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## Abstract

**Background:** Upper Songkhla Lake, a single lagoon of Thailand, is surrounded by sandy, mangrove, and swamp forests. Many plants growing in these areas have medicinal properties, however they have never been investigated. The aim of this study was to explore medicinal plants from upper Songkhla Lake, Songkhla and Phatthalung provinces.

**Materials and Methods:** Semi-structured interviews were conducted with seven key informants to get information regarding the local names, parts and utilization, method of preparation, route of administration and properties of plants. Voucher specimens were prepared, identified and deposited.

**Results:** In total, 95 species belonging to 82 genera in 46 families were found. Among them 26 groups of ailments could be classified, and most of the herbal plants were used for antipyretic (24.30%).

**Conclusion:** It was found that the natural sources of medicinal plants were damaged by many human activities. Therefore, this compilation of medicinal plants will be the data evidence for further conservation of the plants.

**Keywords:** Medicinal plant, Ethnobotany, Traditional medicine, Upper Songkhla Lake, Thailand

## Introduction

Thailand is situated in tropical area covered by biodiversity-rich resources. Approximately 10,000 species of vascular plants are found. Of these only 2% are utilized by Thai people (Santisuk, 1989), in which the most commonly used are medicinal plants (Anderson, 1993).

The medicinal plants are various plants having medicinal properties. It is known that many types of modern drugs have been derived and developed from medicinal plants according to folk wisdom of herbalists. Thereafter, the studies of folk medicinal plants have been interested from scientists worldwide with the hope that they will discover either new modern or folk drugs. In Thailand, several studies of medicinal plants of ethnic minority groups such as the Akha, Hmong, Lahu, Lisu, Mien, Karen, and Thai Song Dam (Anderson, 1993; Paisooksantivatana and Kako, 1996; Thongdonair, 2003) have been conducted.

Several communities in Thailand nurture rich knowledge about medicinal plants and its uses. However, only the local healers and elders know about their traditional utilization. Therefore, it is necessary to explore and gather knowledge concerning medicinal plants and disseminate to the public to promote the use of local and wild plants.

Upper Songkhla Lake is part of Songkhla Lake which is the largest natural water source of Thailand. Although it is widely called Lake, geologically it is a single lagoon of Thailand. The lake is surrounded by patches of discontinuous sandy, mangrove, and swamp forests (Greangkajon, 2006). Up to now, the areas are occupied by local population and existing natural resources have been exploited by inhabitants (Sutiwipakorn, 2007). Nowadays, not only natural forests surrounding the lake is decreased, but medicinal plant diversity is declined due to damaging by human activities such as buildings, agriculture, and tourism. In contrast, the indigenous knowledge of plant utilization has never been explored. It is a necessity and urgent to record as quickly as possible all information about plants and the role of people in conserving them.

This research aimed to explore species and utilization of medicinal plants from the upper Songkhla Lake. This study would be the basis for developing primary health care by using herbal plants.

## Methodology

### Study area

Upper Songkhla Lake (Fig. 1), also known as Thale Luang, is situated between Thale Noi, Phatthalung province in the North and Koh Yai, Krasaesin district, Songkhla province and Ban Laem Chong Thanon, Khao Chaison district, Phatthalung province in the South, covering a total area of 460 square kilometers with approximately 2 meters depth. The lake contains freshwater but can be salty in dry season. Presently, it is believed to be the habitat of Irrawaddy dolphins (Sutiwipakorn, 2007). The area is inhabited by estimated 276,927 people who are mostly Buddhist. Most of people make a living on paddy farming, rubber plantation, orchard, and fishery (Research and Development Office, Prince of Songkla University, 1994).

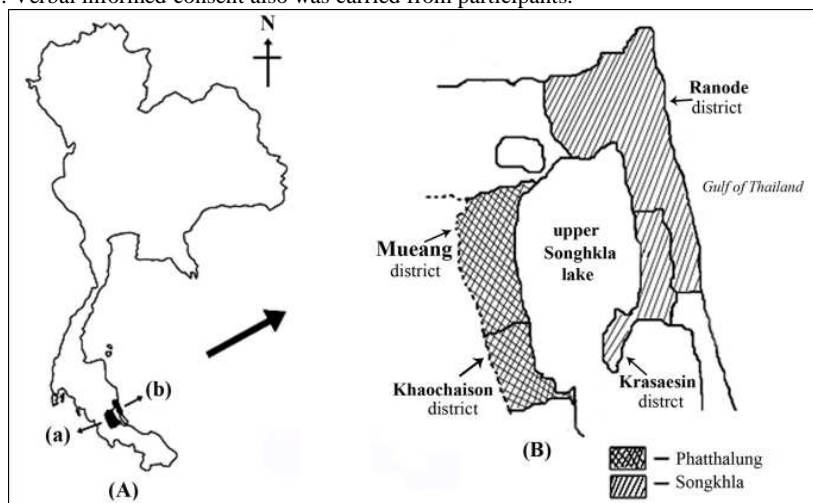
In this study, the survey was carried out in the accessible area of swamp forests and sandy forests in four districts including Ranode and Krasaesin in Songkhla province (2 swamp and 4 sandy forests) and Mueang and Khao Chaison in Phatthalung province (2 swamp and 4 sandy forests).

### Field study

There were seven key informants (2 from Phatthalung province and 5 from Songkhla province) who have experience on folk medicine of at least

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20 years and is accepted by local public health office were selected. At the beginning, all healers were informed with the purposes, method and expected outcome of this study. Verbal informed consent also was carried from participants.



