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# Ethnomedicinal plants used by traditional healers in Phatthalung Province, Peninsular Thailand

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## **Abstract**

### **Background**

In rural communities of Thailand, traditional healers still play an important role in local health care systems even though modern medicine is easily accessible. Meanwhile, natural forests in Thailand which are important sources of materia medica are being greatly destroyed. This has led to an erosion of traditional Thai medicine. Furthermore, the concept of medicinal plant selection as medicine based on their tastes is still an important component of traditional Thai medicine, but no or little publications have been reported. Thus the aim of the present study is to collect ethnomedicinal data, medicinal plant tastes and relevant information from experienced traditional healers before they are lost.

### **Methods**

An ethnobotanical survey was carried out to collect information from nine experienced traditional healers on the utilization of medicinal plants in Phatthalung Province, Peninsular Thailand. Data were obtained using semi-structured interviews and participant observations. Plant specimens were also collected and identified according to the plant taxonomic method.

### **Results**

A total of 151 medicinal plants were documented and 98 of these are reported in the study. Local names, medicinal uses, parts used, modes of preparation, and the relationship between ailments and tastes of medicinal plant species are presented.

### **Conclusions**

This research suggests that traditional healers are still considered important for public health among Thai communities and that many people trust the healing properties of medicinal plants. In the future, it is hoped that traditional Thai medicine will be promoted and therefore will help reduce national public health expense.

## **Keywords**

Medicinal plants, Traditional healers, Peninsular Thailand, Phatthalung, Traditional knowledge

## **Background**

Thailand has its own healing system of traditional medicine commonly referred to as “traditional Thai medicine”. This system is deeply rooted, and has played a key role in Thai culture for many centuries. The diverse way of life and culture in each separate region of Thailand has led to a diverse local health care system. This medicine depends on the knowledge and practical experience of each individual healer with regard to diagnosing and treating ailments using naturally available materials. Nowadays, Thai traditional medicine is supported by the government. It has been incorporated into national health policy for

reducing the use of Western medicine which is very expensive. In 2012, the Ministry of Public Health wanted its subdistrict-level medical facilities to make traditional medicine account for 10 % of their total costs of medicine. Meanwhile, increasing the use of traditional medicine in community hospitals should account for 5 %. Moreover, at least one doctor who specializes in traditional medicine will work at community hospitals [1]. To respond to the government policy and develop the body of knowledge of Thai traditional medicine by using scientific approaches, many academic institutes have set up a 4-year program and curriculum for producing graduates with a Bachelor's degree. However, there are many crucial issues concerning the transfer of knowledge of traditional medicine which is continually declining. Firstly, highly experienced traditional healers are generally older people and they continue to pass away without recording or passing on their knowledge. Secondly, the younger generation of medical practitioners has a low regard for traditional medicine. They are drawn to other occupations because of the job security and higher salaries. Finally, the forests in Thailand are being destroyed and this means that the medicinal plants necessary for traditional healers are in short supply. Consequently, the knowledge of the traditional healers regarding utilization of medicinal plants is being diminished and could possibly be lost before being explored by systematic study. The present study was carried out to document the diagnosis of diseases in general, details of the utilization of medicinal plants and the criteria for selecting medicinal plants in terms of taste property of traditional healers. The present study is the first research carried out in this area and it shows the correlation between medicinal plant tastes and plant selection for making an effective prescription which has never been reported before. Additionally, this ethnomedicinal information was collected from nine highly experienced traditional healers and it will directly benefit people who are interested in traditional medicine and medicinal plant aspects.

## **Materials and methods**

### **Brief introduction to the study area**

Phatthalung is situated in southern Thailand. It is geographically located between latitude: 7<sup>0</sup> 05 to 7<sup>0</sup> 55 N and longitude: 99<sup>0</sup> 44 to 100<sup>0</sup> 25 E. The total area is 3424.473 km<sup>2</sup>. Most areas in Phatthalung can be classified into one of two classifications: 1) the eastern part is flood plain and some rolling terrain with an elevation that ranges between 0–15 m above sea level, 2) the western part is mountainous terrain covered by evergreen forest with an elevation that ranges between 50–1200 m above sea level [2]. It borders Nakhon Si Thammarat province to the north, Songkhla province to the south, Songkhla Lake to the east and Khaobanthad wildlife sanctuary to the west, which is covered with rich evergreen forest (Fig. 1). The annual average rainfall is 1800 mm. Rainfall distribution is divided into 2 periods, the long rains from September to January and the short rains from May to June. The average annual temperature is 28 °C [3]. Phatthalung is divided into 11 districts, Bang Kaeo, Khao Chaison, Khuan Khanun, Kong Ra, Mueang, Pa Bon, Pa Phayom, Pak Phayun, Si Banphot, Srinagarinda and Tamot. The population was approximately 514,492 in the year 2012. Most of the population is Buddhist followed by Muslim. Most people live in rural areas and their main occupation is in agriculture. The agriculture types include rubber, rice, pineapple, fruit orchards, cattle, poultry and fisheries. The way of life of the people still depends on natural products in their daily lives. Although the modern health care system is easy to access, many people still believe in traditional medicine. Therefore, traditional healers are important people in the communities. In the study area, there were various types of traditional healers such as

herbalists, spiritual healers, midwives, massage practitioners and bone healers. The present study was focused only on herbalists who resided in rural areas.

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**Fig. 1** Location of the study sites in Phatthalung province, peninsular Thailand

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### **Ethnobotanical data collection**

The ethnobotanical survey was carried out in Phatthalung province from 2010 to 2012. With an emphasis on accurate information, different types of ethnographic method, such as semi-structured interviews, participatory observation and fieldnotes, were combined to collect data with traditional healers from different areas of Phatthalung province, peninsular Thailand. Before starting the ethnobotanical data collection, snowball sampling was used as a practical method for finding highly experienced traditional healers from Phatthalung provincial health office. Patients who were cured by traditional healers were sought, along with community leaders and also traditional healers who had a well-established network. All traditional healers were selected not only for their extensive experience of traditional treatments, but also because they still actively practised their treatment with patients, including highly respected people within the communities. According to intensive criteria, nine highly experienced traditional healers were chosen. They were all males and their ages ranged from 55 to 110. Their experience ranged from 20 to 70 years in the field of traditional medicine. Five were Muslim and the rest were Buddhist. In terms of educational level, five had attended primary school and four had attended high school. The majority worked in agricultural professions. Their knowledge of traditional medicine was inherited from ancestors and close relatives, and additionally they studied from other experienced traditional healers. The main method of healing was by using medicinal plants. Only one traditional healer treated an ailment with rituals if he thought that an ailment was caused by supernatural forces. The interviews sought to determine the vernacular name of the plant, purposes of utilization, parts used, diseases treated, modes of preparation, administration and taste of individual plants as well as places of collection. Before interviewing commenced, the aims of the study were clearly explained to traditional healers and their family members. Prior informed consent was obtained. A copy of the final report of the study was sent to all traditional healers. The accuracy of information was rechecked by repeatedly visiting all healers at least 4–5 times in different seasons. Observing their various activities and staying at their homes during data collection was also necessary. The interviews were supplemented by walking in the field with traditional healers while collecting plants and checking the habitat preference of plants. The plant specimens were photographed, collected and processed according to the plant taxonomic method [4]. The specimens were identified and the voucher specimens collected from the wild were deposited at the PSU Herbarium. In addition, cultivated and common species were deposited at the herbarium within the Traditional Thai Medicine Faculty, Prince of Songkla University. To analyze the utilization of medicinal plants they were divided into groups of diseases based on properties and applications that were mentioned by the traditional healers.

# Results and discussion

## Diagnostic methods

Based on the study, all traditional healers indicated that illness is caused by the imbalance of the four body elements, soil, water, wind and fire, known as “Tard chao ruan” in Thai. For precise illness diagnosis, several procedures are integrated such as checking the patient’s medical history, physical examinations and pulse - taking. The principal history of patients includes behavioral issues, such as consumption, sleepiness and bowel movements. Feeling body parts is important for physical examination, as is close observation of the skin, eyes, tongue and hair. The taking of the pulse is common with highly experienced traditional healers. They say that they look for the duration between pulses. Different pulse characteristics are used to determine the deficiency of body elements and levels of severity. This procedure is very important and if the traditional healer has sufficient skill, it can give a precise diagnosis. However, very few traditional healers have the necessary pulse - taking skills, especially among the younger generation. After they have ascertained the cause of the illness, traditional prescriptions and treatments are assigned. Prescribing the correct use of medicinal plants is another important skill, which is explained further in the section of this document about medicinal plant tastes.

