

# Ethnobotany of Zingiberaceae for the Phu Thai Ethnic Group in Nakhon Phanom Province, Thailand

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**Abstract.** The objective of this research was studied indigenous knowledge of Zingiberaceae by the Phu Thai ethnic group in Nakhon Phanom province, Thailand. A field survey was performed through observation, participation and interview with local healers and general villagers. The data was analyzed by using Independent-samples t-test, One Way ANOVA, indices of informant consensus factor (ICF), fidelity level (FL%) and use value (UV). The results found that Phu Thai ethnic group continues to use Zingiberaceae for their life, and they got form home garden and forest around the village. A total of 21 species were utilized. They were used as edible about 16 species. Five species was cultural used. And two species was other plant used. Some species used more than one ethnobotanical uses but some use only one ethnobotanical uses. The many parts of plant were used; there were rhizome, leaf, shoot and inflorescence, respectively. The most part used was rhizome. *Alpinia galanga* is the highest use value or UV (0.41) and follow by lower use value. *Kaempferia marginata* is the lowest use value (0.04). The Informants' consensus index factor (ICF) was found to range between 0.93 (Injuries) and 1.00 (each for Blood system disorders, Circulatory system disorder and Pregnancy/Birth/Puerperium disorders). The highest fidelity level (FL%) values were calculated for *Zingiber officinale* (80.83), showing the important species which most use for medicine in Phu Thai. While, the lowest fidelity level values were calculated for *K. rotunda* (10.67) which is less used for medicine Phu Thai. Older informants had highly significant knowledge on plant uses than the younger. Knowledge on plant uses was significant higher in the women. Ethnobotany of Zingiberaceae used by the Phu Thai ethnic group effects the interaction of their life style, beliefs, and rituals. Unfortunately, such knowledge is being lost, thus, these should be promoted and conserved.

## Keywords:

Zingiberaceae, Ethnobotany, Phu Thai ethnic group, Nakhon Phanom province

## 1. Introduction

Zingiberaceae or the ginger family belonging to order Zingiberales is a family of flowering plants made up of about 50 genera of 1,600 species worldwide [5, 6]. The aromatic perennial herbs with creeping horizontal or tuberous rhizomes are found to be the dominant characteristic of this family [11]. It is distributed throughout tropical Africa, Asia, and the Americas [22]. In Thailand, Zingiberaceae was recorded 26 genera and about 300 species [11, 22, 25]. Zingiberaceae is well known for its food, medicinal and economic significance such as *Alpinia galanga*, *A. purpurata*, *Amomum uliginosum*, *Boesenbergia rotunda*, *Curcuma alismatifolia*, *C. longa*, *Etingera elatior*, *Kaempferia galanga*, *K. pulchra*, *K. rotunda*, *Zingiber officinale*, *Z. zerumbet* [11, 12, 22, 25]. Previously study, Saensouk et al. [23] studied Zingiberaceae in Nakhon Phanom Province found that three tribes, 12 genera and 57 species including traditional uses (as food, spices, medicines, rituals, cosmetics and ornamentation) are reported. Later, Pholhiamhan et al. [13] studied the ethnobotany of Phu Thai ethnic group in Nakhon Phanom Province. Moreover, several ethnobotanists studied ethnobotany in Thailand especially in the northeastern region, i.e. Junsongduang et al. [2], Phumthum et al. [9], Saisor et al. [10], Srithi [7]. In addition, some botanists reported the traditional uses of the family Zingiberaceae in Thailand, i.e. *Boesenbergia baimaii* for food by Saensouk and Larsen [15], *B. isanensis* for food by Saensouk and Saensouk [18], *Curcuma* spp. for medicine propose [19–21], *Elettariopsis biphylla* for food by Saensouk and Saensouk [16], *Kaempferia grandifolia* for food by Saensouk and Jenjittikul [14], *K. picheansoonthonii* and *K. udonensis* for foods by Phokham

Received by 20 February 2022  
Revised by 2 March 2022  
Accepted by 12 March 2022

et al. [3], *K. mahasarakhamensis* for food by Saensouk and Saensouk [17], and Zingiberaceae in several regions or provinces by Chumroenphat et al. [24–25], Phumthum and Balslev [8], Saensouk et al. [22–23], Saensouk and Saensouk [11], and Sirirugsa [12].

