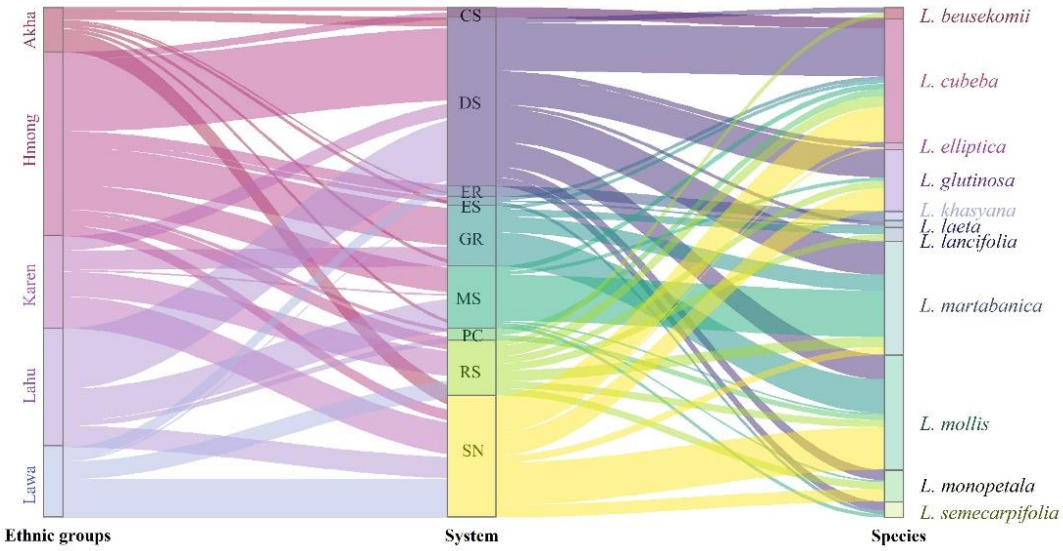

Figure 4. The usefulness of *Litsea* plants among *Karen*, *Akha*, *Lahu*, *Lawa*, and *Hmong* communities from field study: the links of use records as medicinal plants among five ethnic groups in Northern Thailand. The abbreviation in mapping: Circulatory System (CS), Digestive System (DS), Ear (ER), Endocrine, metabolic, and Nutritional System (ES), General (GR), Musculoskeletal System (MS), Pregnancy and Childbearing (PC), Respiratory System (RS), Skin (SN) The analysis was done by using ethnobotanyR in R package

Table 2. Use of the Genus *Litsea* as a medicinal plant found in thirteen villages among five different ethnic groups

Species	Ethnic groups	Plant parts	Preparation	Administration	System (ICPC3)	Ailments	Use-report No.
L. beusekomii	Hmong	Leaves	Decoction	Potions	Respiratory system	Cough	3
(NC 001)	Hmong	Leaves	No preparation	Oral ingestion	Digestive system	Aphthous ulcer	3
L. cubeba	Akha	Bark	Pounded	Poultice	Diseases of skin	Wounds	2
(NC 002)	Akha	Bark	No preparation	Oral ingestion	Musculoskeletal system	Muscle pain (myalgia)	2
	Akha	Fruits	Crushed	Poultice	Skin	Rashes	1
	Akha	Fruits	Decoction	Eaten as tea	Digestive system	Diarrhea	1
	Akha	Fruits	Decoction	Potions	Pregnancy and childbearing	Blood tonic	2
	Akha	Fruits	Decoction	Potions	Circulatory system	Hypertension	2
	Akha	Fruits	No preparation	Oral ingestion	Digestive system	Stomachache	5
	Akha	Leaves	Crushed	Poultice	Skin	Rashes	5
	Akha	Roots	Decoction	Potions	General	Fever	1
	Hmong	Branches	Decoction	Potions	Digestive system	Diarrhea	6
	Hmong	Branches	Decoction	Potions	Circulatory system	Hypertension	4
	Hmong	Branches	Crushed	Poultice	Musculoskeletal system	Muscle pain (myalgia)	1
	Hmong	Branches	Decoction	Potions	General	Fever	1
	Hmong	Fruits	Decoction	Potions	Endocrine, metabolic, and nutritional system	Tonic	1
	Karen	Bark	No preparation	Oral ingestion	Respiratory system	Strep throat	2
	Karen	Bark	No preparation	Oral ingestion	Respiratory system	Cough	3
	Karen	Bark	No preparation	Oral ingestion	Respiratory system	Strep throat	1
	Karen	Fruits	Pounded	Poultice	Skin	Wounds	2
	Karen	Roots	Decoction	Potions	Skin	Bruise	1
	Lahu	Bark	Pounded	Poultice	Pregnancy and childbearing	Blood tonic	1
	Lahu	Leaves	Decoction	Potions	Digestive system	Urethral stone	8
	Lahu	Leaves	Pounded	Poultice	Pregnancy and childbearing	Blood tonic	1
	Lahu	Roots	Decoction	Potions	Digestive system	Urethral stone	8
	Lawa	Flowers	Boiled	Eaten as food	Respiratory system	Strep throat	1
	Lawa	Fruits	Pounded	Poultice	Skin	Wounds	9
	Lawa	Fruits	Raw eaten	Eaten as food	Respiratory system	Strep throat	1
L. elliptica	Hmong	Bark	Decoction	Potions	Skin	Bruise	1
(NC 003)	Lahu	Leaves	Pulped/heated	Poultice over abdominal area	Digestive system	Stomach ache	3
L. glutinosa	Hmong	Fruits	Cooked	Eaten as food	Musculoskeletal system	Muscle pain (myalgia)	1
(NC 004)	Hmong	Leaves	Cooked	Eaten as food	Musculoskeletal system	Muscle pain (myalgia)	1
	Hmong	Roots	Decoction	Baths	Digestive system	Food poisoning	2
	Hmong	Whole plant	Decoction	Baths	Digestive system	Food poisoning	8
	Hmong	Whole plant	Decoction	Potions	Digestive system	Diarrhea	4

