BIODIVERSITAS
Volume 24, Number 8, August 2023
Pages: 4617-4635

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d240844

Ethnobotanical knowledge of medicinal plants in the Don Pu Ta Forest by Kaloeng Ethnic Group, Sakon Nakhon Province, Northeastern Thailand

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Manuscript received: 11 July 2023. Revision accepted: 27 August 2023.

Abstract. *Appamaraka S, Saensouk S, Saensouk P, Junsongduang A, Setyawan AD. 2023. Ethnobotanical knowledge of medicinal plants in the Don Pu Ta Forest by Kaloeng Ethnic Group, Sakon Nakhon Province, Northeastern Thailand. Biodiversitas 24: 4617-4635.* Don Pu Ta Forest (in Thailand) is a vital conservation area with significant natural resources that are intertwined with the way of life, traditions, beliefs, and culture of the local community. This ecosystem fosters interdependence among its components. The local healers rely on the medicinal plants found in the Don Pu Ta Forest to provide healthcare to the people in their community. This research aimed to investigate the plant diversity, ethnobotanical knowledge, and medicinal plant utilization in the Don Pu Ta Forest, specifically within the Kaloeng Ethnic Group of Sakon Nakhon Province, Thailand. Data were collected through semi-structured interviews involving three indigenous healers and 220 local residents between January 2016 and November 2017. The interviews focused on plant usage, local names, utilized plant parts, methods of use, and medicinal properties. We also conducted vegetation analysis to assess the diversity and composition of vegetation in the Don Pu Ta Forest. The findings revealed that the Don Pu Ta Forest of the Kaloeng Ethnic Group in Sakon Nakhon Province contained medicinal plants from 28 families and 44 species. The biodiversity index (H') was calculated as 3.34, the Evenness Index (E) as 0.88, and the highest importance value index (IVI) as 25.26. Interviews with folk medicine healers identified the use of medicinal plants for treating 29 different symptoms. Notably, *Micromelum minutum* (Forst.f.) Wright & Arn., *Rhodamnia dumetorum* (DC.) Merr. & L.M. Perry, *Garcinia cowa* Roxb., and *Casearia grewiifolia* var. *grewiifolia* exhibited the highest Fidelity Level (FL) at 100%. The results of this study imply that ancestral wisdom's role in shaping the Kaloeng group's medicinal traditions, advocating for their integration with contemporary healthcare. In summary, the study offers valuable insights into the diversity, importance, and ethnobotanical use of medicinal plants in Don Pu Ta Forest, emphasizing possibilities for conservation, sustainable practices, and further exploration of these resources for healthcare benefits.

Keywords: Ethnobotany, Kaloeng Ethnic Group, medicinal, Sakon Nakhon, Thailand

INTRODUCTION

Healthcare has long relied on forest plants for treating illnesses and maintaining body fitness. The knowledge on the utilization of plants for health and medicinal purposes is gained from trial and error in nature and then passed down through generations. Each ethnic group has their own unique ways of using these plants and passing on the valuable wisdom. Medicinal plants play a crucial role in rural societies and are integral part of indigenous communities as part of their identity, reflecting ancestral resourcefulness, customs and beliefs. In Thailand, with its high biodiversity, over 1,800 of the 20,000 plant species can be used medicinally (HSRI 2016).

Ethnobotany is the science that explores the relationship between humans and the plants in their surroundings. This is an interdisciplinary field that covers a wide range of research topics and concepts. It encompasses the various uses of plants, including in vital aspects of life such as food, medicine, shelter, clothing, arts, and culture. Beyond such themes, ethnobotany can include the examination plants utilized in rituals, beliefs, and the nourishment of the mind. Nonetheless, ethnobotany that focuses on the medicinal uses of plants hold utmost importance and are considered essential (Tangjitman et al. 2015; Maknoi et al. 2016; Trisonthi 2018). Ethnobotanical research in medical aspect can also focus on specific plants with unique characteristics, such as hallucinogenic or heart-stimulating properties. Medical ethnobotany specifically examines the medicinal uses of plants within human societies, communities, or ethnic groups (Pholhiamhan et al. 2018; Trisonthi et al. 2018; Teerapattarakan and Rujjanawate 2021).

Ethnobotany focusing on the local ecological knowledge of indigenous people, or commonly known as

folk botany, encompasses the study of botanical knowledge among various ethnic groups within specific geographical regions, whether they are large areas or smaller areas of interest. Some examples include folk botany of medicinal plants from swidden fallows and sacred forest of the Karen and the Lawa in Thailand (Junsongduang et al. 2013), the Karen in Northern Thailand (Tangjitman et al. 2013), the ethnobotany of Phu Thai ethnic group in Nakhon Phanom province (Pholhiamhan et al. 2018), the ethnobotany on Zingiberaceae plants in Nakhon Phanom Province (Saensouk et al. 2018), the ethnobotany of edible plants in Muang District, Kalasin Province (Phatlamphu et al. 2021), the traditional use of Zingiberaceae in Udon Thani Province (Saensouk and Saensouk 2021a), and recently the traditional use of Zingiberaceae plants in Mae Hong Son Province (Inta et al. 2023) and in Nakhon Nayok Province (Boonma et al. 2023), etc.

Northeastern Thailand, known as Isan, covers around 170,226 square kilometers, or equal to one-third of the country's total area. It boasts diverse ethnicities, arts, cultures, traditions, and local wisdom. The region's arts and cultures reflect beliefs, social values, religions, and lifestyles (Trisonthi et al. 2018). Ethnic groups in the Northeast Thailand include Thai-Lao or Thai Isan, Phu Thai, Tai Dam or Thai Song Dam–Lao Song, Kula, Kui or Guay-Suai-Yer, Khmer, Yor or Yo-Ngiao, So or Kaso, Saek, Kha or Brue, Kaloeng, and Yoi (Junsongduang et al. 2013; Ethnic groups of Isan 2015; Pholhiamhan et al. 2018). Furthermore, past waves of migration due to war and interactions with people from neighboring countries have facilitated cultural exchanges and the development of local wisdom in healthcare (Pholhiamhan et al. 2018; Trisonthi et al. 2018; Phechphakdee et al. 2019; Phatlamphu et al. 2021).

The Kaloeng Ethnic Group, part of Sakon Nakhon Province, has a deep ancestral history. They originated from Phuwanakradueng, South Vietnam, now part of Laos. Due to invasions, they relocated to Mahachai Kong Kaeo, some crossing the Mekong River into Thailand. They spread to other northeastern provinces like Nakhon Phanom, Sakon Nakhon, and Mukdahan. In Sakon Nakhon, they settled near the Phu Phan Mountains in Kut Haet Subdistrict. The Kaloeng Ethnic Group revere the Don Pu Ta Forest, believing it's protected by the spirits of Pu Ta, who safeguard against deforestation (Klinhom 2014). The Don Pu Ta Forest is vital for Isan communities, connecting people, nature, and supernatural beings. It showcases the interdependence between humans and forests, as well as the deep attachment of the Kaloeng Ethnic Group to nature (Klinhom 2014; Pholhiamhan et al. 2018). Despite its smaller size, the forest's biodiversity rivals ten times larger animal husbandry forests (Klinhom 2014; Pholhiamhan et al. 2018).

According to literature reviews of the related documents and research, it was found that the study of ethnobotany and the uses of medicinal plants in the Don Pu Ta Forest, Thailand was very limited. This was due to the belief that the Don Pu Ta Forest was sacred, and its use was forbidden. Therefore, conducting a comprehensive survey and study in all areas of the Don Pu Ta Forest is necessary. This research aimed to investigate the plant diversity, ethnobotanical knowledge, and medicinal plant utilization in the Don Pu Ta Forest, specifically within the Kaloeng Ethnic Group of Sakon Nakhon Province. The results of this study will serve as an important database to understand the knowledge and wisdom of indigenous healers in utilizing medicinal plants for healthcare, and it will also provide guidelines for conservation to ensure long-term sustainability.

MATERIALS AND METHODS

Study area and period

The study was conducted in Don Pu Ta Forest, Ban Kut Haet, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, which is located in the Phu Phan Mountain range, Northeastern Thailand (17°03'40" N to 17°03'49" N, 103°48'36" E to 17°48'48" E) (Figure 1). Data collection was conducted between January 2016 and November 2017.

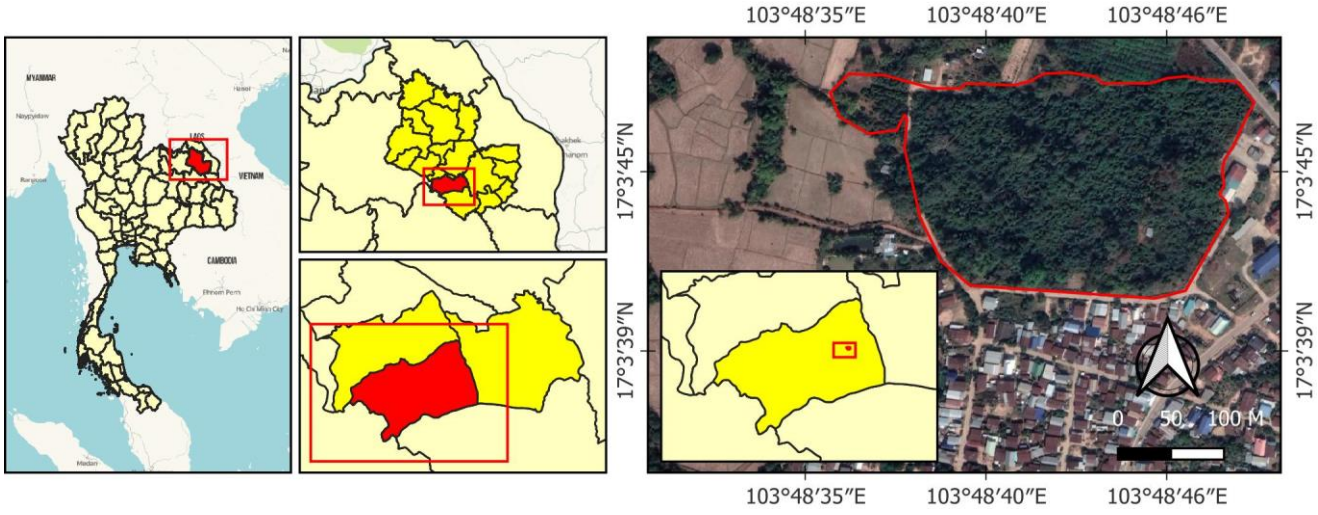

Figure 1. Map of the studied area in Don Pu Ta Forest, Ban Kut Haet, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, Northeastern Thailand

Data collection procedure

This study documents ethnobotanical knowledge of ethnic groups living around Don Pu Ta Forest. The population in the study area consists of villagers from Ban Kut Haet, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, totaling 624 people. The sample group comprised 3 indigenous healers or local philosophers with knowledge and experience in the use of herbal medicines in the Kaloeng Ethnic Group for more than 20 years. The sample was selected through purposive sampling (Yamane 1973). Additionally, 220 villagers aged 40 years or older, residing in the study area, were included in the sample.

Ethnobotanical knowledge and wisdom on the use medicinal plants for the treatment of community diseases was collected through a semi-structured interview by documenting the plant species, the use of plants, local names, useful parts, usage characteristics, and medicinal properties.

Field survey to collect information on the biodiversity of medicinal plants in Don Pu Ta Forest was carried using the Quadrat method. Plots with size from 1×1 square meters to particular sizes (e.g., 2, 3, 4 and so on) were continuously placed until no new species were found for 3 times, resulting in a suitable plot size per area. The distance between each plot is consistently set at 50–100 meters to cover the entire area. Then, three different plot sizes were used. The first plot size was determined based on the size of the plot where no new plants were found, and it was used to study the trees. The plot size of 5×5 meters was used for studying the sapling. Additionally, a plot size of 1×1 meter was used for studying seedlings (Butnamphet 2015).

