BIODIVERSITAS
Volume 23, Number 10, October 2022
Pages: 5012-5019

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d231007

Local herbs for pain relief in the area of Tumbon Khao Hin Son, Chachoengsao, Thailand

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Manuscript received: 18 August 2022. Revision accepted: 24 September 2022.

Abstract. *Pikulthong V, Bhirompan S, Dechkla M, Mokkapan K, Boonman N, Wanna C, Machana K, Phakpaknam S. 2022. Local herbs for pain relief in the area of Tumbon Khao Hin Son, Chachoengsao, Thailand. Biodiversitas 23: 5012-5019.* Local herbs have been used in Thailand for years. However, data collection on the use of local herbs in particular areas has not been thorough. This study aimed to survey local herbs treating pain relief in the area of Tumbon Khao Hin Son, Amphoe Phanom Sarakham, Chachoengsao, Thailand. Semi-structured interviews were used. Purposive sampling was used to determine the sample group. In the survey and study on botanical characteristics, from November 2019 - March 2020, 68 plants were identified and classified into 29 families. The local herbs which were mostly used for pain relief included 7 species from the Acanthaceae family, 6 types from Fabaceae, Lamiaceae, and 5 types from Zingiberaceae. The leaves of herbaceous plants had the highest frequency of use. A remedy, Ko-Klan, was found and prepared using a boiling method that could relieve pain. The surveyed herbs were used to treat 4 main symptoms which were body pain, stomachache, headache, and toothache. It was found that 36 species of herbs, or a majority of them, were used to directly relieve the pain. The interviews showed that 27% of the respondents had some home-grown herbs which were used for cooking and basic illness treatment. The age of the respondents was relevant to the use of herbs. The findings in this study will be the foundation for local herb studies which support and are aware of Thai local wisdom and knowledge as guidance to alter herbs for pharmaceutical purposes in the future.

Keywords: Herbal plants, herbs for pain relief, Thailand, Thai local wisdom

INTRODUCTION

Thailand is located in a tropical climate. Therefore, it is not surprising that there is a wide variety of natural resources which is distributed in every region of the country. Many local plants have been used in the daily life of Thai people for a long time, for example, some edible plants have been served as food, some plant parts have been applied to make clothes, and wood has been provided as a component of the dwelling as well as some herbal plants have been used in healthcare for therapeutic purposes and as dietary supplements (Panyadee et al. 2022). The utilization of each plant species is also varied in each region especially applied in nature to the benefit of the ethnic group.

Thai local wisdom in applying plants for basic treatment has been passed from generation to generation for several years. Traditional medicinal plants have been used to treat a variety of organ system disorders, such as respiratory, muscular-skeleton, digestive, blood circulatory, nervous, endocrine, and metabolic systems (Phumthum and Balslev 2019). Moreover, they have been used to cure many diseases, including fever, dysentery, infections, skin diseases, poisoning, insect bites, pain, wounds, cancer, rheumatism, hypertension, and diabetes (Andrade et al. 2020; Phumthum and Balslev 2019; Phumthum et al. 2018; Prasansuklab et al. 2020). The utility of a plant for traditional treatment by local people is often strictly related to a particular part of the plant such as roots, tubers, bark, stems, vines, leaves, flowers, fruits, seeds, etc. However, the selection of the plant part usually depends on which organ exhibit the highest concentration of bioactive substances with high therapeutic efficacy (Phumthum et al. 2018). In addition, there are various methods for the preparation of medicines, such as boiling in hot water, soaking in water or liquor, grinding and mixing with water or liquor, or direct ingestion without any preparation. Finally, the route of drug administration is different, including ingestion, inhalation of vapors, and external application to affected parts of the body (Phumthum et al. 2018).

Local herbs play a crucial role to serve as a primary health care system, especially in the remote areas of many developing countries for hundreds of years to the present (Van Sam et al. 2019; Palhares et al. 2021; Ullah et al. 2020; Van Wyk et al. 2018). Interestingly, it has been starting to widely receive attention in many developed countries in recent years (Braun et al. 2010). This may be due to the local herbs have more comparative advantages than using synthetic and modern medicines because of a relatively lower cost, ease of use, and minimal side effects.

Ethnobotany is the study of the interaction between

humans and indigenous plants for food, medicine, appliances, and others, which have been practiced and uses throughout time. From a scientific perspective, this approach is based on several disciplines, not only the field observations, collection, botanical identification, documentation, and utilization by local communities but also in botany, chemistry, ecology, economics, pharmacology, and public health (Suntar 2019; Suwardi et al. 2020). Nowadays, ethnobotany has become increasingly important in the development of health and conservation programs around the world, especially in a country with high plant biodiversity and cultural diversity, because it is essential for biodiversity conservation and to fulfill human needs such as food, health, and culture (Pieroni et al. 2014; Tamalene et al. 2016).

