

## Survey and Herbarium Specimens of Medicinal Vascular Flora of Doi Suthep-Pui

Somporn Putiyanan<sup>1\*</sup> and J.F. Maxwell<sup>2</sup>

<sup>1</sup>Department of Pharmaceutical Science, Faculty of Pharmacy, Chiang Mai University, Chiang Mai 50200, Thailand

<sup>2</sup>Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand

\*Corresponding author. E-mail: [somporn@pharmacy.cmu.ac.th](mailto:somporn@pharmacy.cmu.ac.th)

### ABSTRACT

*The herbarium includes over 9,285 specimens from 238 families (270 fam. in the word) in medicinal plant herbarium, Faculty of Pharmacy, Chiang Mai University. From July 1987 to September 1991, a total of 2,044 species have been collected from Doi Suthep-Pui National Park, some of which are of considerable economic, medicinal and botanical interest. Vascular plants in this national park comprise of 193 of the 228 known families of vascular plants in Thailand, including a new family record for the flora of Thailand (Lardizabalaceae), eleven species new records for Thailand, three emended descriptions, two new combinations, and at least two species, with several others that are probably undescribed and new to science. The lowland, mostly disturbed forests up to 350-950 m. elevation, are of two deciduous facies, viz., dipterocarp-oak and mixed (former teak) forest. Elevations above this to the summit of Doi Suthep (c.1,620 m.) and Doi Pui (c.1,685 m.) are primary evergreen (monsoon) with some residual pine on some of the ridges. There is a distinct dry season (December-May) during which there are fires and many of the lowland species flower and fruit, many become leafless while in the evergreen areas, there is no specific flowering or fruiting season, that is, the phenologies of the plants in this habitat vary according to each species throughout the year. This research has enabled other scientists and students to work in other fields (phytochemistry, phytogeography, ecology, entomology, seed germination, ethnobotany, etc.) on Doi Suthep-Pui National Park and nearby forested areas.*

**Key words:** Doi Suthep-Pui, Herbarium specimens, Medicinal plants museum

### INTRODUCTION

Doi Suthep-Pui, which lies a few km west of Chiang Mai city, was designated a national park in 1981, covering 261 km<sup>2</sup>. Two main kinds of forest occur in the park. Evergreen forest is found mostly between 950 m above sea level and the summit (1,685 m). Trees such as *Dipterocarpus costatus* Gaertn f. (Dipterocarpaceae), *Sapium baccatum* Roxb. and *Talauma hodgsonii* Hk. f. & Thoms. grow there. Deciduous forest occurs mostly below 950 m and in particularly dry areas higher up. Trees such as *Dipterocarpus obtusifolius* Bl., *D. tuberculatus* Roxb. and *Quercus kerrii* Craib are common there. Such forest loses its leaves

from February to April and flushes green again at the start of the monsoon rains in April or May. Research carried out at Chiang Mai University (CMU) has shown that the forest on Doi Suthep is exceptionally rich in plant species. In just two and a half years, J.F. Maxwell has collected 1,749 species of vascular plants (more than the entire flora of Britain). There are about 90 tree species (diameter at breast height  $\geq 10$  cm) per hectare (1 ha = 6.25 rai), more than has ever been recorded for any other dry tropical forest in the world. About 250 species of orchid grow on the mountain, 50 of which are rare, threatened or endangered with extinction, due to forest destruction and collection for the horticulture industry.

About 50 mammal species have been recorded in the park (Nabhitabhata, 1987) but due to habitat loss and hunting, several are no longer present, including gibbons (*Hylobates spp.*), sambar deer (*Cervus unicolor*) and bear (*Selenarctos thibetanus*). The largest animal surviving on Doi Suthep is the barking deer (*Muntiacus muntjak*). Even small mammals such as squirrels are captured for the pet trade or killed for their skins. A study at CMU has shown that deciduous and evergreen forests support completely different communities of small mammals, with little or no overlap between the two. In deciduous forest, the ferret-badger (*Melogale personata*), ground squirrel (*Menetes bermorei*), noisy rat (*Rattus sabanus*) and lesser short-nosed fruit bat (*Cynopterus brachyotis*) occur, whilst in evergreen forest the tree shrew (*Tupaia glis*), striped tree squirrel (*Tamiops mccllellandi*), belly-banded squirrel (*Callosciurus flavimanus*) and white-bellied flying squirrel (*Petinomys-setosus*) occur in the canopy and the chestnut rat (*Rattus bukit*), yellow rajah rat (*R. surifer*), root rat (*R. rattus*) and the rare dark-tailed subspecies of Bower's rat (*R. bowersi bowersi*) are found on the ground.

A total of 326 bird species have been observed on Doi Suthep (Round, 1984) but sadly, many have now disappeared including all vulture and hornbill species. Birds of prey are persecuted as pests whilst other species are captured for the caged-bird trade. The smaller species include 500 butterflies, 300 moths, 50 reptiles and 28 amphibians, including several rare or endangered species.

