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Ethnobotanical Use of Plants for Relieving Stress Among Hill Tribes in Northern Thailand: A Pilot Study

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Abstract:

Objective: To describe the ethnobotanical plants used to alleviate stress among the hill tribe communities in Mae Hong Son Province, Thailand.

Material and Methods: Data were collected from 3 hill tribe villages; 246 participants were enrolled based on the inclusion criteria: 1) aged 21 years or older, 2) having parents of Karen ethnicity, and 3) understanding the purpose of the study. The exclusion criterion was a request to withdraw from the research. Plant utilization was recorded and cross-referenced with voucher specimens. Taxonomic identification involved photographing and collecting all plant samples.

Results: The results show that 59.30% of participants were female, and the mean age was 49.47 years (S.D.=0.54). Half of them had no formal education (50.80%). The most commonly used plant part for stress relief was the leaf (35.80%). Participants reported using 20 plants (17 species) for stress relief. Herbaceous plants were the most common type reported, particularly Centella asiatica (used by 37.40% of all participants). Participants reported using various parts of Pinus merkusii for stress relief. The most common preparation methods included raw consumption, cooking, and boiling (oral consumption, 50–100 grams). Stress levels decreased after plant use; a Stuart–Maxwell test confirmed this change was significant (χ^2=14.14, df=2, p-value=0.001).

Conclusion: The study highlights traditional knowledge of plants for stress relief in hill tribe communities, providing insights into culturally relevant therapies. However, limitations such as a small sample size and lack of a control group affect generalizability, emphasizing the need for further research on their therapeutic potential.

Keywords: Ethnobotany, stress relief, Traditional Knowledge, Hill Tribes, Medicinal Plants, Thailand

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Introduction

Chronic stress negatively impacts both physical and mental health, contributing to anxiety, depression, and cardiovascular diseases[1]. While acute stress responses may be adaptive, prolonged stress reduces quality of life and increases long-term health risks. Although pharmaceutical treatments are available, extended use of painkillers and anti-anxiety drugs often leads to side effects and addiction[2]. As a result, many individuals turn to herbal remedies for managing stress-related symptoms. Indigenous knowledge offers natural, culturally rooted, and holistic alternatives that may complement modern medicine, reducing reliance on synthetic drugs while preserving valuable traditional health practices[3].

Ethnobotany studies the relationships between plants, humans, and animals, with ethnobotanical research encompassing all forms of interaction between plants and people, particularly focusing on their medicinal uses[4]. Many plants play a significant role in alleviating the symptoms of neuropsychiatric origin and have proven especially effective for milder forms of neurological disorders[2]. Research has shown that plants in both native and improved interiorscapes can help reduce anxiety and stress[5]. In several countries, including regions of Thailand, there is significant reliance on the rich diversity of medicinal plant species for both healthcare and income generation[6]. Thailand alone is home to over 10,000 medicinal plant species, with 15.5% used in various industries such as pharmaceuticals, cosmetics, food and beverages, spas, and community products[7,8]. Nevertheless, recent studies indicate that the traditional knowledge of medicinal plants is at risk in some ethnic minority groups, as the transfer of knowledge between generations is declining. Additionally, many plant species have not been used in a long time, and some have already disappeared[3].

There is a growing need for research on hill tribe populations in Thailand, a middle-income country where traditional plants are used to treat illness and relieve stress. Mae Hong Son Province, in Northern Thailand, is culturally and ecologically significant. It is home to hill tribes, such as the Karen, who retain traditional knowledge of medicinal plants despite the pressures of modernization. Renowned for its biodiversity, the province remains an underexplored source of plant species with therapeutic potential. Understanding how these communities use medicinal plants offers valuable insights into sustainable health practices and the development of plant-based therapies, particularly for stress management. By preserving cultural heritage and contributing to global health knowledge, this study supports the scientific validation of traditional practices and promotes the integration of indigenous knowledge into modern healthcare systems. The objective of this study was to describe the use of ethnobotanical plants to alleviate stress among hilltribe communities in Mae Hong Son Province, Thailand.

Material and Methods

Study design and setting

This study employed a Participatory Rural Appraisal (PRA) approach for data collection. This research was conducted within an interpretative paradigm, aiming to understand stress levels, the plants used to alleviate stress, and their sources. A qualitative interpretative approach was employed, integrating methods such as literature reviews and interviews to gather comprehensive insights.