Trees in the plot were recorded by measuring the size of trees with a circumference greater than 30 cm in diameter at breast height or at a level of 1.30 m from the ground. We recorded the length, circumference, species name, number of trees, and the height of each tree using the clinometers or a PVC pipe that is 4 meters long. Saplings (young trees with a circumference less than 30 cm in diameter at breast height or at a level of 1.30 m from the ground) were recorded in a small plot of 10×10 meters within a large plot of 20×20 meters. We recorded the circumference length, species name, and number of trees. Seedlings were recorded in small plots of 1×1 meter within the larger plot of 10×10 meters and record the number of species and the number of seedlings in each plot.

We recorded biodiversity data of medicinal plants and their medicinal properties in a notebook, with participation from local healers who provide information, even if only the local name is known. The photographs of all parts of the plant were taken, and the branches, leaves, flowers, or fruits of each plant were cut using. The plant samples were stored in a plastic bag and numbered with ID for further inquiry with knowledgeable individuals or for additional research by using keys to species of plants and reference books and various botanical documents (e.g., Low et al. 2014; Rahman et al. 2014; Smitinand 2014; Van Welzen et al. 2014; Bongcheewin et al. 2015; Esser and Saw 2015; Paton et al. 2016; Saensouk et al. 2016, 2018, 2021a,b,c,d, 2022a,b,c; Ye and Xia 2016; Bongcheewin et al. 2017; Leeratiwong et al. 2017; Chen et al. 2018; Rather et al. 2018; Souvannakhoummane et al. 2018; Boonma and Saensouk 2019; Choopan et al. 2019; Ezedin and Weiblen 2019; Saensouk and Saensouk 2019a, b, 2020a,b,c, 2021a,b, 2023; Boonma et al. 2020a,b, 2021; Chen et al. 2020; Rokade et al. 2020; Chantaranothai 2021; Esser 2021; Johnson et al. 2021; Kumar et al. 2021; Lim et al. 2021; Priscila et al. 2021; Satthaphorn et al. 2021; Bongcheewin et al. 2022; Chantaranothai et al. 2022; Ngernsaengsaruay et al. 2022; Ragsasilp et al. 2022; Rakarcha et al. 2022; Singh 2022; Tagane et al. 2022; Tarmizi et al. 2022; Zhang et al. 2022; Inta et al. 2023; POWO 2023).

Data analysis

Species diversity and composition

The diversity of medicinal plants was analysed using the Evenness Index (E), Shannon Weaver Biodiversity Index (H'), Importance Value Index (IVI), Relative Density (RD), Relative Frequency (RF), and Relative Dominance (RDo).

Evenness Index (E) quantifies the evenness of species distribution across different sample sites. Higher values indicate more even distribution. It's calculated as the ratio of the observed diversity (Sobs) to the maximum possible diversity (Smax), i.e., E = Sobs / Smax.

Shannon Weaver Biodiversity Index (H') combines both species richness and evenness. It considers both the number of species and their relative abundance. It's calculated using the formula $H' = -\Sigma (Pi * \ln(Pi))$, where Pi is the proportion of individuals of the ith species in the total sample.

Importance Value Index (IVI) provides a measure of the ecological importance of each species in a community. It's calculated using the sum of relative density, relative frequency, and relative dominance of each species.

Relative Density (RD) is the proportion of individuals of a particular species relative to the total number of individuals in the sample.

Relative Frequency (RF) is the proportion of samples in which a particular species occurs.

Relative Dominance (RDo) is the proportion of the total biomass or cover contributed by a particular species.

Species utilization

Species utilization was analysed using Informant Consensus Factor (ICF) and Fidelity Leve (FL). ICF assesses the level of agreement among informants regarding the use of specific plants for ailments. It's calculated as (Nur - Nt) / (Nur - 1), where Nur is the number of use citations for a particular ailment and Nt is the number of taxa used for the same ailment.

Fidelity Level (FL) measures the reliability of a particular plant used for a specific purpose. It's calculated as (%Fl = (Np / N) * 100), where Np is the number of informants mentioning a specific plant for a particular purpose and N is the total number of informants.

In both parts of the analysis, conducting interviews with knowledgeable individuals from the community is essential to gather the required data. The quantitative indices provide valuable insights into the diversity, distribution, and

importance of medicinal plant species, while the qualitative indices (ICF and %Fl) shed light on the consensus and reliability of traditional medicinal plant uses.

RESULTS AND DISCUSSION

Medicinal plants diversity in Don Pu Ta Forest used by healers

The species diversity of medicinal plants in the Don Pu Ta Forest used by the Kaloeng Ethnic Healers in Kut Haet Village, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, consists of 44 species belonging to 28 families. The Rubiaceae family is the most diverse, with 4 species, followed by the Ebenaceae, Euphorbiaceae, Fabaceae, and Moraceae families, each with 3 species. The Annonaceae, Arecaceae, Myrtaceae, Phyllanthaceae, and Sapindaceae families each have 2 species. The remaining families, namely Acanthaceae, Apocynaceae, Aspleniaceae, Asteraceae, Bignoniaceae, Calophyllaceae, Capparaceae, Clusiaceae, Connaraceae, Dioscoreaceae, Elaeocarpaceae, Lauraceae, Lythraceae, Ochnaceae, Oleaceae, Rhamnaceae, Rutaceae, and Salicaceae, are represented by only one species each (Table 1).

Biodiversity index of medicinal plants in Don Pu Ta Forest used by healers

Shannon Weaver Biodiversity Index (H') and Evenness Index (E) of medicinal plants in Don Pu Ta Forest showed the diversity and distribution of medicinal plant species in the ancestral upland forest of the Kaloeng Ethnic Group. The Shannon Weaver Biodiversity Index (H') is 3.34 in total, where the tree had the highest diversity index equal to 3.18, followed by sapling with 2.53 and seedling with 1.94, respectively and overall species Evenness Index of 0.88.

Important Value Index (IVI) of medicinal plants in Don Pu Ta Forest used by healers

Based on the analysis of the important value index (IVI), medicinal plants in the Don Pu Ta Forest used by the Kaloeng tribe healers were dominated by *Baliospermum solanifolium* (Burm.) Suresh, followed by *Suregada multiflora* (A.Juss.) Baill., and *Mikania cordata* (Burm.f.) B.L. Rob., respectively, with an important index of 25.26, 25.18 and 18.09, respectively. The least important was *Dasymaschalon lomentaceum* Finet & Gagnep., which had an important value index of 0.98.

Uses of medicinal plants in Don Pu Ta Forest by healers

Using semi-structured in-depth interviews with a group of indigenous healers or local philosophers of Kaloeng Ethnic, it was found that 44 medicinal plants in Don Pu Ta Forest were used to treat 17 symptom groups (Table 1).

The parts of the 44 medicinal plants used by Kaloeng Ethnic Healers in Don Pu Ta Forest, Ban Kut Haet, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province are as follows: the core is the most used part, accounting for the highest percentage of approximately 40.8% of the utilized parts. This is followed by root, which represents about 31.6% of the used parts, and bark, which accounts for about 11.8%. Vine, fruit, and using all parts comprise approximately 5.3% of the utilized parts (Figure 2).

The utilization of the core of plants has the most significant impact, as obtaining the core requires cutting down the entire tree. However, if trees are cut without replanting or increasing the number of replacements in the area to maintain a balance between usage and tree population, it can lead to the extinction of species that use the core part of the Don Pu Ta Forest. Therefore, implementing a conservation plan for sustainable use is crucial to ensure the viability of these plants.

The medicinal plants used by Kaloeng Ethnic Healers in Don Pu Ta Forest are primarily prepared by boiling them for drinking, accounting for approximately 86.96% of the methods used. Other methods, such as roasting for consumption, boiling for bathing, pounding for consumption, steaming for consumption, eating fresh, and grinding into powder for external application, each account for an equal percentage of 2.17%. When comparing internal and external uses, it was observed that most medicinal plants were used for internal consumption, representing approximately 95.66% of the methods employed. Only about 4.34% of the plants were utilized for external purposes, specifically boiling for bathing and grinding into powder for external application (Figure 3).

The medicinal plants used by Kaloeng Ethnic Healers in Don Pu Ta Forest primarily target various symptom groups. Among these, most treatments are focused on gastrointestinal symptoms, accounting for approximately 30.00% of all treated symptom groups. The next significant category is the nutrition and blood group, which aims to nourish the body and improve blood-related conditions, comprising about 24.00% of treatments. Musculoskeletal and joint diseases account for 8.00% of the treatments, while the skin system and laxatives are each addressed at approximately 6.00%. Specific conditions such as aphthous stomatitis and antipyretics are treated at 4.00% each. Treatment for leucorrhea, abdominal abscess, anthelmintics, cardiovascular system issues, headache relief, urinary disorders, improvement of sexual performance, poisoning and toxicology, and hemorrhoids are each addressed at a rate of 2.00% (Figure 4).

Medicinal plant diversity used by the villagers of the Kaloeng Ethnic

Through interviews conducted with villagers in Kut Haet Village, it was discovered that the villagers of the Kaloeng Ethnic Group utilize a total of 135 species (Table 2). These species belong to 53 families, with Fabaceae being the most diverse family, comprising 18 species. Zingiberaceae follows with 8 species, while Asteraceae, Lamiaceae, and Rubiaceae each have 6 species. Euphorbiaceae, Menispermaceae, and Moraceae each have 5 species. Acanthaceae, Poaceae, and Rutaceae each have 4 species. Annonaceae and Sapindaceae each have 3 species. Apocynaceae, Connaraceae, Malvaceae, Phyllanthaceae, Rhamnaceae, Salicaceae, and Sapotaceae each have 2 species. Finally, there are several families represented by only one species, namely Amaryllidaceae, Apiaceae, Asphodelaceae, Bignoniaceae, Boraginaceae, Calophyllaceae, Celastraceae,

Chrysobalanaceae, Clusiaceae, Combretaceae, Cyperaceae, Ebenaceae, Escalloniaceae, Gnetaceae, Hypericaceae, Iridaceae, Lauraceae, Loganiaceae, Loranthaceae, Lythraceae, Magnoliaceae, Melastomataceae, Moringaceae, Myrtaceae, Nepenthaceae, Ochnaceae, Opiliaceae, Passifloraceae, Polypodiaceae, Ranunculaceae, Saururaceae, Simaroubaceae, and Solanaceae.

Out of the one hundred twenty-four species used by the villagers of the Kaloeng Ethnic Group for medicinal purposes, only eleven species were taken from the Don Pu Ta Forest. These include *Calophyllum inophyllum* L., *Casearia grewiifolia* Vent., *Cinnamomum ilicioides* A.Chev., *Croton persimilis* Müll.Arg., *D. lomentaceum*, *Garcinia cowa* Roxb. ex Choisy, *Micromelum minutum* (G.Forst.) Wight & Arn., *Nauclea orientalis* (L.) L., *Pavetta indica* L., *Rhodamnia dumetorum* (DC.) Merr. & L.M.Perry, and *Streblus asper* Lour. Ninety-seven species were brought from other forests, fifty-seven from their home garden, while three species, namely *Andrographis paniculata* (Burm.f.) Wall. ex Nees, *Ficus villosa* Blume, and *Tinospora crispa* (L.) Hook.f. & Thomson, were purchased from the market (Table 2).

The villagers of the Kaloeng Ethnic Group in Don Pu Ta Forest use various plant parts for medicinal purposes. The most used part is the root, accounting for approximately 22.33% of the total parts used. Leaf is the next most utilized part, comprising about 17.96% of the usage. Stem and core parts contribute around 12.14%, followed by vine at approximately 9.71%. Rhizome or bulb and all parts' usage account for about 6.80%. Bark contributes about 5.34% of the usage, while fruit makes up around 4.85%. Flower is used to a lesser extent at roughly 0.97%, and latex and leaf sheath have a usage rate of 0.49% each (Figure 5).

