Hotila: A Natural Consumption Alternative to MSG

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(Received: 16 December 2022, Revised: 23 July 2023, Accepted: 13 August 2023)
https://doi.org/10.57260/rcmrj.2023.262712

Abstract

This article is a mixed-method integration of survey and Participatory Action Research (PAR) conducted with local communities regarding a fern type commonly known as “Hotila” in Sgaw Karen or “Phaktue” in Tai Yai. Hotila is a palatable and nutrient-dense meal and is used as a healthy condiment to flavour various local cuisines with a sweet and mellow taste. Previously, research on and knowledge about it were sparse. The objectives of this study were thus to gather fundamental information about Hotila through in-depth surveys and interviews, to promote the conservation, rehabilitation, and breeding of a native species of Hotila through observation, interviews, and simple experiments, and to compare the satisfaction levels of Hotila consumption with that of Monosodium glutamate (MSG) in 17 communities in Mueang and Khunyuam Districts of Maehongson Province using Hedonic Scale of nine-satisfaction level questionnaires on 12 issues—pigment, smell, taste, texture, pricing, and packaging of Hotila and those of MSG with 319 randomly selected native samples. Results revealed: 1) 13 facts about Hotila, 2) Hotila is not typically grown in communities for at least two factors: unfavourable conditions in the soil, water, humidity, and temperature; and that communities lack the necessary knowledge on how and when to effectively collect and to successfully reproduce the Hotila species, and 3) MSG was inferior to Hotila in all 12 aspects. The findings are valuable to the research communities because they provide firsthand information about Hotila, a food substitute for MSG to encourage good health, especially for people who are health-conscious and allergic to MSG.

Keywords: Hotila, Maehongson, Sgaw karen plant, Food substitute, MSG

Introduction

Monosodium glutamate (MSG) has been a prominent component of people's dietary habits in Maehongson (MHS) for many years due to its easy availability and affordability. It has become a stable that people find difficult to do without. However, there is a lack of awareness among individuals regarding the limited benefits of MSG, as it merely enhances the taste of food and stimulates appetite without providing any significant nutritional advantages. The primary constituents of MSG are sodium (Na) and glutamic acid (E), which is commonly known as MSG sweetener. Na is essentially salt, while E is an amino acid found in protein. Despite the United States Food and Drug Administration classifying MSG as a harmless substance, numerous medical journals have reported direct adverse effects on the body over the past five decades. These effects include numbness in the arms, neck, and back, muscle weakness, palpitations, chest tightness, flushing, and fainting among individuals, particularly those who experience Chinese Restaurant Syndrome or MSG symptom complex (Wachiramon, 2012). Moreover, the consumption of MSG has also been linked to increased asthma attacks and migraines (Stevenson, 2000).

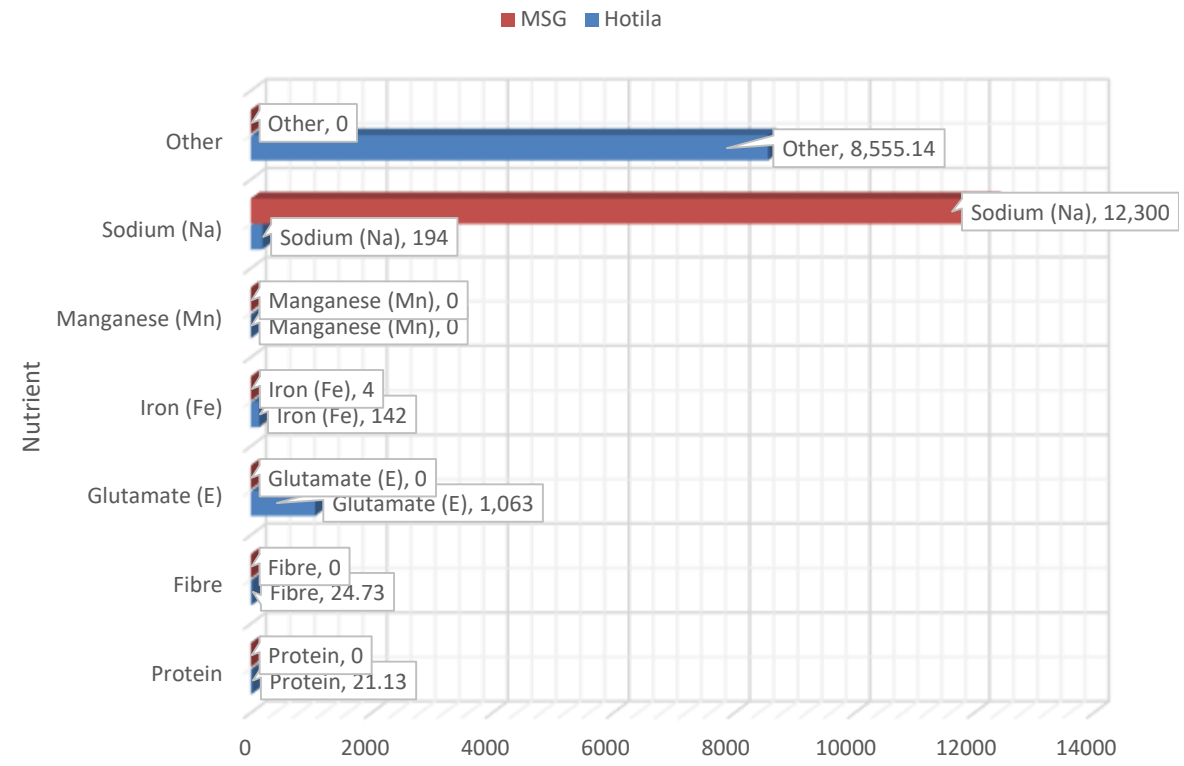
MSG poses a twofold danger: the hazards associated with Na salt from caustic soda and the inherent risks of MSG itself. The adverse effects of Na from caustic soda on the body include a weakened immune system, increased risk for kidney disease, high blood pressure, and heart disease, as well as the possibility of blood clots in children's brains leading to developmental issues or sudden convulsions. On the other hand, the specific dangers of MSG to the body encompass allergic reactions characterized by numbness, mouth and facial heat, chest tightness, and breathing difficulties. Furthermore, MSG can damage the nervous system of the eye, resulting in vision loss or blindness, impair the brain region controlling growth and reproductive functions, affect bone health and the production of red blood cells leading to anaemia, reduce essential vitamins (particularly vitamin B6), promote cancer development, damage the central nervous system, and induce chromosomal abnormalities such as cleft lip, cleft ears, cleft nose, and limb deformities (Wachiramon, 2012; Thai health promotion foundation, 2019).