The studies were conducted between February and December 2023 in villages of the Karen ethnic groups in Northern Thailand. The specific locations included Ban Huay Sua Tao, Ban Pha Kho Lo in Muang Mae Hong Son District, and Ban Maetho, Maelanoi District, Mae Hong Son Province, Thailand.

Study participants and sample size calculation

Participants were recruited from the Karen ethnic population in February 2023 (N=1,900). Villages were selected using purposive sampling based on the following criteria: (1) the population consisted of more than 80% Karen ethnicity, and (2) the community members were willing to collaborate in the research. Three villages were selected: Ban Huay Sua Tao, Ban Pha Kho Lo, and Ban Maetho in Mae Hong Son Province. The sample size was determined using the finite population proportion formula[10]. Systematic random sampling was used to enroll participants who met the following criteria: 1) aged 21 years or older, 2) having parents of Karen ethnicity, and 3) understanding the purpose of the study. The exclusion criterion was a request to withdraw from the research. Ultimately, 246 participants were included in the study.

Study instruments

Semi-structured interviews were conducted with traditional healers, elderly individuals, farmers, and housewives within the hill tribe communities. Surveys were carried out in 3 villages, involving 246 participants. The research instrument was developed through a literature review of ethnobotanical studies and stress assessment methods to ensure content validity. The structure of the questionnaire comprised 3 parts: 1) Demographic Characteristics: This section contained 6 items addressing the demographic profile of participants, using a formalized list of questions for the interviewer. 2) Utilization of Plants to Relieve Stress: This section consisted of 10 items measured on a 3-point Likert scale, with response options of "almost every time," "sometimes," and "almost never." 3) The standard stress test, developed by the Department of Mental Health, Ministry of Public Health, Thailand, comprised 5 items with discriminative values that categorized stress levels into 4 categories: mild stress, moderate stress, high stress, and severe stress. The first 2 parts were tested for content validity using the Index of Item-Objective Congruence (IOC). Three experts in the fields of folk medicine and biology reviewed the questionnaire, and items with scores above 0.5 were considered acceptable. To ensure reliability, a pilot study was conducted with 30 participants in Ban Namsom in Muang Mae Hong Son District, Mae Hong Son Province; the questionnaire achieved an overall Cronbach's alpha coefficient of 0.88, indicating high internal consistency.

Study variables

To assess the relationship between ethnobotanical plant use and stress relief among hill tribe communities in Northern Thailand, the independent variables were as follows: (1) demographic characteristics including age, gender, education level, and presence of chronic illness; and (2) plant usage factors, including plant species used, plant parts used, preparation methods, and sources of plants. The dependent variables were: (1) stress levels, the standard stress test developed by the Department of Mental Health, Ministry of Public Health, Thailand; and (2) the frequency of plant use for stress relief, categorized as almost every time, sometimes, or almost never, respectively.

Data collection and data management

Data were collected through face-to-face interviews conducted at locations selected by the interviewees to minimize distractions and interruptions. Interviews were conducted in Thai for participants who could understand and communicate in the language. However, for those unable to communicate in Thai, a Karen assistant researcher, who had been trained in data collection methods, conducted the interviews and gathered the data. Each interview lasted between 15 and 25 minutes. During the interviews, responses were recorded on a questionnaire, which was reviewed and verified before concluding each session.

Data on plant usage, including utilized parts and preparation methods, were gathered alongside voucher specimens. All plants were photographed and collected for taxonomic identification. The scientific names of the plant specimens were updated using the *Plants of the World Online* database (http://www.plantsoftheworldonline.org/)[11]. The voucher specimens collected during the study are curated and stored at Chiang Mai Rajabhat University, Mae Hong Son College, in Mae Hong Son, Thailand.

Data analyses

Descriptive statistics were used to summarize the sociodemographic data and plant utilization for stress relief, presenting the results as frequencies and percentages. The Stuart–Maxwell test was used to assess significant changes in stress levels before and after using plants, with a significance level set at p-value<0.05.

Ethical considerations

This research was approved by the Chiang Mai Rajabhat University Institutional Research and Biosafety Committee (IRBCMRU) under approval number 2023/018.16.01. Before starting data collection, the investigators informed all participants regarding the study's objective, process, risks, and benefits. Participants were required to submit a signed informed consent document, which warranted that participation was entirely voluntary and participants could withdraw at any time without consequences. In cases where participants were unable to write or sign the consent form, verbal consent was obtained.