Tumbon Khao Hin Son is the joint area of Amphoe Phanom Sarakham and Prachin Buri in Thailand where many factories are located. Highway 304 (Chachoengsao-Kabin Buri) which runs across the central area of the subdistrict is used as the main important route for transporting goods and traveling to Cambodia. These factors result in substantial migration of people from other regions to this area for work not only in industry but also in agriculture, such as mango and cassava farms. This could lead to the loss of genetic diversity. Khao Hin Sorn Royal Development Study Center and the agricultural research site of Kasetsart University are located in the southwest of Tumbon Khao Hin Son. They have concerned that economic growth has greatly stirred changes in society and the environment and caused various health problems. Therefore, these organizations have encouraged the local people to use the traditional herbs for primary health care and instilled their sustainable values of local resource conservation.

As the forest is currently used for agriculture, the sources of herbs and the number of folk healers are consequently decreasing. This also significantly entails the subsidence of local wisdom (Chuakul 2010; Novriyanti et al. 2021). The appropriate and safe use of herbal medicine for pain relief and health promotion will benefit both self-care and the nursing of others (Khaokham et al. 2017). However, it was found that the knowledge in using herbs for the pain relief of local people in Tumbon Khao Hin Son has not been collected. Therefore, it is essential to study, explore, and collect that knowledge, in order to publicize the value of plant resources and to conserve the local wisdom of the area which can support further study and development. This research aims to collect information on the use of herbs for pain relief and to study their general properties and how the local people can use the herbs.

MATERIALS AND METHODS

Study area

This research was carried out by surveying the use of local herbs for pain relief in 10 villages of Tumbon Khao Hin Son, Amphoe Phanom Sarakham, Chachoengsao, Thailand (13°45'59.0184"N, 101°31'1.9488"E) (Figure 1) from November 2019 - March 2020.

Ethnobotanical data collection

Semi-structured interviews were used to collect the data which were slightly modified from Neamsuvan et al. 2012. All 100 respondents, including local philosophers and herbal users, aged between 40-60 years old, were identified using purposive sampling. The purposes were to understand the types of herbs, the local name, medicinal properties, user habits, the usable parts of herbs, preparation method, and sources of herbs using observation, note taking, and photo taking as references.

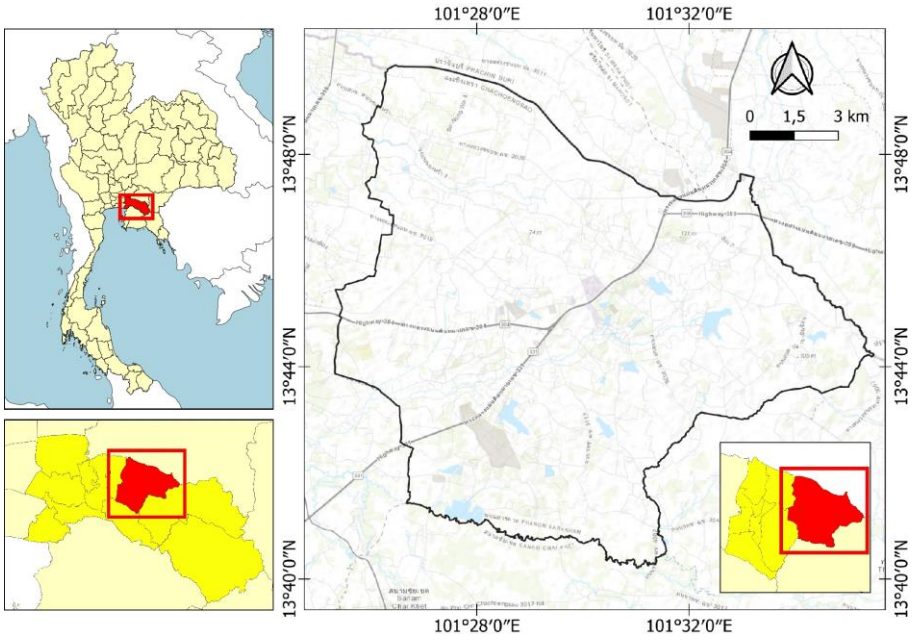

Figure 1. Tumbon Khao Hin Son Area, Amphoe Phanom Sarakham, Chachoengsao, Thailand

Specimen collection, identification and data analysis

1) Verified botanical names from the Thai Plant Name (Tem Smitinand), Herbal Plants in Khao Hin Son Herb Garden (Complete Edition), BGO Plant Database of The Botanical Garden Organization. Compare samples of dried plants collected in form of electronic files (Thaenkham et al. 2019). Phytochemistry and pharmacology were examined after the botanical names were verified, in order to explore the properties and the users' usage methods compared to the Thai Crude Drugs of the Faculty of Pharmacy, Ubon Ratchathani University, and the experts.