## Diversity of medicinal plants

According to the study, 151 species of medicinal plants, belonging to 126 genera in 60 families were documented for various disease treatments. The largest number of medicinal plants were eudicots (76 %) followed by monocots (19 %), ferns (3 %) and gymnosperms and magnoliids (1 % each) (Fig. 2). Of the eudicots, the most represented family was Fabaceae (nine species), followed by Lamiaceae (six species). The most dominant family of monocots was Zingiberaceae (ten species). Other families with low numbers included 30 families which represented only one species. This result was in agreement with the previous study, which mentioned that the most dominant family was Fabaceae [5–7]. As documented here, 98 species were presented which were cited by more than half of the traditional healers (Table 1).

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**Fig. 2** Groups of medicinal plants

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**Table 1** List of major uses of medicinal plants cited by more than five traditional healers

| Scientific name / voucher number  | Local name         | taste      | Ailments treated / uses  | Parts used / form of administration    |
|---|--------------------|------------|--|--|
| Magnoliids  |                    |            |  |  |
| Annonaceae  |                    |            |  |  |
| 1. <i>Goniiothalamus macrophyllus</i> (Blume) Hook. f. & Thomson (N. Saedan & C. Khuniad 096) | Chingdokdiao       | hot        | alleviates body pain, flatulence, suffers from general fatigue       | root / decoction / int                 |
| Piperaceae  |                    |            |  |  |
| 2. <i>Piper chaba</i> Hunt (Y. Teanuan & S. Prom- In 099)                                     | Di pli             | hot        | flatulence, strengthens the body elements                            | fruit / decoction / int                |
| 3. <i>Piper sarmentosum</i> Roxb. (Y. Teanuan & S. Prom- In 048)                              | Cha phlu           | hot        | flatulence, strengthens the body elements, paralysis                 | root / decoction / int                 |
| Eudicots  |                    |            |  |  |
| Acanthaceae   |                    |            |  |  |
| 4. <i>Andrographis paniculata</i> (Burm. f.) Wall. ex Nees / (N. Saedan & C. Khuniad 008)     | Fa thalai chon     | bitter     | fever  | whole plant /juice, decoction / int    |
| 5. <i>Clinacanthus nutans</i> (Burm. f.) Lindau (N. Saedan & C. Khuniad 006)                  | Phaya yo           | bland      | poisonous animal bites, antidote, canker                             | leaf/ juice, decoction / ext           |
| 6. <i>Justicia adhatoda</i> L. (Y. Teanuan & S. Prom- In 024)                                 | Sa niat            | bitter     | eliminates sputum, cough, fever                                      | leaf/ juice, decoction / int           |
| 7. <i>Rhinacanthus nasutus</i> (L.) Kurz (N. Saedan & C. Khuniad 004)                         | Thongphanchang     | nauseating | skin diseases, eczema, scabies                                       | leaf/ paste / ext                      |
| 8. <i>Thunbergia laurifolia</i> Lindl.  | Rang chuet         | bland      | antidote, skin irritation  | leaf / juice / int, ext                |
| Amaranthaceae   |                    |            |  |  |
| 9. <i>Alternanthera bettzickiana</i> (Regel) G. Nicholson (Y. Teanuan & S. Prom- In 090)      | Phak pet daeng     | bland      | arthritis, improves blood circulation, emmenagogue, menstrual cramps | whole plant/ decoction / int           |
| Apiaceae  |                    |            |  |  |
| 10. <i>Centella asiatica</i> (L.) Urb. (Y. Teanuan & S. Prom- In 063)                         | Bua bok            | bitter     | thirst, fever, skin swelling   | whole plant / paste / int, ext         |
| Asteraceae  |                    |            |  |  |
| 11. <i>Acmella oleracea</i> (L.) R. K. Jansen (Y. Teanuan & S. Prom- In 010)                  | Phak khrat hua wan | hot        | toothache  | fruit / juice / int                    |
| 12. <i>Blumea balsamifera</i> (L.) DC. (N. Saedan & C. Khuniad 014)                           | Nat yai            | aromatic   | promotes blood flow, flatulence, itching                             | leaf/ decoction / int                  |
| 13. <i>Chromolaena odoratum</i> (L.) R. M. King & H. Rob. (W. Wongwiwat & S. Pinsook 008)     | Sap suea           | nauseating | stops bleeding, peptic ulcer   | leaf/paste, decoction /int, ext        |
| 14. <i>Eclipta prostrata</i> (L.) L. (Y. Teanuan & S. Prom- In 088)                           | Ka meng            | nauseating | stops bleeding, skin diseases, cervical diseases                     | whole plant /paste, decoction / int    |
| 15. <i>Elephantopus scaber</i> L. (N. Saedan & C. Khuniad 097)                                | Do mai ru lom      | bland      | tonifies the muscles   | whole plant / decoction / int          |
| 16. <i>Pluchea indica</i> (L.) Less. (Y. Teanuan & S. Prom- In 025)                           | Khlu               | bland      | diuretic   | leaf/ decoction / int                  |
| 17. <i>Vernonia cinerea</i> (L.) Less. (N. Saedan & C. Khuniad 009)                           | Ya dok khao        | bland      | smoking cessation, alleviates body pain, fever                       | whole plant /smoking, decoction / int  |
| Capparidaceae   |                    |            |  |  |
| 18. <i>Capparis micracantha</i> DC. (Y. Teanuan & S. Prom- In 019)                            | Chingchi           | bitter     | fever, strengthens the body elements                                 | root / decoction / int                 |
| Clusiaceae  |                    |            |  |  |
| 19. <i>Garcinia mangostana</i> L. (Y. Teanuan & S. Prom- In 020)                              | Mang khut          | astringent | skin diseases, intestinal infection                                  | pericarp / juice, decoction / ext, int |
| Cucurbitaceae   |                    |            |  |  |
| 20. <i>Coccinia grandis</i> (L.) Voigt (Y. Teanuan & S. Prom- In 111)                         | Tamlueng           | bland      | poisonous animal bites, fever  | leaf / juice / ext                     |
| 21. <i>Gymnopetalum chinense</i> (Lour.) Merr. (Y. Teanuan & S. Prom- In 094)                 | Kadom              | bitter     | fever, tonifies the liver  | fruit / decoction / int                |
| 22. <i>Momordica charantia</i> L. (Y. Teanuan & S. Prom- In 095)                              | Mara khinok        | bitter     | fever, appetizer, tonifies the liver                                 | fruit / decoction / int                |
| Euphorbiaceae   |                    |            |  |  |