	Hmong	Whole plant	Decoction	Potions	Respiratory system	Asthma	4
	Karen	Leaves	Decoction	Hair wash	Skin	Dandruff	1
	Lahu	Fruits	Decoction	Potions	Digestive system	Anthelmintic	1
	Lahu	Leaves	Decoction	Hair wash	Skin	Dandruff	12
	Lahu	Leaves	Decoction	Potions	Digestive system	Anthelmintic	1
L. khasyana	Hmong	Bark	Pounded/Squeezed	Ear drop	Ear	Otosclerosis	3
(NC 005)	Hmong	Fruits	Decoction	Potions/Bath	General	Fever	1
	Hmong	Leaves	Crushed	Ear drop	Ear	Otosclerosis	3
	Hmong	Leaves	Decoction	Potions/Bath	General	Fever	1
L. laeta	Karen	Roots	Decoction	Potions	Digestive system	Diarrhea	1
(NC 006)	Lawa	Roots	Decoction	Potions	Digestive system	Diarrhea	1
	Lawa	Roots	Decoction	Potions	Endocrine, Metabolic, and Nutritional system	Tonic	1
L. lancifolia	Hmong	Leaves	Decoction	Potions	General	Fever	1
(NC 007)	Hmong	Leaves	Decoction	Potions/Bath	General	Chickenpox	3
	Karen	Fruits	No preparation	Eaten as food	Respiratory system	Cold	2
	Lawa	Fruits	No preparation	Eaten as food	Respiratory system	Cold	2
	Akha	Leaves	Decoction	Baths	General	Chickenpox	1
	Akha	Leaves	Decoction	Baths	Skin	Rashes	1
L. martabanica	Hmong	Fruits	Decoction	Potions	Digestive system	Food poisoning	1
(NC 008)	Hmong	Fruits	Decoction	Potions	Musculoskeletal system	Muscle pain (myalgia)	1
	Hmong	Fruits	Decoction	Potions	Digestive system	Stomachache	1
	Hmong	Leaves	Decoction	Potions	General	Fever	1
	Hmong	Leaves	Decoction	Potions	Digestive system	Food poisoning	2
	Hmong	Leaves	Decoction	Potions	Musculoskeletal system	Muscle pain (myalgia)	1
	Hmong	Leaves	Decoction	Potions	Digestive system	Stomachache	1
	Hmong	Leaves	Decoction	Potions/Bath	General	Detoxicant	3
	Hmong	Roots	Decoction	Potions	Digestive system	Aphthous ulcer	5
	Hmong	Roots	Decoction	Potions	General	Fever	1
	Hmong g	Roots	Decoction	Potions	Digestive system	Food poisoning	2
	Hmong	Roots	Decoction	Potions	Musculoskeletal system	Muscle pain (myalgia)	6
	Hmong	Roots	Decoction	Potions	Digestive system	Stomachache	1
	Hmong	Roots	Decoction	Potions/Bath	General	Detoxicant	3
	Karen	Roots	Decoction	Potions	Skin	Bruise	3
	Lahu	Bark	Ground/Decoction	Potions	Musculoskeletal system	Muscle pain (myalgia)	8
	Lahu	Roots	Ground/Decoction	Potions	Musculoskeletal system	Muscle pain (myalgia)	10
	Lawa	Bark	Decoction	Potions	Respiratory system	Cough	3
	Lawa	Bark	Decoction	Potions	Digestive system	Diarrhea	3
	Lawa	Roots	Decoction	Potions	Respiratory system	Cough	3
	Lawa	Roots	Decoction	Potions	Digestive system	Diarrhea	3

L. mollis	Hmong	Fruits	Decoction	Potions	General	Fever	1
(NC 009)	Hmong	Fruits	Decoction	Steam bath	Pregnancy and childbearing	Improve blood circulation	1
	Hmong	Leaves	Decoction	Potions	General	Fever	1
	Hmong	Leaves	Decoction	Potions	Musculoskeletal system	Muscle pain (myalgia)	1
	Hmong	Leaves	Ground/Decoction	Potions	General	Fever	1
	Hmong	Leaves	Decoction	Steam bath	Pregnancy and childbearing	Improve blood circulation	1
	Hmong	Whole plant	Decoction	Potions	General	Fever	5
	Karen	Fruits	Decoction	Potions	Skin	Bites (by snakes)	4
	Karen	Fruits	Decoction	Potions	Skin	Poisonings due to bites (by dogs)	1
	Karen	Fruits	Pounded	Poultice	General	Fever	1
	Karen	Fruits	Pounded	Poultice	Digestive system	Toothache	6
	Karen	Fruits	Pounded /heated	Poultice	Skin	Wounds	4
	Karen	Fruits	No preparation	Eaten as food	General	Malaria	10
	Karen	Roots	Decoction	Potions	Respiratory system	Asthma	4
	Karen	Roots	Decoction	Potions	Skin	Bites (by snakes)	2
	Karen	Roots	Pounded/heated	Poultice	Digestive system	Toothache	1
	Lahu	Bark	Ground/Decoction	Potions	Digestive system	Diarrhea	1
	Lahu	Leaves	Ground/Decoction	Potions	Digestive system	Stomachache	4
	Lahu	Leaves	Pounded/Decoction	Potions	Digestive system	Diarrhea	1
	Lahu	Leaves	Pounded/Decoction	Potions	Digestive system	Stomachache	1
	Lahu	Whole plant	Decoction	Steam bath	Pregnancy and childbearing	Improve blood circulation	1
	Lawa	Fruits	Pounded	Poultice	Skin	Wounds	13
L. monopetala	Akha	Bark	Pounded	Poultice	Skin	Wounds	2
(NC 010)	Hmong	Bark	Pounded	Poultice	Skin	Wounds	5
	Karen	Bark	Decoction	Potions	Musculoskeletal system	Muscle pain (myalgia)	1
	Karen	Heartwood	Decoction	Potions	Respiratory system	Cough	2
	Karen	Roots	Decoction	Potions	Respiratory system	Cough	2
	Karen	Roots	Decoction	Potions	Digestive system	Diarrhea	6
L. semecarpifolia	Hmong	Bark	Decoction	Potions	Endocrine, metabolic and nutritional system	Diabetes mellitus	1
(NC 011)	Hmong	Branches	Decoction	Potions	Digestive system	Urethral stone	2
	Hmong	Leaves	Decoction	Potions	Endocrine, metabolic, and Nutritional system	Diabetes mellitus	1
	Hmong	Leaves	Decoction	Potions	Musculoskeletal system	Muscle pain (myalgia)	2
	Hmong	Leaves	Decoction	Potions	Digestive system	Urethral stone	1
	Hmong	Roots	Decoction	Potions	Digestive system	Urethral stone	2

The indigenous people employed many techniques Regarding the administration of medicinal *Litsea* species. The most common technique is oral consumption, especially in the form of-potion (45%). This was followed by external application as a poultice (15%) and baths (10%). Other methods, such as instant hair wash, ear drops, and eating as food, had fewer use reports (Figure 5).

Quantitative analysis of ethnobotanical indices: Relative Frequency of Citation (RFC) and Use Values (UV)

The Frequency of Citation (RFC) and Use Value (UV) were calculated for the medicinal plant in the Genus *Litsea* species. The calculated RFC values ranged from 0.045 to 0.682, with *L. mollis* having the highest value of 0.682, followed by *L. cubeba* (0.606), *L. martabanica* (0.409), *L. glutinosa* (0.273), and *L. monopetala* (0.227) (Figure 6). It should be noted that over half of the plants had low RFC values indicating that they were used in only 1-3 villages. The calculated UV values for this plant ranged from 0.045 to 0.894, with *L. mollis* having the highest value of 0.894. This was followed by *L. cubeba* (0.848), *L. martabanica* (0.576), *L. glutinosa* (0.409), and *L. monopetala* (0.242) (Figures 6 and 7) .