Nakhon Phanom province in northeastern Thailand there are 7 ethnic groups Phu Thai is one of these ethnic groups [13]. The Phu Thai are mainly found in areas of Renu Nakhon, Nakae, That Phanom and Na Wa district. But most live in Renu Nakhon. Their lifestyles are related to learning how to use local plants for existence and then the obtained indigenous knowledge will be passed from the generation to generation [13]. The Phu Thai have their own distinctive culture and beliefs such as Phu Thai Language, welcoming guests with a “Bai Si” ceremony, a “Pha Laeng” typical dinner party, with “U” local liquor, and with the traditional ‘Phu Thai’ dance. Normally, Phu Thai ethnic group in Nakhon Phanom used plants in their daily life, especially the family Zingiberaceae. Therefore, the aim of this research to study indigenous knowledge of Zingiberaceae by the Phu Thai ethnic in Nakhon Phanom province, Thailand.

## 2. Materials and Methods

A field survey was performed through observation, participation and interview with local healers and general villagers in Phu Thai ethnic group in Renu Nakhon, Nakae, That Phanom and Na Wa Districts, Nakhon Phanom Province (Fig. 1). Semi-structured interview and field observation were employed to collect data informants were interviewed about the local names, uses of the plants, which parts of plant were used and how they were used. The ages of the informants were between 15 years and 78 years. 60 informants were selected. Photographs of plants were taken and morphology of each plant was characterized. The plants used were identified (local name), photographed and samples were collected for the preparation of herbarium specimens, which were deposited at Mahasarakham University Herbarium. Plant identification was based largely on taxonomic literature, such as through the use of references entitled the Flora of Thailand. Documented data was analyzed by using Independent-samples t-test, One Way ANOVA, indices of informant consensus factor (ICF), fidelity level (FL%) and use value (UV) (Inta et al. [1]). Independent-samples t-test is used to compare indigenous knowledge between genders and One Way ANOVA is used to compare indigenous knowledge between ages.

## Index

### Use value (UV)

A quantitative measure for the relative importance of a given species known locally (Inta et al. [1]):

$$UV = (\sum U_i)/N \quad (1)$$

$U$  is the number of use-reports cited by each informant for a given species and  $N$  refers to the total number of informants.

### Indices of informant consensus factor (ICF)

To test homogeneity of knowledge, the informant consensus factor was used (Inta et al. [1]):

$$ICF = (Nur - Nt)/(Nur - 1) \quad (2)$$

Where  $Nur$  refers to the number of use-reports for a particular use category and  $Nt$  refers to the number of taxa used for a particular use category by all informants.

### Fidelity level (FL%)

This index is to determine the most preferred species used in the treatment of a particular ailment (Inta et al. [1]).

$$FL(\%) = Np/N \times 100 \quad (3)$$

Where  $Np$  is the number of use-reports cited for a given species for a particular use category and  $N$  is the total number of use-reports cited for any given species.

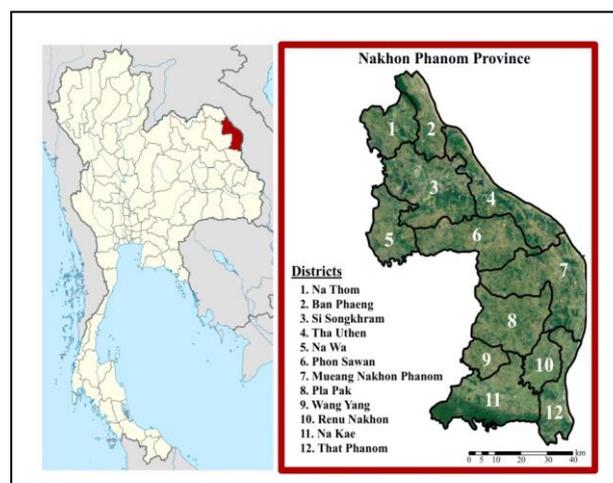


Fig. 1 General location and detail of Nakhon Phanom Province, Thailand [26].

## 3. Result and Discussions

Result of the research (Table 1) is found twenty one species of Zingiberaceae with Phu Thai ethnic group used for edible, medicine, cultural and other use by the Phu Thai ethnic group in Nakhon Phanom province, Thailand which are differs from previously studied by Saensouk et al. [23] who is studied the family Zingiberaceae (three tribes, 12 genera and 57 species) in all area of Nakhon Phanom province. They used for edible, medicine, cultural and other use which is agree with previously studied by Saensouk and Larsen [15], Saensouk and Jenjittikul [14], Saensouk and Saensouk [11, 16–18], Saensouk et al. [22–23], Phokham et al. [3], Chumroenphat et al. [24–25], Phumthum and Bsalslev [8], and Sirirugsa [12] – they

reported uses of the Zingiberaceae as food, spices, medicines, rituals, cosmetics and ornamentation). Sixteen species for edible, thirteen species for medicine, five species for cultural and two species for other use. In the

other hand *Alpinia galanga* is the highest use value (UV) and follow by lower use value because it is always used in community. *Kaempferia marginata* is the lowest use value because it is found in some research area.