The villagers of the Kaloeng Ethnic Group in Don Pu Ta Forest employ various methods for medicinal purposes. The most used method is boiling the plants for consumption as a drink, accounting for approximately 42.11% of the methods employed. Eating the plants in their fresh form is the most prevalent method, comprising about 24.21% of the usage. Crush or rub methods for external applications represent approximately 9.47% while making herbal compresses accounts for 8.42%. Boiling the plants for bathing is utilized at a rate of 7.37%. Soaking the plants in warm water represents 5.26% of the methods while rubbing or squeezing the plants for direct consumption amounts to 2.11%. Finally, grinding the plants into powder for external applications represents 1.05% of the methods employed (Figure 6). When comparing the internal and external uses, it was observed that most medicinal plants were used for internal consumption, accounting for approximately 73.69% of the methods employed. In contrast, around 26.31% of the methods were utilized for external purposes.

The villagers of the Kaloeng Ethnic Group in Don Pu Ta Forest utilize medicinal plants to target various symptom groups. Most treatments focus on nutrition and blood, which nourish the body, strengthen it, and enhance blood health, accounting for approximately 28.14% of all treated symptom groups. The gastrointestinal group follows with about 12.93%, while obstetrics and gynecology represent approximately 8.37% of the treatments. Cure for cough and phlegm expulsion accounted for around 7.22%. The skin system, cardiovascular system, and poisoning and toxicology groups each makeup about 6.84% of the treated symptom groups. Antipyretics, musculoskeletal and joint diseases groups each represent approximately 6.46%. Urinary disorders are targeted at about 3.04%. Hemorrhoid treatment and wound healing constitute about 1.90% of the treatments. Healing aphthous stomatitis is addressed at approximately 1.52%. Headache relief is accounted for at 1.14%. Prevention of cancer and relief from toothache each represent about 0.76%. Laxatives and the improvement of sexual performance make up approximately 0.38% each (Figure 7).

The utilization of medicinal plants by the villagers of the Kaloeng Ethnic Group in Ban Kut Haet, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, relies on various sources of knowledge. Most knowledge, approximately 92.46%, is derived from ancestors, as revealed through interviews with the villagers. The Kaloeng Ethnic Healers contribute 2.51% of the knowledge, while 2.51% comes from hospitals. Approximately 2.01% of the knowledge is acquired through online searching, and a small portion, about 0.50%, is obtained through hearsay (Figure 8 and Table 2).

Table 1. The utilization of medicinal plants in Don Pu Ta Forest by Kaloeng Ethnic Healers, Thailand

Species	Thai Common Name	Used Part	Method of Use	Group of Symptoms
Adenanthera pavonina L.	Ma Klam Ton	Fruit	Roast	Gastro-intestinal
Adina trichotoma (Zoll. & Moritzi) Benth. & Hook.f. ex B.D.Jacks.	Khem Chang	Root, core	Boiling	Nutrition and blood
Akschindlium godefroyanum (Kuntze) H.Ohashi	Chai Hin	Core	Boiled and use for bathing	Skin system
Alstonia scholaris (L.) R.Br.	Phaya Sattaban	Root, core, bark	Boiling	Gastro-intestinal
Aporosa ficifolia Baill.	Muead Khon	Root, core	Boiling	Antipyretics
Arfeuillea arborescens Pierre ex Radlk.	Khong Kha Dueat	All parts	Boiling	Treat hemorrhoids, and wounds healing
Artabotrys harmandii Finet & Gagnep.	Nom Wua	Root, core	Boiling	Nutrition and blood
Artocarpus thailandicus C.C.Berg	Ma Hat	Core, bark	Boiling	Laxative
Baccaurea ramiflora Lour.	Ma Fai	Root, core, bark, flower	Boiling	Healing the aphthous stomatitis
		Fruit	Boiling	Laxative
Baliospermum solanifolium (Burm.) Suresh	Tong Taek	Core	Boiling	Nutrition and blood
Calophyllum inophyllum L.	Kra Thing	Root, core	Boiling	Treatment of leucorrhea and skin system
Campylospermum serratum (Gaertn.) Bittrich & M.C.E.Amaral	Chang nom	Root, core	Boiling	Musculoskeletal and joint diseases
Capparis micracantha DC.	Ching Chi	Root	Boiling	Treatment of abdominal abscess
Casearia grewiifolia Vent.	Kruai Pa	Core	Boiling	Nutrition and blood
Cinnamomum ilicioides A.Chev.	Ta Khrai Ton	Root, core, bark	Boiling	Gastro-intestinal
Connarus semidecandrus Jack	Thop Thaep Khruea	All parts	Boiling	Gastro-intestinal
Croton persimilis Müll.Arg.	Plao Yai	Root, core	Boiling	Gastro-intestinal
Dasymaschalon lomentaceum Finet & Gagnep.	Prong Kio	Root, core	Boiling	Gastro-intestinal
Dimetia capitellata (Wall. ex G.Don) Neupane & N.Wikstr.	Duk Kai Yan	Vine	Boiling	Nutrition and blood
Dioscorea bulbifera L.	Kling Klang Dong	Vine	Boiling	Nutrition and blood, musculoskeletal and joint diseases
Diospyros filipendula Pierre ex Lecomte	Kan Chong	All parts	Boiling	Gastro-intestinal
Diospyros lanceifolia Roxb.	Phlap Hua Khaeng	Root, core	Boiling	Gastro-intestinal
Diospyros mollis Griff.	Ma Kluea	Fruit	Pound	Anthelmintic
		Core, bark	Boiling	Gastro-intestinal
Diplazium esculentum (Retz.) Sw.	Phak Kood	Root, leaf	Boiling	Cardiovascular system
Elaeocarpus lanceifolius Roxb.	Phi Phai	Root, core	Boiling	Nutrition and blood
Fernandoa adenophylla (Wall. ex G.Don) Steenis	Khae Hang Khang	Root, core, bark, flower	Boiling	Musculoskeletal and joint diseases
Ficus villosa Blume	Ma Kra Thuep Rong	Root, core	Boiling	Nutrition and blood
Garcinia cowa Roxb. ex Choisy	Cha Muang	All parts	Boiling	Antipyretics
Jasminum scandens (Retz.) Vahl	Kai Noi	Vine	Boiling	Gastro-intestinal
Lagerstroemia loudonii Teijsm. & Binn.	Salao	Root, core	Boiling	Gastro-intestinal
Micromelum minutum (G.Forst.) Wight & Arn.	Samat Noi	Root, leaf	Steam boiler	Relieve headache
Mikania cordata (Burm.f.) B.L.Rob.	Khee Kai Yan	Bark	Grind into powder	Skin system
Nauclea orientalis (L.) L.	Kan Lueang	Core	Boiling	Musculoskeletal and joint diseases, and urinary disorders
Nephelium hypoleucum Kurz	Kho Laen	Root, core, bark	Boiling	Healing the aphthous stomatitis
		Fruit	Eating fresh	Laxative
Pavetta indica L.	Khem Pa	Core	Boiling	Nutrition and blood
Phlogacanthus pulcherrimus T.Anderson	Dee Pla Gung	Core	Boiling	Gastro-intestinal
Rhapis excelsa (Thunb.) A.Henry	Chang	Root, core	Boiling	Gastro-intestinal
Rhapis laosensis Becc.	Chang	Root, core	Boiling	Gastro-intestinal
Rhodamnia dumetorum (DC.) Merr. & L.M.Perry	Phlong Kaem On	Root, core, bark	Boiling	Nutrition and blood
Sindora siamensis Teijsm. ex Miq.	Ma Kha Tae	Core	Boiling	Nutrition and blood, increase sexual performance
Streblus asper Lour.	Khoi	Root, core	Boiling	Poisoning and toxicology
Suregada multiflora (A.Juss.) Baill.	Khan Thong Phayab	Core	Boiling	Musculoskeletal and joint diseases
Syzygium cumini (L.) Skeels	Wa	Root, core	Boiling	Gastro-intestinal
Ventilago denticulata Willd.	Rang Daeng	Vine	Boiling	Nutrition and blood

Table 2. Species diversity of medicinal plants utilized by the villagers in the Kaloeng Ethnic Group in Kut Haet Village, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, Thailand

Family	Species	Thai Common Name	Vernacular Name	Found in Don Pu Ta Forest	Sources of plant			Used Part	Medicinal Properties	Source of Information
					Other Forest	Home garden	Purchasing			
Acanthaceae	*Acanthus ebracteatus* Vahl	Ngueak Pla Mo	Ngueak Pla Mo		+			Vine	Boil and eat to prevent cancer	Ancestor
Acanthaceae	*Andrographis paniculata* (Burm.f.) Wall. ex Nees	Fa Thalai Chon	Fa Thalai Chon			+		All parts	Boil and eat to cure fever, reduce blood pressure, and diabetes.	Ancestor
					+			Stem	Boil and eat to nourish the body and cure cough	Ancestor
						+		Leaf	Soak in warm water and drink to cure the cold and sore throat remedies	Traditional healers
						+		Leaf	Boil and eat to cure flatulence, diarrhea, and cough, nourish the body, and cure fever, and cold. Eat fresh to cure fever, and reduce blood pressure	Ancestor
						+		Stem	Boil and eat to cure cough and cold; Eat fresh to cure fever	Ancestor
					+			All parts	Boil and eat to cure fever, and cold	Ancestor
							+	Leaf	Boil and eat to cure fever	Traditional healers
Acanthaceae	*Barleria lupulina* Lindl.	Salet Phang Phon	Salet Phang Phon			+		All parts	Detoxify the insect bites	Ancestor
					+			Leaf	Detoxify the insect bites	Searching
Acanthaceae	*Rhinacanthus nasutus* (L.) Kurz	Thong Phan Chang	Thong Phan Chang			+		Leaf	Boil and take a bath to reduce rashes; Boil, eat, and nourish the body and liver	Ancestor
Amaryllidaceae	*Crinum asiaticum* L.	Plab Plueng	Plab Plueng			+		Leaf	Used to relief internal pain	Ancestor
Annonaceae	*Dasymaschalon lomentaceum* Finet & Gagnep.	Prong Kio	Mue Phi	+	+			Fruit	Boil and eat to expel phlegm	Ancestor
					+			Root	Boil and eat to nourish body	Ancestor
Annonaceae	*Goniothalamus laoticus* (Finet & Gagnep.) Bân	Khao Lam Dong	Ton Khao Lam		+			Root	Boiled and eat for diuretic	Ancestor
Annonaceae	*Polyalthia evecta* (Pierre) Finet & Gagnep.	Nom Noi	Tong Laeng		+			Root	Boil and eat to nourish the body; Boil, eat, and bathe after childbirth, relieve diarrhea, and relieve pain	Ancestor
					+			Fruit	Boil and eat to expel phlegm	Ancestor
Apiaceae	*Centella asiatica* (L.) Urb.	Bua Bok	Phak Nok			+		Leaf	Eat fresh, reduce diabetes and blood pressure	Ancestor
Apocynaceae	*Alstonia scholaris* (L.) R.Br.	Phaya Sattaban	Tin Pet			+		Core	Boil and eat to cure gastritis	Ancestor
Apocynaceae	*Cryptolepis buchananii* R.Br. ex Roem. & Schult.	Thao En On	Khruea En On		+			Vine	Boil and eat as a medicine to relax tendons, and relieve pain	Ancestor
					+			Root	Boil and eat to relieve pain	Ancestor
					+			Vine	Make a herbal compress to relieve pain	Hospital