**Figure 1:** Study area

- (A) Map of Thailand representing Phatthalung (a) and a part of Songkhla province (b)  
 (B) Upper Songkhla Lake with studied districts from Phatthalung and Songkhla province

The field studies were conducted during June 2012 to January 2013. The semi-structured interviews were used for information on local names, parts and utilization, method of preparation, route of administration, and properties of plants. The folk healers were interviewed at their houses and also during field survey. For reliable information, consistency of any use by at least 2 informants was recorded.

#### Herbarium specimens

All medicinal plants used by the local healers were photographed and collected for preparing voucher specimens according to the methodology suggested by Chayamarit (1997). The voucher specimens were deposited at the herbarium of Faculty of Traditional Thai Medicine, Prince of Songkla University.

#### Plant identification

The collected specimens were identified based on taxonomic literatures such as Flora of Thailand, Flora Malesiana, and Flora of China.

#### Data analysis

The data were analyzed by descriptive statistics and interpretation.

### Results

#### Diversity of medicinal plants

Totally, 95 species belonging to 82 genera in 46 families were collected as medicinal plants (Table 1). Most of the medicinal plants were found in Phatthalung. From the investigation, it shows that study sites from Phatthalung are more fertile than the area in Songkhla province resulting from the less destroyed farmsteads from human activities. According to habitat, plants from sandy forests were found more species than swamp (71 and 28 species respectively). This result is consistent to the study from nearby area, Sating Phra peninsula, Thailand (Neamsuvan et al., 2012) which revealed more plant species from beach forests than wetland areas.

The most frequently used plant families were Fabaceae (14 species), Asteraceae (7 species) and Euphorbiaceae and Malvaceae (5 species each). It is consistent with the world large plant families with ranking of Asteraceae and Fabaceae in the top five groups (Clayton and Renvoize, 1986). This result depicts that people likely to use natural resource in their circumstance (Neamsuvan et al., 2012). In addition to favorite family, Euphorbiaceae is one of widely distributed family, and it is worldwide important medicinal plants (Mwine and van Damme, 2010).

There were five plant habits found in this study. Herbs were most frequently used with 39 species (39%) followed by trees with 24 species (24%), climber with 20 species (20%), shrubs with 16 species (16%), and epiphytic plants with one species (1%). Most use of herbs and trees

Table 1: Medicinal plant list found in upper Songkhla Lake

Scientific name (local name)	Area <sup>1</sup>	H <sup>2</sup>	H <sup>3</sup>	Plant part/ Preparation method/ Route of administration/ Disease	CN <sup>4</sup>
<b>Acanthaceae</b>					
<i>Ruellia tuberosa</i> L. (Toyting)	P	Sa	H	seed/soak/topical (poultice)/ inflammation of abscess	NS090
<b>Amaranthaceae</b>					
<i>Alternanthera bettzickiana</i> (Regel) Nichols. (Phak pet daeng)	P	Sa	H	whole plant/ decoction/ oral (drink)/fever, lactagogue	NS089
<i>Alternanthera sessilis</i> (L.) DC. (Phak pet khao)	P, So	Sa	H	1) whole plant/ pound/ topical (poultice)/ scald burns 2) whole plant/ decoction/oral (drink)/ fever, thirsty relief	NS045
<i>Gomphrena celosoides</i> Mart. (Kunye)	So	Sa	H	root/ decoction/ oral (drink)/ blood tonic for postpartum woman	NS091
<b>Annonaceae</b>					
<i>Rauwenhoffia siamensis</i> (Scheff) Ban. (Mom maew)	P, So	Sa	S	1) stem/ decoction (alcohol)/ oral (drink)/ paralysis 2) leaf/ decoction/ topical (apply in mouth)/ child refusing milk	NS056
<b>Apocynaceae</b>					
<i>Cerbera odollam</i> Gaertn. (Teen ped nam)	P	Sa	T	leaf/ decoction/ topical (bath)/ blood tonic for postpartum woman	NS070
<b>Asteraceae</b>					
<i>Ageratum conyzoides</i> L. (Sapraeng sapka)	P	Sa	H	leaf/ pound/ topical (poultice)/ wound	NS075
<i>Chromolaena odorata</i> (L.) King & Robinson (Sapsuea)	P, So	Sa	H	root/ decoction/ oral (drink)/ malaria, fever	NS012
<i>Eclipta prostrata</i> L. (Kameng)	P	Sa	H	whole plant/ decoction/ oral (drink)/ body tonic	NS055
<i>Elephantopus scaber</i> L. (Do mairoo lom)	So	Sa	H	whole plant/ decoction/ oral (drink)/ joint and muscle pain	NS092
<i>Pluchea indica</i> (L.) Less. (Khlu)	So	Sa	S	whole plant/ decoction/ oral (drink)/ fever, hemorrhoid, dysuria	NS071
<i>Synedrella nodiflora</i> (L.) Gaertn. (Phak krad)	P	Sa	H	whole plant/ pound/ topical (poultice)/ headache, knee pain, wound	NS049
<i>Vernonia elliptica</i> DC. (Tarn mon)	P	Sa	S	stem, leaf, flower/ decoction/ topical (apply in mouth)/ fever, body tonic, parasites	NS072
<b>Blechnaceae</b>					
<i>Stenochlaena palustris</i> (Burm. f) Bedd. (Lumpeng)	P	Sw	C	whole plant/ decoction/ oral (drink)/ fever	NS118
<b>Boraginaceae</b>					
<i>Heliotropium indicum</i> L. (Ya nguang chang)	P	Sa	H	whole plant/ decoction/ oral (drink)/ diabetes mellitus	NS006
<b>Cleomaceae</b>					
<i>Cleome ruidosperma</i> DC. (Phak sean pa)	P	Sa	H	whole plant/ decoction/ oral (drink)/ dizziness	NS048
<i>Cleome viscosa</i> L. (Phak sean phi)	P, So	Sa	H	leaf, root/ pound/ inhalation/ dizziness	NS033
<b>Capparaceae</b>					
<i>Crateva magna</i> (Lour.) DC. (Kum nam)	P	Sw	T	1) leaf/ decoction/ oral (drink)/ fever 2) bark/ decoction/ oral (drink)/ hemorrhoid 3) heart wood/ decoction/ oral (drink)/ kidney stone, drain pus 4) root/ decoction/ oral (drink)/ thirsty relief	NS073
<b>Casuarinaceae</b>					
<i>Casuarina equisetifolia</i> J.R. & G.Forst (Son thale)	P, So	Sa	T	heart wood/ decoction/ oral (drink)/ carminative	NS093
<b>Combretaceae</b>					
<i>Combretum trifoliatum</i> Vent. (Trood)	P, So	Sa	T	leaf/ pound/ topical (poultice)/ athlete's foot	NS057
<i>Quisqualis indica</i> L. (Lep mue nang)	P	Sa	C	1) leaf/ decoction/ oral (drink)/ fever 2) seed/ decoction/ oral (drink)/ parasites	NS094
<b>Convolvulaceae</b>					
<i>Ipomoea aquatica</i> Forsk. (Phak bung daeng)	P, So	Sw	C	whole plant/ decoction/ oral (drink)/ kidney stone	NS076
<i>Ipomoea sagittifolia</i> Burm.f. (Lob lob)	So	Sa	C	whole plant/decoction/oral (drink)/gastritis, abscesses	NS096
<b>Cucurbitaceae</b>					
<i>Coccinia grandis</i> (L.) Voigt. (Tam lueng)	P, So	Sa	C	1) whole plant/ pound/ topical (poultice)/ wound (insect bites) 2) whole plant/ raw/ oral (eat)/ fever	NS097