Exploration of the use of medicinal *Litsea* plants among ethnic groups

We used a Venn diagram to analyze and visualize the use of the Genus *Litsea* among five ethnic groups in Northern Thailand (Figure 8). The number of plant species used among ethnic groups was counted and analyzed. The result showed that *L. cubeba* and *L. martabanica* were the only two species used by all five ethnic groups. Additionally, the *Hmong* people exclusively used three species, *L. beusekomii*, *L. khasyana*, and *L. semecarpifolia*. Furthermore, *L. elliptica* was used by *Hmong* and *Lahu*. The data indicated that *Hmong* used more medicinal plants in *Litsea* than other ethnic groups. However, the *Litsea* species used among ethnic groups except for *Hmong* (dark green) are not different (Figure 8).

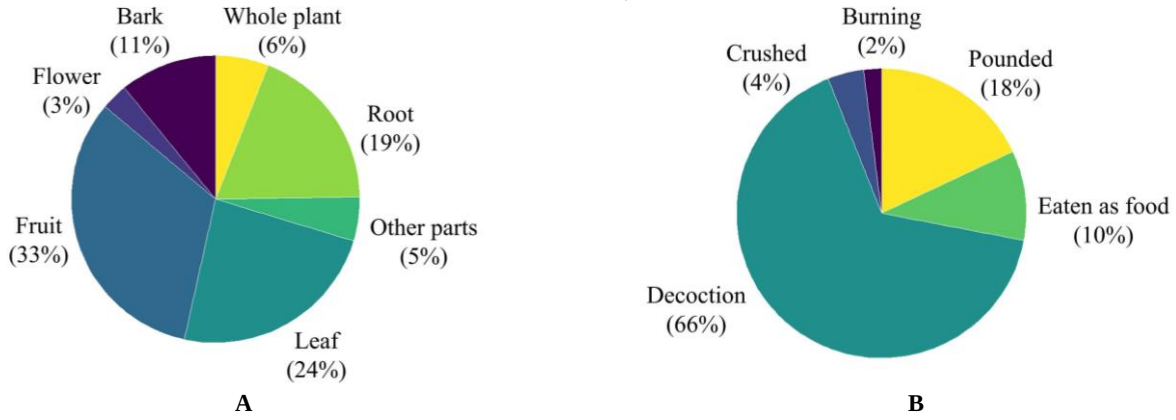

Figure 5. The proportion of the number of use-report: A. The different plant parts within medicinal use categories, and B. The preparation and administration of this work. The analysis was done using ggplot2 in the R package

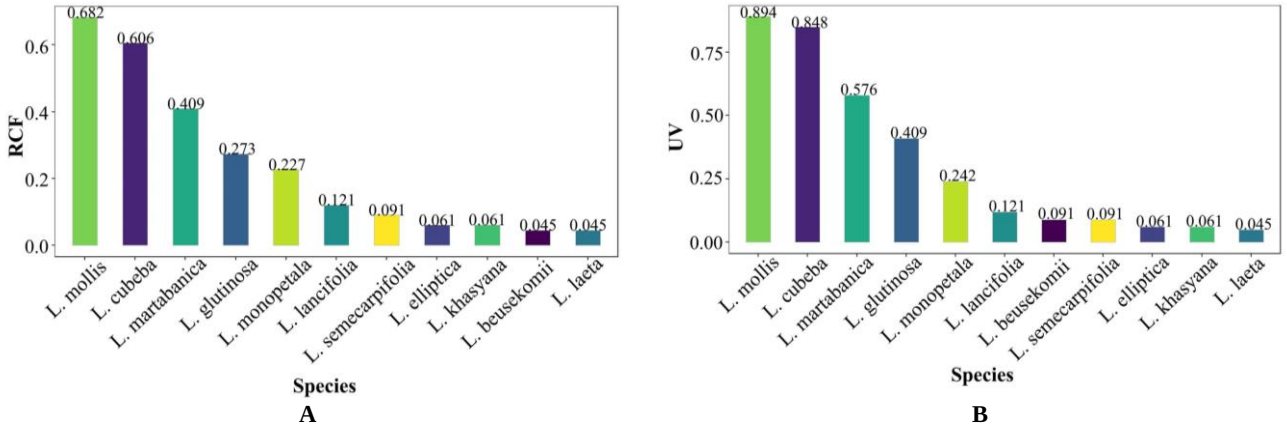

Figure 6. The ethnobotanical indices were analyzed using ggplot2 in the R package. A. The *Litsea* species with the Relative Frequency of Citation (RFC) and, B. Use Value (UV) among five ethnic groups