In the region of Maehongson (MHS), there are 18 species of ferns i.e., Maetaiwan Fern, Doisuthepkut, Hangdaeng Fern, Kandambaiyao Fern, Blue german Fern, Si MHS Fern, Indiadaeng Fern, Doibaimankut, Khaokwangbaitang Fern, Kanoknaribaitang Fern, Hangkaifoi Fern, Doibaichaekkut, Kan Dam Frizlut Fern, Ausmanda taiwan Fern, Nang Fern, Ratsamichot Fern, Doibrazil Fern, and Kandamyokdoikham Fern (Pangtong height service and development centre under the royal initiatives, 2021). These fern plants are typically used for decorative purposes. Unlike, the "Hotila" fern plant which does not have an official Thai name and is not included in the list mentioned earlier has primarily been used by Sgaw Karen (SK) people in MHS to add sweetness to local food for generations, serving as a substitute for MSG (Ministry of natural resources and environment, 2016). Hotila also contributes a pleasant aroma and a mild taste to enhance the appeal of food. It can be consumed fresh or in various other forms such as powder, bouillon, and sauce, with fresh leaves and powder being the most common options. Importantly, Hotila offers health benefits without any reported adverse effects from excessive consumption.

The botanical name for Hotila suspiciously is Asplenium obscurum (Ministry of natural resources and environment, 2016; Thaifern, 2022) or non-officially Asplenium unilaterale lamk (Kut-hin: Srilai, 2021). Hotila belongs to the terrestrial and lithophytic branches of the Aspleniaceae genus which is commonly found near small creeks, rock cliffs, and chilly hills within the forests of MHS. It possesses a robust root system that enables strong adhesion. The

term Hotila comprises three SK morphemes: “ho” (leaf), “ti” (water), and “la” (sweet taste). It refers to a plant with sweetened water properties, growing in moist soil and on cool rocks, not just in water. The Tai Yai ethnic group calls it “Phaktue,” while other SK communities refer to it as “Hoti” or “Hotiloe.” It’s also known as “Doi MSG” (mountainous MSG) due to its glutamate (E) content, providing a sweet flavour like MSG. Hotila contains protein, iron (Fe), and manganese (Mn) (Office of the Health Promotion Fund, 2019), benefiting general consumers and those allergic to MSG, including individuals with asthma, infants, and pregnant women (Chaiprateep, 2015).

As mentioned earlier, Hotila offers a notable advantage by adding a sweet, soft, and mellow taste and aroma to food as a substitute for MSG. Its nutritional properties include 21.13% total protein and 24.73% fibre, supporting excretory health, weight loss, and balance without reducing food intake. Hotila is rich in Fe with over 1,417 mg/kg, crucial for the blood system and red blood cell production in women and children. It also contains about 1,938 mg/kg of Na, which serves as a cofactor for bodily reactions, promoting enzyme activation, muscle and nerve function, and cell structure. Gas Chromatography-Flame Lionization Detector Technique analysis showed Hotila contains 10,628 mg/kg of E, a flavour-enhancing substance like MSG (North Public News Agency, 2018; Srilai, 2009, 2010, 2021). Furthermore, Hotila has been subjected to acute toxicity testing, confirming its safety (Churueangsuk, 2012). Chemical analysis revealed that Hotila is a nutrient-rich plant, containing approximately 1% total protein and 0.6% E, along with significant amounts of Fe and Mn. It does not exhibit strong antioxidant activity, inhibits melanin production and pathogenic microorganisms, and has low phenol content. Acute oral toxicity tests using aqueous and methanol extracts at a maximum dose of 5,000 mg/kg, recommended by the Organization for Economic Co-operation and Development (OECD), demonstrated that Hotila is non-toxic to health (ibid.).



	Protein	Fibre	Glutamate (E)	Iron (Fe)	Manganese (Mn)	Sodium (Na)	Other
MSG	0	0	0	4	0	12,300	0
Hotila	21.13	24.73	1,063	142	0	194	8,555.14

Nutrition Fact on MSG vs. Hotila (mg/100 g)

Figure 1 Nutritional information on MSG (Ajinomoto North America, Inc, 2023) vs. Hotila (Source: Panyawuthakrai, 2023)

Limited research has been conducted on Hotila. The KY District's Office for Agriculture (Somjai, 2021) noted the lack of information except for a community enterprise selling Hotila chilli paste in Tambon Mae Ukho [MUK]. However, two studies focused on Hotila processing: 1) Mae La Noi Darunsik School project transforming Hotila powder into soup cubes and powder, enhancing protein content and assessing consumer satisfaction (National science and technology development agency: NSTDA Library, 2011) and 2) a study comparing Hotila with MSG in instant seasoned fermented fish sauce, where consumers prefer the Hotila product due to its pigment and packaging (Suda & Duangwongsa, 2020).

Hotila, a rare native sweetened plant, has seen increasing demand in local markets during the December to May cold and hot season. The retail price for an approximately 18-gram bag of Hotila powder ranges from 55 baht within the community to higher prices outside, depending on economic demands and supply. However, there are two concerns with Hotila powder from community production: the significantly higher price compared to MSG per gram and the higher dosage required compared to MSG per serving. Consequently, MSG remains more accessible than Hotila.

During field surveys and initial inquiries, three primary issues were identified: 1) limited knowledge about Hotila among the communities, 2) inadequate methods for Hotila propagation within the communities, and 3) the absence of a previous comparison between Hotila and MSG consumption preferences in MHS. The objective of this study was then to

establish accurate foundations regarding the significance, advantages, and methods for promoting the breeding of Hotila and encouraging its consumption instead of MSG, particularly within the 17 SK/TY ethnic communities of Bandoisaeng [DS], Banhuaipukaeng [HPK], Banhuaimakhueasom [HMS], Banhuaikhan [HK], Bannaisoi [NS], Banhuaisueathao [HST], Bannamphiangdin [NPD], Banhuasanambin [HSB], and Banmai [BM] in Mueang MHS, as well as those in Ban Na Hua Laem [NHL], Banhua-ngao [HNG], Banhuaina [HN], Bansuanoi [SO], Banpratumueang [PM], Ban Huai Ton Noon [HTN], Banluang [BL], and Bantophae [TP] of Khun Yuam [KY], MHS.

Objectives

The aims of this study were as follows: 1) to investigate, survey, and gather information about the indigenous Hotila plant in eight communities located in Tambon Mae Ngao [TMNG] of KY, MHS; 2) to enhance the preservation, restoration, and cultivation of Hotila in twelve communities; and 3) to assess the level of satisfaction associated with consuming Hotila compared to consuming conventional MSG.