Species	Thai name	Local name	uses				Source of plants*	Use value (UV)
			edible	medicine	cultural	other		
<i>Alpinia galanga</i>	Kha ban	Kha	✓	✓			1	0.41
<i>Zingiber officinale</i>	King	King	✓	✓			1	0.39
<i>Z. montanum</i>	Plai	Wan fai	✓	✓	✓		1	0.36
<i>Curcuma longa</i>	Kha min chan	Kee min	✓	✓			1	0.35
<i>A. zerumbet</i>	Kha pa	Kha	✓	✓			2	0.30
<i>Globba winitii</i>	Wan sao long	Wan sao long		✓	✓		1	0.29
<i>Hedychium coronarium</i>	Ma ha hong	Sai hern	✓		✓	✓	1	0.28
<i>A. siamensis</i>	Kha yai	Kha	✓				1	0.27
<i>C. angustifolia</i>	Krachiew dang	Ka chew	✓	✓			2	0.25
<i>Kaempferia rotunda</i>	Perāa pa	Wan din	✓	✓	✓	✓	2	0.24
<i>Z. zerumbet</i>	Kra thūx	Kha thūx	✓	✓			1	0.21
<i>Etligeria elatior</i>	Da la	Da la			✓		1	0.2
<i>C. zedoaria</i>	Kha min oil	Kee min		✓			1	0.2
<i>C. singularis</i>	Krachiew Khaw	Ka chew	✓				2	0.19
<i>K. parviflora</i>	Kra chai dam	Kha sai dam		✓			1	0.14
<i>A. conchigera</i>	Kha ling	Kha	✓				1	0.13
<i>C. comosa</i>	Wan chak mod look	Wan mod lu		✓			2	0.12
<i>Boesenbergia rotunda</i>	Kha chai	Ka sai	✓				1	0.12
<i>Z. ottensii</i>	Plai dam	Pai dam	✓	✓			1	0.11
<i>Amomum villosum</i>	Erew	Ma neng	✓				1	0.07
<i>K. marginata</i>	Perāa pa	Wan tub moob	✓				2	0.04

**Table 1** Ethnobotany of Zingiberaceae for the Phu Thai ethnic group in Nakhon Phanom province, Thailand

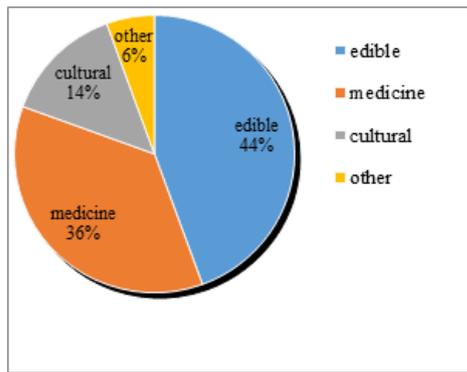


Fig. 2 Zingiberaceae uses for the Phu Thai ethnic group in Nakhon Phanom province, Thailand

Fig. 2 shows the percentage of Zingiberaceae uses for Phu Thai. The result found that the most usage is for edible followed by medicine, cultural and other because the most species were used for local vegetables.

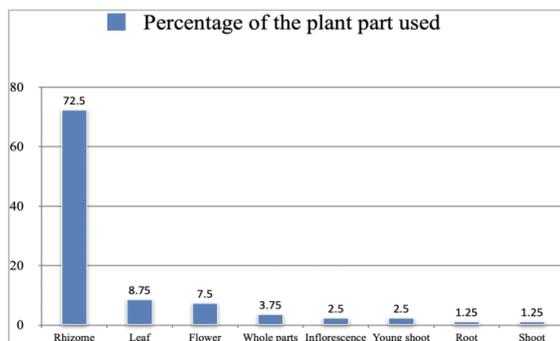


Fig. 3 Zingiberaceae parts used for the Phu Thai ethnic group in Nakhon Phanom province, Thailand

Fig. 3 presents the percentage of plants parts use of Zingiberaceae uses for Phu Thai ethnic group in Nakhon

Phanom province, Thailand. The highest parts use is rhizome followed by leaf, flower, whole pant inflorescence, young shot root and shoot because rhizomes of this plant have been found the most aromatic in rhizomes.