Asphodelaceae	*Aloe vera* (L.) Burm.f.	Wan Hang Jorakae	Wan Hang Jorakae			+	Leaf	Used to apply wounds caused by burns or scald	Ancestor
Asteraceae	*Blumea balsamifera* (L.) DC.	Nat Yai	Nat		+		Leaf	Boil and eat to nourish energy and body; or bath after giving birth	Ancestor
						+	Leaf	Warming and apply compresses over the body for good blood circulation	Ancestor
Asteraceae	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Sap Suea	Ya Farang		+		Root	Boiled roots and eat to cure gastritis, and stems boiled eat to relieve migraines	Ancestor
					+		Basal of stem	Boil and eat to relieve migraines	Ancestor
					+		Leaf	Crush and apply to fresh wounds to stop bleeding	Ancestor
						+	Leaf	Rub to cure the stomach and flatulence, apply to close fresh wounds for stop bleeding	Ancestor
Asteraceae	*Cyanthillium cinereum* (L.) H.Rob.	Ya Dok Khaow	Ya Dok Khaow			+	Root and Leaf	Boiled roots are eaten to cure boredom and drunkenness; The leaves are used to help stop the bleeding	Ancestor
Asteraceae	*Elephantopus scaber* L.	Do Mai Ruu Lom	Kingfai		+		Stem	Boil and eat to cure cold and cough	Ancestor
Asteraceae	*Helianthus tuberosus* L.	Than Tawan Hua	Kaen Tawan			+	Rhizome	Dried and boiled, eaten to cure hemorrhoids	Ancestor
Asteraceae	*Stevia rebaudiana* (Bertoni) Bertoni	Ya Wan	Ya Wan		+		Leaf	Boil and eat to nourish the body, reduce diabetes	Ancestor
Bignoniaceae	*Dolichandrone serrulata* (Wall. ex DC.) Seem.	Khae Na	Khae Pa			+	Flower	Boil and eat to cure fever	Ancestor
Boraginaceae	*Heliotropium indicum* L.	Ya Nguang Chang	Nguang Chang		+		All parts	Boil and eat to cure urination	Ancestor
Calophyllaceae	*Calophyllum inophyllum* L.	Kra Thing	Khao Kra Thing	+	+		Vine	Boil and eat to nourish the blood and the milk	Ancestor
Celastraceae	*Salacia chinensis* L.	Kam Phaeng Chet Chan	Ta Kai		+		Root	Boil and eat to relieve diarrhea	Ancestor
					+		Stem	Boil and eat to nourish strength and body	Ancestor
Chrysobalanaceae	*Parinari anamensis* Hance	Ma Phok	Phok		+		Core	Boil and eat to cure gastritis	Ancestor
Clusiaceae	*Garcinia cowa* Roxb. ex Choisy	Cha Muang	Leb Mong	+	+		Leaf	Boil and eat to nourish the blood	Ancestor
Combretaceae	*Terminalia bellirica* (Gaertn.) Roxb.	Samo Phi Phek	Haen			+	Core	Boil and eat to nourish body	Ancestor
Connaraceae	*Ellipanthus tomentosus* subsp. *tomentosus*	Kam Rok	Nok Krod		+		Core	Boil and eat to relieve cough and pain	Traditional healers
					+		Core	Boil and eat to cure cough, fever, cold, and sore throat	Ancestor
					+		Core	Boil or soak in water, eat to cure cough	Searching
						+	Core	Boil and eat to cure a cold	Ancestor
					+		Stem	Boil and eat to cure cough, cold, sore throat, and fever	Ancestor
Connaraceae	*Rourea stenopetala* (Griff.) Hook.f.	Ma Kham Khruea	Ma Kham Khruea		+		Vine	Boil and eat to nourish body	Ancestor
Cyperaceae	*Cyperus rotundus* L.	Ya Haeo Mu	Ya Haeo Mu			+	Root	Boil and eat to relieve flatulence	Ancestor
Ebenaceae	*Diospyros ehretioides* Wall. ex G.Don	Taptao Ton	Tong Tung		+		Root	Boil and eat after childbirth	Ancestor
Escalloniaceae	*Polyosma fragrans* (Wall.) Benn.	Yor Pa	Yor Pa		+		Core	Boil and eat to relieve waist pain	Ancestor
						+	Fruit	Eat to treat urinary disease	Ancestor
Euphorbiaceae	*Croton persimilis* Müll.Arg.	Plao Yai	Plao	+	+		Root	Boil and drink to cure caugh	Ancestor

				+		Leaf	Boil and take a shower after childbirth to nourish	Ancestor
Euphorbiaceae	*Croton stellatopilosus* H.Ohba	Plao Noi	Plao Noi	+		Root	Boil and eat to cure gastritis	Ancestor
Euphorbiaceae	*Euphorbia hirta* L.	Nam Nom Ratchasi	Nam Nom Ratchasi	+		Root	Boil and eat to nourish milk	Ancestor
Euphorbiaceae	*Jatropha curcas* L.	Sabu Dam	Sabu Dam		+	Leaf	Boil and bath to cure chickenpox fever	Ancestor
Euphorbiaceae	*Plukenetia volubilis* L.	Daow In Kha	Tua In Kha		+	Stem	Boil and eat to reduce diabetes and blood pressure	Hearsay
					+	Leaf, Fruit	Boil and eat to heal the uterus	Ancestor
Fabaceae	*Biancaea sappan* (L.) Tod.	Fang	Fang	+		Core	Boil and eat to nourish the blood, nourish the kidneys, nourish the energy, nourish the body, cure gastritis, reduce diabetes, cure cough, reduce cold, and relieve stomach pain	Ancestor
					+	Core	Boil and drink to nourish blood	Ancestor
Fabaceae	*Butea superba* Roxb. ex Willd.	Kwaow Khruea Daeng	Kwaow Khruea Daeng	+		Rhizome	Boiled and drink for nourishing body, and strength	Ancestor
Fabaceae	*Caesalpinia pulcherrima* (L.) Sw.	Hang Nok Yung Thai	Som Pho	+		Root	Boil and eat to nourish the body and blood	Ancestor
Fabaceae	*Crotalaria spectabilis* Roth	Rang Jued	Rang Jued		+	Root	Boil and eat to relieve fatigue and reduce blood pressure	Ancestor
					+	Leaf	Boil and eat to help increase appetite, nourish boiled blood, or eat fresh to cure boredom	Ancestor
					+	All parts	Boil and eat to detoxify caused by eating the wrong food; Boil or eat fresh to cure boredom and drunk	Ancestor
					+	Stem	Boil and eat to detoxify and cure boredom	Ancestor
				+		All parts	Boil and eat, detoxification caused by eating the wrong food; Eat fresh to detoxify and cure drunkenness	Ancestor
				+		Root	Boil or rub and eat to cure a hangover	Ancestor
Fabaceae	*Dalbergia volubilis* Roxb.	Khruea Maet	Khruea Am Ai	+		Stem	Boil and eat to cure gastritis	Ancestor
Fabaceae	*Dialium cochinchinense* Pierre	Nang Dam	Mak Khleng		+	Bark	Boil, helps heal wounds	Ancestor
Fabaceae	*Indigofera suffruticosa* Mill.	Khram Yai	Ja Khram		+	Bark	Boil and eat to relieve dizziness	Ancestor
				+		Bark	Eat fresh to cure poisoning from mushrooms	Ancestor
Fabaceae	*Lysiphyllum strychnifolium* (Craib) A.Schmitz	Ya Nang Daeng	Ya Nang Daeng		+	Leaf	Boil and eat to nourish the body and blood, reduce diabetes, and cure flatulence; Eat fresh as a cold medicine for detoxification caused by eating the poisonous food	Ancestor
				+		Leaf	Boil and eat to reduce diabetes, detox, and nourish energy, body, and blood	Ancestor
Fabaceae	*Mimosa pudica* L.	Maiyarap	Maiyarap		+	Root	Boil and eat to cure hemorrhoids	Ancestor
Fabaceae	*Mucuna pruriens* (L.) DC.	Ma Mui	Ma Mui	+		Root	Boil and drink to cure caugh	Ancestor
Fabaceae	*Phanera sirindhorniae* (K.Larsen & S.S.Larsen) Mackinder & R.Clark	Sam Sip Song Pradong, Sirindhorn wanli	Khruea Pradong		+	Stem	Boil and eat to cure cough	Ancestor
Fabaceae	*Phyllodium longipes* (Craib) Schindl.	Klet Lin Yai	Klet Lin	+		Root	Boil and drink to nourish body and blood	Ancestor
				+		Stem	Boil and eat for diuretics	Ancestor
Fabaceae	*Piliostigma malabaricum* (Roxb.) Benth.	Som Siao	Som Siao	+		Root	Boil to relieve stomachache	Ancestor
Fabaceae	*Pueraria mirifica* Airy Shaw &	Kwaow Khruea	Kwaow Khruea	+		Vine	Boil and drink to nourish the blood after childbirth, and body	Ancestor

	Suvat.	Khaow	Khaow			+	Latex	Treat body scars	Ancestor
					+		Rhizome	Boil and drink to make breasts bigger and to nourish strength and body	Ancestor
					+		Vine	Boiled and drink to nourish blood	Ancestor
Fabaceae	*Senegalia rugata* (Lam.) Britton & Rose	Som Poi	Som Poi		+		Leaf	Make a herbal compress to relieve pain	Hospital
Fabaceae	*Senna tora* (L.) Roxb.	Chumhet Thai	Ya Lep Muen			+	Root	Boil and eat to nourish the body, detoxify after giving birth	Ancestor
						+	All parts	Boil and eat to detoxify caused by eating poisonous food	Ancestor
					+		Root	Boil and eat, detoxification caused by eating the wrong food; Eating while on fire after giving birth	Ancestor
					+		Leaf	Boil and eat to detoxify caused by eating poisonous food	Ancestor
Fabaceae	*Tamarindus indica* L.	Ma Kham	Ma Kham Som			+	Bark	Scrape and boil and eat after giving birth	Ancestor
Fabaceae	*Xylia xylocarpa* (Roxb.) W.Theob.	Daeng	Daeng		+		Core	Boil and eat to nourish the blood, cure gastritis, detoxify after giving birth, help drive amniotic fluid, and relieve lumbar pain	Ancestor
						+	Core	Boil and eat to reduce diabetes and blood pressure, and nourish the blood after childbirth	Ancestor
Gnetaceae	*Gnetum macrostachyum* Hook.f.	Mueai Duk	Mueai Lueat		+		Vine	Boil and eat after giving birth to nourish the blood, relieve pain, nourish energy, nourish the body, and relieve flatulence	Ancestor
						+	Root	Boil and eat to nourish the blood	Ancestor
						+	Vine	Boil and eat to nourish the blood	Ancestor
Hypericaceae	*Cratoxylum neriifolium* Kurz	Tio Dam	Tio Dam		+		Core	Boil and eat for a diuretic	Ancestor
Iridaceae	*Sisyrinchium palmifolium* L.	Wan Hom Daeng	Wan Hom Daeng			+	Bulb	Crushed and used to compress the wound	Ancestor
Lamiaceae	*Clerodendrum paniculatum* L.	Phanom Sawan Pa	Phuang Phee Daeng			+	Root	Boil, and eat to nourish the body, detoxify after giving birth	Ancestor
Lamiaceae	*Clerodendrum schmidtii* C.B.Clarke	Phut Racha	Phuang Phee Khaow		+		Root	Boil and eat to nourish milk	Ancestor
Lamiaceae	*Coleus amboinicus* Lour.	Niam Hu Suea	Hu Suea		+		Leaf	Crush and apply on the stomach to relieve flatulence	Ancestor
						+	Leaf	Eat fresh to cure the flatulence	Ancestor
						+	Leaf	Eat fresh to relieve colic	Searching
Lamiaceae	*Ocimum tenuiflorum* L.	Kra Prao	Kra Prao			+	Leaf	Boil and eat to relieve flatulence	Ancestor
Lamiaceae	*Rotheca serrata* (L.) Steane & Mabb.	Tri Chawa	Akkhi Thawan		+		Root	Boil and eat to cure hemorrhoids	Ancestor
Lamiaceae	*Vitex peduncularis* Wall. ex Schauer	Ga Sam Peek	Ga Sam Peek		+		Root	Boiled and drink for nourishing body, strength, and blood	Ancestor
					+		Core	Boiled and drink for nourishing body	Ancestor
					+		Leaf	Boiled and eat for nourishing the blood	Ancestor
					+		Root	Boiled and drink for nourishing body	Ancestor
Lauraceae	*Cinnamomum ilicioides* A.Chev.	Ta Khrai Ton	Ta Khrai Ton	+	+		Core	Boil and eat as a laxative	Traditional healers
					+		Leaf, Core	Soak in water and drink to cure cough	Searching
Loganiaceae	*Strychnos axillaris* Colebr.	Khwak Kai	Kamlang Suae		+		Vine	Boil and drink to nourish body	Ancestor
			Krong		+		All parts	Boil and drink to nourish body	Ancestor
Loranthaceae	*Dendrophthoe pentandra* (L.) Miq.	Kafak Ma Muang	Kafak			+	Vine	Boil and eat to relieve pain and stomachache	Ancestor