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<i>Momordica charantin</i> L. (Mara khinok)	P, So	Sw, Sa	C	whole plant/ decoction/ oral (drink)/ fever, diabetes mellitus, hypertension	NS098
<i>Trichosanthes cordata</i> Roxb. (Khi ka din)	P, So	Sa	C	fruit/ decoction/ oral (drink)/ fever, constipation	NS017
<i>Luffa cylindrica</i> (L.) M. Roem. (Buab khom)	P	Sa	C	fruit/ decoction/ oral (drink)/ fever	NS059
<b>Cyperaceae</b>					
<i>Cyperus involucratus</i> Rottb. (Kok lungka)	P	Sa	H	rhizome/ decoction/ oral (drink)/ fever	NS077
<b>Dilleniaceae</b>					
<i>Tetracera loureiri</i> (Finet et Gagnep.) Pierre ex Craib (Thao linsuea)	P	Sa	C	1) climbing stem/ powder/ oral (eat)/ joint and muscle pain 2) flower/ powder/ oral (eat)/ carminative	NS002
<b>Euphorbiaceae</b>					
<i>Croton caudatus</i> Geiseler. (Kho khlan)	P	Sa	S	root, stem/ decoction/ oral (drink)/ joint and muscle pain	NS058
<i>Euphorbia hirta</i> L. (Nannom ratchasi)	P	Sa	H	leaf/ crush/ topical (dropping into eyes)/ eye disease	NS030
<i>Euphorbia heterophylla</i> L. (Ya yang)	P, So	Sa	H	leaf/ decoction/ oral (drink)/ constipation	NS050
<i>Excoecaria agallocha</i> L. (Tatum thale)	P, So	Sw	T	latex/ decoction/ oral (drink)/ constipation	NS099
<i>Sapium indicum</i> Willd. (Samor thale)	P, So	Sw	T	1) leaf/ decoction/ oral (drink)/ hemorrhoid 2) fruit/ decoction/ oral (drink)/ thirsty relief	NS081
<b>Fabaceae</b>					
<i>Albizia procera</i> (Roxb.) Benth. (Thing thon)	P	Sa	T	1) bark/ decoction/ oral (drink)/ asthma, cough, diarrhea 2) fruit/ decoction/ oral (drink)/ carminative	NS051
<i>Crotalaria albida</i> Heyne ex Roth. (Hing hai)	P	Sa	H	1) whole plant/ decoction/ oral (drink)/ fever 2) fruit/decoction/oral (drink)/headache in postpartum	NS082
<i>Dalbergia candanensis</i> (Dennst.) Prain. (Khri)	P	Sa	C	heart wood/ decoction/ oral (drink)/ carminative, fever, lymphatic waste	NS043
<i>Derris scandens</i> Benth. (Thaowan priang)	P, So	Sw	C	1) climbing stem/ decoction/ oral (drink)/ joint and muscle pain 2) climbing stem/ powder/ oral (eat)/ joint and muscle pain 3) whole plant/ decoction/ oral (drink)/ fever 4) whole plant/ powder/ oral (eat)/ fever	NS021
<i>Derris trifoliata</i> Lour. (Thop thep)	P	Sw	C	whole plant/ decoction/ oral (drink)/ constipation, fever, expectorant	NS046
<i>Indigofera tinctoria</i> L. (Khram)	So	Sa	H	whole plant/ decoction/ topical (bath)/ itching	NS107
<i>Lablab purpureus</i> (L.) Sweet. (Thua pap)	P, So	Sa	C	rhizome/ decoction/oral (drink)/joint and muscle pain	NS018
<i>Leucaena leucocephala</i> (Lam.) de Wit. (Tor bao)	So	Sa	S	whole plant/ decoction/ oral (drink)/ carminative	NS109
<i>Mimosa pudica</i> L. (Ngub)	P, So	Sa	H	whole plant/ decoction/ oral (drink)/ hemorrhage	NS103
<i>Pithecellobium dulce</i> (Roxb.) Benth. (Makham thet)	So	Sa	T	root, wood/ powder/ oral (eat with a little vinegar)/ dizziness in postpartum woman	NS104
<i>Senna alata</i> (L.) Roxb. (Chumhed thet)	So	Sa	S	root, leaf/ decoction/ oral (drink)/ constipation	NS101
<i>Senna occidentalis</i> L. (Phak khed)	P	Sa	T	root/ decoction/ oral (drink)/ fever, joint and muscle pain	NS040
<i>Senna siamea</i> (Lam.) Irwin & Barneby. (Khi lek)	P, So	Sa	T	leaf, flower/ decoction/ oral (drink)/ constipation	NS105
<i>Senna tora</i> (L.) Roxb. (Chumhed Thai)	P, So	Sa	H	whole plant/ decoction/ oral (drink)/ fever, joint and muscle pain	NS106
<b>Flacourtiaceae</b>					
<i>Scolopia macrophylla</i> (Wight & Arn.) Clos. (Sai kho)	P, So	Sw	T	young leaf/ decoction/ oral (drink)/ Joint and muscle pain	NS108
<b>Flagellariaceae</b>					
<i>Flagellaria indica</i> L. (Wai ling)	P	Sw, Sa	C	whole plant/ decoction/ oral (drink)/ diabetes mellitus, hypertension	NS060
<b>Lamiaceae</b>					
<i>Clerodendrum inerme</i> (L.) Gaertn. (Summa nga)	So	Sa	S	1) whole plant/ decoction/ oral (drink)/ fever 2) leaf/ decoction/ topical (bath)/ itching	NS001
<i>Ocimum basilicum</i> L. (Horapha)	So	Sa	H	whole plant/ decoction/ oral (drink)/ fever	NS110
<i>Leucas zeylanica</i> L. (Break)	P, So	Sa	H	whole plant/ pound/ topical (poultice at neck)/ cough	NS083