|   |                  |            |   |   |
|---|------------------|------------|---|---|
| 23. <i>Croton roxburghii</i> N. P. Balakr. (Y. Teanuan & S. Prom- In 102)                 | Plao yai         | hot        | alleviates body pain, flatulence, prevention of fever after parturition                       | wood / decoction / int                              |
| 24. <i>Croton tiglium</i> L. (Y. Teanuan & S. Prom- In 071)                               | Salot            | hot        | diuretic, hemorrhoids, constipation   | root, seed oil / decoction / int                    |
| 25. <i>Croton stellatopilosus</i> Ohba (Y. Teanuan & S. Prom- In 011)                     | Plao noi         | hot        | flatulence, peptic ulcer, stomachache   | wood / decoction / int                              |
| 26. <i>Excoecaria oppositifolia</i> Griff. (N. Saedan & C. Khuniad 023)                   | Fai duean ha     | hot        | menstrual problems  | wood / decoction / int                              |
| 27. <i>Shirakiopsis indica</i> (Willd.) Esser (N. Saedan & C. Khuniad 025)                | Samo thale       | sour       | constipation  | fruit / decoction / int                             |
| Fabaceae  |                  |            |   |   |
| 28. <i>Abrus precatorius</i> L. (N. Saedan & C. Khuniad 026)                              | Ma klam khrua    | sour       | fever, sore throat  | root / decoction / int                              |
| 29. <i>Albizia myriophylla</i> Benth. (W. Wongwiwat & S. Pinsook 096)                     | Cha em thai      | sweet      | strengthens the body in general, sore throat  | root, wood / decoction / int                        |
| 30. <i>Cassia fistula</i> L. (Y. Teanuan & S. Prom- In 100)                               | Ratcha phruek    | sweet      | fever, constipation, eliminates sputum (mixed with bitter salt for constipation)              | fruit, pulp / decoction / int                       |
| 31. <i>Caesalpinia major</i> (Medik.) Dandy & Exell (W. Wongwiwat & S. Pinsook 126)       | Sa wat           | nauseating | expels worms  | leaf / decoction / int                              |
| 32. <i>Derris scandens</i> (Roxb.) Benth. (N. Saedan & C. Khuniad 027)                    | Thaowanpriang    | nauseating | alleviates body pain  | wood / decoction / int                              |
| 33. <i>Mimosa pudica</i> L. (Y. Teanuan & S. Prom- In 014)                                | Maiyarap         | bland      | fever, measles, chickenpox  | whole plant / decoction / int                       |
| 34. <i>Senna alata</i> (L.) Roxb. (N. Saedan & C. Khuniad 028)                            | Chumhet thet     | nauseating | skin diseases, constipation   | leaf / paste / ext; inflorescence / decoction / int |
| 35. <i>Senna tora</i> (L.) Roxb. (Y. Teanuan & S. Prom- In 029)                           | Chumhet thai     | nauseating | constipation, skin diseases, appetizer, insomnia  | whole plant / decoction / int                       |
| 36. <i>Tamarindus indica</i> L. (Y. Teanuan & S. Prom- In 147)                            | Ma kham          | sour       | eliminates sputum, improves blood flow, constipation, cold in children                        | fruit / decoction / int                             |
| Gentianaceae  |                  |            |   |   |
| 37. <i>Fagraea fragrans</i> Roxb.   | Kan krao         | bitter     | fever   | wood / decoction / int                              |
| Lamiaceae   |                  |            |   |   |
| 38. <i>Clerodendrum petasites</i> (Lour.) S. Moore (Y. Teanuan & S. Prom- In 137)         | Mai thoa yai mom | bitter     | fever, constipation   | root / decoction / int                              |
| 39. <i>Clerodendrum serratum</i> (L.) Moon (N. Saedan & C. Khuniad 022)                   | Ak khi thawan    | bitter     | hemorrhoids, itching  | leaf / decoction / int                              |
| 40. <i>Ocimum americanum</i> L. (Y. Teanuan & S. Prom- In 116)                            | Mang lak         | aromatic   | flatulence, increases milk production   | leaf / decoction / int                              |
| 41. <i>Ocimum basilicum</i> L. (Y. Teanuan & S. Prom- In 117)                             | Horapha          | aromatic   | flatulence, increases milk production   | leaf / decoction / int                              |
| 42. <i>Ocimum tenuiflorum</i> L. (Y. Teanuan & S. Prom- In 115)                           | Ka phrao daeng   | aromatic   | flatulence, dizziness, asthma in children   | leaf / decoction / int, ext                         |
| 43. <i>Orthosiphon aristatus</i> (Blume) Miq. (Y. Teanuan & S. Prom- In 152)              | Ya nuat maeo     | bland      | diuretic  | whole plant / decoction / int                       |
| Lythraceae  |                  |            |   |   |
| 44. <i>Punica granatum</i> L. (Y. Teanuan & S. Prom- In 139)                              | Thap thim        | astringent | dysentery, diarrhea   | pericarp / decoction / int                          |
| Malvaceae   |                  |            |   |   |
| 45. <i>Sida rhombifolia</i> L. (Y. Teanuan & S. Prom- In 028)                             | Khat mon         | fat        | severe fever, liver diseases, alleviates body pain  | whole plant / decoction / int                       |
| Menispermaceae  |                  |            |   |   |
| 46. <i>Tiliacora triandra</i> (Colebr.) Diels (Y. Teanuan & S. Prom- In 092)              | Yanang           | bland      | fever, antidote   | root / decoction / int                              |
| 47. <i>Tinospora crispa</i> (L.) Miers ex Hook. f. & Thomson (N. Saedan & C. Khuniad 016) | Bora phet        | bitter     | promotes blood flow, appetizer, fever, diabetes, reduces body heat, thirst                    | wood / decoction / int                              |
| Opiliaceae  |                  |            |   |   |
| 48. <i>Lepionurus sylvestris</i> Blume (Y. Teanuan & S. Prom- In 018)                     | Mak mok          | fat        | strengthens the body in general, promotes blood flow, alleviates body pain, cervical problems | root / decoction / int                              |
| Phyllanthaceae  |                  |            |   |   |
| 49. <i>Bridelia ovata</i> Decne. (Y. Teanuan & S. Prom- In 076)                           | Maka             | bitter     | constipation  | leaf / decoction / int                              |



|  |                          |            |   |                               |
|--|--------------------------|------------|---|-------------------------------|
| 50. <i>Phyllanthus emblica</i> L. (N. Saedan & C. Khuniad 015)                     | Ma kham pom              | sour       | promotes blood flow, eliminates sputum, cough, thirst, mixed with <i>Terminalia chebula</i> Retz. and <i>Terminalia bellirica</i> (Gaertn.) Roxb. for body tonic (Tri pha la) | fruit / decoction / int       |
| 51. <i>Phyllanthus pulcher</i> Wall. ex Müll. Arg. (W. Wongwiwat & S. Pinsook 094) | Thorani san              | bland      | fever   | root/ decoction / int         |
| 52. <i>Phyllanthus urinaria</i> L.   | Ya tai bai               | bitter     | alleviates body pain, fever   | whole plant / decoction / int |
| 53. <i>Sauropus androgynus</i> (L.) Merr. (Y. Teanuan & S. Prom- In 030)           | Phak wan ban             | bland      | fever, increases milk production  | leaf / decoction / in         |
| Plumbaginaceae   |                          |            |   |                               |
| 54. <i>Plumbago indica</i> L. (Y. Teanuan & S. Prom- In 120)                       | Chetta mun phloeng daeng | hot        | strengthens the body elements, emmenagogue  | root / decoction / int        |
| 55. <i>Plumbago zeylanica</i> L. (Y. Teanuan & S. Prom- In 073)                    | Chetta mun phloeng khao  | hot        | strengthens the body elements, emmenagogue, improves blood flow   | root / decoction / int        |
| Rubiaceae  |                          |            |   |                               |
| 56. <i>Mitragyna speciosa</i> (Roxb.) Korth. (Y. Teanuan & S. Prom- In 012)        | Kra thom                 | nauseating | dysentery, diarrhea, skin diseases  | leaf / decoction / int/ext    |
| 57. <i>Morinda citrifolia</i> L. (Y. Teanuan & S. Prom- In 078)                    | Yo ban                   | aromatic   | dizziness   | fruit / decoction / int       |
| 58. <i>Morinda elliptica</i> Ridl. (W. Wongwiwat & S. Pinsook 024, 079)            | Yo pa                    | hot        | flatulence, women's diseases  | wood / decoction / int        |
| 59. <i>Saprosma brunneum</i> Craib (Y. Teanuan & S. Prom- In 046)                  | Phahom ton               | aromatic   | strengthens the body in general, flatulence   | whole plant / decoction / int |
| Rutaceae   |                          |            |   |                               |
| 60. <i>Aegle marmelos</i> (L.) Corrêa ex Roxb. (N. Saedan & C. Khuniad 110)        | Matum                    | fat        | strengthens the body elements   | fruit / decoction / int       |
| 61. <i>Citrus aurantifolia</i> (Christm.) Swingle (Y. Teanuan & S. Prom- In 132)   | Manao                    | sour       | cough, eliminates sputum  | fruit / juice / int           |
| 62. <i>Citrus hystrix</i> DC. (Y. Teanuan & S. Prom- In 131)                       | Makrut                   | aromatic   | flatulence, dizziness, eliminates sputum, improves blood flow   | pericarp / decoction / int    |
| 63. <i>Zanthoxylum cf. nitidum</i> (Roxb.) DC. (W. Wongwiwat & S. Pinsook 077)     | Phakrut                  | aromatic   | expels worms, diarrhea, toothache   | wood / decoction / int        |
| Sapindaceae  |                          |            |   |                               |
| 64. <i>Cardiospermum halicacabum</i> L. (Y. Teanuan & S. Prom- In 042)             | Khok kra om              | bland      | itching   | whole plant / juice / ext     |
| Sapotaceae   |                          |            |   |                               |
| 65. <i>Mimusops elengi</i> L. (Y. Teanuan & S. Prom- In 043)                       | Phikun                   | aromatic   | tonifies the heart, dizziness   | flower / decoction / int      |
| Simaroubaceae  |                          |            |   |                               |
| 66. <i>Brucea javanica</i> (L.) Merr. (W. Wongwiwat & S. Pinsook 079)              | Ratcha dat               | bitter     | malaria   | whole plant / decoction / int |
| 67. <i>Eurycoma longifolia</i> Jack (Y. Teanuan & S. Prom- In 111)                 | Pla lai phueak           | bitter     | alleviates body pain, fever, malaria  | root / decoction / int        |
| 68. <i>Harrisonia perforata</i> (Blanco) Merr. (N. Saedan & C. Khuniad 037)        | Khontha                  | bitter     | fever   | root / decoction / int        |
| Solanaceae   |                          |            |   |                               |
| 69. <i>Datura metel</i> L. var. <i>metel</i> (Y. Teanuan & S. Prom- In 130)        | Lam phong                | nauseating | skin diseases   | leaf / paste / int            |
| 70. <i>Solanum indicum</i> L. (Y. Teanuan & S. Prom- In 149)                       | Mawaeng ton              | bitter     | cough, eliminates sputum  | fruit / juice / int           |
| 71. <i>Solanum trilobatum</i> L. (N. Saedan & C. Khuniad 038)                      | Mawaeng khrua            | bitter     | cough, eliminates sputum  | fruit / juice / int           |
| Thymelaeaceae  |                          |            |   |                               |
| 72. <i>Aquilaria malaccensis</i> Lam. (Y. Teanuan & S. Prom- In 001)               | Kritsana                 | aromatic   | tonifies heart, alleviates fatigue, promotes blood flow, fever, strengthens the body in general, dizziness  | wood / decoction / int        |
| Vitaceae   |                          |            |   |                               |
| 73. <i>Cissus quadrangularis</i> L. (N. Saedan & C. Khuniad 003)                   | Phet sangkhat            | nauseating | hemorrhoids, sinusitis, intestinal infection  | wood / capsule / int          |
| Monocots   |                          |            |   |                               |
| Acoraceae  |                          |            |   |                               |
| 74. <i>Acorus calamus</i> L. (N. Saedan & C. Khuniad 039)                          | Wan nam                  | aromatic   | flatulence, strengthens the body elements   | rhizome / decoction / int     |
| Araceae  |                          |            |   |                               |