Lythraceae	*Lagerstroemia speciosa* subsp. *speciosa*	Inthanin Nam	Inthanin		+			Core	Boil and eat to cure hemorrhoids	Ancestor
Magnoliaceae	*Magnolia champaca* (L.) Baill. ex Pierre	Champa	Champa		+			Core	Boil and eat to relieve flatulence and hemorrhoids	Ancestor
Malvaceae	*Bombax ceiba* L.	Ngio Ban	Ngio		+			Bark	Boil and eat as medicine for hangovers	Ancestor
Malvaceae	*Helicteres isora* L.	Po Bit	Po Ka Bit		+			Core	Boil and drink to nourish the blood	Ancestor
Melastomataceae	*Osbeckia stellata* Buch.-Ham. ex D.Don	En Ar Khon	En Ar		+			Root	Boil and eat to nourish body and strength	Ancestor
Menispermaceae	*Arcangelisia flava* (L.) Merr.	Khamin Khruea	Khamin Khruea		+			Root	Boil and eat to cure diuresis	Ancestor
Menispermaceae	*Cissampelos pareira* L.	Krung Kha Mao	Khruea Ma Noi			+		Leaf	Drink to cure diabetes; squeezing and eat to cure the aphthous stomatitis	Ancestor
						+		Stem	Treatment of fissures of the tongue and mouth disease	Ancestor
Menispermaceae	*Stephania venosa* (Blume) Spreng.	Kra Thom Lueat	Pao Lueat		+			Root	Boil and eat to nourish the body, and relieve pain and bruises	Ancestor
					+			Core	Boil and eat to nourish strength, body, and blood	Ancestor
					+			Stem	Boil and eat after giving birth, nourishing the body, strength, and blood, to relieving pain and bruises	Ancestor
						+		Core	Boil and drink to nourish the blood	Ancestor
Menispermaceae	*Tiliacora triandra* (Colebr.) Diels	Thao Ya Nang	Kao Nang Nee		+			Leaf	Boil the leaves and eat them to detoxify the poison caused by eating the poisonous food	Ancestor
					+			Root	Boil and eat to nourish strength and body, eat after giving birth, and detoxify. Boil or grind, then mix with water, and eat to detoxify from eating poisonous food	Ancestor
					+			Fruit	Fermented with alcohol, drink to nourish the blood	Ancestor
					+			Stem	Boil and eat to detoxify caused by eating poisonous food	Ancestor
Menispermaceae	*Tinospora crispa* (L.) Hook.f. & Thomson	Bora Phet	Khruea Khor Hor		+			Vine	Eat fresh to cure fever, anthelmintic, cure gastritis, anti-cancer, and reduce diabetes; Boil and eat to nourish strength and body, wounds healing, relieve stomachaches, and cure internal heat, and bruises	Ancestor
						+		Vine	Eating fresh to reduce blood pressure	Ancestor
							+	Vine	Boil and eat to cure fever	Traditional healers
					+			Vine	Cut into pieces, dried and boiled, and eaten to reduce diabetes and blood pressure	Ancestor
Moraceae	*Ficus benghalensis* L.	Krang	Kang Kong		+			Stem	Boil and eat to cure cough, and cold	Ancestor
Moraceae	*Ficus racemosa* L.	Ma Duea U Thum Phon	Ma Duea Na		+			Root, Leaf	Boil root and bath, or Eat boiled leaves to nourish the blood	Ancestor
Moraceae	*Ficus villosa* Blume	Ma Kra Thuep Rong	Ma Kra Thuep Rong		+			Vine	Boil and eat to nourish the blood, energy, and body, to relieve pain	Ancestor
							+	Vine	Boil and eat to nourish body	Ancestor
						+		Vine	Boil and eat to nourish blood	Ancestor
Moraceae	*Morus alba* L.	Mon	Mon			+		Leaf	boil and eat to cure fever	Ancestor
Moraceae	*Streblus asper* Lour.	Khoi	Khoi	+	+			Bark	Grind and mix with salt to relieve toothache	Ancestor
						+		Bark	Boil and eat to heal wounds	Ancestor

					+		Stem	Boil and eat to relieve flatulence; crush and fill the teeth to relieve toothache	Ancestor
Moringaceae	*Moringa oleifera* Lam.	Ma Rum	Phak E Hum		+		Leaf, Fruit, Flower	Boil and eat to prevent cancer	Ancestor
Myrtaceae	*Rhodamnia dumetorum* (DC.) Merr. & L.M.Perry	Phlong Kaem On	Kaem On	+	+		Stem	Boil and eat to nourish body	Ancestor
Nepenthaceae	*Nepenthes mirabilis* (Lour.) Druce	Mo Khao Mo Kaeng Ling	Mo Khao Mo Kaeng Ling		+		All parts	Boil and eat to nourish energy and body	Ancestor
Ochnaceae	*Ochna integerrima* (Lour.) Merr.	Chang Nao	Kamlang Chang San		+		Root	Boiled and eaten to increase libido	Ancestor
Opiliaceae	*Cansjera rheedei* J.F.Gmel.	Nang Chum	Nom Saow		+		Core	Boil and eat to nourish milk	Ancestor
					+		Stem	Boil and eat to nourish milk	Ancestor
					+		All parts	Boil and eat to help appetite	Ancestor
Passifloraceae	*Adenia viridiflora* Craib	Phak Sap	E-Noon		+		Vine	Boil and bathe to stimulate blood circulation	Ancestor
Phyllanthaceae	*Phyllanthus acidus* (L.) Skeels	Ma Yom	Ma Yom			+	Leaf, Fruit	Eat fresh to reduce diabetes and blood pressure	Ancestor
Phyllanthaceae	*Phyllanthus emblica* L.	Ma Kham Pom	Ma Kham Pom		+		Fruit	Eat fresh to cure caugh	Ancestor
Poaceae	*Centotheca lappacea* (L.) Desv.	Ya Repair	Ya Repair		+		All parts	Boil and eat to relieve asthma, nourish the blood, tighten the uterus; Dried, boiled and eat after giving birth, nourishing, nourishing the body	Ancestor
						+	All parts	Boil and eat after giving birth to nourish the body and blood	Ancestor
Poaceae	*Cymbopogon citratus* (DC.) Stapf	Ta Khrai	Ta Khrai		+		Rhizome	Eat to relieve flatulence	Ancestor
						+	Rhizome	Chopped to make a herbal compress to relieve pain	Hospital
Poaceae	*Imperata cylindrica* (L.) Raeusch.	Ya Kha	Ya Kha		+		Root	Boiled and eaten as an elixir	Ancestor
Poaceae	*Saccharum* × *sinense* Roxb.	Oi Dam	Oi Dam			+	Stem	Boil and eat to reduce diabetes and blood pressure, nourishing the body and energy, relieving aches and pains	Ancestor
Polypodiaceae	*Platycerium holttumii* Jonch. & Hennipman	Chai Pha Sida	Hu Chang		+		Root	Boil and eat to cure urination	Ancestor
Ranunculaceae	*Clematis smilacifolia* Wall.	Khruea Chang Luang	Khruea Chang Luang		+		Bark	Grated, and soaked in water to cure mouth ulcers	Ancestor
					+		Stem	Boil and eat to relieve sore mouth	Ancestor
Rhamnaceae	*Colubrina asiatica* (L.) Brongn.	Khan Song	Khan Hung		+		Root	Boil and eat, to nourish the body and blood	Ancestor
Rhamnaceae	*Ventilago denticulata* Willd.	Rang Daeng	Khruea Khao Klaep		+		Vine	Boil and eat to nourish energy and body, and detoxify after giving birth	Ancestor
Rubiaceae	*Adina cordifolia* (Roxb.) Brandis	Khwao	Khwao		+		Core	Boil and eat to hemodialysis	Ancestor
Rubiaceae	*Gardenia obtusifolia* Roxb. ex Hook.f.	Kra Mop	Mak Sida Khok		+		Stem	Boil and eat to cure gastritis	Ancestor
Rubiaceae	*Nauclea orientalis* (L.) L.	Kan Lueang	Kok Kan Lueang	+	+		Core	Boil and eat to relieve pain	Ancestor
					+		Core	Boiled and eat to cure gastritis	Ancestor
Rubiaceae	*Oxyceros horridus* Lour.	Khat Khao Khruea	Khat Khao		+		Root	Boil to nourish the body, eliminate poisoning from eating poisonous food, and nourish those who lie by the fire after childbirth	Ancestor
Rubiaceae	*Pavetta indica* L.	Khem Pa	Khem Pa	+	+		Root	Boil and eat to nourish the body and blood after giving birth	Ancestor

						+	Root	Boil and eat to cure cough	Ancestor
Rubiaceae	*Pavetta tomentosa* Roxb. ex Sm.	Khao San Pa	Khao San Khaow		+		Root	Boil and eat to diuretic, nourishing the body	Ancestor
Rutaceae	*Aegle marmelos* (L.) Corrêa	Ma Tum	Ma Tum		+		Fruit	Dried fruits are boiled to cure flatulence and cough	Ancestor
					+		Root	Boil to nourish the body	Ancestor
Rutaceae	*Citrus hystrix* DC.	Ma Krut	Ma Krut			+	Bark	Make a herbal compress, used to relieve pain	Hospital
Rutaceae	*Clausena wallichii* var. *guillauminii* (Yu.Tanaka) Molino	Song Fa	Song Fa		+		Leaf	Soak in water and drink to cure a cold	Ancestor
Rutaceae	*Micromelum minutum* (G.Forst.) Wight & Arn.	Samat Noi	Samat	+	+		Root	Boil and bathe to stimulate blood circulation	Ancestor
Salicaceae	*Casearia grewiifolia* Vent.	Kruai Pa	Mak Pha Sam	+	+		Root	Boil and eat to nourish body	Ancestor
Salicaceae	*Flacourtia indica* (Burm.f.) Merr.	Ta Khop Pa	Mak Ben		+		Bark	Boil and eat during the fire after giving birth; nourishing the blood, energy, and body; detoxing after giving birth	Ancestor
						+	Bark	Boiled and eat to nourish the body after childbirth	Ancestor
Sapindaceae	*Dimocarpus longan* Lour.	Lamyai	Lamyai			+	Root	Boil to relieve pain	Ancestor
Sapindaceae	*Lepisanthes rubiginosa* (Roxb.) Leenh.	Ma Huat	Huat Kha		+		Root	Boiled and eat for diuretic	Ancestor
Sapindaceae	*Sapindus rarak* DC.	Ma Kham Di Khwai	Mai Tee Khwai		+		Stem	Boil and eat to nourish body and strength	Ancestor
Sapotaceae	*Madhuca pierrei* (F.N.Williams) H.J.Lam	Ma Sang	Sang Na		+		Stem	Boil and eat to nourish strength and body	Ancestor
Sapotaceae	*Planchonella obovata* (R.Br.) Pierre	Nga Sai	Nang Whan		+		Stem	Boil and eat to nourish body	Ancestor
Saururaceae	*Houttuynia cordata* Thunb.	Phlu Khaow	Phlu Khaow			+	Leaf	Eat fresh, reduce diabetes and blood pressure	Ancestor
Simaroubaceae	*Eurycoma longifolia* Jack	Pla Lai Phueak	Pla Lai Phueak		+		All parts	Boil and eat to nourish strength and body	Ancestor
Solanaceae	*Solanum aculeatissimum* Jacq.	Ma Khuea Proh	Ma Khuea Lueang		+		Fruit	Compress on hand when blisters	Ancestor
Zingiberaceae	*Curcuma longa* L.	Khamin Chan	Khamin Chan			+	Rhizome	Apply to reduce rashes; Boil or eat fresh to treat gastritis, stomach pain, wound healing, flatulence, and skin care	Ancestor
					+		Rhizome	Apply to reduce rash	Ancestor
Zingiberaceae	*Curcuma wanenlueanga* Saensouk, Thomudtha & Boonma	Wan En Lueang	Wan En Lueang (Saensouk et al. 2021)			+	Rhizome	Eat fresh to reduce colic; Boiled to cure gastritis	Ancestor
Zingiberaceae	*Curcuma zanthorrhiza* Roxb.	Wan Chak Mot Luk	Wan Chak Mot Luk			+	Rhizome	Boiled to eat after childbirth for helping to tighten the uterus	Ancestor
Zingiberaceae	*Kaempferia parviflora* Wall. ex Baker	Kra Chai Dam	Kra Chai Dam			+	Rhizome	Boiled and drink for nourishing body, and strength	Ancestor
Zingiberaceae	*Wurfbainia villosa* var. *xanthioides* (Wall. ex Baker) Škorničk. & A.D.Poulsen	Reo	Mak Neng		+		Root	Boil and eat to relieve flatulence	Ancestor
Zingiberaceae	*Zingiber montanum* (J.Koenig) Link ex A.Dietr.	Plai	Wan Plai		+		Leaf sheath	Scraping on the stomach area to relieves flatulence and pain	Ancestor
						+	Rhizome	Apply to the stomach area to relieve stomach pain; Eat fresh to cure flatulence	Ancestor