<b>Lauraceae</b>						
<i>Cassytha filiformis</i> L. (Yan tai plai pen)	P, So	Sa	C	1) whole plant/ powder/ oral (eat)/ Joint and muscle pain 2) whole plant/ decoction/ oral (drink)/ Joint and muscle pain		NS111
<b>Lecythidaceae</b>						
<i>Barringtonia racemosa</i> Roxb. (Jik suan)	P	Sa	T	root/ decoction/ oral (drink)/ snake poisoning		NS029
<b>Loranthaceae</b>						
<i>Dendrophthoe pentandra</i> (L.) Miq. (Ka fak)	P	Sa	Ep	whole plant/ decoction/ oral (drink)/ diarrhea		NS003
<b>Lythraceae</b>						
<i>Lagerstroemia floribunda</i> Jack. (Tabaek)	So	Sw	T	wood, root/ decoction/ oral (drink)/ fever		NS112
<i>Lagerstroemia speciosa</i> (L.) Pers. (Inthanin)	P	Sw	T	leaf/ decoction/ oral (drink)/ diabetes mellitus		NS052
<i>Sonneratia caseolaris</i> (L.) Engl. (Lum phoo)	P	Sw	T	whole plant/ decoction/ oral (drink)/ diarrhea		NS068
<i>Sonneratia ovata</i> Backer (lum phan)	P	Sw	T	stem/ burn to be charcoal & infusion/ oral (drink)/ joint and muscle pain		NS088
<b>Malvaceae</b>						
<i>Abutilon hirtum</i> Sweet (Krob Chakkawan)	P, So	Sa	S	1) whole plant/ decoction/ oral (drink)/ fever, chicken pox, malaria, scurvy 2) leaf/ decoction/ oral (drink)/ hemorrhoid		NS047
<i>Abelmoschus moschatus</i> Medik. (Fai phi)	P, So	Sw	H	fruit/ raw/ oral (eat)/ expectorant		NS113
<i>Hibiscus tiliaceus</i> L. (Por thale)	So	Sw	T	wood/ root/ decoction/ oral (drink)/ scurvy		NS084
<i>Sida acuta</i> Burm. f. (Khad mon)	P, So	Sa	H	whole plant/ decoction/ oral (drink)/ fever		NS114
<i>Thespesia populnea</i> (L.) Sol. ex Correa. (Po thale)	P, So	Sw	T	flower/ decoction/ oral (drink)/ cardiotonic		NS085
<b>Marantaceae</b>						
<i>Donax canifformis</i> (Forst. f.) K. Schum. (Khlum)	P	Sw	H	rhizome/ decoction/ oral (drink)/ fever, thirsty relief		NS086
<b>Melastomataceae</b>						
<i>Melastoma malabathricum</i> L. (Mrey)	So	Sa	S	leaf/ decoction/ oral (drink)/ diarrhea		NS106
<b>Menispermaceae</b>						
<i>Tiliacora triandra</i> (Colebr.) Diels. (Ya nang)	P	Sa	C	whole plant/ decoction/ oral (drink)/ fever		NS032
<b>Myrsinaceae</b>						
<i>Ardisia elliptica</i> Thunb. (Philungkasa)	P	Sa	S	1) root/crush/oral (drink)/venereal disease, gonorrhea 2) root/pound/topical (poultice)/insect bites, urticaria		NS062
<b>Myrtaceae</b>						
<i>Melaleuca cajuputi</i> Powell. (Samed khao)	P	Sw,Sa	T	leaf/ decoction/ topical (bath)/ haemorrhage and blood tonic for postpartum woman		NS011
<i>Syzygium cumini</i> (L.) Skeels. (Wa)	P	Sw	T	bark/ decoction/ oral (drink)/ wound, diarrhea		NS039
<b>Nelumbonaceae</b>						
<i>Nelumbo nucifera</i> Gaertn. (Bua luang)	P, So	Sw	H	seed/ decoction/ oral (drink)/ cardiotonic		NS063
<b>Onagraceae</b>						
<i>Ludwigia adscendens</i> (L.) H. Hara (Pheng phuay nam)	P	Sw	H	whole plant/ decoction/ oral (drink)/ fever, diarrhea		NS064
<b>Pandanaceae</b>						
<i>Pandanus amaryllifolius</i> Roxb. (Toey hom)	P	Sw	H	leaf/ decoction/ oral (drink)/ dysuria		NS053
<i>Pandanus odoratissimus</i> L. (Lam jiak)	P	Sa	S	root/ decoction/ oral (drink)/ dysuria		NS065
<b>Passifloraceae</b>						
<i>Passiflorra foetida</i> L. (Katok rok)	P, So	Sa	C	1) whole plant/ decoction/ oral (drink)/ fever, menstrual disorder 2) fruit/ raw/ oral (eat)/ venereal disease		NS066
<b>Phyllanthaceae</b>						
<i>Flueggea virosa</i> (Roxb. ex Willd.) Royle	P, So	Sa	S	whole plant/ decoction/ oral (drink)/ fever		NS079