Research questions

This research aimed to address the following questions: 1) What is the level of knowledge among local individuals regarding the use of Hotila? 2) Can Hotila be successfully cultivated within the communities, similar to other ferns? and 3) Is Hotila preferred over MSG as a choice for consumption?

Framework

The theoretical framework of this study was based on Participatory Action Research (PAR) and community-based development principles. PAR involves a collaborative process that integrates scientific principles and problem-solving approaches to address community issues. It emphasizes experiential learning and recognizes that the researcher is not the sole source of knowledge. The conceptual framework revolves around raising awareness of problems, fostering a sense of responsibility, and promoting solidarity within the community. The goal is to empower individuals and encourage active participation in community development.

Methodology

This study was conducted using the following research methodologies: 1) The location of the study, 2) Population and sample, 3) Tools and data collection, 4) Data analysis, 5) Procedures for research conducting, and 6) Hypothesis.

1) The location of the study. This PAR was conducted in 17 communities of Mueang and KY Districts of MHS which are DS, HPK, HMS, HK, NS, HST, NPD, HSB and BM of M, MHS, NHL, HNG, HN, SO, PM, HTN, BL, and TP of KY, MHS. The reasons why these communities were chosen for this study are firstly,

2) Population and sample. To obtain information on the Hotila plant, a sample of 20 communities' knowledgeable elders, claimed to possess a lot of knowledge about the native Hotila plant, as recommended by the village chiefs from NHL, HNG, HN, SO, PM, BL, TP. To enhance the plant preservation, restoration, and cultivation, three individuals simply experimented with planting Hotila within their residential complexes in NHL, HN, and TP as advised by the village heads. And, to assess the level of satisfaction associated with consuming Hotila to that of typical MSG consumption, the study randomly selected 319 participants from 17 communities who claimed to be accustomed to both the tastes of Hotila and MSG additives.

3) Tools and data collection. To gather information about the Hotila plant, small focus group techniques of the communities' knowledgeable elders were implemented through question and answer discussions. Examples of questions included—How does Hotila appear? Where is it to be found? Why is it your preferred culinary ingredient? With some assistance from SK to Thai translators, the responses were publicly documented in notetaking formats, examined, and double-checked. And throughout the rechecking procedures, two third (2/3) or more of the focus group's 20 communities' wise elders had to concur with each item of knowledge regarding the Hotila plant; the minor percentage, however, was intended to be clarifying their disagreement

To enhance the cultivation of Hotila, three simple experiments were conducted on planting Hotila within home complexes in NHL, HN, and TP were done and public relations efforts were undertaken in nine communities in MMHS. Additionally, until the Hotila plant lasted steadily for a long time or died itself, basic queries into their planting processes were performed every day or two to gather data for the studies.

To compare the favour of Hotila with that of MSG, a set of questionnaires with 12 items concerning pigment, smell, taste, texture, pricing, and packaging plus an additional part for personal recommendations were developed and distributed, excluding sensory testing. The Hedonic scale of satisfaction was applied to rate the responses, with 1 representing "immensely dislike," 2 "very much dislike," 3 "moderately dislike," 4 "slightly dislike," 5 "neither like nor dislike," 6 "slightly like," 7 "moderately like," 8 "very much like," and 9 being "exceptionally like". There could only be 5% or less inaccuracy in the data collection, which meant that only 16 or fewer incomplete questionnaires may be approved.

In an attempt to conduct Hotila breeding experiments within the community, other research methods, including personal observation, literature reviews, and unstructured interviews were additionally deployed.

4) Data analysis. Due to the appropriate instruments and data-collecting procedures, the information on the Hotila plant and its planting experiments was deemed accurate, thus it was qualitatively broken down into aspects. Unlike the data from the satisfaction comparison surveys, all data would primarily be evaluated into statistical findings as arithmetic means and percentages. The data from other sources, i.e. personal observation, literature reviews, and unstructured interviews would subjectively be characterized.

5) Procedures for research conducting. This study commenced with identifying an issue which was relevant to the communities through private discussions and meetings. Next, a research team, which consisted of both researcher and the community members, was formed to collaborate in planning and carrying out the study processes. Then, the study plan, including the objectives, research questions, and methods to be used was collaboratively designed with respect for the communities' perspectives. After that, a range of research methods which involved document analysis, focus group discussions, interviews, surveys, and community participation was employed to collect data. Later, the collected data was collaboratively analyzed using quantitative and qualitative methods in the search for patterns, themes, or trends in the data as well as interpreting their significance within the existing contexts. Furthermore, to gain a deeper understanding of the issue and to identify potential solutions, the analyzed data and findings were reflected by the research team. Finally, the study findings and outcomes were shared with the relevant communities and wider audiences through various means e.g. reports, presentations, and articles in the hope that the knowledge could contribute to broader discussions and actions.

6) Hypothesis. The following presumptions formed the basis of this study: Hotila is toxic to health in some or all circumstances, is bitter and smells like ordinary decorative ferns, making it unsuitable for some particular groups of people, and is only found in deep forests. Finally, Hotila is simple to breed like other fern varieties. Interviews, field surveys, and direct

observation were conducted to verify the presumption about its location. Interviews, a local hospital's medical records, and other papers were all examined to bolster the presumption of the toxicity of the plant. Interviews and self-tests were conducted to confirm the presumption against its taste and smell. Also, interviews and simple experiments took place in different areas to attest to the final presumption.

Results

Research findings mainly emerged from unstructured in-depth interviews, surveys, questionnaires, relevant papers and the researcher's observation and are based on the research objectives: (1) to investigate, survey, and gather information about the indigenous Hotila plant in eight communities located in Tambon Mae Ngao [TMNG] of KY, MHS; (2) to enhance the preservation, restoration, and cultivation of Hotila in twelve communities; and (3) to assess the level of satisfaction associated with consuming Hotila compared to consuming conventional MSG. The following are the outcomes.

(1) As per research objective 1, there are 13 items of information on the Hotila plant:

1.1) Etymology: Hotila is called in SK. The term Hotila is composed of three different single words— "ho" /hɔʔ/ means a leaf, "ti" /tiː/ means water, and "la" /laː/ means sweet taste. So Hotila means (a) sweetened water leaf (leaves). Hotila can sometimes be called "Hoti" for short. Besides, in Shan or TY, Hotila is commonly known as "Phaktue." Hotila is not only popular among SKs, but TYs who give its name Phaktue. Hotila is a fern type, which is officially known as *Asplenium unilaterale lamk* which belongs to the *Terrestrial* (earth) and *Lithophytic* (rock) Branch of the *Aspleniaceae genus.*

1.2) Physical look: Hotila leaves are shaped like a green bird's wings whose upper edges are scalloped, curved a little, flat and thin—aka personally calling Bird's-wing fern [เฟิร์นปีกนก]. Its stalks and roots are glossy-black. Hotila always grows in a clump deep in the forests. Many inexperienced Hotila collectors may, however, collect other fern types natively called "Hotikha" in mistake for Hotila by its almost similar look except for greener stalks and green matt leaves (see Figure 2 for reference).