				+	Rhizome	Make a herbal compress to relieve pain	Hospital
				+	All parts	Make a herbal compress to relieve fatigue	Ancestor
Zingiberaceae	*Zingiber officinale* Roscoe	Khing	Khing	+	Rhizome	Eat fresh as food to carminative	Ancestor
Zingiberaceae	*Zingiber purpureum* Roscoe	Plai	Plai Hom	+	Stem	Boil and eat to cure gastritis, and reduce diabetes	Ancestor

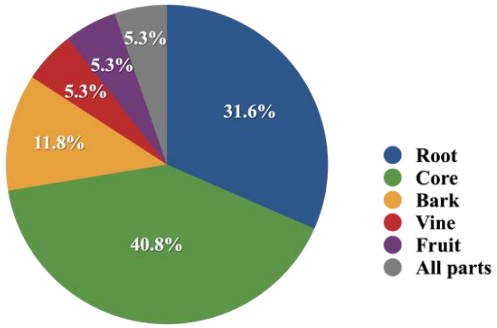

Figure 2. Comparative pie chart of percentages of parts of medicinal plants used by Kaloeng Ethnic Healers in Don Pu Ta Forest, Thailand

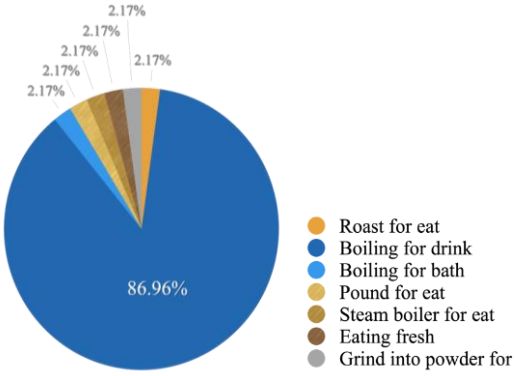

Figure 3. Comparative pie chart of percentages of method of medicinal plants used by Kaloeng Ethnic Healers in Don Pu Ta Forest, Ban Kut Haet, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, Thailand

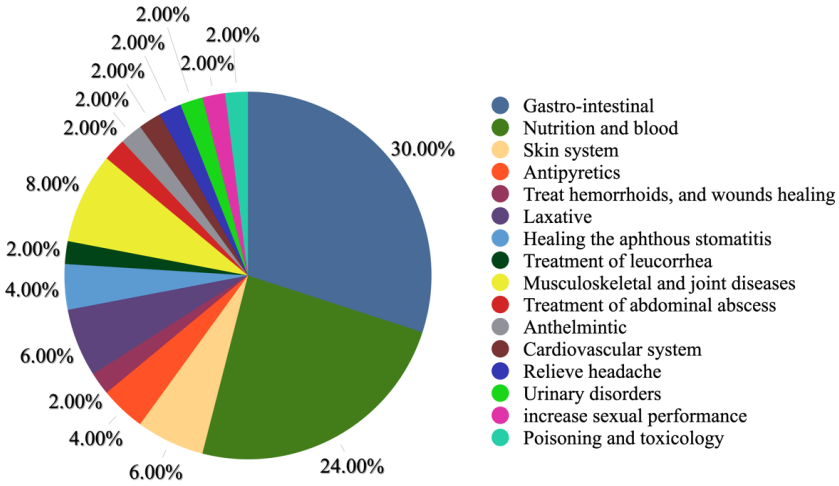

Figure 4. Comparative pie chart of percentages of group of symptoms treated by medicinal plants used by Kaloeng Ethnic Healers in Don Pu Ta Forest, Ban Kut Haet, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, Thailand

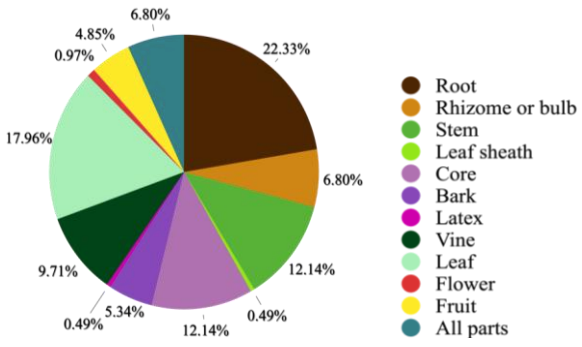

Figure 5. Comparative pie chart illustrating the percentages of different plant parts used for medicinal purposes by the villagers of the Kaloeng Ethnic Group in Ban Kut Haet, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, Thailand

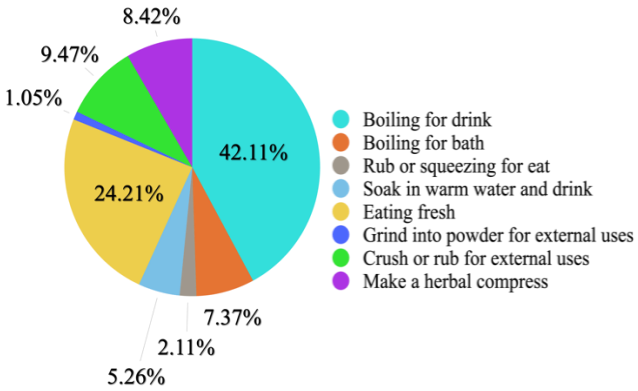

Figure 6. Comparative pie chart illustrating the percentages of different method of used for medicinal purposes by the villagers of the Kaloeng Ethnic Group in Ban Kut Haet, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, Thailand

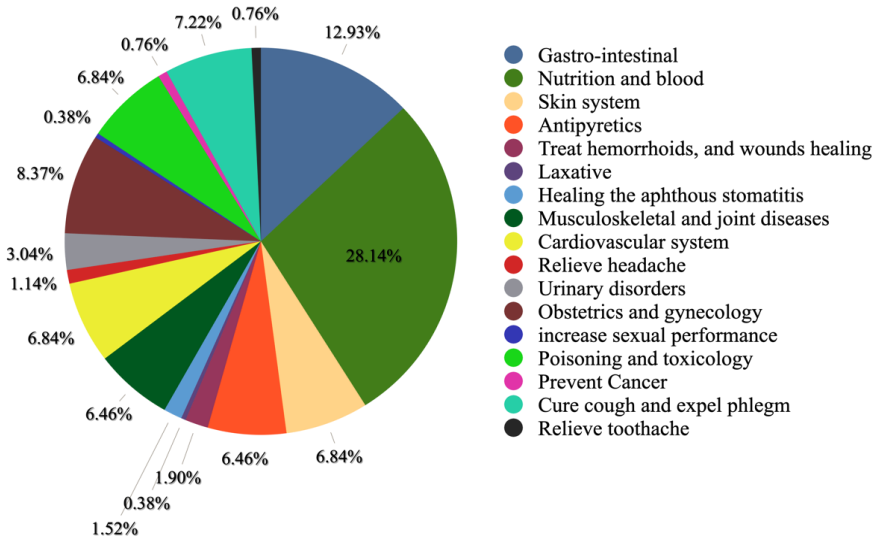

Figure 7. Comparative pie chart illustrating the percentages of group of symptoms treated by medicinal plants used by the villagers of the Kaloeng Ethnic Group in Ban Kut Haet, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, Thailand

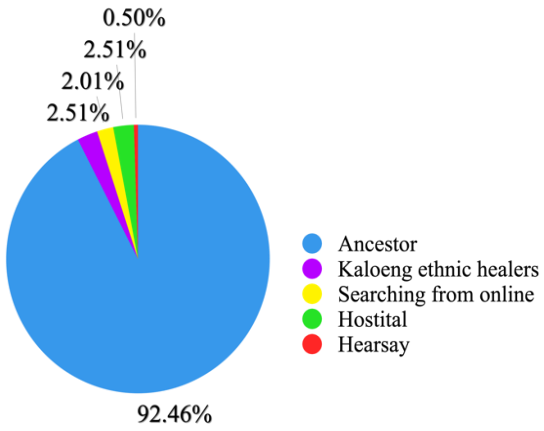

Figure 8. Comparative pie chart illustrates the percentages of sources of knowledge on the utilization of medicinal plants by the villagers of the Kaloeng Ethnic Group in Ban Kut Haet, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, Thailand

Discussion

The results of this study revealed that the diversity index of trees in the Don Pu Ta Forest was higher than that of saplings and seedlings. These findings align with a study conducted by Klinhom (2014), which explored the diversity of plant and animal species in the Don Pu Ta Forest in Maha Sarakham Province. The study found that most Don Pu Ta Forest plants were large trees, surpassing the number of saplings and seedlings. These trees are widely dispersed throughout the forest, providing ample shade. The Don Pu Ta Forest holds significant cultural and conservation value for the Isan villagers, characterized by a specific management style. Situated in Kut Haet Village, Kut Bak Sub-district, Kut Bak District, Sakon Nakhon Province, the Don Pu Ta Forest, belonging to the Kaloeng Ethnic Group, boasts an impressive abundance of large trees. These trees serve as essential habitats and sanctuaries for wildlife. The stringent regulations imposed on activities such as cutting, harvesting, and hunting within the forest contribute to its rich biodiversity. The forest exhibits a uniformity index of 0.88, indicating a well-balanced species distribution. The Don Pu Ta Forest's preservation as a dry evergreen forest and conservation area, free from encroachment, enhances its fertility and supports a thriving ecosystem. These factors play a pivotal role in sustaining the forest's diverse plant and animal life.

The positive result of forest conditions in the Don Pu Ta Forest can be attributed to the topography and settlement of the Kaloeng Ethnic Group community situated in the Phu Phan Mountain range within Sakon Nakhon Province. The area is characterized by a naturally fertile deciduous and dry evergreen forest adorned with abundant plants and scattered herbs. Furthermore, the customs and beliefs of the community, deeply intertwined with the founding ancestors, hold significant importance. Consequently, they have chosen the forest area near their dwellings to establish the Don Pu Ta Forest while constructing the Pu Ta shrine as a symbol for future generations to pay homage to their ancestors. Annually, before the farming season, they perform a ritual dedicated to their grandparents, which serves as an expression of respect, belief, and unwavering faith in the ancestral spirits safeguarding the community, ensuring peace and happiness, and warding off any potential perils. They also pass down the sacred tales of the ancestral spirits residing within the Don Grandfather Forest to their children. The community has embraced the responsibility of preserving the forest without encroachment or destruction. Consequently, the Don Pu Ta Forest exhibits greater fertility compared to forests found in other general areas (Ketthet 1999).