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(Kang pla khao)

<i>Phyllanthus amarus</i> Schum & Thonn. (Look taibai)	P	Sa	H	whole plant/ decoction/ oral (drink)/ diabetes mellitus, hypertension	NS080
<i>Phyllanthus urinaria</i> L. (Ya taibai)	P	Sa	H	whole plant/ decoction/ oral (drink)/ fever	NS100
<i>Sauropus bacciformis</i> (L.) Airy Shaw (Phraow- nokkhoom)	P	Sa	H	fruit/ raw/ oral (eat)/ body tonic	NS109
<b>Poaceae</b>					
<i>Chrysopogon aciculatus</i> (Retz.) Trin. (Ya chaochu)	P, So	Sa	H	whole plant/ decoction/ oral (drink)/ fever	NS024
<i>Panicum repens</i> L. (Ya chan kard)	So	Sw	H	rhizome/ decoction/ oral (drink)/ fever	NS117
<b>Polygonaceae</b>					
<i>Polygonum tomentosum</i> Willd. (Ueng ped ma)	P, So	Sw	H	whole plant/ powder/ oral (eat)/ carminative	NS067
<b>Pteridaceae</b>					
<i>Acrostichum aureum</i> L. (Prong thale)	P, So	Sw	S	rhizome/ decoction/ oral (drink)/ Joint and muscle pain in post partum	NS009
<b>Rhamnaceae</b>					
<i>Ziziphus oenoplia</i> (L.) Mill. (Yubyiew)	So	Sa	S	root, stem/ decoction/ oral (drink)/ dysuria/ fever	NS119
<b>Rubiaceae</b>					
<i>Mitragyna diversifolia</i> ( Roxb.) Kuntze (Thom khimu)	P	Sw	T	leaf/ decoction/ oral (drink)/ diabetes mellitus/ hypertension	NS042
<i>Oldenlandia corymbosa</i> L. (Ya lin ngu)	P	Sa	H	whole plant/ decoction/ oral (drink)/ fever	NS087
<i>Paederia foetida</i> L. (Pha home)	So	Sa	C	whole plant/ decoction/ oral (drink)/ carminative constipation	NS120
<b>Rutaceae</b>					
<i>Glycosmis pentaphylla</i> (Retz.) DC. (Khoi tai)	P	Sa	S	leaf/ pound/ topical (poultice)/ scald burns	NS041
<b>Sapindaceae</b>					
<i>Cardiospermum halicacabum</i> L. (Phok Om)	P, So	Sa	C	whole plant/ decoction/ oral (drink)/ fever, heart disease	NS026
<b>Solanaceae</b>					
<i>Physalis angulata</i> L. (Phung phing)	P	Sa	H	whole plant/ decoction/ oral (drink)/ diabetes mellitus, hypertension	NS034
<b>Tiliaceae</b>					
<i>Corchorus aestuans</i> L (Nguag pla mo)	So	Sa	H	stem/ decoction/ oral (drink)/ Joint and muscle pain	NS121
<b>Verbenaceae</b>					
<i>Phyla nodiflora</i> (L.) Greene. (Ya lek khoo)	So	Sa	H	whole plant/ pound/ topical (poultice)/ fever	NS122
<i>Stachytarpheta jamaicensis</i> (L.) Vahl. (Phan ngu khiew)	P	Sa	H	whole plant/ decoction/ oral (drink)/ fever, dysuria, inflammation, gonorrhea	NS054
<b>Vitaceae</b>					
<i>Cayratia trifolia</i> (L.) Domin. (Thao khan)	P, So	Sw,Sa	C	1) whole plant/ decoction/ oral (drink)/ prickly heat, joint and muscle pain 2) fruit/ decoction/ oral (drink)/ blood tonic, expectorant	NS069

<sup>1</sup>Area: Pn= Phatthalung province, So = Songkhla province

<sup>2</sup>Habitat: Sa = Sandy forest, Sw = Swamp forest

<sup>3</sup>Habit: C = Climber, H = Herb, S = Shrub, T = tree, Ep = Epiphyte

<sup>4</sup>CN = Collector number

conforms to species diversity of these habits found in adjacent area, Thale Noi wetland (Bunpapong, 2000). In addition, herbs were frequently used probably due to their simplicity of harvesting.