1.3) Discovery: Only in the dense forests nearby four villages—HTN, HN, HNG and NHL of MNG in KY—can Hotila be discovered. The features that follow the locations where Hotila may be found include high altitude, rapid onset of cold and humidity, abnormally huge surrounding trees, and the presence of natural streams, wet rocks, and wet soil.

Table 1 An approximation of distances to discover Hotila by sources and communities

Source	Villages nearby	Distance*(km)	Direction
1	Huai-ngao	10.5	NW**
2		13.5	
3		15.5	
4		6.5	
5		5.0	
6	Huaitonnun	0.3	
7		4.0	
8	Huaina	6.0	W/SW***
9		7.5	W/NW****

Note *Approximately from the entrance to the village by using distance and area measurement tools in 2D mode with Google Earth (earth.google.com). ** Northwest; *** West/Southwest, and ****West/Northwest.

There are more sources of Hotila in HN than in HTN and HN while the distance to it ranges from four to seven and a half kilometres. In HTN, Hotila flourishes at elevations of 466 m (http://google.earth.com, 2022), and around 550 m in the mountains close to the community's farms to the northwest. Hotila is also found west-southwest of HN Village. Hotila is more prevalent in the deep forests farther away from the communities to the west, north, or south, at elevations of 450 m up to 950 m or higher, along the Thai-Myanmar border.

Hotila, however, is not typically seen inside communities or in nearby settlements in the research areas. Interestingly, the only place inside HTN that Hotila can grow is at Mochi and Chiche's place[1] where all seems to facilitate its growth—temperature, moisture, soil, and weather. However, Hotila's size is not as large as the one in the forests.

1.4) Taste and scent: Hotila naturally tastes sweet, soft, and mellow, but smells like soft dried fish, so often it is chosen to add in savoury foods instead of sugar and MSG. It does not smell like fragrant flowers for certain. One more thing, it seems like fresh Hotila tastes and smells stronger than dried Hotila or Hotila powder—the more Hotila be added, the stronger taste and smell the food has. However, an inexperienced one may not know Hotika's taste mistake for Hotila's until he takes a bite. Soon, he will discover that Hotika tastes bitter (see Endnote for reference).

1.5) Size: The size of Hotila stalks and leaves depends on its age and the fertility of the forests it grows in—the older, the bigger and the more the forests are fertile, the larger Hotila becomes. Nonetheless, it is possible to classify Hotila into four sizes, namely "super small sized," about 2.5 inches in length, not popularly taken; "small-sized," with a length of about 3-4 inches (half a palm); "medium-sized" approximately 7 inches long (a palm); and "large-sized" approximately 10-11 inches long (one palm and a half).

1.6) Harvesting season: People can collect Hotila from the forests all year round. Especially, Hotila becomes abundant about October to December at the end of the rainy season and the beginning of the cold season when the weather is getting cool and humid. It is better and safer to trek into the forests than to do so during the rainy season. Also, it is the right time when Hotila leaves are fully mature in dark green pigment, and the taste is more sweet, mellow, and all the best. From January until September every year, people sense that it is time to conserve this plant so that it has an opportunity to continue propagating and balancing nature. In addition, the weather begins to become dry and hotter. The forests begin to lack moisture and get drier to start wildfires. There are simple Hotila collecting tools such as boots to prevent blood-sucking slugs and a cloth bag to carry Hotila. A sharp knife is not a necessary tool because Hotila can be easily picked by bare hands. One day of a round-walk trip is possible within 10 km from starting point, but it can hardly be possible for the one-day walk round trip. So, a plan for an overnight stay or more in the forest may also be necessary. The only reason for doing so is to go hunting wild animals or find some rare wild herbs. For a one-day plan, bringing lunch would be ideal, and for a more-than-one-day plan, a pack of some cooking ingredients would be an advantage. Going for Hotila in the forests requires only walking off-road, along creeks, streams, and flowing waters of the mountains.

1.7) Life cycle: Hotila life cycle depends on three common seasons in Thailand: the four-month hot season, which begins around mid-February/March and ends around mid-June/July; the four-month rainy season, which starts around mid-June/July and ends around mid-October/November and; the four-month cold season, which starts around mid-October/November and ends around mid-February/March. However, Hotila may last approximately nine months, from around mid-May (the first rain pour) to mid-February

[1] Location: 18°45'18" N, 97°49'36" E at an elevation of 466 m from https://earth.google.com/

through six stages. Stage 1 is "preparing for shedding leaves" (prothallia) which lasts about two months. Stage Two is "putting out sprouts and young leaves" which takes about three months. Stage Three is the "true stalks and leaves" stage which starts in about the fourth month. Stage Four is "growing up" which occurs in the fifth month. Stage Five is "adulthood" around the sixth or the seventh month. Stage Six "drooping" happens in the eighth or the ninth month, when the cold season ends to begin the hot and dry season. The study also found that the best stage for collecting Hotila should be in stages Four (fully mature) to Six (ageing) when Hotial spores turn to be brown and darker—ready for species propagation. Despite this, in some places outside the research areas, Hotila can be found in all seasons due to their higher altitudes and forest fertility prolonging the Hotila life cycle.

1.8) Nutritional benefits: Hotila fresh stalks and leaves or dried Hotila powder, to the extent necessary, are good to flavour a variety of local dishes such as Ta Pho Pho [ต่าพอเผาะ] (Khao Boe [ข้าวเบ๊อะ] in TY or Karen spicy boiled rice, Musato [มูส่าโต่] (Nam Phrik [น้ำพริก]) or chilli paste, melon curry with fish, banana blossom curry with crabs, Ta Chue Ti [ต่าจีที] or cold curry, green pumpkin curry with pork and all kinds of water menus except for stir-fried, fried, steamed and spicy mix dishes. TY ethnic group likes to use them to flavour food on various menus as well, such as Kaengpli [แกงปลี] or banana blossom curry, cucumber curry, Nam Phrik (chilli paste) Nok [น้ำพริกน๊อก], Namphrikong [น้ำพริกอ่อง], Iluen [อีหลืน] chilli paste, cooked potato, olive salad, tamarind salad, bamboo shoot curry, kahan sprout [หน่อคาหาน] curry and Wettamarind [มะขามเปียก], etc. Recently, there have never been any reports that Hotila is a cause of diseases or shows negative effects on the health of humans and even raised animals—cattle and buffalo that graze in the forests are also fond of eating Hotila, amazingly.