In the Don Pu Ta Forest of the Kaloeng Ethnic Group, an analysis of the importance index for all tree species revealed significant findings. Among the medicinal plants,

Tong Taek (*B. solanifolium*) stood out with the highest importance index of 25.26. Conversely, Prong Kio (*D. lomentaceum*) had the lowest importance index, measuring 0.98. These findings provide valuable insights for prioritizing conservation efforts and identifying key species for further research and development of medicinal treatments.

In studying the knowledge and traditional use of medicinal plants in the Don Pu Ta Forest, an analysis was conducted by comparing the medicinal benefits, plant parts used, and medicinal properties of plants obtained through interviews with Kaloeng folk medicine healers and interviews with local residents of the Kaloeng Ethnic Group, as well as a survey of the forest. The findings revealed that both the Kaloeng folk medicine healers and villagers from the Kaloeng Ethnic Group utilized the same 14 species of plants. These species include *Alstonia scholaris* (L.) R.Br., *C. inophyllum*, *C. grewiifolia*, *C. ilicioides*, *C. persimilis*, *D. lomentaceum*, *F. villosa*, *G. cowa*, *M. minutum*, *N. orientalis*, *P. indica*, *R. dumetorum*, *S. asper*, and *Ventilago denticulata* Willd.

Research has demonstrated that *S. asper* is utilized across different regions to address similar symptoms. For instance, the Kaloeng Ethnic Group grinds and mixes *S. asper* with salt to alleviate toothaches, boils and consumes it to promote wound healing and relieve flatulence, and crushes and applies it to teeth to alleviate toothaches. According to the herbal database of Mahidol University, *S. asper* contains linalool, nonanal, and decanal, and a high percentage (92-98 mg%) of vitamin C, which aids in strengthening teeth and preventing toothaches. Furthermore, the seeds of *S. asper* contain nitrogen compounds (13-15%), inorganic compounds (7%), and volatile oil (1%), with approximately 70% consisting of d-linalool. The plant's roots and intestines also contain substances that have cardiac effects, including over 30 types of cardiac glycosides like asperoside, strebloside, and glucostreblolide (Chuakul 2002).

In addition, this study revealed that various traditional medicine healers utilize medicinal plants of the same species to treat different ailments. For instance, *Sindora siamensis* Teijsm.ex Miq., a plant employed by Kaloeng folk healers, is used to enhance nutrition, blood circulation, and improve sexual performance. On the other hand, the Phu Thai ethnic group employs it as an anthelmintic, while healers from the Thai-Lao ethnic group use it to treat chickenpox and croup in children.

G. cowa, a plant utilized by various ethnic groups for different medicinal purposes, showcases the diversity of its applications. The Kaloeng Ethnic folk healers employ it as an antipyretic, while the Yon ethnic folk healers rely on it for treating jungle fever. Additionally, the Phu Thai and Thai Lao ethnic groups' folk healers utilize it as a laxative. In line with the herbal database of Mahidol University, *G. cowa* contains Chamuangon, a potent compound recognized for its strong anticancer properties. Extensive research has demonstrated its effectiveness against lung cancer, leukemia cells, and its ability to combat *Helicobacter pylori* bacteria causing gastrointestinal diseases. Moreover, it exhibits inhibitory effects on the protozoan *Leishmania major*, a previous epidemic strain in southern Thailand (Chuakul et al. 1997). This highlights how indigenous healers from each ethnic group leverage their knowledge and wisdom to employ herbs that align with the essential substances found in medicinal plants, validated through phytochemical tests.

The assessment of biodiversity using the Shannon and Weaver index provided a further understanding of the forest's ecological dynamics. The diversity index was highest for big trees, followed by saplings and seedlings. This suggests variations in species composition and abundance across different growth stages and habitats within the forest. The overall species consistency index indicated a relatively high level of stability and consistency in the medicinal plant population.

The ethnobotanical study explored the traditional knowledge and practices of the Kaloeng Ethnic Group in utilizing medicinal plants for treating community diseases. The indigenous healers exhibited a comprehensive understanding of the medicinal properties and applications of 44 plant species, covering a wide range of symptom groups. The utilization of different plant parts varied, with the core, root, and bark being the most commonly used. However, the heavy reliance on the core part raises concerns about sustainable usage and potential impacts on species extinction. It emphasizes the need for a conservation plan that ensures the long-term viability of these medicinal plants.

The villagers predominantly employed boiling as the primary method for preparing medicinal plants, highlighting their focus on internal consumption. Gastrointestinal symptoms and nutrition-related conditions were the most frequently treated symptom groups. The villagers' knowledge and wisdom in using medicinal plants were primarily derived from their ancestors, highlighting the intergenerational transmission of traditional healing practices. While hospitals and online sources contributed to their knowledge, ancestral wisdom played a central role.

Conclusions, The Don Pu Ta Forest of the Kaloeng Ethnic Group in Kut Haet Village, Sakon Nakhon Province, harbors significant plant species diversity with medicinal uses, consisting of 44 species distributed across 28 families. The Rubiaceae family stands out as the most diverse, and the forest ecosystem demonstrates stability and consistency in species composition. The importance index analysis identifies key medicinal plant species, highlighting the potential for further research and conservation efforts.

The ethnobotanical study highlights the extensive knowledge and utilization of medicinal plants by the Kaloeng Ethnic Group. The reliance on core parts raises concerns about sustainable usage and the need for conservation measures to protect these valuable resources. The villagers predominantly use boiling as a preparation method, emphasizing internal consumption for treating various symptom groups, with a particular focus on gastrointestinal and nutrition-related conditions.

The study underscores the significance of ancestral knowledge in shaping the medicinal practices of the Kaloeng Ethnic Group. It emphasizes the need to preserve and integrate traditional wisdom with modern healthcare

practices. Overall, this research contributes valuable insights into the species diversity, importance, and ethnobotanical usage of medicinal plants in the Don Pu Ta Forest, highlighting the potential for conservation, sustainable use, and further exploration of these natural resources for healthcare applications.

ACKNOWLEDGEMENTS

This study was financially supported by Mahasarakham University. We fully acknowledge the key informants for sharing their local knowledge on the use of plants. We are extremely grateful to Walai Rukhavej Botanical Research Institute (WRBRI), Mahasarakham University, and the Biodiversity-based Economy Development Office (Public Organization) (BEDO), Thailand for allowing us to use their facilities during the fieldwork. Without their contribution, this study would have been impossible, thanks to Dr. Jolyon Dodgson for language editing and suggestions to improve the manuscript.

REFERENCES

Bongcheewin B, Chantaranothai P, Paton A. 2015. *Elsholtzia* (Lamiaceae) in Thailand. Blumea 59 (3): 209-214. DOI: 10.3767/000651915X688696.

Bongcheewin B, Poopath M, Paton A. 2022. *Gomphostemma phetchaburiense* (Lamiaceae), a new species from a limestone karst in southwest Thailand. Blumea 67 (1): 33-36. DOI: 10.3767/blumea.2022.67.01.07.

Bongcheewin B, Pramali K, Traiperm P, Chantaranothai P, Paton A. 2017. *Pogostemon nudus* sp. nov. (Lamiaceae) from Thailand. Nordic J Bot 35 (3): 289-299. DOI: 10.1111/njb.01439.

Boonma T, Saensouk S, Saensouk P. 2020a. *Amomum foetidum* (Zingiberaceae), a new species from Northeast Thailand. Taiwania 65 (3): 371-381.

Boonma T, Saensouk S, Saensouk P. 2020b. Two new species of *Kaempferia* L. (Zingiberaceae) from Thailand. Taiwania 65 (3): 371-381.

Boonma T, Saensouk S, Saensouk P. 2021. *Kaempferia nigrifolia* (Zingiberaceae), a new species from Central Thailand. Rheedea 31 (1): 11-17. DOI: 10.22244/rheedea.2020.31.01.02.

Boonma T, Saensouk S, Saensouk P. 2023. Diversity and traditional utilization of the Zingiberaceae plants in Nakhon Nayok Province, Central Thailand. Diversity 15: 904. DOI: 10.3390/d15080904.

Boonma T, Saensouk S. 2019. *Curcuma saraburiensis* (Zingiberaceae) a new species from Thailand. Taiwania 64: 245-248.

Butnamphet T. 2015. Study of plant society and analysis of forest data. Department of Environmental Technology, Faculty of Environment and Resource Studies Mahasarakham University, Mahasarakham.

Chantaranothai P, Kunasit P, Kladwong P. 2022. *Madhuca kanchanaburiensis* (Sapotaceae), a new species from Thailand. Phytotaxa 574 (2): 173-178. DOI: 10.11646/phytotaxa.574.2.6.

Chantaranothai P. 2021. Taxonomic notes on *Pavetta* L. (Rubiaceae) from Thailand and new records for Cambodia, Laos, and Myanmar. Trop Nat Hist 21 (1): 146-166.

Chen J, Chalermglin P, Saunders RMK. 2018. Two new species and two new records of *Artabotrys* (Annonaceae) from Thailand. PhytoKeys 95: 71-81. DOI: 10.3897/phytokeys.95.23434.

Chen ZH, Mei XD, Chen F, Xie WY, Li GY. 2020. *Ficus jingningensis* (Moraceae), a new species from Zhejiang. J Zhejiang For Sci Technol 40: 52-54.

Choopan T, Grote PJ, Chayamarit K, Simpson DA. 2019. A checklist of Acanthaceae subfamily Nelsonioideae in Thailand. Thai For Bull (Bot.) 47 (2): 241-259. DOI: 10.20531/tfb.2019.47.2.14.

Chuakul W, Saralamp P, Paonil W, Temsiririrkkul R, Clayton T. 1997. Medicinal Plants in Thailand Volume II. First published. Amarin Printing and Publishing Public Co., Ltd, Bangkok.

Chuakul W. 2002. Taxonomy of medicinal plants. Department of Pharmacy Botany Faculty of Pharmacy, Mahidol University, Bangkok.

Esser H, Saw LG. 2015. A new species of *Polyosma* (Escalloniaceae/ Polyosmaceae) from Thailand and new synonyms. Phytotaxa 221 (1): 89-92. DOI: 10.11646/phytotaxa.221.1.10.

Esser H. 2021. Taxonomic notes on the Rutaceae of Thailand. Thai For Bull (Bot.) 49 (1): 27-31. DOI: 10.20531/tfb.2021.49.1.02.

Ezedin Z, Weiblen G. 2019. Additions and changes to *Ficus* (Moraceae) in New Guinea with comments on the world's largest fig. Gard Bull (Sing) 71: 197-216. DOI: 10.26492/gbs71(suppl.2).2019-15.

Inta A, Trisonthi C, Pongamornkul W, Panyadee P. 2023. Ethnobotany of Zingiberaceae in Mae Hong Son, Northern Thailand. Biodiversitas 24 (4): 2114-2124. DOI: 10.13057/biodiv/d240422.

Johnson DM, Bunchalee P, Chalermglin P, Chantaranothai P, Leeratiwong C, Murray NA, Saunders RM, Sirichamorn Y, Su YCF, Suthisaksopon P. 2021. Additions to Annonaceae in the Flora of Thailand. Thai For Bull (Bot) 49 (2): 163-172. DOI: 10.20531/tfb.2021.49.2.02.

Junsongduang A, Balslev H, Inta A, Jampeetong A, Wangpakapattanawong P. 2013. Medicinal plants from swidden fallows and sacred forest of the Karen and the Lawa in Thailand. J Ethnobiol Ethnomed 9 (1): 1-10. DOI: 10.1186/1746-4269-9-44.

Ketthet B. 1999. Don Pu Ta Forest Institute and behavioral roles of Tao Jum in Isan communities. J Mahasarakham Univers 17 (2): 23-26.