Results

The results are presented in 4 sections: Sociodemographic of the hill tribe, plants used to relieve stress among the hill tribe, plants used to relieve stress in daily life, and a comparison of the participants' stress levels before and after using plants for stress relief in Mae Hong Son, Northern Thailand.

Sociodemographics of the Hill Tribe in Mae Hong Son, Northern Thailand

Table 1 shows that 146 participants were female and 100 were male. Nearly half of the participants were aged 46–65 years (42.70%), followed by those aged 21–45 years (42.30%). The mean age was 49.47 years (S.D.=0.54, range: 21–85 years). Most participants had no formal education (50.80%). Regarding stress levels, nearly 60% reported moderate levels of stress. The most commonly used plant part for stress relief was the leaf, with 94 participants (38.20%) indicating that the plants were grown by themselves.

Table 1 Number and percentage of the sociodemographics of the hill tribe in Northern Thailand

Variable	n	%
Gender		
Male	100	40.70
Female	146	59.30
Total	246	100
Age (Year)		
21–45	104	42.30
46–65	105	42.70
66–85	37	15.00
Total	246	100
Education		
Had no formal education	125	50.80
Elementary	78	31.70
Secondary	24	9.80
Diploma	14	5.70
Bachelor degree	5	2.00
Total	246	100
Stress level		
High	19	7.70
Moderate	141	57.30
low	86	35.00
Total	246	100

Table 1 Continued

Variable	n	%
Chronic illness		
Yes	87	35.40
No	159	64.60
Total	246	100
Used parts		
Root	68	27.60
Stem bark	76	30.90
Leaf	88	35.80
Flower	10	4.10
Fruit	4	1.60
Total	246	100
Resources		
Forest	37	15.00
Grow	94	38.20
Buy	80	32.50
Get from others	35	14.20
Total	246	100

Plants used to relieve stress among the Hill Tribe in Mae Hong Son, northern Thailand

The results show that 20 plants (17 species) were reported to have stress-relieving benefits, with herbaceous plants being the most commonly utilized. *Pinus merkusii* Jungh. & de Vriese provided various parts, such as the needle, root, and stem bark, which were used for stress relief. The most commonly used plant parts were leaves, fruit, and stem bark, respectively. In terms of preparation, the most common methods were raw consumption, cooking, and boiling. The most common application method was oral consumption (50-100 g), followed by steam inhalation (1x1), as shown in Table 2.

Plants used to relieve stress in daily life among the Hill Tribe in Mae Hong Son, northern Thailand

In terms of daily plant use for stress relief, the results show that *Centella asiatica* (L.) Urb. was used most frequently, with 37.40% of participants reporting "almost every time," followed by *Piper betle* L. (36.60%) and *Momordica charantia* L. (36.30%), as shown in Table 3.

Table 4 compares the stress levels of participants before and after using plants to relieve stress in daily life. Before using plants, 7.72% of participants reported high stress, and 57.32% experienced moderate stress. After incorporating plants into their routine, the percentage of participants with high stress decreased to 4.88%, while those reporting moderate stress dropped slightly to 54.47%. The number of participants experiencing mild stress increased to 40.65%. A Stuart–Maxwell test indicated a significant change in stress levels before and after using plants to relieve stress in daily life, $\chi^2(2)=14.14$, p-value=0.001.

Discussion

The current study aimed to examine how hill tribe people in Mae Hong Son, Northern Thailand, utilize plants for stress relief as part of their ethnobotanical practices concerning traditional knowledge and plant therapies. The herbaceous plants were the most commonly used for stress relief (17 species of 20 plants). In terms of daily life, the most frequently used plants included *Centella asiatica* (L.) Urban, *Piper betle* L., and *Momordica charantia* L., while the primary preparation methods were raw consumption, cooking, and boiling, with oral consumption as the most common application. A comparison of stress levels before and after plant use indicated a slight reduction in high and moderate stress levels, suggesting potential benefits of these plants in stress management. These findings could be useful for public-health and traditional-medicine practitioners, as they could be used in plant-based therapies for stress management. Researchers in ethnobotany, herbal medicine, and pharmacology should explore the therapeutic potential of traditional medicinal plants. Additionally, policymakers and healthcare providers may find this study valuable for preserving indigenous knowledge and promoting

sustainable, culturally relevant healthcare solutions. Lastly, local communities and herbalists can benefit by reinforcing and passing down traditional plant-based healing practices.