1.9) Medicinal properties: Hotila leaf is rich in dietary fibre to help pass solid or liquid waste matter from the body, strengthen joints and bones, and reduce inflammation. Also, the SK, rather than Shan or TY locals, intuitively find that Hotila better keeps them fit. Additionally, Hotila is not toxic to health in any case for two main reasons: 1) there have been no scientific findings, reports, or records of the hazards associated with the use of Hotila in either fresh leaves, dried powder, or other forms; and 2) the results of toxicity testing from the Research and Development Institute for Highland Areas (HRDI: Public Organization [สถาบันวิจัยและพัฒนาพื้นที่สูง: องค์การมหาชน]) (Srilai, 2021) confirmed that it was not toxic even when used in more significant than usual amounts.

1.10) Preservation: Hotila naturally can stay fresh and green for a couple of hours after being plucked from a clump and begin to wilt only within one day and become crisply dried completely within two or three days, depending on temperature, heat, and sunlight. However, in the moist soiled clump, it can stay fresh longer. If not hurriedly stored in a dry plastic bag and put in a moist and cool place like the refrigerator or at one corner of the bathroom, Hotila will wither indefinitely but be taken for cooking without losing its mellow taste and greenish pigment. Unlike its odour, fresh Hotila gives a stronger smell than the dry one. The completely dried Hotila is substantially preservative, especially in-ground or powder form, and it lasts as long as a year if stored in the proper place. The locals simply keep it dry and cool in a glass or plastic bottle under their house or in a kitchen. Usually, the ground Hotila is used every day, so it rarely stays for months or a year until the harvesting season comes again. However, ground Hotila can become spoiled, mouldy, and smelly if kept in a hot, humid, and stuffy area. The water that directly sprays on fresh Hotila can damage it like vegetables in common.

1.11) Propagation: Natural Hotila propagates well in suitable, brown-conditioned soil or on rocky terrain. Hotila cannot grow well in black soil. The optimum climate for Hotial must be cool and humid. Hot and dry weather is not suitable for Hotila. Within the community, there have been attempts to breed Hotila. Over 20 people report to have been doing so, but only one

achieved it: Mr Mo Chi and Chi Che Ngaopruksa of Huaitonnun Village. There are main problems with growing Hotila in the community: first, the locals hardly know that the spots on Hotila back leaves are sporangium for natural reproduction; second, they never know how to plant Hotila deliberately, and third, they rarely find a proper place for it to grow.

1.12) Processing Hotila powder: The following are simple processes of making traditional ground Hotila; first, wash stalks and leaves thoroughly in water twice to remove dirt, sand, and leaf debris; second, expose them to direct sunlight for two or three days (aka Daet colloquially); third, pound them with a pestle in a mortar thoroughly to a fine powder; fourth, sieve the powder to eliminate twigs and unwanted compounds; fifth, pack the powder into dry and clean bags for family consumption and commerce.

1.13) Marketing: The target Hotila consumers are TY and SK, who are commonly used to Hotila and outnumber other ethnic groups in MHS. To the locals, prices are high, varying from 55 baht (2022) to 190 baht per 230 ml bag, depending on intimacy, proximity, and package. A report said that last year's local price was lower at 40 baht a bag, and the non-local price was as twice much as 80-100 bath a bag. It is likely to say that the price is negotiable though being fixed by the community on their own. There are no reports about Hotila on online or international markets.

(2) According to the research objective 2: 2.1) the simple experiments to breed the Hotila plant in the housing complexes were unsuccessful because it only lived for 10 days or less—the plant shrank and withered easily, especially when exposed to direct sunlight, warmth, and breeze, and eventually let its leaves fall to the ground before dying out; 2.2) natural Hotila is very rare in the city of MHS except in Phakholo [พะโข่โหล่: PKL] Village's forest. Abundant natural Hotila, however, is found in MNG, KY District, despite being more likely to be at risk and deteriorate. The community therefore proposed guidelines for the conservation, rehabilitation, and breeding of Hotila as follows: 1) impart the community that the dark buttons on the back of Hotila leaf are spores aka breeding powder and how to properly collect Hotila in the forest with guidelines for choosing only medium-large Hotila and avoiding uprooting small and young Hotila; 2) there should be some Hotila propagation experiments in the community and; 3) conduct a campaign to promote the consumption of Hotila instead of MSG in the community.

(3) For research objective 3, by using a questionnaire with 12 questioning items: pigment, smell, taste, texture, pricing, and packaging of both Hotila and generic MSG, without the need for sensory testing, with 319 respondents, results showed that Hotila was more enjoyable to consume than generic MSG.

Six age groups of 160 males and 159 females were created from the total respondents: 11.9% of the respondents aged 18-25 (Ag1), 21.0% aged 26-35 (Ag2), 20.7% aged 36-45 (Ag3), 17.9% aged 46-55 (Ag4), 15.7% aged 56-65 (Ag5), and 12.5% aged 66 and over (Ag6). Only 0.3% of them were non-applicable. These results are illustrated in Figure 2.