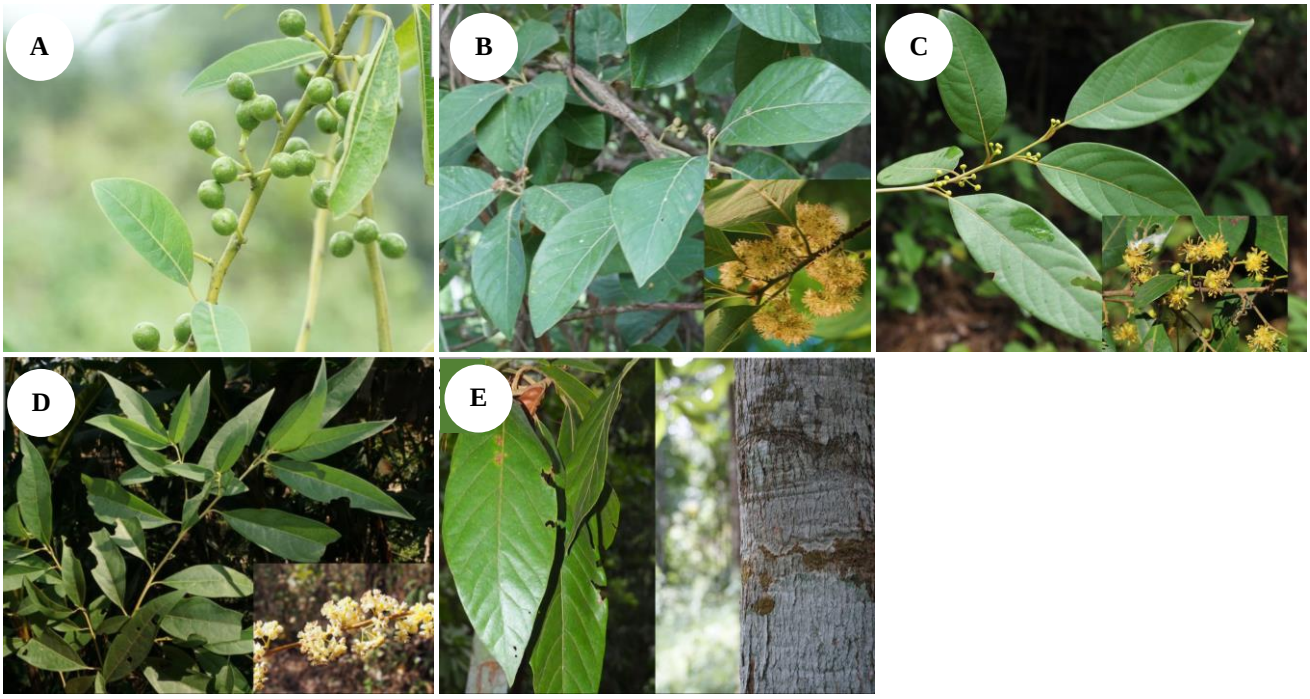

Figure 7. Some examples of highlight species: A. *L. cubeba*; B. *L. glutinosa*; C. *L. martabanica*; D. *L. mollis;* E. *L. monopetala*

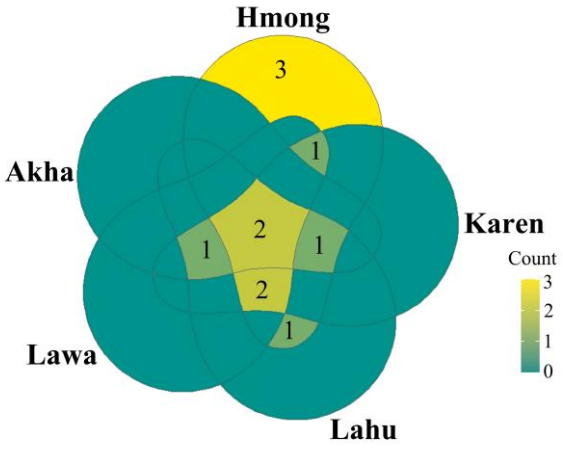

Figure 8. The comparison of the use of *Litsea* species among ethnic groups in Northern Thailand. The analysis was done using Venn Diagram in the R package

Discussion

The restrictions on previous ethnobotany of Litsea *species in Thailand*

The previous ethnobotanical data of *Litsea* species in Thailand reveals limited data, with only seven species recorded from 32 species explored in the revision of *Litsea* in Thailand. This contrasts with the extensive ethnobotanical record of *Litsea* species in China, where 48 species have been documented (Wang et al. 2016). This di uet oce may be due to the widespread distribution and diversity of *Litsea* plants in China (74 species), especially in southern and southwestern China (Au et al. 2008), compared with the diversity in Thailand, where only 35 species were found (Ngearnsaengsaruay et al. 2011). Moreover, some species, such as *L. cubeba* and *Litsea pungens* Hemsl. in China, served as a source of domesticated species and provided valuable genetic resources for developing new crops for preserving and adding value, making it worth studying (Chen et al. 2013; Luo et al. 2019; Fan et al. 2023). In China, 55 officially recognized ethnic groups are established in mainland China. They have their knowledge of cultural plants and pass on this knowledge from generation to generation (Kong et al. 2015; Gou et al. 2020; Geng et al. 2022; Long et al. 2023). The rise in plant use recorded by their local people prompts a rapid investigation of ethnobotanical studies in China. To find the high number of plant use in the local communities is not surprising because this country is the largest in Asia with high biodiversity, and the communities tend to pass on the knowledge to the younger generation. This explains why they still have a lot of ethnobotanical records of various plants, especially the *Litsea* species.

The possible confusion between *L. mollis* and *L. cubeba* may have contributed to the limited documentation of species in the plant use record. These two species have the same local name and the same morphological characters, making it difficult to identify the correct scientific name. As a result, possible that these two species were counted as a single species in previous studies. These results emphasize the importance of proper identification and future research in traditional medicinal plants.

Traditional medicinal use of Litsea *species: A comparison of past discoveries and new insights*

Our work shows that the ethnobotanical study resulted in *Litsea* species in more new insight than previous discoveries. The most straightforward explanation for this is that the reported number of *Litsea* species in the present study is significantly higher (13 species) in comparison with that of the previous study (7 species) (Figure 3). Moreover, the most dominant used in previous species was *L. cubeba*, primarily for medicinal and food purposes. Our study found that *L. cubeba* is still widely used in medicinal and food categories but also that *L. mollis* is a significant species not previously documented. The *L. mollis* was more commonly used as food than *L. cubeba*. Surprisingly, six new records except for *L. mollis* were found in our study, which are *L. elliptica*, *Litsea grandis* (Wall. ex Nees) Hook.fil., *L. khasyana*, *L. laeta*, *Litsea myristicifolia* (Wall. ex Nees) Hook.fil., and *L. semecarpifolia, L. grandis* and *L. myristicifolia* were used as food in *Lahu* communities; other species were used for medicinal purposes. *Karen* and *Lawa* communities used *L. laeta* to treat diseases. The *L. khasyana* was popularly used for treating otosclerosis and fever in *Hmong* communities as *L. semecarpifolia* was used to treat urethral stones, muscle pain, and diabetes, while *L. elliptica* is popularly used for digestive system disorders in *Lahu*.

As stated previously, four species of *Litsea* spp. in both studies are used for medicinal purposes, namely *L. cubeba*, *L. glutinosa*, *L. monopetala*, and *L. martabanica*. Noticeably, these four species showed other uses apart from medicinal uses. Interestingly, the categories of cholecystitis, hypertension, and muscle pain, not implicated in the past investigation, were found in *L. cubeba*. *Lahu*, *Akha*, and *Hmong* communities used this species to treat cholecystitis, hypertension, and muscle pain, but in a previous exploration, we observed that only *Karen* and *Hmong* communities were using this species. The fruits of *L. cubeba* have potent antidiabetic and antihyperlipidemic properties in pharmacological analysis (Chakraborty et al. 2022). Moreover, numerous studies confirm that the essential oil of *L. cubeba* fruits has the potential to be anti-inflammatory (Liao et al. 2015; Lin et al. 2016; Gogoi et al. 2018). Also, the leaf of *L. glutinosa* was reported to be commonly used to treat hair/scalp symptoms in many ethnic groups (Mueangyen 2013), while *Hmong* uses this species to treat asthma, diarrhea, gastrointestinal infection, and muscle pain in this study. This result follows the study of the natural surfactant of *L. glutinosa* leaves, while the chemical compound, Pyrazoles, can be used to induce diarrhea in animal models (Sitthithaworn et al. 2018; Wisetkomolmat et al. 2021; Rahman et al. 2023). It was known that *L. martabanica* was used to treat muscle pain in *Karen* in a previous study (Kantasrila et al. 2017). Surprisingly, this species is used to treat various symptoms in the present study, i.e., chickenpox, rash, fever, gastrointestinal infection, and digestive system diseases, in *Hmong* and *Akha* communities. Unfortunately, it is not easy to find and propagate. The root extract of this species was tested for acetylcholinesterase activity that decreases in pesticide-exposed rats (Kunnaja et al. 2021). The *L. monopetala* is known to treat an injury in *Karen* in Chiang Mai (Junsongduang et al. 2014). Our investigation uses it to treat cough, muscle pain, and diarrhea in *Karen* and *Lahu* communities (Table 2). In addition, leaf extracts of *L. monopetala* can potentially treat diarrheal activity in mice (Nasrin and Hakim 2015).