Regarding these valuable insights into the use of medicinal plants for stress relief, there are some concerns, including the selection bias that may arise from purposive sampling, information bias related to self-reporting, and recall bias. Plant identification inaccuracies could occur due to vernacular names, misclassification, or morphological similarities.

Table 2 Plants utilized to relieve stress among the hill tribe in northern Thailand

Scientific name	Family	Plant habit	Parts	Preparation	Application method	Dosage
Aegle marmelos (L.) Correa	Rutaceae	Tree	Root, Fruit	Boiled*	Oral	1 glass; 1x2
Allium sativum L.	Alliaceae	Herbaceous plant	Bulb	Raw or cooked**	Oral	50–100 g
Alpinia galanga (L.) Willd.	Zingiberaceae	Herbaceous plant	Rhizome	Boiled	Steam inhale*** Oral	50–100 g
Azadirachta indica A.Juss.	Meliaceae	Tree	Leaf, Stem bark	Boiled	Oral	50–100 g
Blumea balsamifera (L.) DC.	Inuleae	Herbaceous plant	Leaf	Boiled	Steam inhale	5–10 min, one a day
Boesenbergia rotunda (L.) Mansf.	Zingiberaceae	Herbaceous plant	Rhizome	Raw or cooked	Oral	50–100 g
Centella asiatica (L.) Urb.	Apiaceae	Herbaceous plant	Leaf	Raw or cooked	Oral	100–150 g
Citrus hystrix DC.	Rutaceae	Tree	Leaf, Fruit	Raw or cooked	Oral	50–100 g
Croton oblongifolius Roxb.	Euphorbiaceae	Tree	Leaf	Boiled	Steam inhale	5–10 min, one a day
Cymbopogon schoenanthus Spreng.	Poaceae	Herbaceous plant	Leaf	Boiled or cooked	Oral	50–100 g; 1x2
Mentha cordifolia Opis.	Lamiaceae	Herbaceous plant	Leaf	Raw or cooked	Oral	50–100 g
Momordica charantia L.	Cucurbitaceae	Herbaceous plant	Fruit	Boiled	Oral	100–150 g
Morinda citrifolia L.	Rubiaceae	Tree	Fruit	Boiled	Oral	50–100 g
Oroxylum indicum (L.) Kurz.	Bignoniaceae	Tree	Fruit	Grill	Oral	100–150 g
Pinus merkusii Jungh. & de Vriese.	Pinus	Tree	needle, Root, Stem bark	Boiled, Direct inhalation	Steam inhale Bathing; Inhale	(1–2 min); 2x1
Piper betle L.	Piperaceae	Climber	Leaf	Decoction	Oral	1 glass; 1x2
Piper nigrum L.	Piperaceae	Herbaceous plant	Fruit	Raw or cooked	Oral	50–100 g
Psophocarpus tetragonolobus (L.) D.C.	Fabaceae	Climber	Fruit	Raw or cooked	Oral	50–100 g
Senna siamea (Lam.)	Cassieae	Tree	Leaf	Cooked	Oral	100–150 g
Tinospora crispa (L.) Miers ex Hook.f. & Thomson.	Menispermaceae	Climber	Stem bark	Raw or juice	Oral	10 g

*Boiled: indicates that the plant parts are immersed in boiling water to extract their medicinal properties, **Raw or cooked: refers to the preparation of plant parts either in their natural, uncooked state or after being heated for consumption, ***Steam inhale: refers to the practice of inhaling steam from boiled plant material to relieve symptoms, typically for respiratory or stress-related issues

Table 3 Number and percentage of the plants utilized in daily life to relieve stress among hill tribes in Mae Hong Son, Northern Thailand