2) Analyzed the utilization of herb properties using descriptive statistics and make comparisons to the results of the study.

RESULTS AND DISCUSSION

The results showed that from all 100 respondents, their ages were between 51-60 years old, and 40-50 years old, which were 83% and 17% respectively. When studying the source of herbs, it was found that 73% of the users preferred to buy herbs from herb shops and 27% of them grew herbs for household purposes, such as cooking and basic illness treatment, which also resulted in the retreat of local wisdom. The results showed that the respondents of the young age were less likely to use herbs which may be dangerous for new generations in the study area. This corresponds to the study of Hong et al. (2015) and Soemarwoto and Iskandar (2021) which explained that the decrease of local wisdom among youths is limited not only to the use of herbs or to the study area but also encompasses a lack of faith from the majority of youths in the immediate life benefits resulting from the study of local wisdom. The traditional knowledge system is immensely important for plant, utilization, and environmental management (Suwardi et al. 2020).

The study by Maneenoon et al. (2017) showed that the majority of local people prefer buying herbs from herb shops because it is more convenient. Since they are rare, some herbs are not recognized among the working-age population. This finding corresponds with some earlier studies which found that the change in the environment can lead to the loss of local plants (Soemarwoto and Iskandar 2021). However, it was found in this study that the respondents living near Khao Hin Sorn Royal Development Study Center understand and can use herbs for basic illness treatment. This could be the result of the greater consolidation and support given to projects for youths by making schools and communities become plant genetics conservation areas.

The study of herbs used for treating pain in the area of Tumbon Khao Hin Son can classify 4 groups of pain based on the treatment properties which are muscle pain, headache, stomachache, and toothache. Different herbs, but with relevant functions, are used with each symptom. There are 35 types of herbs that are mostly used for relieving overwork-related muscle pain (Chuakul 2010) which is followed by many illnesses. There are 33 types, 15 types, and 5 types of herbs used for soothing stomachache, headache, and toothache respectively. Those 68 types of herbs are from 29 families. There are 7 types of herbs from the Acanthaceae family, 6 types from the Fabaceae and Lamiaceae families, and 5 types from the Zingiberaceae family which are mostly used consecutively (Table 1). These types of herbs are effective in relieving body aches)Huang et al. 2015). Only one or two types of herbs are found to be derived from other families. They are mostly herbaceous plants. Since they are small)Hong et al. 2015), it is easier to harvest them and prepare remedies)Yaseen et al. 2015) compared to a tree or a shrub.

According to the users, the herbs which are mostly claimed to relieve muscle pain are *Cryptolepis dubia*, Sappan wood tree, and pepper. They are classified in the report as a remedy for muscle pain and this corresponds to the Thailand National List of Essential Medicines (Medicines Regulation Division 2012) which also classifies them as a remedy for musculoskeletal pain. Red basil and turmeric are mostly referred to as herbs for relieving stomachache. They can fight against ulcerative colitis (Sawasdichai and Im-iam 2016). Andrographis paniculate is mostly claimed to relieve headaches. Peppermint is mostly mentioned for relieving toothache. In addition, it was found that plants from the Piperaceae family contain alkaloids, as does pepper, which can resist inflammation, pain, and seizures in laboratory guinea pigs)Khoka 2017). It treats oral wounds and bad breath. Tungtrakanpoung and Tungtrakanpoung (2016) found that peppermint can suppress *Staphylococcus* sp., which is the cause of cariostatic. Furthermore, it is noticeable that Andrographis paniculate and turmeric are herbaceous plants that are easily grown and found in every area. The whole plants give a bitter taste which contains medical treatment properties. According to the botanical characteristics and properties mentioned above, these plants are outstanding in comparison to others.

According to the user habits, there are 5 types of plants that are used as herbs. In respective order, they are 23 types (34%) of herbaceous plants, each of 15 types (22%) of shrubs and climbers, 14 types (21%) of trees, and 1 type (1%) of grass (Table 1, Figure 1). The parts of the plants which are mostly used for herbs, from Figure 3, are 24 types of leaves, 10 types of roots and rootstock, 8 types of whole plants, 7 types of fruits, 6 types of stems, 5 types of vines, 4 types of bark, 3 types of seeds, and 1 type of flower respectively. Maroyi (2013) reported that using roots or bark presents a threat to the whole plant to be cut or extirpated. Therefore, leaves and fruit are easier and more appropriately used as the damage to the whole plant is modest.