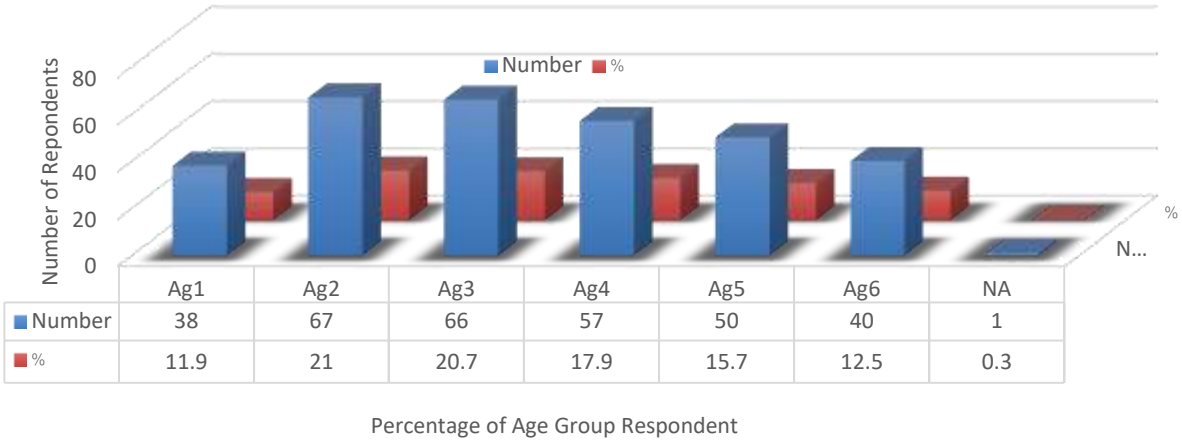
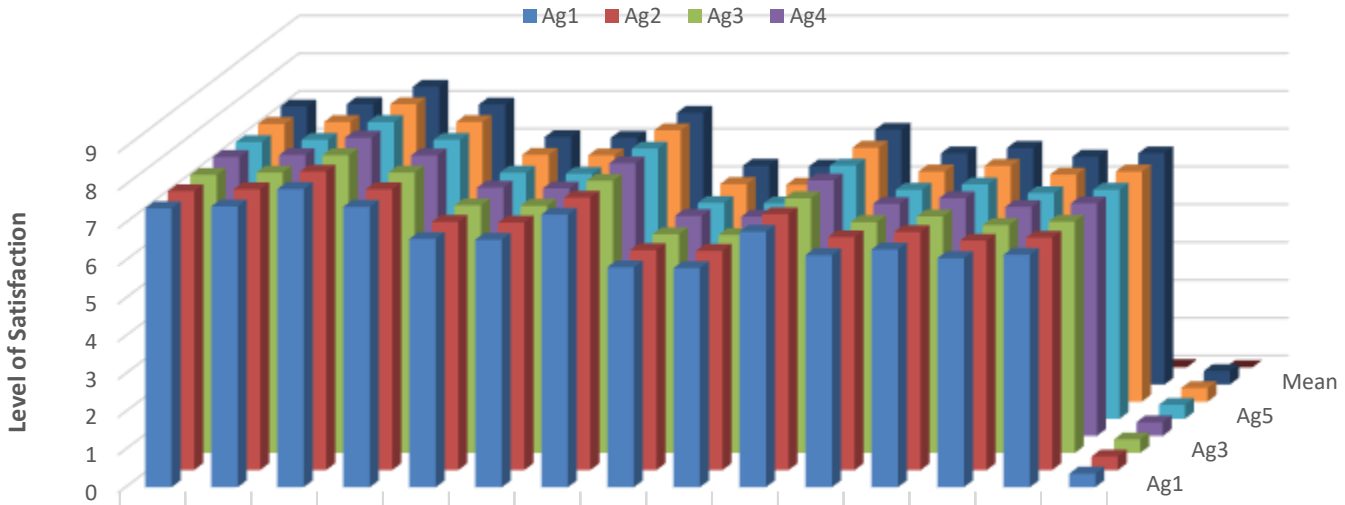


Figure 2 Number and percentage **of** age group respondent
(Source: Panyawuthakrai, 2023)

Note. "Age group" abbreviated to Ag.

According to Hedonic's nine scales of satisfaction, each age group (Ag1 to Ag6) in Figure 3 below displays a different average degree of favour for each of the following features of Hotila and MSG: pigment, smell, taste, texture, pricing, and packaging, as follows: 7.21, and 6.15, 7.21 and 6.15, 7.20 and 6.12, 7.21 and 6.15, 7.15 and 6.06, and 7.18 and 6.09, respectively. All age groups that were satisfied with the use of Hotila at a level of 7.19 (moderately like), which was higher than MSG at a level of 6.12 (slightly like) dignified that Hotila was favoured by all age groups over MSG.

Concerning the relationship between sex and satisfaction with using Hotila and MSG, Figure 4 reveals that males' average satisfaction with Hotila and MSG was 7.21 and 6.15, respectively. While females' mean satisfaction with Hotila and MSG was 7.12 and 6.00, respectively. That is, the preference for Hotila and MSG did not significantly differ based on gender.

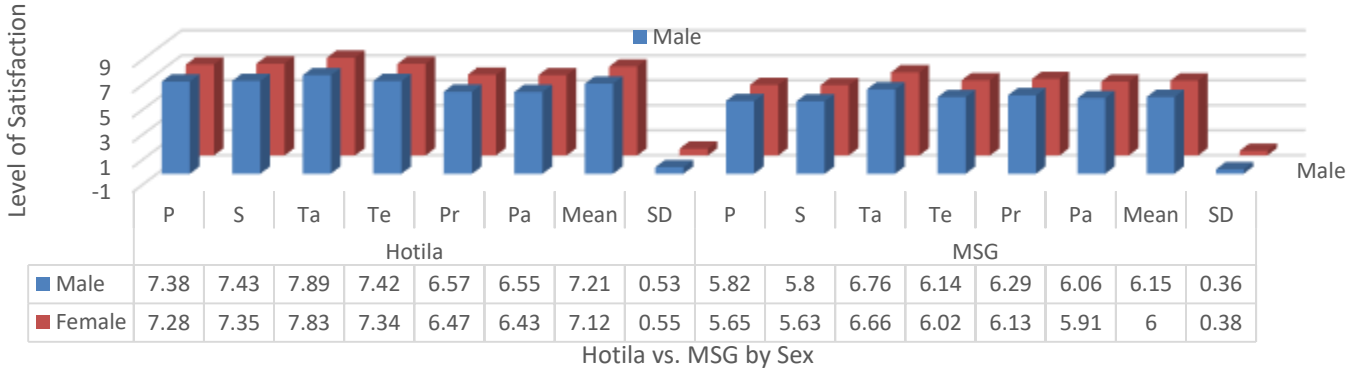


	P	S	Ta	Te	Pr	Pa	Mean	P	S	Ta	Te	Pr	Pa	Mean	SD
	Hotila							MSG							
Ag1	7.38	7.43	7.89	7.42	6.57	6.55	7.21	5.82	5.8	6.76	6.14	6.29	6.06	6.15	0.36
Ag2	7.38	7.43	7.9	7.43	6.57	6.55	7.21	5.82	5.8	6.77	6.16	6.3	6.07	6.15	0.36
Ag3	7.36	7.42	7.88	7.42	6.55	6.54	7.2	5.79	5.77	6.74	6.11	6.26	6.03	6.12	0.36
Ag4	7.38	7.43	7.89	7.42	6.57	6.55	7.21	5.82	5.8	6.76	6.14	6.29	6.06	6.15	0.36
Ag5	7.32	7.38	7.85	7.38	6.51	6.48	7.15	5.71	5.7	6.7	6.06	6.2	5.97	6.06	0.37
Ag6	7.35	7.4	7.87	7.4	6.53	6.52	7.18	5.76	5.74	6.72	6.09	6.24	6.01	6.09	0.36
Mean	7.36	7.42	7.88	7.41	6.55	6.53	7.19	5.79	5.77	6.74	6.12	6.26	6.03	6.12	0.36
SD	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.01

Hotila vs. MSG by Attribute

Figure 3 Statistics on how various age groups favour the attributes of Hotila vs. MSG
(Source: Panyawuthakrai, 2023)

Note. "Pigment" is abbreviated to P, "Smell" to S, "Taste" to Ta, "Texture" to Te, "Pricing" to Pr, "Packaging" to Pa, and "Standard Deviation" to SD.