No.	Scientific name	Family	Habit	Almost every time		Sometime		Almost never	
				N	%	n	%	n	%
1.	*Aegle marmelos* (L.) Correa	Rutaceae	Tree	79	32.20	99	40.20	68	27.60
2.	*Azadirachta indica* A.Juss.	Meliaceae	Tree	88	35.70	122	49.70	36	14.60
3.	*Boesenbergia rotunda* (L.) Mansf.	Zingiberaceae	Herbaceous plant	86	35.00	112	45.50	48	19.50
4.	*Centella asiatica* (L.) Urb.	Apiaceae	Herbaceous plant	92	37.40	118	48.00	36	14.60
5.	*Momordica charantia* L.	Rubiaceae	Herbaceous plant	89	36.20	109	44.30	48	19.50
6.	*Morinda citrifolia* L.	Rubiaceae	Tree	86	35.00	113	45.90	47	19.10
7.	*Piper betle* L.	Piperaceae	Climber	90	36.60	97	39.40	59	24.00
8.	*Psophocarpus tetragonolobus* (L.) D.C.	Fabaceae	Climber	80	32.50	121	49.20	45	18.30
9.	*Senna siamea* (Lam.)	Cassias	Tree	63	25.70	145	58.90	38	15.40
10.	*Tinospora crispa* (L.) Miers ex Hook.f. & Thomson	Menispermaceae	Climber	85	34.50	107	43.50	54	21.90

Table 4 Comparison of stress levels before and after using plants in daily life to relieve stress among hill tribes in Mae Hong Son, Northern Thailand, and results of the Stuart–Maxwell Test

Stress level	Before n (%)	After n (%)
High	19 (7.72)	12 (4.88)
Moderate	141 (57.32)	134 (54.47)
Mild	86 (34.96)	100 (40.65)

a Stuart–Maxwell test: χ^2=14.14, df=2, p-value=0.001

The reported moderate levels of stress among participants (57.32%) may reflect a range of chronic health issues prevalent in the community. Chronic illnesses such as hypertension, heart disease, and diabetes are commonly observed in hill tribe populations, which may contribute to increased stress levels. Previous national data also indicate that 1 in 4 adult Thais have hypertension. These chronic conditions are likely stress-inducing and may contribute to an imbalance between reactive oxygen species (ROS), commonly known as free radicals, and the body's antioxidant defenses, leading to oxidative stress and potential health complications[12-14].

The plants identified in this study, including *Pinus merkusii, Centella asiatica, Piper betle*, and *Momordica charantia*, have well-documented antioxidant properties that could contribute to reducing oxidative stress in the body, a key factor in the pathogenesis of various diseases.

The potential mechanisms of action in these plants were as follows:

Pinus merkusii Jungh. & de Vriese. The needles and bark contain compounds that have antioxidant and

anti-inflammatory properties, which may help mitigate stress-induced oxidative damage[15–18].

Centella asiatica (L.) Urb. Commonly used as a brain tonic in traditional medicine, *Centella asiatica* (L.) Urb. has been shown to improve cognitive function and reduce anxiety in clinical studies[14,19–20].

*Piper betl*e L. This plant has antioxidant effects, which can counteract oxidative stress and its associated health impacts[21,22].

Momordica charantia L. Known for its high antioxidant content, which plays a role in reducing stress through its ability to balance oxidation in cells[23].

This study suggests that the traditional use of these plants may offer a natural alternative or complement to pharmacological treatments for stress. However, further research, including clinical trials and laboratory studies, is needed to confirm their efficacy and to better understand their mechanisms of action[24]. Moreover, the current study found that the resources of the plants used for reducing stress among hill tribes were grown by themselves. Regarding this finding, "green space" can be helpful for adults to reduce stress[25–27]. Adults who have increased access to green spaces experience a decrease in psychological distress, depressive symptoms, clinical anxiety, and mood disorders[28–33].

Strengths, limitations, and future research

The study highlights the valuable traditional knowledge of plants used for stress relief in hill tribe communities, providing insights that may inform future holistic health approaches. However, there were some limitations, such as the small sample size and lack of a control group, which affected generalizability. Self-reported data on usage and stress relief may be subject to recall bias.

Future research should expand the sample size, include a comparable control group, and assess biochemical or clinical assessments to validate the effectiveness of these plants in stress reduction. Further investigation into their phytochemical properties is also necessary to support their potential integration into evidence-based healthcare.

Conclusion

This pilot study demonstrates the potential of selected ethnobotanical plants as natural stress-relief remedies, particularly among indigenous Thai communities. Species such as *Pinus merkusii*, *Centella asiatica*, and *Piper betle* may exert beneficial effects through antioxidant and adaptogenic mechanisms. These findings provide a foundation for future clinical studies to validate their efficacy and inform safe application in modern healthcare systems.

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Conflict of interest

None to declare.

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