|  |                    |            |   |                                     |
|--|--------------------|------------|---|-------------------------------------|
| 75. <i>Amorphophallus</i> cf. <i>paeoniifolius</i> (Dennst.) Nicolson (Y. Teanuan & S. Prom- In 057) | Buk                | nauseating | habitual constipation, skin diseases  | tuber / decoction / int             |
| 76. <i>Lasia spinosa</i> (L.) Thwaites (Y. Teanuan & S. Prom- In 057)                                | Phak nam           | nauseating | habitual constipation, skin diseases  | rhizome / decoction / int           |
| Asparagaceae   |                    |            |   |                                     |
| 77. <i>Asparagus racemosus</i> Willd. (N. Saedan & C. Khuniad 041)                                   | Sam sip            | fat        | strengthens the body in general   | root / decoction / int              |
| Asphodelaceae  |                    |            |   |                                     |
| 78. <i>Aloe vera</i> (L.) Burm. f. (N. Saedan & C. Khuniad 042)                                      | Wan hang chora khe | bland      | peptic ulcer, poisonous animal bites, burns   | leaf / juice / int, ext             |
| Cyperaceae   |                    |            |   |                                     |
| 79. <i>Cyperus rotundus</i> L. (Y. Teanuan & S. Prom- In 151)  | Hao mu             | aromatic   | flatulence, strengthens the body elements   | corm / decoction / int              |
| Dioscoreaceae  |                    |            |   |                                     |
| 80. <i>Dioscorea hispida</i> Dennst. (W. Wongwiwat & S. Pinsook 011)                                 | Kloi               | nauseating | tuber: strengthens the body in general; stem: sinusitis   | tuber, stem / decoction / int       |
| 81. <i>Tacca chantrieri</i> André (Y. Teanuan & S. Prom- In 017)                                     | Khang khao dam     | bland      | sexual stimulants   | rhizome / decoction / int           |
| 82. <i>Tacca integrifolia</i> Ker Gawl. (N. Saedan & C. Khuniad 052)                                 | Wan nang khruan    | bland      | alleviates body pain, sexual stimulants   | rhizome / decoction / int           |
| Marantaceae  |                    |            |   |                                     |
| 83. <i>Donax grandis</i> (Miq.) Ridl. (Y. Teanuan & S. Prom- In 025)                                 | Khlum              | bland      | fever   | rhizome/ decoction / int            |
| 84. <i>Schumannianthus dichotomus</i> (Roxb.) Gagnep. (Y. Teanuan & S. Prom- In 018)                 | Khla               | bland      | skin diseases, fever, reduces body heat   | rhizome / decoction / int           |
| Poaceae  |                    |            |   |                                     |
| 85. <i>Panicum repens</i> L. (Y. Teanuan & S. Prom- In 021)  | Ya khrun           | bland      | diuretic  | whole plant / decoction / int       |
| Stemonaceae  |                    |            |   |                                     |
| 86. <i>Stemona tuberosa</i> Lour. (W. Wongwiwat & S. Pinsook 078)                                    | Non tai yak        | nauseating | kill parasites  | root / juice / int, ext             |
| Zingiberaceae  |                    |            |   |                                     |
| 87. <i>Amomum testaceum</i> Ridl. (N. Saedan & C. Khuniad 045)                                       | Krawan             | aromatic   | flatulence, promotes blood flow, asthma, menstrual problems   | fruit / decoction / int             |
| 88. <i>Boesenbergia rotunda</i> (L.) Mansf. (Y. Teanuan & S. Prom- In 113)                           | Kra chai           | aromatic   | strengthens the body in general, increases milk production, dysentery   | root / juice / int                  |
| 89. <i>Curcuma comosa</i> Roxb. (Y. Teanuan & S. Prom- In 022)                                       | Wan chak motluk    | astringent | discharge amniotic fluid after giving birth, treat postpartum uterine swelling                                | fruit / decoction / int             |
| 90. <i>Curcuma longa</i> L. (Y. Teanuan & S. Prom- In 023)   | Khamin chan        | astringent | peptic ulcer, intestinal infections, skin diseases  | rhizome / paste / ext, int          |
| 91. <i>Curcuma zedoaria</i> (Berg) Roscoe (Y. Teanuan & S. Prom- In 114)                             | Khamin oi          | astringent | skin diseases   | rhizome / paste / ext               |
| 92. <i>Kaempferia galanga</i> L. (W. Wongwiwat & S. Pinsook 028)                                     | Pro hom            | aromatic   | flatulence  | rhizome / juice / int               |
| 93. <i>Kaempferia parviflora</i> Wall. ex. Baker (N. Saedan & C. Khuniad 046)                        | Krachai dam        | aromatic   | strengthens the body in general, sexual stimulants  | rhizome / extracted with alc. / int |
| 94. <i>Zingiber montanum</i> (Koenig) Link ex Dietr. (Y. Teanuan & S. Prom- In 040)                  | Phlai              | astringent | flatulence, alleviates muscle pain, strain, skin swelling (mixed with “Ya dam”, latex of <i>Aloe vera</i> L.) | rhizome / juice, decoction / int    |
| 95. <i>Zingiber officinale</i> Roscoe (Y. Teanuan & S. Prom- In 062)                                 | Khing              | hot        | flatulence, appetizer   | rhizome / juice, decoction / int    |
| 96. <i>Zingiber zerumbet</i> (L.) Sm. (Y. Teanuan & S. Prom- In 122)                                 | Kra thue           | bitter     | flatulence, dysentery   | rhizome / juice, decoction / int    |
| Gymnosperms  |                    |            |   |                                     |
| 97. <i>Gnetum montanum</i> Markgr. (N. Saedan & C. Khuniad 071)                                      | Ma mueai           | nauseating | alleviates muscle pain  | wood / decoction / int              |
| Ferns  |                    |            |   |                                     |
| Polypodiaceae  |                    |            |   |                                     |
| 98. <i>Drynaria quercifolia</i> (L.) Sm. (N. Saedan & C. Khuniad 032)                                | Kratae tai mai     | bland      | diuretic  | rhizome / decoction / int           |

The result of this study indicated that the majority of medicinal plants used by traditional healers are still harvested from the wild (Fig. 3). In the case of cultivated plants, the original habitats were wild and located far away from the traditional healers' villages. For convenience, these medicinal plants were moved and planted in cultivated fields or home gardens and used whenever required. However, most traditional healers said that the current situation of medicinal plants is a concern. Some medicinal plant species have become rare or extinct because of overexploitation and continued deforestation. As a result, the shortage of medicinal plants has affected healing treatments. The result was in agreement with the study of Tabuti [7] and Wodah and Asase [8] who reported on the decrease of medicinal plants in northwest Ghana and Uganda. This study showed that shrubs were found to be the most used plants (48 species) followed by herbs (40 species), climbers (35 species) and trees (22 species) (Fig. 4). This result indicated that shrubs were common and easily harvested when compared to others. Furthermore, most of the study areas for this study were open areas suitable for shrub growing.