### Ailments treated

All 95 medicinal plants were grouped into 26 categories based on ailments treated. Fever was the largest group with 37 species (24.03%), followed by joint and muscle pain with 15 species (9.74%) as well as skin diseases with 14 species (9.09%) (Table 2).

Fever, also known as pyrexia, is one of the common medical signs with high body temperature, fatigue, and headache. Based on the interviews, the examples of medicinal plants are capable of reducing those symptoms including *Alternanthera bettzickiana* (Regel) Nichols., *Pluchea indica* (L.) Less., and *Crateva magna* (Lour.) DC. Traditionally, it is believed that medicinal plants for fever are bitter, cool and tasteless (Bureau of Sanatorium and Art of Healing, 1998). The plants used by local healers conform to those from Thai medicinal theory.

Joint and muscle pain is a group of symptoms could be found in all ages. It is caused by wrong movement or physical signs of some diseases such as knee pain, muscle pain from fever or paralysis. In Thai medicinal theory, it is caused by muscle and tendon contraction which badly effect to blood circulation (Bureau of Sanatorium and Art of Healing, 1998). The medicinal plants to get rid of those symptoms namely, *Croton caudatus* Geiseler., *Sennatoria* (L.) Roxb. and *Derris scandens* Benth are used.

In folk medicine of Thailand, there is doctrine of signature that climber plants tend to be drugs for joint and muscle pain. This result is concordant to that belief. *Derris scandens* Benth., *Tetracera loureiri* (Finet et Gagnep.) Pierre ex Craib and *Lablab purpureus* (L.) Sweet are climbers and are used for healing the symptoms.

**Table 2:** Ailments treated by medicinal plants

Diseases/symptoms	Frequency (species)	Percentage
Fever	37	24.30
Joint and muscle pain	15	9.74
Skin diseases	14	9.09
Blood circulation	10	6.49
Bloating	7	4.55
Constipation	7	4.55
Diabetes mellitus	7	4.55
Urinary system	7	4.55
Diarrhea	6	3.90
Hypertension	5	3.25
Headache & Dizziness	5	3.25
Respiratory	5	3.25
Thirsty relief	4	2.60
Hemorrhoids	4	2.60
Snake & insect poison	3	1.95
Body tonic	3	1.95
Gonorrhea	2	1.30
Venereal disease	2	1.30
Malaria	2	1.30
Parasites	2	1.30
Scurvy	2	1.30
Chicken pox	1	0.65
Gastritis	1	0.65
Eye problems	1	0.65
Lactagogue	1	0.65
Bored milk in child	1	0.65

**Table 3:** Plant part used

Plant part	Frequency (species)	Percentage
Whole plant	44	36.97
Leaves	22	18.49
Root/rhizome	19	15.97
Fruits	9	7.56
Stem	8	6.72
Wood/heart wood	6	5.04
Flowers	4	3.36
Bark	3	2.52
Seed	3	2.52
Latex	1	0.84

**Table 4:** Method of herbal preparation

Method	Frequency (species)	Percentage
Decoction	78	77.23
Pound	10	9.90
Powder	5	4.95
Raw	4	3.96
Crush	2	1.98
Burn	1	0.99
Soak	1	0.99