Changes in ethnobotanical practices often reflect the transformation of lifestyle patterns within ethnic communities. With the onset of modernization, these communities experience an evolution in the ethnobotanical knowledge they pass down through generations (Srithi et al. 2009). A significant manifestation of this shift is the transition from traditional plant-based fuel sources to liquefied petroleum gas in many households. This shift has led to decreased use and variety of plant materials for fuel, including fuel woods traditionally included under 'material plants' in previous studies (Gould and Urpelainen 2020; Ma et al. 2022). Contrasting the findings from our current study with previous ones, we note a unique predominance of *L. martabanica*, while *L. cubeba* and *L. punctulata* were primarily used for social purposes (60% and 40%, respectively, in the comprehensive review). The leaves of these plants, traditionally employed to ward off bad spirits, can be substituted by other plants, such as thorn-bearing species (Panyadee 2022). The deviation in our findings may be attributed to the participant demographics of our study, which included a significant proportion of traditional healers. This group may demonstrate a preference for the medicinal properties of plants, thus influencing the results. Differences in plant usage can also be attributed to geographical variations between our study sites and those in the comprehensive review. Each region's unique flora and environmental conditions can shape the local ethnobotanical practices (Figure 3). Moreover, the adaptability of communities to utilize different plant species based on their availability introduces another layer of variability. Depending on the season or period, communities may substitute one plant species for another across diverse categories, including uses such as firewood, construction, or fence-making (Srithi 2012).

The fruit and leaves of the Genus Litsea were most frequently used for medicinal purposes, while the flowers were used the least. This was probably because the fruit of this genus, especially *L. cubeba* and *L. mollis*, are easily found in food additives. Both species are widely utilized in the pharmaceutical study and food industries, as supported by various studies, especially *L. cubeba* (Chen et al. 2013; Phumthum et al. 2018; Liang et al. 2021). These findings, therefore, confirm previous results, which indicated that the essential oil of fruit of *Litsea* species, as well as the leaves, are used to treat various symptoms, whereas other plant parts are less popular (Devi et al. 2010; Si et al. 2012; Feng et al. 2023). Other plant parts, such as the roots and flowers, are probably difficult to collect and require usage in large quantities to use economically.

Most preferred and rare species of Litsea *species in this study*

High UV and RFC values were used to determine the priority, importance, recommendation, and dissemination of medical information among the ethnic groups. The study

of *Litsea* species showed that *L. mollis* and *L. cubeba* had extraordinarily high values (Figure 6). The results were unsurprising, as *L. cubeba* was commonly used in various categories, including food, material, and medicine. It is also widely used in medicinal categories in many countries (Bharali et al. 2017; Fan et al. 2019) because its chemical composition has a high potential for bioactivities (Yang et al. 2014; Nguyen et al. 2016; Thielmann and Muranyi 2019). These could be linked to *L. mollis*, though it has no ethnobotanical record in previous studies; indigenous people used this species similarly to *L. cubeba* because they are thought to be the same species. Moreover, both species are easy to find; they grow around the forest not far from their villages. That suggests the chemical potential and the pharmaceutical ability of *L. mollis* and *L. cubeba* in each of their plant parts are worth exploring. Interestingly, when looking at other species, *L. glutinosa* and *L. martabanica*, with high RFC, UV, and percentage of use reports, it can be noticed that both species were also used among ethnic groups, especially in medicinal categories. It is important to point out that *L. martabanica* was widely used to treat diseases in all five ethnic groups, while *L. glutinosa* was used in *Karen*, *Hmong*, and *Lahu*. However, many reports show that *L. glutinosa* was commonly used for hair washing in *Tai Lue*, *Tai Yai*, and *Tai Yuan* communities (Mueangyen 2013) with high potential in bioactivity (Kunnaja et al. 2021). In our work, we observed that even though *L. martabanica* was widely used for medicinal purposes among five ethnic groups; it is a rare plant that is difficult to find in their villages. One of the reasons could be that they contain numerous phytochemical compounds that are effective in various treatments (Arunodaya et al. 2016; Kisnawaty et al. 2019; Kunnaja et al. 2021). This highlights the potential of ethnobotanical studies of underexplored species that could lead to developing new plant products or identifying questionable species in some genera.

In conclusion, this work aims to explore and analyze medicinal plants in *Litsea* among five ethnic groups in Northern Thailand using ethnobotanical knowledge for future exploitation via phytochemistry, bioactivities, and nutrition. We found seven species from the literature and 13 species from our study. Then, we focus on 11 species among five ethnic groups that can be used as medicinal plants. However, we found more *Litsea* species from the field survey than from the literature review. Therefore, focusing on one genus in ethnobotany can facilitate the discovery of underexplored plant data, narrowing the search for future chemical compounds. The *L. martabanica* is a highlighted species in this work, widely used in the *Hmong* group. This species has been used to treat digestive disorders. Moreover, In the case of *L. cubeba* and *L. mollis*, all ethnic groups considered them as a single ethnospecies, called "*Soe Lue Sa*" in *Karen*, "*Lo*" in *Lawa*, and more. Therefore, ethnospecies with confusing taxonomic identities may be understood better through detailed ethnobotanical explorations and chemical composition analysis.

ACKNOWLEDGEMENTS

We are deeply indebted to the villagers who participated in this study and shared their knowledge. We also sincerely thank the Junior Science Talent projects foundation for supporting NC's Ph.D. study. Special thanks to Dr. Pachara Sattayawat, an Imperial College London, UK graduate, for improving language editing. Conceptualization, NC; Ethnobotanical surveys were conducted by NC, PP, and AI; Specimens were identified by NC; Data was analyzed by NC. This manuscript was drafted by NC and revised by PP, CL, CN, TC, and AI.

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Table S1. Questionnaire for investigating the Genus Litsea in Northern Thailand.