Despite its status as a national park, Doi Suthep-Pui is threatened by encroachment and a multitude of detrimental development projects. Each one, considered in isolation, appears insignificant but in combination, they are causing the rapid deterioration of the forest and its genetic diversity. The continual expansion of tourist facilities, the upgrading of tracks into surfaced roads, the construction of T.V. relay stations and the continuation of slash-and-burn-agriculture have all taken their toll on the forest. About 500 hilltribe families have encroached upon more than 800 ha whilst agricultural research stations, run by various government agencies, cover a similar area. A total of 25 government agencies have buildings in or some involvement with the park. Plans to build a cable car system to Prataht of Doi Suthep Temple would also involve further loss of forest. When so many different groups impose such widely-differing demands on a national park, the problems of management are formidable. Such problems are compounded by lack of finance and adequately-trained personnel, lack of cooperation from local people and lack of support from both local and national government. In 1904, Dr. Carl Hosseus from Germany, led the first major botanical expedition to northern Thailand (then Siam) and Doi Suthep was one of his primary collecting sites. The specimens, many living, were sent back to Germany and distributed to various botanists for identification. Between 1907 and 1911, enumerations of the species of bryophytes, ferns and flowering plants, many of them new to science, were published (Hosseus, 1907, 1910, 1911).

Dr. A.F.G. Kerr, an Irish botanist-physician stationed in Chiang Mai since 1901, started, initially with orchids, to collect specimens on Doi Suthep in 1908. These specimens were sent to W.G. Craib, then at Kew and later Aberdeen University in Scotland, for identification. The Kerr-Craib collaboration on the flora of Thailand, beginning with the plants from Doi Suthep, lasted until 1933 when Craib died.

As with the Hosseus collections, the Kerr specimens resulted in many new and interesting species which Craib first began to describe in 1911-1913, and sporadically thereafter. More than 300 species of plants have been described from Doi Suthep, far more than any place in Thailand, and more than 1,800 different kinds of higher (vascular) plants are known from the mountain.

The first description of the vegetation was written by Hosseus in 1908 and then by Kerr in 1911. It was not until 1966 that a more detailed study was made (Kuchler and Sawyer, 1967), while the most recent survey has been made by Maxwell (1988). The first flora of Doi Suthep, produced as a result of the 1966 ecological study by Kuchler and Sawyer, was compiled by Sawyer and Chermisrivathana in 1969, while our group of researchers have been collecting a more detailed flora since July 1987 to 1991.

### METHODOLOGY

Surveying and collecting the essential part of medicinal plants of Suthep-Pui National Park conservation area for taxonomic identification and medicinal herbarium specimens to be authentic specimens in Pharmacy Herbarium, Faculty of Pharmacy, Chiang Mai University. The collection method and criteria are as follow :

- Collect plants that have leaves, flowers and fruits for identification
- Collect root and remove all dirt
- Collect the whole plant
- Choose about 5 blooming and just-budding flowers, with leaves and fruits if possible
- Choose about 5 young and ripen fruits with leaves
- If the specimens is not complete, collect more in other seasons with note attached
- Collect at least 5 duplicates, i.e.,
  - 2 duplicates for taxonomic identification
  - 3 duplicates for herbarium specimens

### RESULTS, DISCUSSION AND CONCLUSION

#### Vegetational History

Doi Suthep Temple, established in A.D.1367 (B.E.1910), as well as the city of Chiang Mai which was founded before that prove the fact that forests on Doi Suthep have been continuously utilized, damaged, exploited and altered for over 600 years. Although botanists cannot be absolutely certain of what the vegetation on the mountain was like before human interference, the amount of primary evergreen cover has diminished and deciduous growth has increased.

The deciduous forests, due to their accessibility, have suffered more continuous disturbance, i.e., cutting and burning, than the evergreen forests. It has only been during this

century that many of the more-valuable trees like teak, the large dipterocarps and legumes, etc. have been removed in ecologically-disrupting quantities.

These deciduous forests, especially the dipterocarp-oak areas, while not primary (i.e., original) in development, are certainly climax (ultimate) associations that will remain intact under present conditions. The “mixed” or “closed” deciduous areas are not as uniform or stable and show variation ranging from strong dipterocarp-oak mixtures to an abundance of evergreen species. These “mixed” forests are, due to disturbance, more apt to develop into dipterocarp-oak or evergreen facies if left alone since they are far less stable, as a consequence of various amounts of disturbance, than other kinds of forests on the mountain. There have always been “mixed” deciduous forests on Doi Suthep-Pui but these areas have suffered greatly in the past and still have not become stabilized as the dipterocarp-oak and evergreen areas have.