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**Fig. 3** Sources of medicinal plants

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**Fig. 4** Habits of medicinal plants

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### **Plant parts used**

Among the different parts of medicinal plants used by traditional healers, the underground parts (root, rhizome, tuber, corm) were most frequently used to make the prescriptions for healing treatments, while the whole plant and leaves were second and third respectively (Fig. 5). The study was in agreement with the study of Tabuti [7], Cheikhoussef [5] and Wodah and Asase [8]. Interestingly, Tabuti [7] mentioned that the uses of root and tuber parts can threaten medicinal plant populations or species viability. This observation was in agreement with this study, most traditional healers said that some species such as *Goniothalamus macrophyllus* (Blume) Hook. f. & Thomson, *Capparis micracantha* DC. and *Gnetum montanum* Markgr. are becoming rare because of overexploitation without sustainability. On the other hand, the result of this study was not in agreement with other studies which reported that leaves [9, 10], the whole plant [11] and the stem [12] were the most used parts.

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**Fig. 5** Parts used of medicinal plants

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### **Tastes of individual medicinal plants**

Tastes of individual medicinal plants play a key role for plant selection when used as medicine in the traditional Thai medicine system. Different tastes are associated with curing properties and applications. Based on traditional Thai medicine concepts, tastes are divided into ten types i.e., astringent, sweet, nauseating, bitter, hot, fat, salty, sour, aromatic and bland (tasteless). The idea of taste is in agreement with the Ayurvedic system [13] and traditional uses of plants by tribal communities [14, 15]. The result of this study showed that all medicinal plants were classified into nine groups by their tastes (Table 2). The most frequently found taste was bland (20 species) followed by bitter (18 species) and aromatic and nauseating (16 species each). Bland plants were clearly found to be used for fever (six species) and for their diuretic properties (four species). They were generally used as ingredients together with bitter plants for making remedies for the treatment of fever. Traditional healers explained that bitter plants can kill pathogens while bland plants decrease

body temperature by urine excretion. The result of the study was not accordant with Ankli [14], who reported that Maya of the Yucatan peninsula (Mexico) used bland plants (tasteless) for women's diseases whereas bitter plants were used to treat animal bites and dermatological conditions. Aromatic and hot plants were generally used to treat gastrointestinal diseases (16 species and 12 species, respectively), especially flatulence. Flatulence was the most prominent symptom that occurred in most people, therefore it has various medicinal plants for treatment. Likewise, Ankli [14] reported that aromatic plants were used to treat gastrointestinal diseases. Nauseating plants were related with various illnesses such as gastrointestinal diseases (six species), skin conditions (seven species), muscle pain (two species), women's diseases and bleeding (one species each).

**Table 2** Medicinal plant tastes and medicinal applications (cited by more than five traditional healers)

| Groups of ailment                  | Ailment                              | aromatic | astringent | bitter | bland | hot | nauseating | sour | sweet | fat | total |
|------------------------------------|--------------------------------------|----------|------------|--------|-------|-----|------------|------|-------|-----|-------|
| Gastrointestinal system            | flatulence                           | 11       |            |        |       | 4   |            |      |       |     | 15    |
| (34 species)                       | canker                               |          |            |        | 1     |     |            |      |       |     | 1     |
|                                    | peptic ulcer                         |          | 1          |        |       | 1   |            |      |       |     | 2     |
|                                    | intestinal infections                |          | 1          | 1      |       |     | 1          |      |       |     | 3     |
|                                    | laxative, constipation               |          |            | 2      |       | 1   | 2          | 2    | 1     |     | 8     |
|                                    | hemorrhoids                          |          |            |        |       |     | 2          |      |       |     | 2     |
|                                    | expel worms                          |          |            |        |       |     | 1          |      |       |     | 1     |
|                                    | toothache                            | 1        |            |        |       | 1   |            |      |       |     | 2     |
| Respiratory system (6 species)     | eliminate sputum, cough, sore throat |          |            | 2      |       |     |            | 3    | 1     |     | 6     |
| Fever, malaria (19 species)        |                                      |          |            | 12     | 6     |     |            |      |       | 1   | 19    |
| Skin conditions                    | eczema, scabies, abscess             |          | 2          |        |       |     | 6          |      |       |     | 8     |
| (12 species)                       | animal bites, itching                |          |            |        | 2     |     |            |      |       |     | 2     |
|                                    | skin swelling, burns                 |          |            | 1      | 1     |     |            |      |       |     | 2     |
|                                    | stop bleeding                        |          |            |        |       |     | 1          |      |       |     | 1     |
| Female problems (5 species)        | women's diseases                     |          |            |        | 1     | 2   | 1          |      |       | 1   | 5     |
| Antidote (2 species)               |                                      |          |            |        | 2     |     |            |      |       |     | 2     |
| Musculoskeletal system (8 species) |                                      |          | 1          |        | 3     | 1   | 2          |      |       | 1   | 8     |
| Nephrological system (4 species)   | diuretic                             |          |            |        | 4     |     |            |      |       |     | 4     |
| The heart and circulatory system   | dizziness, tonifies heart            | 3        |            |        |       |     |            |      |       |     | 3     |
| (3 species)                        |                                      |          |            |        |       |     |            |      |       |     |       |
| Miscellaneous (4 species)          | improve body elements                | 1        |            |        |       | 2   |            |      |       | 1   | 4     |
|                                    | total                                | 16       | 5          | 18     | 20    | 12  | 16         | 5    | 2     | 4   | 98    |

The most interesting group was the one related to skin conditions. Skin conditions were treated using a combination of nauseating, astringent, bland and bitter plants. The preferred treatment for various infections used nauseating and astringent tasting plants, whereas the preferred option for swellings was bitter and bland plants. In the case of chronic skin diseases, all four tastes of plants were combined to make remedies. Astringent plants were also used to treat intestinal infections such as dysentery, diarrhea and peptic ulcer. This result was similar to the study of Leonti [16], which revealed that diarrhea and dysentery were treated with astringent plants, for example pericarp of *Garcinia mangostana* L., an astringent plant which is used for its anti-inflammatory activity [17] and extracts of *Garcinia mangostana* L. and *Punica granatum* L. which exhibit antibacterial activity [18]. *Curcuma longa* L., an astringent plant, has long been used in traditional medicine and as a food additive. Its rhizome has played a key role in traditional medicine for treating various diseases such as flatulence, peptic ulcer, intestinal infection, and skin conditions. It was scientifically confirmed in various aspects such as antioxidant activity [19, 20], anti-inflammation [19, 21], antibacterial activity [22] and anti-ulcer activity [23]. The curing properties of other tastes are represented in Table 2. However, this study suggested that the selection of medicinal plants to be used as medicines and the efficacy of treatments derives from a combination of the experience of individual healers as well as medicinal plant selection. This study was in agreement with Casagrande [15] who reported that taste should not be allowed to predict the properties of medicinal plants of the Tzeltal Maya alone, but it should be combined with the experience of each traditional healer. However, Ankli [14] mentioned that taste and secondary products of medicinal plants are relative and traditional knowledge can help healers to distinguish between medicinal and non-medicinal plants.