Table 2 shows the knowledge between genders of the Phu Thai ethnic group in Nakhon Phanom province, Thailand. It can be seen that the female have more indigenous knowledge than male Statistically Significant at  $p < 0.05$ . Table 3 shows the knowledge between ages we found that more than fifty years old were the highest of indigenous knowledge followed by thirty-one to fifty and fifteen to thirty years old. Older informants had significantly more knowledge of plant uses than younger ones *Statistically Significant* at  $p < 0.05$ .

Gender	N	Mean	SD	t	P value
Male	30	0.19	0.06	-3.160	.003
Female	30	0.24	0.06		

Table 2 Knowledge between genders of the Phu Thai ethnic group in Nakhon Phanom province, Thailand

Age	N	Mean	SD	F	p value
15-30	20	0.16	0.06	31.718	.000
31-50	20	0.19	0.04		
> 50	20	0.22	0.04		
total	20	0.27	0.05		

Table 3 Knowledge of age for the Phu Thai ethnic group in Nakhon Phanom province, Thailand

Ailment category	Number of Taxa (N <sub>t</sub> )	Number of use reports (N <sub>ur</sub> )	ICF
Blood system disorders	1	6	1
Circulatory system disorder	1	31	1
Pregnancy/Birth/Puerperium disorders	1	30	1
Digestive system disorders	7	626	0.99
Respiratory system disorders	2	82	0.99
Genitourinary system disorders	2	62	0.98
Treat infections/infestations	4	100	0.97
Skin/Subcutaneous cellular tissue disorders	4	79	0.96
Muscular-skeletal system disorders	6	124	0.95
Injuries	5	59	0.93

Table 4 Informants' consensus index factor (ICF) for the Phu Thai ethnic group in Nakhon Phanom province, Thailand

Table 4 shows that the Informants' consensus index factor (ICF) was found to range between .93 and 1.00. The disease categories with the highest use reports were for Blood system disorders, Circulatory system disorder and Pregnancy/Birth/Puerperium disorders (1.00 each), followed by Digestive system disorders, Respiratory

system disorders, Genitourinary system disorders, Treat infections/infestations, Skin/Subcutaneous cellular tissue disorders, Muscular-skeletal system disorders and Injuries. It means that a higher ICF value indicating the best agreement among the informants knowledge of medicinal plants that were used to treat ailments in these categories.

Species	ailment	(FL%)
<i>Zingiber officinale</i>	Cough, Flatulence	80.83
<i>Curcuma zedoaria</i>	Gastric ulcers, stomach ache, Dislocations	80.00
<i>C. longa</i>	Gastric ulcers, Bites(non-venomous), Itching	70.00
<i>Alpinia galanga</i>	Dysuria, Ringworm (Tinea), Muscle pain (myalgia)	64.44
<i>Kaempferia parviflora</i>	Cardiac tonic, Gastric ulcers, Bloody stool, stomach ache, Cough	55.33
<i>Z. ottensii</i>	Gastric ulcers, Bloody stool, Constipation, Stomach ache, Flatulence, Lumbago	48.33
<i>Z. zerumbet</i>	Flatulence	48.33
<i>C. comosa</i>	Gastric ulcers, Stomach ache, pelvic pain/ prolapsed uterus	47.50
<i>A. zerumbet</i>	Stomach ache, flatulence	37.50
<i>Z. montanum</i>	Diarrhoea, stomach ache, Flatulence, Cold, Fever, Irritation (due to hairy caterpillar), Anthelmintic	37.14
<i>C. angustifolia</i>	Itching	26.67
<i>Globba winitii</i>	Lumbago	16.67
<i>K. rotunda</i>	Blood tonic, Gastric ulcers, Diarrhoea, Bruises, Wounds, Burns, Muscle pain (myalgia), Lumbago, Itching, stomach ache	10.67

**Table 5** Zingiberaceae used for medicine in the Phu Thai ethnic group at Nakhon Phanom province, Thailand

Table 5 shows species of Zingiberaceae used for medicine. The highest Fidelity Level (FL%) was recorded as *Zingiber officinale* (80.83), followed by *Curcuma zedoaria*, *C. longa*, *Alpinia galanga*, *Kaempferia parviflora*, *Zingiber ottensii*, *Z. zerumbet*, *C. comosa*, *A. zerumbet*, *Z. montanum*, *C. angustifolia*, *Globba winitii* and *K. rotunda*.