GENERAL QUESTIONNAIRE FOR INVESTIGATING THE GENUS LITSEA IN NORTHERN THAILAND

Name……..	Gender……...
Age……	Occupation……
Education.....	
Addresses.....	
Villages.....	Income..... per.....
Number of farmlands by size ……	
Cultivation.....	
Settlement ……. month/ years	
Treatment options	
(…..)Healers	(…..)Community health and medical service
(…..)Shaman	(…..)Consults with drugstore
(…..)Hospital	(…..)Other
Household information	
1. Gender: ♂/ ♀ Age ……..	Occupation.....
2. Gender: ♂/ ♀ Age ……..	Occupation.....
3. Gender: ♂/ ♀ Age ……..	Occupation.....
4. Gender: ♂/ ♀ Age ……..	Occupation.....
5. Gender: ♂/ ♀ Age ……..	Occupation.....

A QUESTIONNAIRE-BASED STUDY ON MEDICINAL PLANT USE OF THE GENUS LITSEA

No/Local name	
Treating	
Plant parts of use	(….) Roots (….) Leaves (….) Flowers(….) Fruits (….) Whole plant (….) Other .....
Preparation and administration	
Satisfaction level (1, 2, 3, 4, 5)	(….) 1 (….) 2 (….) 3 (….) 4 (….) 5
Source	(….) Villages (….) Forest (….) Field (….) Buying (….) Neighboring village (….) Other.....
Number of plants	(….) Good (….) Fair (….) Poor
Frequency of using	(….) every day (….) 1-3 time/week (….) 1-3 time/month (….) 1-6 time/year (….) Other .....
Warning	

Table S2. The usefulness on Genus Litsea is found in Thailand among different ethnic groups

Species	Local name	Ethnic groups	Use	Part of plants used	Preparation	Administration	Usage	ICPC 3	Reference/year
L. beusekomii Kosterm.	*Toe Wo*	*Karen*	Materials	Stem	-	-	Construction	-	Kaewsangsai (2016)
L. cubeba (Lour.) Pers.	-	*Hmong*	Medicines	Branch	Decoction	Potions	Menstrual pain	Symptoms, complaints and abnormal findingsof the genital system	Trisonthi and Trisonthi (2009)
	-	*Hmong*	Medicines	Fruit	Raw eaten	Orally	Diarrhea	Symptoms, complaints and abnormal findings of the digestive system	Nguanchoo (2014)
	Sakhrai	*H'tin*	Food	Fruit	Raw eaten	Orally	Spice	-	Tangtragoon (2006)
	Ser Lu Sa	*Karen*	Medicines	Bark	Decoction	Potions	Fever	General symptoms, complaints and abnormal findings	Tangjitman (2014)
	Ta Lues A	*Karen*	Social use	Branch	-	-	Protecting from spirit	-	Kantasrila (2016)
	Soe Lue Sa	*Karen*	Food	Fruit	Raw eaten	Orally	Spice	-	Yawut (2001)
	Takhraiton	*Karen*	Food	Fruit	Fresh	Eaten as food	Spice	-	Pongamornkul et al. (2002)
	Ser Lu Sa	*Karen*	Food	Fruit	Fresh	Eaten as food	Spice	-	Kamwong (2010)
	Lum PlaeKlueng	*Karen*	Medicines	Fruit	Decoction	Potions	Cough	Symptoms, complaints and abnormal findingsof the respiratory system	Srithi (2012)
	Li-U-Hlae	*Karen*	Food	Fruit	Dry fruit	Eaten as food	Spice	-	Pongamornkul and Muangyen (2013)
	Sir Hloo Sa	*Karen*	Food	Fruit	Fresh	Eaten as food	Spice	-	Junsongduang (2014)
	Ser Ler Sa	*Karen*	Medicines	Fruit	Decoction	Potions	Malaria	General diagnosesand diseases	Tangjitman (2014)
	Sa Hreui Sa	*Karen*	Medicines	Fruit	Pounded	Poultice	Other specified or unknown skin injury	Diagnoses and diseases of the skin	Junsongduang (2014)
	Sir Hloo Sa	*Karen*	Medicines	Fruit	Decoction	Potions	Other specified or unknown skin injury	Diagnoses and diseases of the skin	Junsongduang (2014)
	Ka Lue Sa	*Karen*	Food	Fruit	Fresh	Eaten as food	Spice	-	Inta and Pongamornkul (2015)
	Ka Lue Sa	*Karen*	Medicines	Fruit	Pounded	Poultice	Animal or human bite	Diagnoses and diseases of the skin	Inta and Pongamornkul (2015)
	Ka Lue Sa	*Karen*	Medicines	Fruit	Decoction	Potions	Malaria	General diagnoses and diseases	Inta and Pongamornkul (2015)
	Ka Lue Sa	*Karen*	Medicines	Fruit	Decoction	Potions	Diarrhea	Symptoms, complaints and abnormal findings of the digestive system	Inta and Pongamornkul (2015)
	Ka Lue Sa	*Karen*	Medicines	Fruit	Decoction	Potions	Bites (by insect)	Diagnoses and diseases of the skin	Inta and Pongamornkul (2015)
	Ta Lue Sa	*Karen*	Food	Fruit	Raw eaten	Eaten as food	Spice	-	Kantasrila (2016)
	Ta Lue Sa	*Karen*	Food	Fruit	Dry fruit	Eaten as food	Spice	-	Kantasrila (2016)