There are many methods used to prepare remedies (Figure 4). There are 39 types of herbs that are prepared using the boiling method, 13 types for infusing, 7 types for eating fresh, 5 types for extracting, and 2 types for brewing in liquor and grinding and plastering sequentially. The study by Cheentam et al. (2019) reported that boiling is the method generally used for preparing herb remedies (Chunyan et al. 2009).

Table 1. Some of type and species, and the utilization of herbs from the interviews with the respondents

Family, Botanical name	Habit	Usable part	Preparation of remedy	Properties from users	Medicinal properties from references*,**,***
Acanthaceae					
Andrographis paniculata (Burm.f.) Nees	Shrub	Leaf	Infuse in hot water	Relieve stomachache and headache	Leaf: Boil in hot water to boost appetite, relieve fever and cough. Grind the leaf and plaster to treat abscesses.
Barleria lupulina Lindl.	Shrub	Leaf		Relieve toothache	Leaf: Boil in hot water and drink to stimulate better blood circulation and treat malaria. Grind and mix with liquor to drink. The pomace can be used to plaster the wound to treat urticaria or rash.
Barleria strigosa Willd.	Shrub	Whole plant	Boil in hot water for drink	Relieve pain	Root: Boil in hot water and drink to relieve aphthous ulcer and thirst. Leaf: Relieves pharyngitis and flu Whole plant: Boil in hot water for analeptic drink
Clinacanthus nutans (Burm.f.) Lindau	Shrub	Leaf	Boil in hot water for drink	Relieve pain	Root: Tonic Stem and leaf: Treats insect bites
Justicia gendarussa Burm.f	Shrub	Leaf	Boil in hot water for drink	Relieve pain and headache	Root: Treats sprains Leaf: Drink as a blood tonic, treats fever and headache Whole plant: Carminative
Rhinacanthus nasutus (L.)	Shrub	Leaf	Infuse in hot water	Relieve pain and headache	Root and leaf: Grind and brew in liquor. Rub to treat dermatophytosis, chloasma, and rash Leaf: Infuse in hot water and drink to relieve fever.
Thunbergia laurifolia Lindl.	Climber	Leaf	Infuse in hot water	Relieve headache	Vine and leaf: Treats fever, intoxication, aphthous stomatitis, and thirst. Grind and plaster to relieve joint pain
Fabaceae					
Biancaea sappan (L.) Tod.	Tree	Bark or Duramen	Boil in hot water for drink	Relieve pain and headache	Duramen: Nourishes blood and lungs. Treats aphthous stomatitis, thirst, diarrhea, hemorrhoids, cough, menstruation, and nosebleeds. It is also an expectorant
Lamiaceae					
Clitoria ternatea L.	Herbaceous plant	Seed	Infuse in hot water	Relieve stomachache	Root: Rub it on teeth to relieve toothache and strengthen the teeth. Flower: Squeeze the water boiled from flowers used to wash hair and it can also treat falling hair and nourish the eyes and brain.
Bauhinia sirindhorniae K. Larsen & S. S. Larsen	Climber	Stem	Boil in hot water for drinking	Relieve pain	Root and Stem: Relieves body aches and treats diabetes. Boil them with water and use them to take a bath to treat the rash Leaf: Grind the leaf before plastering it on fresh wounds or inflamed wounds with pus Flower: Enhances appetite and nourishes the body
Derris scandens (Roxb.) Benth.	Climber	Vine	Boil in hot water for drinking	Relieve pain	Vine: It helps with diuretics, dysentery, and colds. Roast it with heat for a good smell and drink it as tea to treat muscle pain, tendon deterioration, dysentery, cough, and colds.