**Table 5:** Biological activities reported

Botanical name	Traditional uses (plant part/disease)	Pharmacological activities (Reference)
<i>Abutilon indicum</i> L.	Leaves/ hemorrhoids.	Anti-inflammatory activity (Ponnudurai et al., 2011)
<i>Ageratum conyzoides</i> L.	Leaves/ Wound	Anti-inflammatory and antibacterial activities (Amadi et al., 2012)
<i>Ardisia elliptica</i> Thunb.	Root/ Gonorrhoea	Antimicrobial activity (Phadungkit and Luanratana, 2006)
<i>Cardiospermum halicacabum</i> L.	Whole plant/ Fever	Antipyretic activity (Asha and Pushpangadan, 1999)
<i>Clerodendrum inerme</i> (L.) Gaertn.	Whole plant/ Fever	Antifungal activity (Anitha and Kannan, 2005)
	Leaves/ Skin diseases	
<i>Coccinia grandis</i> (L.) Voigt.	Whole plant/ Fever	Antioxidant activity (Umamaheswari and Chatterjee, 2008)
<i>Crateva magna</i> (Lour.) DC.	Leaves/ Fever	Antipyretic activity (Chidambaram et al., 2011)
<i>Derris scandens</i> Benth.	Climbing stem/ Tendon tonic	Anti-inflammation activity (Ganapaty et al., 2006)
<i>Eclipta prostrata</i> L.	Whole plant/ Restorative	antioxidant activities (Karthikumar et al., 2007)
<i>Elephantopus scaber</i> L.	Whole plant/ joint and muscle pain	Analgesic and anti-inflammatory activities (Ruppelt et al., 1991)
<i>Flueggea virosa</i> (Roxb. ex Willd.) Royle	Whole plant/ Fever	Antipyretic activity ( Ezeonwumelu et al., 2012)
<i>Hibiscus tiliaceus</i> L.	Wood, Root/ Scurvy	Anticeptive, anti-inflammatory activities (Kumar et al., 2009)
<i>Lagerstroemia speciosa</i> (L.) Pers.	Leaves/ Diabetes mellitus	Hypoglycemic (Tanquilut et al., 2009)
<i>Ludwigia adscendens</i> (L.) H. Hara	Whole plant/ Fever	Antibacterial (Ahmed et al., 2005)
<i>Melastoma malabathricum</i> L.	Leaves/ Diarrhea	Antidiarrhoeal activity (Sunilson et al., 2009)
<i>Mitragyna rotundifolia</i> ( Roxb.) Kuntze.	Leaves/ Diabetes mellitus	Antioxidant activity (Kang et al., 2010)
<i>Momordica charantia</i> L.	Whole plant/ Diabetes mellitus	Anti-diabetic activity (Raman and Lau, 1996)
<i>Nelumbo nucifera</i> Gaertn.	Seed/ Cardiogenic	Antioxidant activity (Huang et al., 2010)
<i>Ocimum basilicum</i> L.	Whole plant/ Fever	Antibacterial activity (Patil et al., 2011)
<i>Oldenlandia corymbosa</i> L.	Whole plant/ Fever	Anti-malarial activity (Mishra et al., 2009)
<i>Paederia foetida</i> L.	Leaves/ Laxative	Anti-diarrhoeal activity (Afroz et al., 2006)
<i>Pandanus odoratissimus</i> L.	Root/ Dysuria	Anti-inflammatory (Londonkar et al., 2010)
<i>Passiflora foetida</i> L.	Whole plant/ Fever	Antibacterial activity (Mohanasundari et al., 2007)
<i>Phyllanthus amarus</i> Schum & Thonn.	Whole plant/ Diabetes mellitus	Antidiabetic activity (Shetti et al., 2012)
<i>Phyllanthus urinaria</i> L.	Whole plant/ Fever	Antimalarial and antipyretic activity (Hout et al., 2006)
<i>Pluchea indica</i> (L.) Less.	Whole plant/ Hemorrhoids	Anti-inflammatory activity (Sen and Nag Chaudhuri ,1991)
<i>Quisqualis indica</i> L.	Leaves/ Fever	Antipyretic activity (Singh et al., 2010)
<i>Sauropus bacciformis</i> (L.) Airy Shaw	Fruit/ Restorative	Antioxidant activity (Alphonse et al., 2012)
<i>Senna alata</i> (L.) Roxb.	Root, Leaves/ Laxative	Laxative (Elujoba et al., 1989)
<i>Senna occidentalis</i> L.	Root/ Fever	Antimicrobial activity (Arya et al., 2010)
<i>Senna siamea</i> (Lam.) Irwin & Barneby.	Leaves/ Laxative	Laxative (Sakulpanich and Gritsanapan, 2009)
<i>Senna tora</i> (L.) Roxb.	Whole plant/ Fever	Antimicrobial activity (Chukeatirote et al., 2007)
<i>Sida acuta</i> Burm. f.	Whole plant/ Fever	Antibacterial activity (Karou et al., 2005)
<i>Sonneratia caseolaris</i> L.	Bark/ Diarrhea	Antidiarrhoeal activity (Ahmed et al., 2007)
<i>Stachytarpheta jamaicensis</i> (L.) Vahl.	Whole plant/ Fever, gonorrhoea	Antimicrobial activity (Idu et al., 2007)
<i>Stenochlaena palustris</i> (Burm. f) Bedd.	Whole plant/ Fever	Antipyretics (Suhartono and Suhartono, 2010)
<i>Synedrella nodiflora</i> (L.) Gaertn.	Whole plant/ Wound	Anti-inflammatory (Abad et al., 1996)
<i>Thespesia populnea</i> (L.) Sol. ex Correa.	Flower/ Cardiogenic	Antilipidperoxidative activity (Dhanarasu et al., 2010)
<i>Tiliacora triandra</i> (Colebr.) Diels.	Whole plant/ Fever	Antimalarial activity (Saiin and Markmee, 2003)

### Methods of preparation

Nine herbal preparations were investigated from this study (Table 4). The most three methods of preparation were decoction with 78 species (72.23%), followed by pound with 10 species (9.90%) and powder with 5 species (4.95%). Some medicinal plants can be prepared with various



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methods. For example, climbing stem of *Derris scandens* Benth. is prepared by decoction or powder for joint and muscle pain whereas its whole plant is prepared by decoction or powder for fever.

Traditionally, decoction is more preferred than other preparation methods because it is believed that active ingredients could be extracted well. Decoction is made by boiling crude drugs until solution decreased to be a third of original volume.

#### Route of administration

There were three routes of administration including oral with 82 species (82%), topical with 17 species (17%), and inhalation with 1 species (1%). In oral route, there were two used methods including drinking and eating according to type of drug. However, drinking of decoction was mostly preferred. Notably, some plants can be administered by more than one route depending on treated disease. For example, *Vernonia elliptica* DC. is administered orally for parasites and toxin treating, while it is administered topically for fever in child. *Rauwenhoffia siamensis* (Scheff) Ban. is administered orally for paralysis, while it is administered topically by applying in the mouth for craving milk in child.