Ta Lue Sa	*Karen*	Medicines	Fruit	Decoction	Eaten as tea	Diarrhea	Symptoms, complaints and abnormal findings of the digestive system	Kantasrila (2016)
Ta Lue Sa	*Karen*	Medicines	Fruit	Decoction	Eaten as tea	Vomiting	Symptoms, complaints and abnormal findings of the digestivesystem	Kantasrila (2016)
Ta Lue Sa	*Karen*	Medicines	Fruit	Decoction	Potions	Bites (by insect)	Diagnoses and diseases of the skin	Kantasrila (2016)
Ta Lue Sa	*Karen*	Medicines	Fruit	Pounded	Apply on body	Chickenpox	General diagnosesand diseases	Kantasrila (2016)
Ka Lue Sa	*Karen*	Medicines	Fruit	Pounded	Poultice	Animal or human bite	Diagnoses and diseases of the skin	Kaewsangsai (2016)
Ka Lue Sa	*Karen*	Medicines	Fruit	Decoction	Potions	Malaria	General diagnoses and diseases	Kaewsangsai (2016)
Ka Lue Sa	*Karen*	Medicines	Fruit	Decoction	Potions	Fever	General symptoms, complaints and abnormal findings	Kaewsangsai (2016)
Taluesa	*Karen*	Medicines	Fruit	Decoction	Potions	Diarrhea	Symptoms, complaints and abnormal findings of the digestivesystem	Kantasrila (2016)
Soe Lue Sa	*Karen*	Food	Leave	Raw eaten	Orally	Spice	-	Yawut (2001)
Takhraiton	*Karen*	Medicines	Leave	Decoction	Potions	Growth delay	Symptoms, complaints and abnormal findingsof endocrine, metabolic and nutritional system	Tangtragoon (2006)
Takhraiton	*Karen*	Medicines	Leave	Decoction	Potions	Concern or fear of disease of the endocrine,metabolic and nutritional system	Symptoms, complaints and abnormal findings of endocrine, the metabolic and nutritional system	Tangtragoon (2006)
Soeluesa	*Karen*	Materials	Leave	Extraction with water	-	Spray	-	Arikun and Oonlamun (2009)
Ser Lu Sa	*Karen*	Medicines	Root	Decoction	Potions	Malaria	General diagnosesand diseases	Sukkho (2008)
Ser Lu Sa	*Karen*	Medicines	Root	Decoction	Potions	Cough	Symptoms, complaints and abnormal findingsof respiratory system	Kamwong (2010)
Ka Lue Sa	*Karen*	Medicines	Root	Decoction	Potions	Other specified or unknown peptic ulcer	Diagnoses and diseases of the digestive system	Inta and Pongamornkul (2015)
Ta Lue Sa	*Karen*	Medicines	Root	Decoction	Potions	Contact or allergic dermatitis	Diagnoses and diseases of the skin	Kantasrila (2016)
Ta Lue Sa	*Karen*	Medicines	Root	Decoction	Potions	Other specified or unknown peptic ulcer	Diagnoses and diseases of the digestive system	Kantasrila (2016)
Sir Hloo Sa	*Karen*	Materials	Stem	-	-	Construction	-	Junsongduang (2014)
Ho Wo Toe Po	*Karen*	Social use	Leave	-	-	Spray	-	Khamfachuea (2008)
Chuesue	*Lahu*	Food	Fruit	Raw eaten	Orally	Spice	-	Ponpim (1996)
Lo	*Lawa*	Food	Fruit	Raw eaten	Orally	Spice	-	Munjai (2001)
Lo	*Lawa*	Food	Fruit	Fresh	Eaten as food	Spice	-	Tangtragoon (2006)
Lum Plae Klueng	*Lawa*	Food	Fruit	Fresh	Eaten as food	Spice	-	Srithi (2012)

	Coh Loh	*Lawa*	Food	Fruit	Fresh	Eaten as food	Spice	-	Junsongduang (2014)
	Coh Loh	*Lawa*	Medicines	Fruit	Decoction	Potions	Other specified or unknown skin injury	Diagnoses and diseases of the skin	Junsongduang (2014)
	Lum Plae Klueng	*Lawa*	Social use	Leave	Extractionwith water	-	Spray	-	Srithi (2012)
	Su Su Sue	*Lisu*	Food	Fruit	Dry fruit	Eaten as food	Spice	-	Panta (2015)
	Sususue	*Lisu*	Food	Fruit	Dry fruit	Eaten as food	Spice	-	Panta (2015)
L. glutinosa (Lour.) C.B.Rob.	*Tood Trool*	*Karen*	Food	Fruit	Fresh	Eaten as food	Spice	-	Srithi (2012)
	Hmi-Hmen	*Karen*	Materials	Leave	Fresh	Cleansers	Shampoo	-	Yawut (2001)
	Hmi Hmen	*Karen*	Materials	Leave	Pounded	Cleansers	Shampoo	-	Pongamornkul (2009)
	Tood Trool	*Karen*	Materials	Leave	Pounded	Cleansers	Shampoo	-	Srithi (2012)
	Sey Or Hla	*Karen*	Materials	Leave	Fresh	-	wrap	-	Junsongduang (2014)
	Sey Or Hla	*Karen*	Materials	Stem	-	-	Fuels	-	Junsongduang (2014)
	Sey Or Hla	*Karen*	Materials	Stem	-	-	Construction	-	Junsongduang (2014)
	Hmi-Hmen	*Lawa*	Materials	Bark	Pounded	Cleansers	Shampoo	-	Inta and Pongamornkul (2015)
	Kho Som Sai	*Lawa*	Fuels	Heartwood	-	-	Construction	-	Tangtragoon (2006)
	Coh Pu Pry	*Lawa*	Materials	Stem	-	-	Construction	-	Junsongduang (2014)
	Hmi Hmen	Shan	Medicines	Leave	Pounded	Shampoo	Hair/scalp symptom/complaint	Symptoms, complaints and abnormal findingsof skin	Tangtragoon (2006)
	Hmi	*Tai Lue*	Materials	Leave	Pounded	Cleansers	Shampoo	-	Muangyen (2013)
	May Hmi	*Tai Yuan*	Materials	Leave	Pounded	Cleansers	Shampoo	-	Panyadee (2010)
	May Hmi	*Tai Yuan*	Materials	Leave	Pounded	Cleansers	Shampoo	-	Varipo (2012)
	May Hmi	*Tai Yuan*	Materials	Leave	Pounded	Cleansers	Shampoo	-	Varipo (2012)
	Ba Yeai	*Tai Yuan*	Medicines	Leave	Pounded	Shampoo	Hair/scalp symptom/ complaint	Symptoms, complaints and abnormal findingsof skin	Inta (2018)
L. lancifolia (Roxb. Ex Nees) Fern. -Vill.	*Se Glow Bo*	*Karen*	Materials	Stem	-	-	Construction	-	Junsongduang (2014)
	Coh Yeum Ngo	*Lawa*	Materials	Stem	-	-	Fuels	-	Junsongduang (2014)
L. martabanica (Kurz) Hook.fil.	*Sey Hleu Sa*	*Karen*	Food	Leave	Fresh	Eaten as food	Spice	-	Junsongduang (2014)
	Sey Hleu Sa	*Karen*	Materials	Stem	-	-	Fence	-	Junsongduang (2014)
	-	*Karen*	Fuels	Stem	-	-	Fuels	-	Kantasrila (2016)
	-	*Karen*	Medicines	Wholeplant	Decoction	Potions	Muscle pain	Symptoms, complaints and abnormal findingsof musculoskeletalsystem	Kantasrila (2016)
	Miad	*Lawa*	Materials	Bark	-	-	Construction	-	Songsangchun
	Pai Piang	*Lawa*	Food	Fruit	Fresh	Eaten as food	Spice	-	Junsongduang (2014)
	Pai Piang	*Lawa*	Materials	Stem	-	-	Fuels	-	Junsongduang (2014)