	P	S	Ta	Te	Pr	Pa	Mean	SD	P	S	Ta	Te	Pr	Pa	Mean	SD
	Hotila								MSG							
Male	7.38	7.43	7.89	7.42	6.57	6.55	7.21	0.53	5.82	5.8	6.76	6.14	6.29	6.06	6.15	0.36
Female	7.28	7.35	7.83	7.34	6.47	6.43	7.12	0.55	5.65	5.63	6.66	6.02	6.13	5.91	6	0.38

Hotila vs. MSG by Sex

Figure 4 Statistics on how male and female respondents favour the attributes of Hotila vs. MSG
(Source: Panyawuthakrai, 2023)

Discussions

The findings of the research can be discussed in several points as follows:

1) Given its scarcity even inside the communities, Hotila may be used considerably less frequently by young adults and adults who typically commute and work outside of the villages. Consequently, seniors have more knowledge about Hotila. Additionally, it is rare to witness the new integration or invention of the plant with foods other than their ethnic cuisines. More people from diverse backgrounds participating in the study, though, could lead to future discoveries about the plant.

2) Although there have been initiatives for the conservation and rehabilitation of Hotila within communities for many years, Hotila cannot properly grow or be cultivated. Besides, because they lacked the knowledge and techniques for cultivating and propagating this plant, most of them failed in their endeavours. Additionally, the elevation and moisture content of the rock and soil including their pigment and ambient temperature are all vital to Hotila growth. These all make Hotila not as easy to breed as other types of edible ferns or general ornamental ferns. The crucial factors which may affect Hotila's growth and survival are soil, water, air, humidity, altitude above sea level, and atmospheric pressure.

Apart from Hotila, three additional native fern species which are edible in the same way as other local plants are Kikudo/Popledo, Lekhido (aka Phak Kut (Diplazium esculentum) or bow-headed type and Phak Kut King in Thai, respectively), and Hotikha. In SK cuisine, Kikudo/Popledo is frequently found in stir-fries, curries, and spicy salads. This fern type is reported to be effective in reducing cholesterol and fever, nourishing blood cells, stopping bleeding, healing rashes, and treating haemorrhoids and diuretics (Charoenchit 2022). Lekhido is not as well known for cooking as the former fern type due to its inner mucilage, flavour and odour. And Hotikha is rarely used for cooking due to its bitter unpleasant taste—even the buffalos and oxen grazing in the forests are anxious to avoid it. They can have diarrhoea from having taken it for their meals. In terms of the research on these ferns, it appears that Kikudo/Popledo is the most frequent; Hotila is a little less common, Lekhido might be even less frequent, and Hotikha might not even exist. Figure 5 shows the different types of local edible ferns.

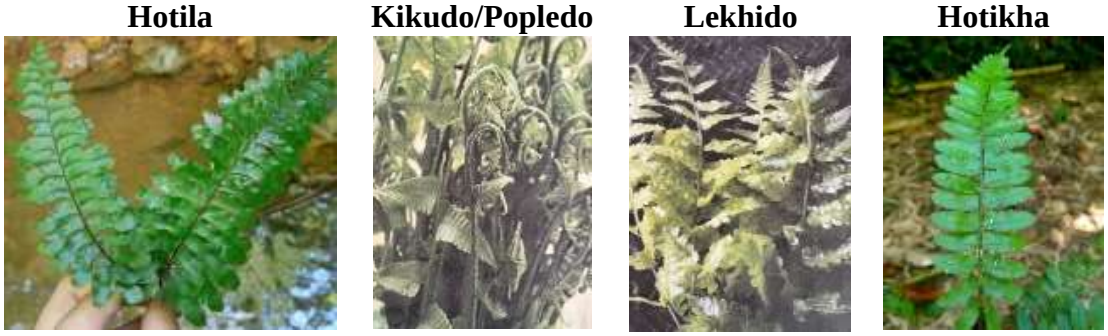


Figure 5 Different types of local edible ferns
(Source: Panyawuthakrai, 2023)

3) The preference of Hotila over MSG among the participants is evident. However, in terms of cost per weight per quantity, marketing, and packaging, MSG is often more widely accessible and used in typical cooking than Hotila. Nonetheless, it is plausible to assume that MSG may have harmed community members' health for decades, even though this study did not focus on the MSG impacts on their health. Some participants argued that “whereas our great-grandparents of yesteryear could cross mountains without feeling tired or experiencing

discomfort in their knee, back, or shoulder bones, they could no longer even climb mountains without a knapsack. MSG, which was first used fifty or sixty years ago, might be to blame for this while Hotila on the other hand has been well known for over a century."

Although not providing an extensive scientific explanation of the nutrition or nutrient availability of the Hotila plant and several people are uninformed of Hotila's nutritional information, this study would adequately convince non-specialist readers that Hotia is safer and healthier than MSG. The fact that locals prefer Hotila to MSG in all dimensions may benefit a health campaign against MSG, particularly in health-conscious groups and those with a medical record of MSG allergies.

Conclusion and suggestions

The following are some recommendations from the author: firstly, new facts about Hotila should be added to the local education system in the form of a school curriculum or a local curriculum at both primary and secondary levels; secondly, this study may in some way oppose the use of MSG in encouraging people to live healthier lives and; thirdly, this new knowledge about Hotila should raise awareness of marketing Hotila a local product.

This research may contribute to propose to adding information on the new type of ferns to many relevant agencies, such as the Service Center and Development at the Height of Pang Tong under the Royal Initiative MHS, as there has been no information about Hotila from there before.

Further research on Hotila should concentrate on its nutrition chemicals, the chemicals that compose the rock and soil from which it naturally develops, and whether and how it adversely impacts humans.