**Table 6:** Comparison to PROSEA

Scientific name	Part/ Local use	PROSEA
<i>Cardiospermum halicacabum</i> L.	Whole plant/ Fever	Antipyretic (South-East Asia)
<i>Cassia alata</i> (L.) Roxb.	Root, Young leaves / Laxative	Purgative (India)
<i>Clerodendrum inerme</i> (L.) Gaertn.	Leaves/Skin disease	Skin diseases and febrifuge (Thailand)
<i>Crateva magna</i> (Lour.) DC.	Wood / Calcul	Urolithiasis(India)
<i>Croton caudatus</i> Geiseler.	Root, Stem/ Tendon tonic	Sprains healing (India)
<i>Derris scandens</i> Benth.	Whole plant /Fever	Common cold and backache (Thailand)
<i>Derris trifoliata</i> Lour.	Whole plant/ Laxative	Laxative (Thailand)
<i>Eclipta prostrata</i> L.	Whole plant/ Restorative	Tonic (Vietnam)
<i>Euphorbia heterophylla</i> L.	Leaves/ Laxative	Laxative (South-East Asia)
<i>Euphorbia hirta</i> L.	Leaves/ Eye disease	Conjunctivitis, ulcerated cornea (Thailand)
<i>Excoecaria agallocha</i> L.	Latex/ Laxative	Purgative (New Guinea)
<i>Heliotropium indicum</i> L.	Whole plant/ Wound	Anti-inflammatory (Thailand)
<i>Ludwigia adscendens</i> (L.) H.Hara	Whole plant/ Fever/ Dysentery	Dysentery, Fever (Malaysia, China, Indo-China)
<i>Melastoma malabathricum</i> L.	Leaves/ Dysentery	Dysentery (Java, Fiji)
<i>Ocimum basilicum</i> L.	Whole plant/ Fever	Fever, malaria (Vietnam)
<i>Oldenlandia corymbosa</i> L.	Whole plant/ Fever	Fever (India)
<i>Phyllanthus urinaria</i> L.	Whole plant/ Fever	Malaria (Cambodia)
<i>Pluchea indica</i> (L.) Less.	Whole plant / Fever	Febrifuge (Malesia, Indo-China, India)
<i>Quisqualis indica</i> L.	Leaves/ Fever Seed/Parasites	Skin diseases, fever (China)
<i>Stachytarpheta jamaicensis</i> (L.) Vahl.	Whole plant/ Fever, Gonorrhoea	Gonorrhoea (Java) , Febrifuge (Indo-China)

#### Plant parts used

A total of 10 plant parts were used by folk healers for treating diseases (Table 3). Among them, the whole plant was mostly utilized with 44 species (36.79%), followed by leaves with 22 species (18.49%), and root or rhizome with 19 species (15.97%). Although underground parts were commonly used, local healers recommended using stems instead of underground part to prevent the plant from extinction.

The results revealed that several plants can be utilized with more than one part either for healing one or different diseases. For example, both roots and leaves of *Senna alata* (L.) Roxb. can be used for constipation healing. Leaves of *Quisqualis indica* L. are used for fever whereas its seeds are used for parasite treatment. According to Thai Medicine, healing property of materia medica is based on drug taste. If different plant parts in one plant have different tastes, each part can be used for curing different diseases. Concordantly, whole plant can be used for curing one disease because it has one taste throughout the parts.

## Discussion

### Comparison to related studies

This study was compared to a survey of adjacent areas in mangrove and beach forests from Sating Phra Peninsula, Songkhla province, Thailand (Neamsuvan et al., 2012). It was found that 13 medicinal species are similar used. For example, *Altemanthera sessilis* (L.) R. Br. ex DC. is used to treat fever, and *Pluchea indica* (L.) Less is used to treat hemorrhoids. In addition, it was compared to the study from lower part of Southern Thailand (Upho, 2005). It was found that 11 herbal species are consistently used. For example, *Ageratum conyzoides* L. is used to treat wound and

*Phyllanthus amarus* Schum & Thonn. is used to treat fever, diabetes as well as high blood pressure. The similar uses between related studies show reliable uses of plants.

### Medicinal plants for the first report

There are 6 herbal species that had never been reported for their folk use before. They are included whole plant of *Indigofera tinctoria* L. for itching skin; roots of *Gomphrena celosioides* Mart. for blood circulation in postpartum women; whole plant of *Ipomoea sagittifolia* Burm.f. for gastric ulcer and abscess; *Stenochlaena palustris* (Burm. f) Bedd. for fever; charcoal of *Sonneratia ovata* Backer for aches of bone and leaves of *Scolopia macrophylla* (Wight & Arn.) Clos. for muscle pain. These plants should be further studied in biological activities to confirm local utilization.

### Biological activities

From literature reviews, 39 herbal species have their folk properties consistent to biological activities (Table 5). For example, *Momordica charantia* L. is locally used to treat diabetic and its biological activity for Anti-diabetic (Raman and Lau, 1996). *Tiliacora triandra* (Colebr.) Diels. is locally used for fever and its biological activity for anti-malaria (Sain and Markmee, 2003). These consistent biological activities assist to confirm the healers' folk knowledge and get widely accepted from patients.

### Comparison to PROSEA (PROSEA Foundation, 2006)

PROSEA (Plant Resources of South-East Asia) is Cooperation among Southeast Asian countries to collect information on plant resources for both academic research and industrial applications. Therefore, PROSEA is a project that promotes the sustainable use of plant resources. From comparison, it was found that 20 species corresponds to PROSEA (Table 6). For example, *Cardiospermum halicacabum* L., *Cassia alata* (L.) Roxb. and *Melastoma malabathricum* L. are used to treat fever, constipation and diarrhea, respectively. Comparison to PROSEA supports that the southern Thai utilization is reliable data and also suggests that some kinds of uses are transferred outside Thailand.

### Interesting plants for promoting

Lumpeng (*Stenochlaena palustris* (Burm. f) Bedd.), the plant grows sparsely along swamp forest it is medicinal plant for antipyretic. In addition, it can be taken as vegetables in various traditional dishes belonging to southern Thailand. However, it is not widely used and the natural abundant is inadequate. Therefore, this species should be promoted for cultivation and consumption both inside and outside the study area.

### Conclusion

This study provides the folk knowledge of herbal utilization from upper Songkhla Lake. The data collected show that most of medicinal plants are used for antipyretic. Several plants have never been previously studied for their biological activities. Therefore, it is interesting to focus on these activities to confirm folk utilization of local healers. The treasure of knowledge is retained only by folk healers and medicinal plants are destroyed by human activities nowadays. Therefore, this compilation of medicinal plants will promote their practical use and be the data evidence for further conservation of the plants.

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