Sesbania grandiflora (L.) Pers.	Tree	Bark	Boil in salt water and keep in the mouth and rinse off	Relieve toothache	Root: Expectorant, treats cough and aphthous ulcers Bark: Treats diarrhea, dysentery, toothache, and bleeding Leaf: Treats headache Flower: Treats fever and intoxication
Mentha villosa Huds.	Herbaceous plant	Leaf	Infuse in hot water	Relieve stomachache and toothache	Leaf: Perspiration, treats asthma, carminative, relieves toothache and contracture
Ocimum africanum Lour.	Herbaceous plant	Leaf	Eat fresh	Relieve stomachache and flatulence	Leaf: Treats dermatophytosis. Eat fresh leaves as a carminative. Seed: For weight loss and biliation
O. basilicum L.	Herbaceous plant	Leaf	Boil in hot water for drinking	Relieve stomachache and headache	Leaf: and shoot: Drink as a tea to relieve dizziness and stomachache for children by infusing the leaf and mixing it with milk. It works as carminative
O. gratissimum L.	Shrub	Leaf	Infuse in hot water	Relieve stomachache	Leaf: Nourishes the body, perspiration, treats poor appetite, period pain, and stomachache caused by dyspepsia. It works as carminative
O. tenuiflorum L.	Herbaceous plant	Leaf	Grind and plaster or scrub and rub on belly	Relieve stomachache	Leaf: Nourishes fire element. It warms the body and prevents cold. Relieves nausea, stomachache, flatulence, and it works as carminative. Use it externally to treat skin disease and stomachache in children
Orthosiphon aristatus (Blume) Miq.	Herbaceous plant	Stem	Boil in hot water for drinking	Relieve pain	Leaf and whole plant: It helps with diuretics. It treats lithiasis, nephrosis, and the bladder. It relieves spinal and lowers back pain, and rheumatoid arthritis
Sesbania grandiflora (L.) Pers.	Tree	Bark Stem	Boil in salt water and keep in the mouth and rinse off	Relieve toothache	Root: Expectorant, relieves cough and aphthous ulcer. Bark: Treats diarrhea, dysentery, toothache, and bleeding Leaf: Relieves headache Flower: Relieves fever and intoxication
Zingiberaceae					
Boesenbergia rotunda (L.) Mansf.	Herbaceous plant	Rootstock	Boil in hot water for drinking	Relieve stomachache	Rootstock: Relieves flatulence and colic. Relieves stomachache, enhances stomach and intestine functions, treats colitis and nourishes the body
Curcuma longa L.	Herbaceous plant	Rootstock	Infuse in hot water	Relieve stomachache, flatulence, and period pain	Rootstock: Nourishes appetite and body elements. Treats and nourishes skin, blood purification, flatulence, colic, period pain, dizziness, cold, toothache, gumboil, joint pains, and heals fresh wounds
Kaempferia parviflora Wallich. ex Baker.	Herbaceous plant	Rootstock	Brew in liquor and drink	Relieve pain	Rootstock: Boosts energy, relieves muscle pain and fatigue, enhances potency. It is an elixir that works as a carminative, treats colic and stomachache
Zingiber montanum (Koenig) Link ex Dietr.	Herbaceous plant	Rootstock	Infuse in hot water	Relieve stomachache	Rootstock: It is a carminative. It treats menstruation, beriberi, stomachache, and flatulence Leaf: It gives an unsatisfying taste, but it treats fever, muscle pain, and feverish feeling
Z. officinale Roscoe	Herbaceous plant	Rootstock	Eat fresh	Relieve pain and stomachache	Rootstock: Treats flatulence, colic, and pre-post period pain, appetite, pain, cough, and colds

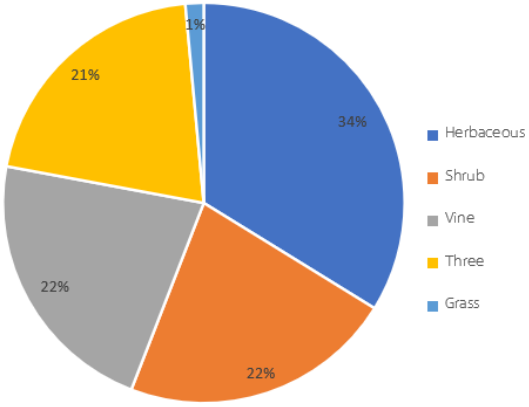

Figure 2. Plant habits used for relieving body pain in the area of Tumbon Khao Hin Son

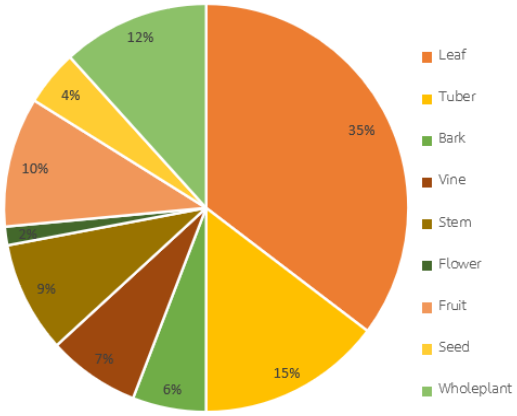

Figure 3. Percentage of plant organs used for relieving pain in the area of Tumbon Khao Hin Son

The Ko-Klan remedy contains *Mallotus repandus*, *Elephantopus scaber*, *Rhinacanthus nasutus*, and Indian bael. It can relieve muscle and lower back pain, and micturition. It is one of the remedies on the Thailand National List of Essential Medicines B.E.2555. There are 3 remedies. *Mallotus repandus* contains various phytochemicals)Maitnork et al. 2010). If its potency is verified in pharmacology, the standard of herbal medicines would be raised to reach international standards. Currently, quality control is one of the obstacles in research)Phakpaknam and Padumanonda 2008). In addition, there are 21 types of herbs found, but not related to the reference document. There are 3 types of herbs that are scarcely referred to.