Fidelity Level (FL%) showing conformity of knowledge on species with the best healing potential. It means that High FLs (*Zingiber officinale*) are the important species which most use for medicine in Phu Thai and *Kaempferia rotunda* less use for medicine Phu Thai.

In conclusions, this research was studied indigenous knowledge of Zingiberaceae (twenty one species) with used for edible, medicine, cultural and other use by the Phu Thai ethnic group in Nakhon Phanom province, Thailand. A field survey was performed through observation, participation and interview with local healers and general villagers. The data was analyzed by using Independent-samples t-test, One Way ANOVA, indices of informant

consensus factor (ICF), fidelity level (FL%) and use value (UV). Therefore, Zingiberaceae still play an important role among Phu Thai ethnic group culture. Knowledge is being lost and should be promoted and conserved. Twenty-one species of Zingiberaceae are used for edible, medicine, cultural and other use by Phu Thai. Sixteen species for edible, thirteen species for medicine, five species for cultural and two species for other use. The high UV and FL values will be discovery of new compounds, new drugs for the treatment of diseases.

### Acknowledgements

This research was financially supported by Biodiversity-Based Economy Development Office (Public Organization) or BEDO. We would like to thank the Walai Rukhvej Botanical Research Institute and Mahasarakham University for their facilities during the research. I would like to thanks Dr. Jolyon Dodgson (a native English speaker from UK) for language editing and suggestions to improve the manuscript.