New knowledge and the effects on society and communities

Based on the objectives and previous enquiries into the extent of local knowledge on the application of Hotila, if the plant can be effectively grown in the communities like other ferns, and whether it is preferred over MSG as a choice for consumption, the research results conclude that:

1) The communities' elders are more knowledgeable about Hotila than young people or even adults, therefore the 13 bodies of knowledge about Hotila have been produced and are beneficial to anyone interested in learning about the use and preservation of this native plant as an alternative to MSG consumption;

2) Due to improper moisture, soil, sunlight, wind, and improper acts of collecting natural Hotila, it cannot typically be grown well within housing complexes, so some guidelines for conservation, rehabilitation and propagation of Hotila species have been proposed: educating people about the benefits of Hotila, increasing awareness of Hotila harvest, and promoting Hotila propagation in the community where suitable, and;

3) Although people are unaware of Hotila's nutritional information, it is preferred over MSG in all aspects, i.e. pigment, smell, taste, texture, pricing, and packaging.

Acknowledgments

This research was part of Ethno-Semantics in Food Terms among Karen Minorities in Maehongson Province which was funded for the year 2022 by the Royal Plant Genetic Conservation Project under Her Royal Highness Princess Maha Chakri Sirindhorn (Public Organization).

Endnotes

1. Two methods of propagation of Hotila adapted from "Black stem fern" as introduced in Thai Kasetsart (2012) are clump division and sporulation.

The method of dividing the clumps is more popular than the sporulation method, whether that type of fern is a clump or a bundle. Simply but effectively, this method works through the following processes: divide and hurriedly store the clumps in a high level of humidity because as pulled apart from the forest the clump will soon evaporate, dry up and die within one or two days.

The sporulation method involves how to breed Red-brown/dark brown spores through following processes: a) Cut and leave spore-bearing leaves in a dry paper bag; b) Close the bag tightly; c) Hang the bag for two or three hours until most spores fall from the leaves; d) Flick the bag with fingers occasionally to accelerate the spores' fall; e) Prepare composted potting soil mixed with loam, burnt brick dirt, some decaying tree leaves and fine sand at 1:1:1:1 ratio, and with ½ manure and ¼ lime; f) Bring a shallow-bottomed burnt brick pot; g) Fill the pot with the potting soil and heat it to remove mold and sterilize other plant seeds, or roast the pot; h) Spray water all over the soil; i) Sow the spores from the paper bag in the pot and never spray water again; j) Cover the pot tightly with clear plastic; k) Leave it under shades and in a damp and cool place or on a watering plate to keep the soil moist all the time; l) Leave it for about two or three months until very young Hotila germinate and grow to Stage 2; m) Plant the young Hotila in a nursery box with a soil mix like a potting soil; n) When the leaves grow stronger for about four to five months, plant it separately in three-inch pots.

The necessary and supportive atmosphere for Hotila spores to grow must be as follows: 1) shady— do not expose the spores or seedlings to direct sunlight. Doing so for only three minutes, the seedlings will die quickly; 2) highly humid; 3) calm from winds— winds will make Hotila evaporate too quickly; 4) damp or do not allow waterlog to cause the roots to absorb much water or Hotila will rot and die, and; 5) Soil is highly fertilized.

2. An opposite of Hotila that poorly experienced may mistake for is called "Hotikha [เฮาะทีข่า]" in SK. This fern plant has a bitter taste, greenish stalks, and short dark green leaves. Even wild-raising buffalos and oxen avoid grazing this plant because it always makes them sick. So, it is abundant around and in forests. Furthermore, Hotikha is a more familiar plant easily found along the foot of mountains.

APPENDICES

1. Abbreviations

m = meters
km = kilometers
M = Mueang
BL = Banluang/Luang Village
BM = Banmai/Mai Village
DS = Bandoisaeng/Doisaeng Village
HK = Banhuaikhan/Huaikhan Village
HN = Banhuaina/Huaina Village
KY = Khunyuam
NS = Bannaisoi/Naisoi Village
PK = Banpuku/Puku Village
PM = Banpratumueang/Pratu mueang Village
SO = Bansuanoi/Suanoi Village
TP = Bantophae/Tophae Village
HMS = Banhuaimakhueasom/Huai makhueasom Village
HNG = Banhua-ngao/Hua-ngao Village
HPK = Banhuaipukaeng/Huaipukaeng Village
HSB = Banhuasanambin/Hua sanambin Village
HST = Banhuaisueathao/Huaisueathao Village
HTN =Banhuaitonnun/Huaitonnun Village
MHS = Maehongson/Maehongson Province
MSG = Monosodium glutamate

NHL = Bannahuailaem/Nahuailaem Village
NPD = Bannamphiangdin/Nam phiangdin Village
PAR = Participatory action research
PKL = Banphakholo/Phakholo Village
MMHS = Mueang Maehongson
OECD = The organization for economic co-operation and development
NSTDA = National science and technology development agency
HRDI = The highland research and development institute

2. English–Thai Transcription/Translation

Ausmanda taiwan = ออสมันดาไต้หวัน
Bird's-wing fern= เฟิร์นปีกนก
Blue german = น้ำเงินเยอรมัน
Doibaichaekkut = ผักกูดดอยใบแฉก
Doibaimankut = ผักกูดดอยใบมัน
Doibrazil = ดอยบราซิล
Doi MSG = ผงชูรสดอย
Doisuthepkut= ผักกูดดอยสุเทพ
Hangdaeng = หางแดง
Hangkaifoi = หางไก่ฝอย
Hoti = เฮาะที
Hotikha = เฮาะทีข่า
Hotila = เฮาะทีหล่า
Hotiloe = เฮาะทีเล่อ
Iluen = อีหลืน
Indiadaeng = อินเดียแดง
Kaengpli = แกงปลี
Kahan sprout = หน่อคาหาน
Kandambaiyao = ก้านดำใบยาว
Kandamflizlut= ก้านดำฟริซลุท
Kandamyokdoikham = ก้านดำหยกดอยคำ
Kanoknaribaitang = กนกนารีใบตั้ง
Khaokwangbaitang = เขากวางใบตั้ง
Kuthin = กูดหิน
Maetaiwan = แม่ไต้หวัน
Namphriknok = น้ำพริกน๊อก
Namphrikong = น้ำพริกอ่อง
Nang = นาง
Office for the health promotion fund = สำนักงานกองทุนสนับสนุนการสร้างเสริมสุขภาพ (สสส)
Pangtong height service and development centre under the royal initiatives = ศูนย์บริการและพัฒนาที่สูงปางตองตามพระราชดำริ
Phaktue = ผักตื่อ
Ratsamichot = รัศมีโชติ
Sgaw Karen = กะเหรี่ยงสกอ
Simaehongson = ศรีแม่ฮ่องสอน
Tai Yai = คนไทใหญ่
Wettamarind = มะขามเปียก

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