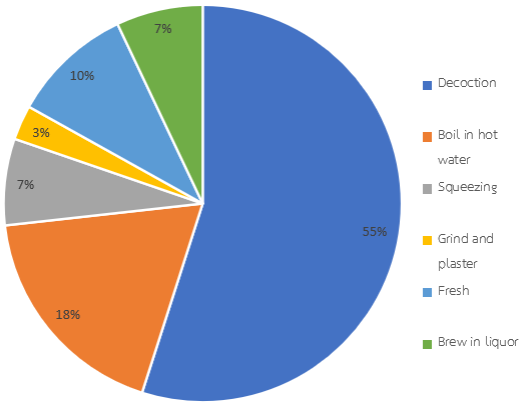

Figure 4. The preparation method remedies in the area of Tumbon Khao Hin Son

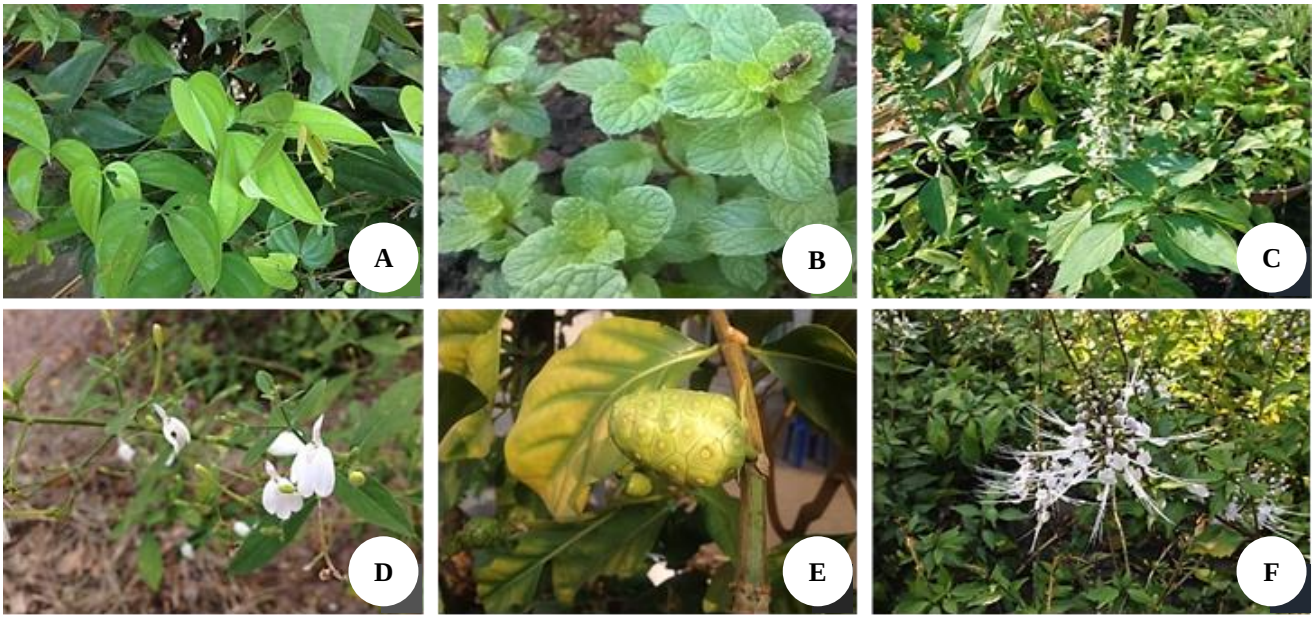

Figure 5. Some of herbs used for relieving body pain in the area of Tumbon Khao Hin Son. A. *B. sirindhorniae* K. & S. S. Larsen, Nord. J.Bot., B. *M. villosa* Huds.,C. *O. africanum* Lour., D. *R. nasutus* (L.) Kurz, E. *Morinda citrifolia* L., F. *Orthosiphon stamineus* Benth.

They are *Cinnamomum parthenoxylon*, *Bauhinia sirindhorniae*, and *Plumbago zeylanica*. Therefore, it is essential to study and prove their properties to confirm the use of these local remedies)Neamsuvan et al. 2012) and to consider the antioxidant properties of gourd, pumpkin, and cucumber)Wanna 2019). This basic information will be beneficial for the basic use of herbs among local people in each area.