## References

- [1] A. Inta, P. Shengji, H. Balslev, P. Wangpakapattanawong, and C. Trisonthi, "A comparative study on medicinal plants used in Akha's traditional medicine in China and Thailand," *cultural coherence or ecological divergence. J Ethnopharmacol*, vol.116, pp. 508–517, 2008.
- [2] A. Junsongduang, W. Kasemwan, S. Lumjoomjung, W. Sabprachai, W. Tanning, and H. Balslev, "Ethnomedicinal Knowledge of Traditional Healers in Roi Et, Thailand," *Plants* vol. 9, 1177, 2020.
- [3] B. Phokham, P. Wongsuwan, and C. Picheansoonthon, "Three new species of *Kaempferia* (Zingiberaceae) from Thailand and Laos," *J Jpn Bot*, vol. 88, no. 5, pp. 297–308, 2013.
- [4] G.J. Martin, *Ethnobotany: A Methods Manual*, Chapman & Hall, London, 1995.
- [5] J. Leong-Škorničková, H.Đ. Trần, Q.B. Nguyễn, H. Kristýna, H.T. Luu, Q.Đ. Nguyễn, T.T. Nguyễn, and M. Newman, "The identity of *Amomum trilobum* and *Amomum unifolium* (Zingiberaceae: Alpinioideae), and description of four new related species from Vietnam," *Phytotaxa*, vol. 401, no. 3, pp. 149–165, 2019. DOI: 10.12705/671.2.
- [6] KewScience 2021, World Checklist of Selected Plant Families (WCSP), 2021.
- [7] K. Srithi, H. Balslev, P. Wangpakapattanawong, P. Srisanga, and C. Trisonthi, "Medicinal plant knowledge and its erosion among the Mien (Yao) in northern Thailand," *Journal of Ethnopharmacology* vol. 123, pp. 335–342, 2009.
- [8] M. Phumthum, and H. Balslev, "Using ICPC-2 standard to identify Thai Zingiberaceae of pharmacological interest," *Plants*, vol.9, no. 7, 906, 2020. DOI:10.3390/plants9070906.
- [9] M. Phumthum, K. Srithi, A. Inta, A. Junsongduang, K. Tangjitman, W. Pongamornkul, C. Trisonthi, and H. Balslev, "Ethnomedicinal plant diversity in Thailand," *Journal of Ethnopharmacol*, vol. 214, pp. 90–98, 2018.
- [10] N. Saisor, P. Prathepha, and S. Saensouk, "Ethnobotanical study and utilization of plants in Khok Nhong Phok forest, Kosum Phisai District, Northeastern Thailand," *Biodiversitas*, vol. 22, no. 10, pp. 4336–4348, 2021.
- [11] P. Saensouk, and S. Saensouk, "Diversity, traditional uses and conservation status of Zingiberaceae in Udorn Thani Province, Thailand," *Biodiversitas*, vol. 22, no. 8, pp. 3083–3097, 2021.
- [12] P. Sirirugsa, "Thai Zingiberaceae: species diversity and their uses," *International Conference on Biodiversity and Bioresources: Conservation and Utilization*, 23–27 November 1997, Phuket, Thailand, 1998.
- [13] R. Pholhiamhan, S. Saensouk, P. Saensouk, "Ethnobotany of Phu Thai ethnic group in Nakhon Phanom Province, Thailand," *Walailak Journal of Science and Technology*, vol. 15, no. 10, pp. 679–699, 2018.
- [14] S. Saensouk, and T. Jenjittikul, "*Kaempferia grandifolia* sp. nov. (Zingiberaceae) a new species from Thailand," *Nordic J Bot*, vol. 21, no. 2, pp. 139–142, 2001. DOI: 10.1111/j.1756-1051.2001.tb01349.x.
- [15] S. Saensouk, and K. Larsen, "*Boesenbergia baimaii*, a new species of Zingiberaceae from Thailand," *Nordic J Bot*, vol. 21, no. 6, pp. 595–597, 2001. DOI: 10.1111/j.1756-1051.2001.tb00818.x.
- [16] S. Saensouk, and P. Saensouk, "*Elettariopsis biphylla*, a new species of Zingiberaceae from Thailand," *Phytotaxa*, vol. 159, no. 1, pp. 23–25, 2014. DOI: 10.11646/phytotaxa.159.1.4.
- [17] S. Saensouk, and P. Saensouk, "*Kaempferia maharakhamensis* sp. nov. (Zingiberaceae), a new species from Northeastern Thailand," *Taiwania*, vol. 64, no. 1, pp. 39–42, 2019. DOI: 10.6165/tai.2019.64.39.
- [18] S. Saensouk, and P. Saensouk, "*Boesenbergia isanensis* (Zingiberaceae), a new species from Thailand," *J Jpn Bot*, vol. 95, no. 2, pp. 65–68, 2020.
- [19] S. Saensouk, T. Boonma, and P. Saensouk, "Six new species and a new record of *Curcuma* L. (Zingiberaceae) from Thailand," *Biodiversitas*, vol. 22, no. 4, 1658–1685, 2021a. DOI: 10.13057/biodiv/d220410.
- [20] S. Saensouk, T. Boonma, and P. Saensouk, "A new species and a new record of *Curcuma* subgen. *Curcuma* (Zingiberaceae) from Northern Thailand," *Biodiversitas*, vol. 22, no. 9, pp. 3661–3670, 2021b. DOI:10.13057/biodiv/d220904.
- [21] S. Saensouk, T. Boonma, A. Thomudtha, P. Thomudtha, and P. Saensouk, "*Curcuma wananlueanga* (Zingiberaceae), a new species of subgenus *Curcuma* from Thailand," *Biodiversitas*, vol. 22, no. 7, 2988–2994, 2021c. <https://doi.org/10.13057/biodiv/d220752>.
- [22] S. Saensouk, P. Saensouk, P. Pasorn, and P. Chantaranothai, "Diversity, Traditional Uses and New Record of Zingiberaceae in Nam Nao National Park, Petchabun Province, Thailand," *Agriculture and Natural Resources*, vol. 50, pp. 445–453, 2016. DOI: 0.1016/j.anres.2016.08.002.
- [23] S. Saensouk, P. Saensouk, P. Pasorn, and N. Chanshotikul, "Diversity and traditional uses of Zingiberaceae in Nakhon Phanom province, Thailand," *Research & Knowledge*, vol. 4, no. 1, pp. 47–55, 2018.
- [24] T. Chumroenphat, I. Somboonwathanakul, S. Saensouk, and S. Siriamornpun, "Changes in curcuminoids and chemical components of turmeric (*Curcuma longa* L.) under freeze-drying and low-temperature drying methods," *Food Chem*, 339: 128121, 2021. DOI: 10.1016/j.foodchem.2020.128121.
- [25] T. Chumroenphat, I. Somboonwathanakul, S. Saensouk, and S. Siriamornpun, "The diversity of biologically active compounds in the rhizomes of recently discovered Zingiberaceae plants native to North-Eastern Thailand. *Pharmacog Journal* 11(5), pp. 1014–1022, 2019. DOI:10.5530/pj.2019.11.160.
- [26] Thailand, Nakhon Phanom, locator map, <https://www.google.com/maps/place/> Accessed by 2021.

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