A greater understanding of the medicinal plant tasting concept is necessary for medicinal plant selection so that more efficient traditional prescriptions can be made. Additionally, the relationship between plant tastes and biological activities have been scientifically confirmed (Table 3). Some common medicinal plants have been used for a long time in traditional medicine such as *Curcuma longa* L.; it is used for wound healing, peptic ulcer and various skin diseases. These activities were already confirmed by scientific validation and were accordant with traditional uses, including other medicinal plant species such as *Aloe vera* (L.) Burm. f., *Amomum testaceum* Ridl., *Andrographis paniculata* (Burm. f.) Wall. ex Nees, *Boesenbergia rotunda* (L.) Mansf., *Centella asiatica* (L.) Urb., *Cissus quadrangularis* L., *Eurycoma longifolia* Jack, *Punica granatum* L., *Solanum trilobatum* L., *Thunbergia laurifolia* Lindl., *Tiliacora triandra* (Colebr.) Diels, *Zingiber montanum* (Koenig) Link ex Dietr. and *Zingiber officinale* Roscoe. These have all been scientifically confirmed.

**Table 3** The relationship between ailment and taste of some medicinal plant species

| Ailment   | Tastes of plant species | Example   | Pharmacological activity   |
|---|-------------------------|---|--|
| Gastrointestinal system   |                         |   |  |
| - flatulence, peptic ulcer  | hot, aromatic           | <i>Acorus calamus</i> L.  | anti-ulcer activity [43]   |
|   |                         | <i>Boesenbergia rotunda</i> (L.) Mansf.                         | anti-ulcerogenic property [44]   |
|   |                         | <i>Cyperus rotundus</i> L.                                      | cytoprotective effects [45]  |
|   |                         | <i>Kaempferia galanga</i> L.                                    | against gastric mucosal [46]   |
|   |                         | <i>Kaempferia parviflora</i> Wall. ex. Baker                    | anti- <i>Helicobacter pylori</i> [47]  |
|   |                         | <i>Ocimum basilicum</i> L.                                      | anti-ulcer activity [48]   |
|   |                         | <i>Ocimum tenuiflorum</i> L.                                    | antimicrobial activity [49]  |
|   |                         | <i>Zingiber officinale</i> Roscoe                               | anti-ulcerogenic effect [50]   |
| - intestinal infections   | astringent              | <i>Curcuma longa</i> L.   | antioxidant and anti-inflammatory activities [51], antibacterial activity [22] antibacterial and mycobacterial activities [20] |
|   |                         | <i>Curcuma zedoaria</i> (Berg) Roscoe                           | antimicrobial activity [51], anti-inflammation [52]  |
| - diarrhea, dysentery   | bitter                  | <i>Zingiber zerumbet</i> (L.) Sm.                               | antimicrobial activity [53], antinociceptive [54]  |
|   | astringent              | <i>Punica granatum</i> L.                                       | antidiarrheal activity [55], anti-inflammatory effect [56]   |
| - laxative, constipation  | sour                    | <i>Tamarindus indica</i> L.                                     | antioxidative effect [57]  |
|   | sweet                   | <i>Cassia fistula</i> L.  | pediatric functional constipation [58], laxative effect [59]   |
|   | hot                     | <i>Croton tiglium</i> L.  | gastrointestinal effect [59]   |
| - hemorrhoids   | nauseating              | <i>Cissus quadrangularis</i> L.                                 | efficacy and side effects of acute hemorrhoids [60] analgesic and anti-inflammatory activities [61]                            |
| - toothache   | hot                     | <i>Zanthoxylum nitidum</i> (Roxb.) DC.                          | anti-inflammation [62, 63] antibacterial activity [62], analgesic activity [64]  |
| Fever, malaria  | bitter                  | <i>Andrographis paniculata</i> (Burm. f.) Wall. ex Nees         | antimalarial activity [65], antibacterial activity [66], anti-inflammation [67], antiviral activity [68]                       |
|   |                         | <i>Brucea javanica</i> (L.) Merr.                               | antimalarial activity [69], antiplasmodial activity [70]   |
|   |                         | <i>Centella asiatica</i> (L.) Urb.                              | Antinociceptive and anti-inflammatory activity [71], anti-allergic activity [72]   |
|   |                         | <i>Clerodendrum petasites</i> S. Moore                          | antipyretic activity [61]  |
|   |                         | <i>Eurycoma longifolia</i> Jack                                 | antiplasmodial activity [73], antiparasitic activity [74]  |
|   |                         | <i>Momordica charantia</i> L.                                   | Antibacterial and antifungal activities [75]   |
|   |                         | <i>Phyllanthus urinaria</i> L.                                  | anti-inflammation [76], anti-HSV [77]  |
|   |                         | <i>Tinospora crispa crispa</i> (L.) Miers ex Hook. f. & Thomson | antimalarial activity [78], antinociceptive and anti-inflammatory activities [79]  |
|   | bland                   | <i>Tiliacora trianda</i> (Colebr.) Diels                        | antimycobacterial activity [80]  |
|   |                         | <i>Vernonia cinerea</i> (L. ) Less.                             | antipyretic and anti-inflammatory activities [81], antibacterial activity [82], antimalarial activity [83]                     |
| Skin conditions   |                         |   |  |
| - eczema, scabies, abscess itching, measles, skin diseases, poisonous animal bites, | nauseating              | <i>Amorphophallus paeoniifolius</i> (Dennst.) Nicolson          | anti-inflammatory activity [84]  |
|   |                         | <i>Datura metel</i> L.  | antimicrobial activity [85], antimycotic activity [86]   |

|   |            |  |   |
|---|------------|--|---|
|   |            | <i>Mitragyna speciosa</i> (Roxb.) Korth.               | antioxidant and antibacterial activities [87], anti-inflammatory and antinociceptive activities [88]      |
|   |            | <i>Rhinacanthus nasutus</i> (L.) Kurz                  | antimicrobial activity [89], antiallergic activity [90], antifungal and anti-inflammatory activities [91] |
|   |            | <i>Senna alata</i> (L. ) Roxb.                         | antiallergic activity [92], antifungal activity [93]  |
|   |            | <i>Senna tora</i> (L. ) Roxb.                          | antioxidant and antibacterial activities [94] antibacterial activity                                      |
|   |            | <i>Stemona tuberosa</i> Lour.                          | antibacterial activity [95]   |
| - burns, skin swelling                  | bland      | <i>Aloe vera</i> (L.) Burn. f.                         | antioxidant and anti-inflammatory activities [96] wound healing property [97]                             |
| - stop bleeding                         | nauseating | <i>Chromolaena odoratum</i> (L.) R. M. King & H. Roxb. | hemostatic and wound healing properties [98]  |
| Respiratory system                      |            |  |   |
| - eliminates sputum, cough, sore throat | sour       | <i>Abrus precatorius</i> L.                            | anti-inflammatory and antiallergic activity [99]  |
|   |            | <i>Albizia myriophylla</i> Benth.                      | antibacterial activity [100]  |
|   |            | <i>Phyllanthus emblica</i> L.                          | anti-inflammatory activity [101], anti-Coxsackie Virus B3 [102]   |
|   |            | <i>Tamarindus indica</i> L.                            | antimicrobial activity [103]  |
|   | bitter     | <i>Solanum trilobatum</i> L.                           | antimicrobial activity [104], anti-inflammatory and analgesic activities [105]                            |
| Female problems                         | fat        | <i>Sida rhombifolia</i> L.                             | antinociceptive and anti-inflammatory activities [106]  |
| Nephrological system                    |            |  |   |
| - diuretic                              | bland      | <i>Orthosiphon aristatus</i> (Blume) Miq.c             | anti-inflammatory activity [107]  |
|   |            | <i>Pluchea indica</i> (L. ) Less.                      | anti-inflammatory activity [108], antimicrobial activity [109]  |



However, there are many medicinal plants which have been commonly used in the area. The activities of these medicinal plants which are accordant with traditional uses have been unproven such as, *Aquilaria malaccensis* Lam., *Baliospermum solanifolium* (Burm.) Suresh, *Bridelia ovata* Decne., *Cardiospermum halicacabum* L., *Capparis micracantha* DC., *Clerodendrum serratum* (L.) Moon, *Donax grandis* (Miq.) Ridl., *Drynaria quercifolia* (L.) Sm., *Excoecaria oppositifolia* Griff., *Fagraea fragrans* Roxb., *Gnetum montanum* Markgr., *Goniothalamus macrophyllus* (Blume) Hook. f. & Thomson, *Gymnopetalum chinense* (Lour.) Merr., *Lasia spinosa* (L.) Thwaites, *Lepionurus sylvestris* Blume, *Panicum repens* L., *Saprosma brunneum* Craib, *Schumannianthus dichotomus* (Roxb.) Gagnep. and *Shirakiopsis indica* (Willd.) Esser.