Klinhom U. 2014. Don Pu Ta Forest. Reported to Department of Cultural Promotion, Ministry of Culture. Rak Isan Foundation, Maha Sarakham.

Kumar ESS, Shailajakumari S, Shareef SM. 2021. *Madhuca balakrishnanii* (Sapotaceae), a new species from Kerala, India. Phytotaxa 510 (1): 78-82. DOI: 10.11646/Phytotaxa.510.1.8.

Leeratiwong C, Chantaranothai P, Paton A. 2017. Notes on the genus *Rotheca* (Lamiaceae) in Thailand. Kew Bull 73: 3. DOI: 10.1007/s12225-017-9727-0.

Lim CK, Lee KE, Cho HS, Saysavanh V, Won H. 2021. New records of flowering plants collected from the Phou Khao Khouay National Biodiversity Conservation Area for the flora of Laos. Kor J Pl Taxon 51 (3): 305-318. DOI: 10.11110/kjpt.2021.51.3.305.

Low YW, Leong PKF, Tee Sp, Singh R, Tay MLC, Wong KM. 2014. *Margaritaria* (Phyllanthaceae), a new generic record for the Singapore flora. Gard Bull Sing 66 (1): 47-56.

Maknoi C, Saensouk S, Maneenoon K, Pongamornkul W. 2016. Uses of Zingiberaceae in Thailand. Queen Sirikit Botanic Garden, The Botanical Garden Organization Thailand.

Ngernsaengsaruay C, Leksungnoen N, Boonthasak W, Utharatsamee S, Racharak P, Leetanasakskul K, Pongamorn P, Saengbuapuean A. 2022. Additional knowledge on the genus *Mitragyna* (Rubiaceae) in Thailand. Thai For Bull (Bot) 50 (1): 20-39. DOI: 10.20531/tfb.2022.50.1.03.

Paton A, Suddee S, Bongcheewin B. 2016. Two new species of *Scutellaria* (Lamiaceae) from Thailand and Burma. Kew Bull 71: 3. DOI: 10.1007/s12225-016-9620-2.

Phatlamphu N, Saensouk S, Saensouk P, Junsongduang A. 2021. Ethnobotany of edible plants in Muang District, Kalasin Province, Thailand. Biodiversitas 22 (12): 5432-5444. DOI: 10.13057/biodiv/d221226.

Phechphakdee T, Saensouk S, Saensouk P. 2019. The diversity of Zingiberaceae in Pathumrat District, Roi-Et Province. Khon Kaen Agric J 47 (suppl.1): 1527-1532.

Pholhiamhan R, Saensouk S, Saensouk P. 2018. Ethnobotany of Phu Thai ethnic group in Nakhon Phanom province, Thailand. Walailak J Sci Technol 15 (10): 679-699. DOI: 10.48048/wjst.2018.3737.

POWO. 2023. Plant of the world online, Facilitated by the Royal Botanic Gardens, Kew. www.plantsoftheworldonline.org/

Priscila O, Inês C, Ribeiro MJC, Antônio CR, Castro SV. 2021. A new species of Phyllocladiferous *Phyllanthus* (Phyllanthaceae) from the Atlantic Rain Forest. Syst Bot 46 (4): 1011-1015. DOI: 10.1600/036364421X16370109698669.

Ragsasilp A, Saensouk P, Saensouk S. 2022. Ginger family from Bueng Kan Province, Thailand: Diversity, conservation status, and traditional uses. Biodiversitas 23: 2739-2752. DOI: 10.13057/biodiv/d230556.

Rahman MS, Hossain GM, Khan SA, Uddin SN. 2014. *Colubrina javanica* Miq. (Rhamnaceae), a new angiosperm record for Bangladesh. Bangladesh J Plant Taxon 21 (2): 199-202. DOI: 10.3329/bjpt.v21i2.21362.

Rakarcha S, Saensouk S, Maknoi C, Wongnak M, Thammarong W, Saensouk P. 2022. *Curcuma lampangensis* and *C. sabhasrii*, two new species of the family Zingiberaceae from Northern Thailand. Biodiversitas 23 (9): 4448-4459. DOI: 10.13057/biodiv/d230910.

Rather SA, Subramaniam S, Danda S, Pandey AK. 2018. Discovery of two new species of *Crotalaria* (Leguminosae, Crotalarieae) from Western Ghats, India. Plos One 13 (2): e0192226. DOI: 10.1371/journal.pone.0192226.

Rokade K, Dalavi JV, Gaikwad S, Gaikwad N. 2020. *Crotalaria shrirangiana* (Fabaceae): A new rattlepod from the Western Ghats of India. Phytotaxa 449 (2): 188-194. DOI: 10.11646/phytotaxa.449.2.7.

Saensook S, Saensouk P. 2020a. *Boesenbergia isanensis* (Zingiberaceae), a new species from Thailand. J Jpn Bot 95 (2): 65-68.

Saensouk P, Boonma T, Saensouk S. 2021a. *Curcuma siamensis* (Zingiberaceae: ZIngibereae), a new species of *Curcuma* subgen. *Ecomatae* from Southeastern Thailand. Biodiversitas 22 (12): 5239-5246. DOI: 10.13057/biodiv/d221201.

Saensouk P, Boonma T, Saensouk S. 2022a. *Curcuma nakhonphanomensis* (Zingiberaceae), a new species from the lower Mekong River basin, Northeastern Thailand. Biodiversitas 23 (11): 6040-6048. DOI: 10.13057/biodiv/d231159.

Saensouk P, Boonma T, Saensouk S. 2022b. *Curcuma pulcherrima* (Zingiberaceae), a new rare species of *Curcuma* subgen. *Ecomatae* from Eastern Thailand. Biodiversitas 23 (12): 6635-6644. DOI: 10.13057/biodiv/d231262.

Saensouk P, Saensouk S. 2021a. Diversity, traditional use, and conservation status of Zingiberaceae in Udon Thani Province, Thailand. Biodiversitas 22 (8): 3083-3097. DOI: 10.13057/biodiv/d220801.

Saensouk P, Saensouk S. 2021b. Two new species of *Kaempferia* (Zingiberaceae) from Thailand. J Jpn Bot 96 (4): 193-198.

Saensouk S, Boonma T, Saensouk P. 2021b. A new species and a new record of *Curcuma* subgen. *Curcuma* (Zingiberaceae) from Northern Thailand. Biodiversitas 22 (9): 3617-3626. DOI: 10.13057/biodiv/d220903.

Saensouk S, Boonma T, Saensouk P. 2021c. Six new species and a new record of *Curcuma* L. (Zingiberaceae) from Thailand. Biodiversitas 22 (4): 1658-1685. DOI: 10.13057/biodiv/d220410.

Saensouk S, Boonma T, Thomudtha A, Thomudtha P, Saensouk P. 2021d. *Curcuma wanenlueanga* (Zingiberaceae), a new species of subgenus *Curcuma* from Thailand. Biodiversitas 22 (7): 2988-2994. DOI: 10.13057/biodiv/d220410.

Saensouk S, Saensouk P, 2019a. *Kaempferia mahasarakhamensis*, a new species from Thailand. Taiwania 64 (1): 39-42. DOI: 10.1007/s13237-020-00318-z.

Saensouk S, Saensouk P, Pasorn P, Chanshotikul N. 2018. Diversity and traditional uses of Zingiberaceae in Nakhon Phanom Province, Thailand. Res Knowl 4 (1): 47-55.

Saensouk S, Saensouk P, Pasorn P, Chantaranothai P. 2016. Diversity, traditional uses, and new record of Zingiberaceae in Nam Nao National Park, Phetchabun Province, Thailand. Agric Nat Resour 50: 445-453. DOI: 10.1016/j.anres.2016.08.002.

Saensouk S, Saensouk P. 2019b. *Kaempferia phuphanensis* (Zingiberaceae), a new species from Thailand. J Jpn Bot 94 (3): 149-152.

Saensouk S, Saensouk P. 2020b. Comparative leaf surfaces of Orchidaceae species from Thailand. Suranaree J Sci Technol 27 (3): 030032(1-8).

Saensouk S, Saensouk P. 2020c. *Globba sirirugsae*, a new species of Zingiberaceae from Thailand. J Jpn Bot 95 (6): 327-331.

Saensouk S, Saensouk P. 2023. Palynology of the genus *Lagerstroemia* (Lythraceae) in Thailand. Biodiversitas 24 (6): 3222-3229. DOI: 10.13057/biodiv/d240616.

Satthaphorn J, Paton A, Leeratiwong C. 2021. *Clerodendrum angustipetalum*, a new species of *Clerodendrum* (Lamiaceae) from Thailand. Phytotaxa 491 (2): 177-183. DOI: 10.11646/phytotaxa.491.2.7.

Singh LJ. 2022. *Dendrophthoe longensis* L.J. Singh, A new species of *Dendrophthoe* (Loranthaceae) from Andaman and Nicobar Islands, India. Feddes Repert 134 (1): 54-65. DOI: 10.1002/fedr.202200034.

Smitinand T. 2014. Plant names of Thailand. Amendment edition 2014. Forest and Plant Conservation Research Office, Bangkok.

Souvannakhoummane K, Fici S, Lanorsavanh S, Lamxay V. 2018. Studies on the genus *Capparis* L. (Capparaceae) in Lao PDR. III: A new species from the deciduous forest of the Hin Nam No National Protected Area. Webbia 73: 175-177. DOI: 10.1080/00837792.2018.1470708.

Tagane S, Souvannakhoummane K, Souldeth P. 2022. *Croton nagaoi*, a new species of Euphorbiaceae from Southern Laos. Phytotaxa 570 (2): 102-108. DOI: 10.11646/phytotaxa.570.2.1.

Tangjitman K, Wongsawad C, Kamwong K, Sukkho T, Trisonthi C. 2015. Ethnomedicinal plants used for digestive system disorders by the Karen of Northern Thailand. J Ethnobiol Ethnomed 11: 27-39. DOI: 10.1186/s13002-015-0011-9.

Tangjitman K, Wongsawad C, Winijchaiyanan P, Sukkho T, Kamwong K, Pongamornkul W, Trisonthi C. 2013. Traditional knowledge on medicinal plant of the Karen in Northern Thailand: A comparative study. J Ethnopharm 150 (1): 232-243. DOI: 10.1016/j.jep.2013.08.037.

Tarmizi NM, Halim SASA, Hasain Z, Ramli ESM, Kamaruzzaman MA. 2022. Genus *Lepisanthes*: Unravelling Its Botany, Traditional Uses, Phytochemistry, and Pharmacological Properties. Pharmaceuticals 15 (10): 1261. DOI: 10.3390/ph15101261.

Teerapattarakan N, Rujjanawate C. 2021. The presence of monoterpenes in *Rhychanthus longiflorus* Hook.f. confirms the vatue of its use in Akha folk medicine. Great Mekong Subregion Med J 1 (2): 65-70.

Trisonthi C. 2018. Ethnobotany: The Science of Local Wisdom. Botanical Garden Organization, Ministry of Natural Resources and Environment in collaboration with the Department of Biology, Faculty of Science, Chiang Mai University, Muang.

Van Welzen PC, Haegens RM, Slik JW, Bollendroff SM, Dressler S, Esser HJ. 2014. Checklist of the genera of Thai Euphorbiaceae-1. Thai For Bull (Bot) 28: 59-111.

Yamane T. 1973. Statistics: An Introductory Analysis. 3rd ed. Harper and Row Publications, New York.

Ye XE, Xia NH. 2016. *Gardenia reflexisepala* (Rubiaceae), a new species from Hainan Province, China with Typification of *G. angkorensis* and *G. cambodiana*. Phytotaxa 257 (2): 193-197. DOI: 0.11646/phytotaxa.257.2.10.

Zhang Z, Zhang MJ, Zhang JH, Zhang DS, Li HQ. 2022. *Ficus motuoensis* (Moraceae), a new species from southwest China. PhytoKeys 206: 119-127. DOI: 10.3897/phytokeys.206.89338.