The survey on the use of herbs for relieving pain in the area of Tumbon Khao Hin Son, Amphoe Phanom Sarakham, Chachoengsao can classify 4 symptoms based on the treatment properties. They are muscle pain, headache, stomachache, and toothache. The use of herbs tends to be decreased following the age of the respondents. There are 68 species of plants found which can be classified into 29 families. Plants from the Acanthaceae family are mostly used to relieve pain. Leaves and boiling methods are mostly used to prepare remedies. The survey on the herbs used to relieve pain in Tumbon Khao Hin Son collected basic information from different community members. This information would be extremely beneficial if there were further studies that extended into traditional products. This communal forest will still exist when the community unites and has knowledge on the use of herbs, and conserves local wisdom on herbs and food plants (Cheentam et al. 2015). In conclusion, this study collects and proves the identity of local herbs affecting pain relief and local remedies which are active against inflammation. These findings will be the basic information for the study of local herbs in order to develop them into medicines in the future.

ACKNOWLEDGEMENTS

We would like to express my sincere appreciation to Kanchit Kenchalerm, local philosopher, and the Environmental Biology Program, Faculty of Science and Technology, Suan Sunandha Rajabhat University, Thailand for the support.

REFERENCES

Andrade C, Gomes NG, Duangsrisai S, Andrade PB, Pereira DM, Valentao P. 2020. Medicinal plants utilized in Thai Traditional Medicine for diabetes treatment: Ethnobotanical surveys, scientific evidence and phytochemicals. J Ethnopharmacol 263: 113177. DOI: 10.1016/j.jep.2020.113177.

Braun LA, Tiralongo E, Wilkinson JM, Spitzer O, Bailey M, Poole S, Dooley M. 2010. Perceptions, use and attitudes of pharmacy customers on complementary medicines and pharmacy practice. BMC Compl Altern Med 10: 38. DOI: 10.1186/1472-6882-10-38.

Cheentam S, Attisilwet J, Takolpuckdee P. 2015. The study of herbal medicine diversity and local wisdom by parcipatory process in Dongbang community, Tambol Dongbang, Amphoe Mueang, Changwat Prachin Buri. J Thai Interdiscip Res 10 (30): 1-8.

Cheentam S, Takolpuckdee P, Attisilwet J. 2019. Local wisdom of herbal medicines utilization in Bongoen Sub Distric community, Lat Lum Kaew Distric, Pathumthani Province. Journal of Graduate Studies Valaya Alongkorn Rajabhat University. 13(3): 137-148.

Chuakul W. 2010. Folk herbs to relieve aches. Thai Pharmaceut Health Sci J 5 (1): 1-13.

Chunyan Y, Zhiling D, Yanchun L, Yitao L, Chunlin L. 2009. Medicinal plants used by Tibetans in Shangri-la, Yunnan. China. J Ethnobiol Ethnomed 5 (1): 5-15. DOI: :10.1186/1746-4269-5-15.

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

Huang WC, Chiu WC, Chuang HL, Tang DW, Lee ZM, Wei L, Huang C. 2015. Effect of curcumin supplementation on physiological fatigue and physical performance in mice. Nutrients 7 (2): 905-921. DOI: 10.3390/nu7020905.

Khaokham S, Taneeruttana T, Phrapalad Payogo S. 2017. The use of herbal medicine by the Buddha's permission for primary health care. J MCU Peace Stud 5 (2): 237-249.

Khoka A. 2017. Phytochemicals from *Piper nigrum* and their pharmacological effects. PKRU Sci Tech J 1 (2): 28-39.

Maitnork K, Sombutphoothorn S, Noontum P, Sumalee A, Konsue A. 2010. Total phenolic content and antioxidant activities of aqueous extract from Ko klan remedy. KKU Sci J 48 (1): 95 - 107.

Maneenoon K, Chatawatee B, Damkhong C, Khiankhan N, Kunworarath N. 2017. Knowledge of traditional healers on utilization of medicinal plants used for menstrual disorders in Krabi and Songkhla Provinces, Thailand. Burapha Sci J 22 (3): 243-258.

Maroyi A. 2013. Traditional use of medicinal plants in south - central Zimbabwe: review and perspectives. J Ethnobiol Ethnomed 9 (31): 2-18. DOI: 10.1186/1746-4269-9-31.

Medicines Regulation Division. 2012. National list of essential medicines. http://kpo.moph.go.th /webkpo/ tool/ Thaimed2555. pdf. Thailand

Neamsuvan O, Jaisamut P, Maneenoon K, Subhateerasakul S. 2012. A Survey of medicinal plants for tonic from Ban Toong Soong community forest, Auluk District, Krabi Province. Burapha Sci J 17 (2): 160-166.

Novriyanti N, Nursanti N, Wulan C. 2021. Short Communication: Do women have a piece of traditional knowledge ofmedicinal plants? A case study around Jambi Urban Forest, Indonesia. Asian J Ethnobiol 4 (2): 115-119. DOI: 10.13057/asianjethnobiol/y040206.