## Groups of ailments and medicinal plants

One hundred and fifty one medicinal plants were divided into 16 ailment groups (Fig. 6). The largest number of medicinal plants were found to be used for treating the gastrointestinal system, such as flatulence, toothache, canker, stomachache, constipation, diarrhea, dysentery, peptic ulcer and liver diseases, for which 67 species were used, for example *Zingiber zerumbet* (L.) Sm. for flatulence and dysentery, *Baliospermum solanifolium* (Burm.) Suresh for hemorrhoids and constipation and *Clerodendrum serratum* (L.) Moon for hemorrhoids. Neamsuvan [24] mentioned that gastrointestinal disorders were frequently found in southern Thailand because of climate and food consumption culture and also reported that *Senna alata* (L.) Roxb. was predominantly used for constipation, which was in agreement with the present study. The second largest group of ailments was found to be with the respiratory system, such as asthma, elimination of sputum, coughs, sore throats and sinusitis, for which 41 species were used, for example *Justicia adhatoda* L. for the elimination of sputum and coughs, *Millingtonia hortensis* L. f. for sinusitis and asthma. The third largest group of ailments was fever for which 36 species of plants were found, such as *Capparis micracantha* DC., *Clerodendrum petasites* (Lour.) S. Moore, *Harrisonia perforata* (Blanco) Merr. and *Tiliacora triandra* (Colebr.) Diels. These plants constitute the ingredients of a traditional Thai formula which is called “Ya-Ha-Rak” and it has been routinely used for fever treatment. Furthermore, *Harrisonia perforata* (Blanco) Merr. was reported that its aqueous extract showed the highest activity against HIV-1 IN [25]. Other interesting plant species for the treatment of fever include *Andrographis paniculata* (Burm. f.) Wall. ex Nees, *Donax grandis* (Miq.) Ridl., *Gymnopetalum chinense* (Lour.) Merr., *Panicum repens* L., *Tinospora crispa* (L.) Miers ex Hook. f. & Thomson and *Vernonia cinerea* (L.) Less. Interestingly, these plants are bitter and bland. According to the belief of traditional Thai healers, bitter plants have the potential to reduce body temperature and kill microorganisms, whereas bland plants are used as diuretics which decrease body heat. In Sating Phra, peninsular Thailand, *Vernonia cinerea* (L.) Less was used for wound healing [26]. This particular usage differed from examples in this study. Additionally, *Vernonia cinerea* (L.) Less was well known for smoking cessation. Interestingly, *Chromolaena odoratum* (L.) R. M. King & H. Roxb. was commonly used for wound bleeding. [26–29]. The study of Pandith [30] confirmed that hemostatic and wound healing activities were related with the expression of genes, heme oxygenase-1, thromboxane synthase and MMP-9. The smallest number of medicinal plants were used to treat malaria and as antidotes. For malaria treatment, two plant species were found, i.e., *Brucea javanica* (L.) Merr. and *Eurycoma longifolia* Jack. The taste of both species is bitter. Based on traditional Thai medicine, malaria is a type of fever which is frequently treated with bitter medicinal plants. Maneenoon [31] reported that *Eurycoma longifolia* Jack was used by the Sakai tribe, a minority of southern Thailand, to treat fevers as well as malaria. In northern Thailand, the whole plant of *Brucea javanica* (L.) Merr was used to treat itching, whereas

malaria was treated with *Phyllanthus urinaria* L. [27]. As recorded here *Phyllanthus urinaria* L. was used for treating normal fever or body pain caused by fever. *Tiliacora triandra* (Colebr.) Diels and *Thunbergia laurifolia* L. were used for their antidotal properties. Both species have been widely used by Thai traditional healers for treating food poisoning and environmental toxicants. Furthermore, *Tiliacora triandra* (Colebr.) Diels has been added to traditional Thai formulas to lessen the toxicity of the formula. Similarly, *Thunbergia laurifolia* L. was widely used as an antidote by Tai Yai [27], Karen [29] and Buddhist and Muslim Thais in southern Thailand [32]. Pharmacological activities of both plants have been scientifically confirmed, especially the properties of *Thunbergia laurifolia* Lindl., which has been proven effective in the detoxification of insecticide residues [33]. It is used for its antimutagenic activity [34], in the treatment of drug addiction [35], for its antioxidant activity and in the detoxification of cytotoxicity [36], against  $\text{Pb}(\text{NO}_3)_2$  toxicity in Nile tilapia [37], against chronic toxicity [38], for protection against oxidative stress and cell death in brain tissues caused by lead exposure [39] and for prevention of renal toxicity induced by cadmium [40].

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**Fig. 6** Groups of ailments

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The accepted use of *Tiliacora triandra* (Colebr.) Diels is as a detoxifying agent as well as a fever reducing treatment. The result was in agreement with Upho [32], which indicated that this plant species was used as a refrigerant. Saiin & Markmee [41], reported that the extracts of *Tiliacora triandra* (Colebr.) Diels and *Harrisonia perforata* (Blanco) Merr. inhibited *Plasmodium falciparum*, which is the cause of malaria. Moreover, Sireeratawong [42] mentioned that the water extracts of *Tiliacora triandra* (Colebr.) Diels did not cause acute or subchronic toxicities in rats. Based on traditional uses, the consumption of leaf juice of *Tiliacora triandra* (Colebr.) Diels decreases body temperature, but it must not be consumed continuously for longer than seven days.

### **Interesting medicinal plants that are promoted to cure common diseases in rural areas and new properties of some medicinal plants**

Many medicinal plants and traditional prescriptions referred to in the present study have been strongly promoted in rural areas for self-healing. Their healing properties, as confirmed by scientific approach, have proven to be consistent. For example, *Thunbergia laurifolia* L. is strongly promoted for chemical detoxification in agriculturist. *Andrographis paniculata* (Burm. f.) Wall. ex Nees, *Phyllanthus urinaria* L., Ya-Ha-Rak (composed of five roots of *Harrisonia perforata* (Blanco) Merr., *Capparis micracantha* DC., *Tiliacora triandra* (Colebr.) Diels, *Clerodendrum petasites* (Lour.) S. Moore and *Ficus racemosa* L.) and Tri-Pha-La (composed of fruits of *Phyllanthus emblica* L., *Terminalia chebula* Retz. and *Terminalia bellirica* (Gaertn.) Roxb.) are used for treating fever, especially Tri-Pha-La, which is widely used not only for reducing fever but also for tonifying the body elements. Pulp of *Cassia fistula* L. is mixed with bitter salt and Ya-Dam (latex of *Aloe vera* L.) to increase the efficacy for the treatment of constipation. *Clinacanthus nutans* (Burm. f.) Lindau, *Garcinia mangostana* L., *Rhinacanthus nasutus* (L.) Kurz and *Senna alata* (L.) Roxb. are appropriate for treating skin disorders, and many members of Zingiberaceae are suitable for gastrointestinal disorders. Local health care compliance officers should promote these plants to rural people, including advice on their planting and conservation in local communities. The main advantages which rural people gain from these plants are reduced expenses and the avoidance of side effects from chemical drugs.

The present study found new properties of *Ocimum tenuiflorum* L. and *Zingiber montanum* (Koenig) Link ex Dietr. Normally, both plants are well known for treating flatulence. In addition, the latter is widely used for the treatment of muscle pain. Furthermore, the leaves of *Ocimum tenuiflorum* L. are crushed and the extract is anointed on the chest and back of children for the treatment of asthma. An extract of rhizome of *Zingiber montanum* (Koenig) Link ex Dietr is mixed with Ya-Dam and placed on swollen areas for the treatment of bruises.

## Conclusions

The study concluded that even though conventional medicine is available, many people in rural communities still continue to depend on traditional Thai medicine, and highly experienced traditional healers are still important to the communities. Unfortunately, the rapid disappearance of traditional medicine and natural resources due to urbanization suggests that unrecorded data may be lost forever. Therefore, further study will be needed for systematic documentation of traditional Thai medicine including scientific confirmation through biological activities. Clinical studies will also be required.

## Competing interests

The authors declare that they have no competing interests.