L. monopetala (Roxb. ex Baker) Pers.	*Hyeung*	*Karen*	Food	Leave	Fresh	Eaten as food	Spice	-	Junsongduang (2014)
	Pey Jeu Ya	*Karen*	Food	Leave	Fresh	Eaten as food	Spice	-	Junsongduang (2014)
	Hyeung	*Karen*	Food	Leave	Fresh	Eaten as food	Food	-	Junsongduang (2014)
	Pey Jeu Ya	*Karen*	Medicines	Leave	Decoction	Barth	Menstrual pain	Symptoms, complaints and abnormal findingsof the genital system	Junsongduang (2014)
	Pey Jeu Ya	*Karen*	Materials	Root	-	-	Dying	-	Junsongduang (2014)
	Pey Jeu Ya	*Karen*	Medicines	Root	Pounded	Poultice	Other specified or unknown skin injury	Diagnoses and diseases of the skin	Junsongduang (2014)
	Hyeung	*Karen*	Fuels	Stem	-	-	Fuels	-	Junsongduang (2014)
	Pey Jeu Ya	*Karen*	Materials	Stem	-	-	Construction	-	Junsongduang (2014)
	Hyum Ngo	*Lawa*	Food	Leave	Fresh	Eaten as food	Food	-	Junsongduang (2014)
	Hyum Ngo	*Lawa*	Medicines	Leave	Decoction	Potions	Menstrual pain	Symptoms, complaints and abnormal findingsof the genital system	Junsongduang (2014)
	Pey Jeu Ya	*Lawa*	Medicines	Root	Ground for poultices	Apply on body	Other specified or unknown skin injury	Diagnoses and diseases of skin	Junsongduang (2014)
	Hyum Ngo	*Lawa*	Materials	Stem	-	-	Construction	-	Junsongduang (2014)
L. punctulata Kosterm.	*Si So Be*	*Karen*	Social use	Bark	-	-	Protecting from spirit	-	Kaewsangsai (2016)
	Si So Be	*Karen*	Social use	Bark	Dry bark	Eaten with betel nut	-	-	Kaewsangsai (2016)
	Si So Be	*Karen*	Medicines	Fruit	Fresh	Inhalant	Fainting	General symptoms, complaints andabnormal	Kaewsangsai (2016)
	Si So Be	*Karen*	Materials	Stem	-	-	Construction	-	Kaewsangsai (2016)
Litsea sp.	*Ka Ma O*	*Karen*	Medicines	Root	Decoction	Wash	Other specified or unknown skin injury	Diagnoses and diseases of the skin	Tangjitman (2014)

Table S3. The usefulness of Genus *Litsea* is found in thirteen villages among five different ethnic groups

Species	Ethnic Group	Use	Use Report No.	Plant Part Used
L. beusekomii Kosterm.	*Hmong*	Medicine	3	Leaf
(NC 001)			3	Leaf
L. cubeba (Lour.) Pers.	*Akha*	Food	1	Fruit
(NC 002)		Medicine	2	Bark
			2	Bark
			1	Fruit
			1	Fruit
			2	Fruit
			2	Fruit
			5	Fruit
			5	Leaf
			1	Root
	Hmong	Food	1	Fruit
		Medicine	6	Branch
			4	Branch
	Hmong	Medicine	1	Branch
			1	Branch
			1	Fruit
	Karen	Food	2	Flower
		Medicine	2	Bark
			3	Bark
			1	Bark
			2	Fruit
			1	Root
	Lahu	Food	1	Fruit
		Medicine	1	Bark
			8	Leaf
			1	Leaf
			8	Root
	Lawa	Food	2	Flower
			6	Fruit
	Lawa	Food	6	Leaf
		Material	2	Bark
		Medicine	1	Flower
			9	Fruit
			1	Fruit
L. elliptica Blume	*Hmong*	Medicine	1	Bark
(NC 003)	*Lahu*	Medicine	3	Leaf
L. glutinosa (Lour.) C.B.Rob.	*Hmong*	Medicine	1	Fruit
(NC 004)			1	Leaf
			2	Root
			8	Whole plant
			4	Whole plant
			4	Whole plant
	Karen	Food	2	fruit
			2	Leaf
		Medicine	1	Leaf
	Karen	Medicine	1	Fruit
			12	Leaf
			1	Leaf
	Lawa	Food	3	Fruit
			3	Leaf
L. grandis (Wall. ex Nees) Hook.fil. (NC 005)	*Lahu*	Food	10	Fruit
L. khasyana Meisn.	*Hmong*	Medicine	3	Bark
(NC 006)			1	Fruit
			3	Leaf
			1	Leaf
L. laeta (Nees) Trimen	*Karen*	Medicine	1	Root
(NC 007)	*Lawa*	Medicine	1	Root
			1	Root
L. lancifolia (Roxb. ex Nees) Fern.-Vill.	*Hmong*	Medicine	1	Leaf
(NC 008)			3	Leaf
	Karen	Medicine	2	Fruit
	Lawa	Medicine	2	Fruit

L. martabanica (Kurz) Hook.fil.	*Akha*	Medicine	1	Leaf
(NC 009)			1	Leaf
	Hmong	Medicine	1	Fruit
			1	Fruit
			1	Fruit
			1	Leaf
			2	Leaf
			1	Leaf
			1	Leaf
			3	Leaf
			5	Root
			1	Root
			2	Root
	Hmong	Medicine	6	Root
			1	Root
			3	Root
	Karen	Food	2	Fruit
		Material	1	Stem
		Medicine	3	Root
	Lahu	Medicine	8	Bark
			10	Root
	Lawa	Food	1	Flower
		Medicine	3	Bark
			3	Bark
			3	Root
			3	Root
L. mollis Hemsl.	*Hmong*	Food	6	Fruit
(NC 010)		Food additive	1	Fruit
	Hmong	Medicine	1	Fruit
			1	Fruit
			1	Leaf
			1	Leaf
			1	Leaf
			1	Leaf
			5	Whole plant
	Karen	Food	4	Fruit
		Medicine	4	Fruit
			1	Fruit
			1	Fruit
			6	Fruit
			4	Fruit
			10	Fruit
			4	Root
			2	Root
	Karen	Medicine	1	Root
	Lahu	Food	1	Fruit
		Medicine	1	Bark
			4	Leaf
			1	Leaf
			1	Leaf
			1	Whole plant
	Lawa	Food	6	Flower
			7	Fruit
			7	Leaf
			13	Fruit
L. monopetala (Roxb. ex Baker) Pers.	*Akha*	Medicine	2	Bark
(NC 011)	*Hmong*	Medicine	5	Bark
	Karen	Medicine	1	Bark
			2	Heartwood
			2	Root
	Karen	Medicine	6	Root
L. myristicifolia (Wall. ex Nees) Hook.fil.	*Lahu*	Food	1	Shoot Leaf
(NC 012)				
L. semecarpifolia (Nees) Hook.fil.	*Hmong*	Medicine	1	Bark
(NC 013)			2	Branch
			1	Leaf
			2	Leaf
			1	Leaf
			2	Root