Palhares RM, Baratto LC, Scopel M, Mügge FL, Brandão MG. 2021. Medicinal plants and herbal products from Brazil: how can we improve quality?. Front Pharmacol 11: 606623. DOI: 10.3389/fphar.2020.606623.

Panyadee P, Meunrew J, Balslev H, Inta A. 2022. Ethnobotany and ecosystem services in a tidal forest in Thailand. Sustainability 14 (10): 6322. DOI: 10.3390/su14106322.

Phakpaknam S, Padumanonda T. 2008. A study of the botanical origin and oil components of the herp Phak Chee La. J Tradit Complement Med 6 (3): 133-140.

Phumthum M, Balslev H. 2019. Use of medicinal plants among thai ethnic groups: A comparison. Econ Bot 73 (1): 64-75. DOI: 10.1007/s12231-018-9428-0.

Phumthum M, Srithi K, Inta A, Junsongduang A, Tangjitman K, Pongamornkul W, Trisonthic C, Balslev H. 2018. Ethnomedicinal plant diversity in Thailand. J Ethnopharmacol 214: 90-98. DOI: 10.1016/j.jep.2017.12.003.

Pieroni A, Anely N, Avni H, Mustafa B, Bruno S, Kevin C, Cassandra LQ. 2014. Local knowledge on plant and domestic remedies in the mountain village of Peshkopia (Eastern Albania). J Mt Sci 11 (1): 180-194. DOI: 10.1007/s11629-013-2651-3.

Prasansuklab A, Brimson JM, Tencomnao T. 2020. Potential Thai medicinal plants for neurodegenerative diseases: A review focusing on the anti-glutamate toxicity effect. J. Tradit Complement Med 10 (3): 301-308. DOI: 10.1016/j.jtcme.2020.03.003.

Sawasdichai C, Im-iam S. 2016. Thai traditional medicine and Thai herbs. J Prapokklao Hosp Clin Med Educ Center 33 (3): 265-270.

Soemarwoto R, Iskandar J. 2021. Plant knowledge richness in the Sundanese upland village: A case study in Sindangsari, West Java, Indonesia. Biodiversitas. 22 (9): 3722-3736. DOI: 10.13057/biodiv/d220916.

Suntar I. 2019. Importance of ethnopharmacological studies in drug discovery: role of medicinal plants. Phytochem Rev 19: 1199-1209. DOI: 10.1007/s11101-019-09629-9.

Suwardi AD, Navia Z, Hamawan T, Ardi S, Mukhtar E. 2020. Ethnobotany and conservation of indigenous edible fruit plants in South Aceh, Indonesia. Biodiversitas 21 (5): 1850-1860. DOI: 10.13057/biodiv/d210511.

Tamalene MN, Al Mudhar MHI, Suarsini E, Rahman F, Hasan S. 2016. Ethnobotany of Canarium plant species used by Tobelo Dalam

(Togutil) ethnic community of Halmahera Island, Indonesia. Biodiversitas 17 (1): 61-69. DOI: 10.13057/biodiv/d170109.

Thaenkham A, Tiyaworanant S, Padumanonda T. 2019. The ethnobotanical survey of treaditional plant of Pamanow Subdistrict, Banfang District, Khon kaen Province. Udon Thani Rajabhat Univ Sci Technol 7 (2): 61-75.

Tungtrakanpoung R, Tungtrakanpoung J. 2016. Antibacterial activity from leaf extracts of *Mentha cordifolia* Opiz. by ethanol extraction. KKU Sci J 44 (1): 79-87.

Ullah R, Alqahtani AS, Noman OM, Alqahtani AM, Ibenmoussa S, Bourhia M. 2020. A review on ethno-medicinal plants used in traditional medicine in the Kingdom of Saudi Arabia. Saudi J Biol Sci 27 (10): 2706-2718. DOI: 10.1016/j.sjbs.2020.06.020.

Van Sam H, Van Chu T, Nguyen TS. 2019. Traditional knowledge of local people on medicinal plants in Pu Hu nature reserve, Vietnam. J Biol Dis 10: 72-102. DOI: 10.24259/fs.v3i2.6005.

Van Wyk AS, Prinsloo G. 2018. Medicinal plant harvesting, sustainability and cultivation in South Africa. Biol Conserv 227: 335-342. DOI: 10.1016/j.biocon.2018.09.018.

Wanna C. 2019. Free radical scavenging capacity and total phenolic contents in peel and fleshy crude extracts of selected vagetables. Phamacogn J 11 (6): 1351-1358. DOI: 10.5530/pj. 2019.11.209.

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