## Authors' contributions

KM conceptualized the study and wrote the manuscript, while the other authors carried out the field work and helped with plant identification. All authors read and approved the final manuscript.

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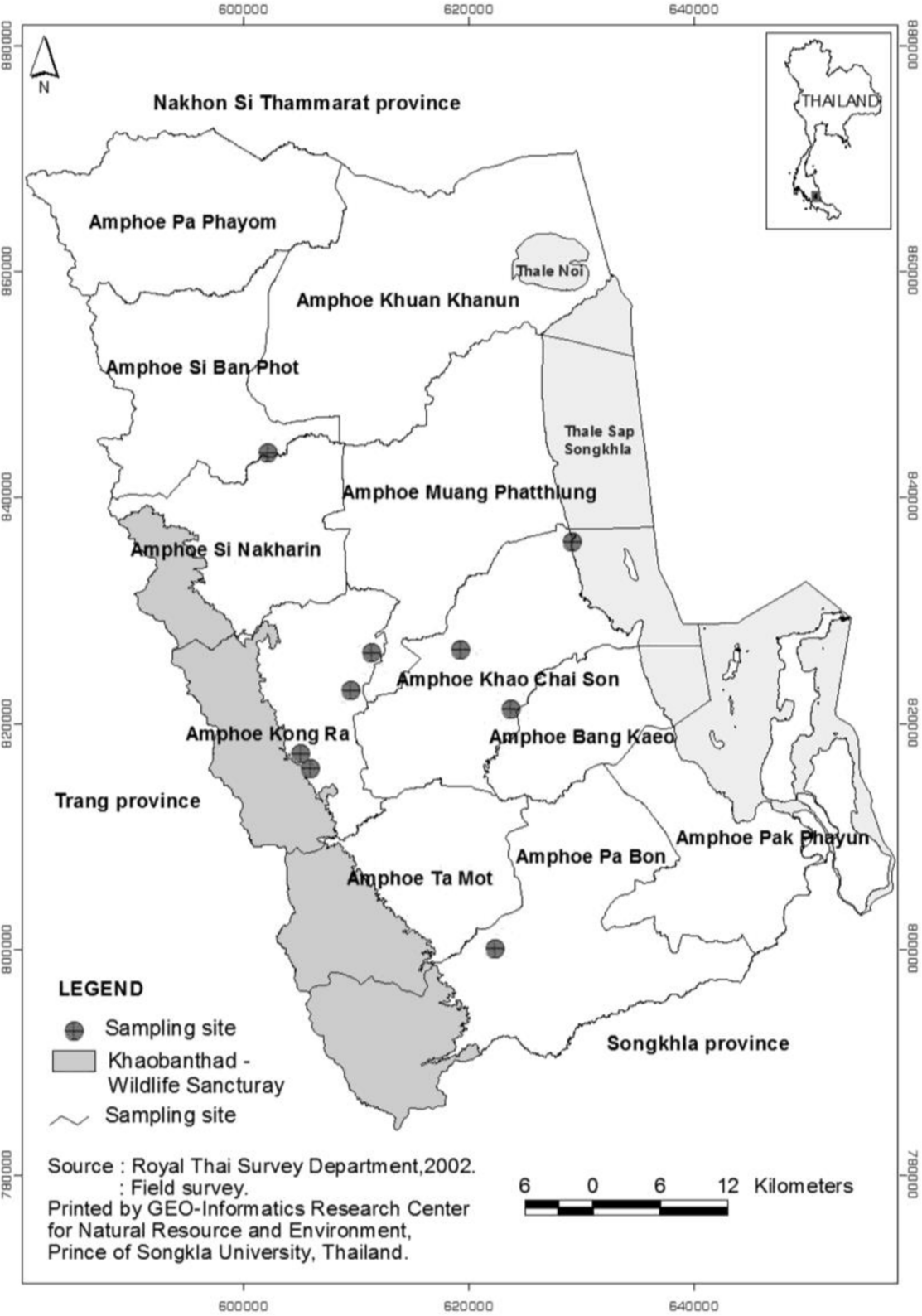
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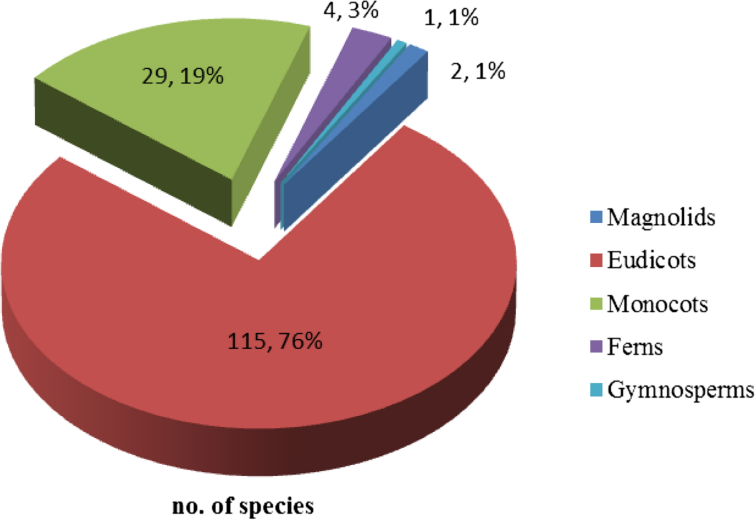


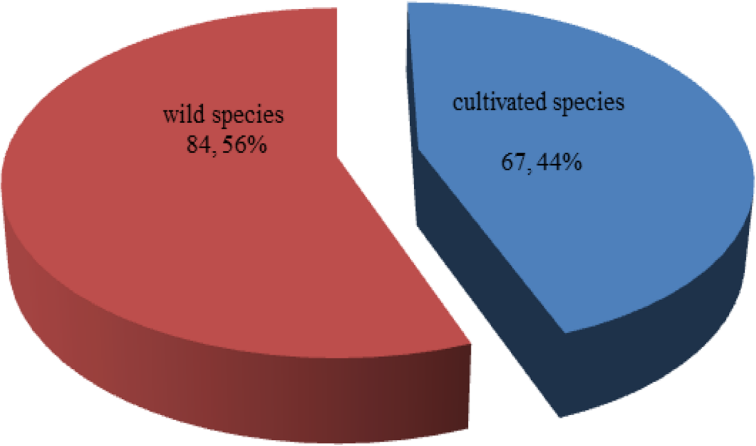
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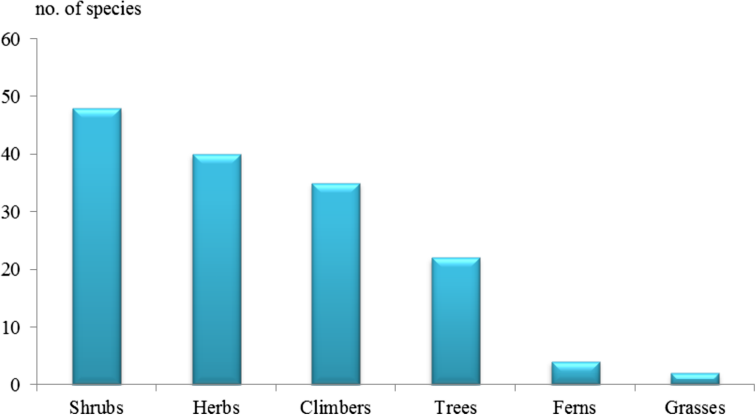
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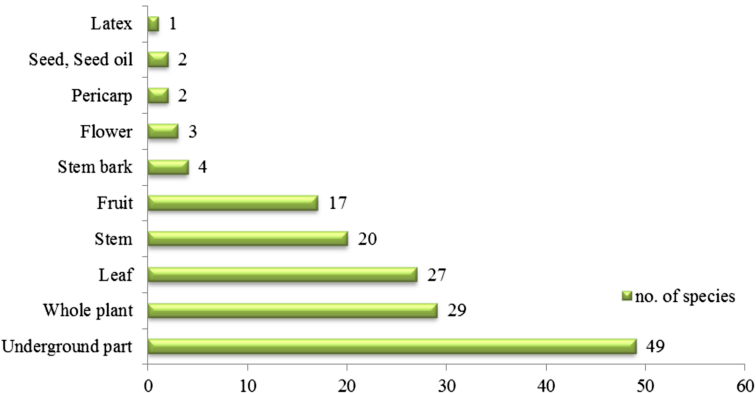








parts used





no. of species