### Secondary Growth

In contrast to the primary and climax vegetation on Doi Suthep-Pui, areas that have been severely disturbed, e.g., roadsides, construction sites, settlements, etc. include a completely different assemblage of vegetation that, if left alone, usually develops into the original forest cover. Some common secondary trees are : *Callicarpa arborea* Roxb. var. *arborea* Roxb. (Verbenaceae), *Ficus hispida* L. f. var. *hispida* (Moraceae), *Trema orientalis* (L.) Bl. (Ulmaceae) and *Macaranga denticulata* (Bl.) M.-A. (Euphorbiaceae), all of which are fast-growing and short-lived. Weeds such as *Tridax procumbens* L. (Compositae), *Mitracarpus villesus* (Sw.) DC. (Rubiaceae) and many grasses, e.g., *Pennisetum pedicelletum* Trin. are common in recently-disturbed places at all elevations. The very noxious, rampant and exotic climber, *Mimosa diplotricha* C. Wright ex Sauv. f. var. *diplotricha*, and the equally-unwanted and troublesome treelet *M. pigra* L. are in an increasing number of places, rapidly spreading at the expense of native plants.

### The Present Situation

Since the time of Hosseus and Kerr, essentially all of the Ping River valley, on which Doi Suthep-Pui occupies the west side, has been either settled or converted into rice fields, orchards, etc. Much of the deciduous dipterocarp-oak areas have vanished, especially on the west side of the mountain and, in many places, the “mixed” or “closed” deciduous forest has been ruined by the removal of many to all of the tall and unfortunately-valuable timber trees. The SW side of the mountain in the Mae Hia village area consists, in many places, of pure stands of bamboo scrub while the situation on the northern part of the national park in the Mae Sa region is nearly as disastrous.

The primary evergreen forests have suffered greatly in recent years due to the destructive agricultural practices of various hilltribe folks plus governmental coffee and fruit tree plantations that have been carved out of pristine areas. Thus, nearly the entire Sisangwan valley has been ruined as well as several large areas in Chang Kian valley, not to mention the almost-total devastation of the forest in the vicinities of the 3 hilltribe villages in the national park. The “development” of Doi Suthep village as well as promotion of Doi Pui Hmong village as tourist attractions has resulted in undesirable commercialism and resultant forest destruction in these areas. Increasing incidents of forest fires, soil removal, trash dumping, water pollution and logging are a result of easier access to the mountain plus inefficient control by the

national park authorities. Recent developmental proposals such as the cable car project, road construction/pavement plans, tourist accommodations, etc. lack conservation considerations, therefore while “development” progresses, nature suffers.

The national park lacks nature education services, nature trails and nature guides but has allowed the construction of numerous private houses, resorts, several TV facilities and daily extension of fields and plantations inside its boundaries. Surely, unless the present concept of Doi Suthep-Pui as a place for tourist development, exploitation and uncontrolled devastation is changed, its current status as a national park will surely become that of a national disgrace.

From various notes written by Kerr (1911) and Craib (1911-1913), Doi Suthep-Pui used to have several ponds and marshes in the primary evergreen forest and from these areas, several new species of plants were collected and described. Presently, there is only one pond, in a plantation, and almost all of its ecology and original forest surroundings have been altered. As for the other ponds and marshes which have been drained or otherwise destroyed, the loss is irreparable since both the habitats and species, some of which may have evolved there, are gone.

### Botanical Losses

In the fact that several plant species have disappeared from Doi Suthep-Pui National Park as a result of habitat destruction or illegal collection, many others have become rare or endangered due to the same reasons. Hosseus (1911) noted that what is now known as *Psilotum nudum* (L.) Beauv. (Psilotaceae), an epiphyte and most primitive of vascular plants found in Thailand, was found in the primary evergreen forest on Doi Suthep. This species has not been recorded from the mountain since that time and it must be assumed that it is no longer there.

*Mussaenda sanderiana* Ridl. (Rubiaceae), previously known as *M. hossei* Craib apud Hoss. and *M. sutepensis* Hoss., were both originally from Doi Suthep. This shrub has very colourful inflorescences, which in the days of Hosseus and Kerr, must have added much beauty to the deciduous forests. Since the species has considerable ornamental value, it has been collected to the point of disappearance from the mountain.

Only one area on the summit of Doi Suthep where the extremely-delicate saprophytic herb *Hypopithys lanuginosa* Rafin. (Ericaceae) can be found. Unfortunately, the population of this species is in critical danger due to soil removal. Indeed, about 3 m<sup>2</sup> of soil was taken from a nearby area recently and since soil removal is common and unchecked, this and other plants may eventually disappear from the national park. The sad fact of the matter is that weeds, not native plants, rapidly invade the scars where the soil has been removed. *Lilium primulinum* Bak. (Liliaceae), the largest and most spectacular lily in Thailand, used to be common in the summit areas but has become scarce due to commercial exploitation.

*Paphiopedilum villosum* (Ldl.) Pfitz., an epiphytic “slipper” orchid, was once collected by Kerr on Doi Suthep and has not been collected or apparently seen by botanists on the mountain again. A related species, *P. callosum* (Rchb. F.) Pfitz., also has been exploited by commercialized orchid collecting and may also be extinct from the national park.

Another epiphyte, related to *Mussaenda*, (Rubiaceae) which is very scarce, but readily extracted by those who find them, is *Hymenopogon parasiticus* Wall. (Rubiaceae) which has very large and showy inflorescences. This species, unfortunately, is found at elevations over 1,400 m and cannot survive at lower elevations where they are sold in various urban flower

markets.

The list of rare and endangered plants as well as those which are no longer found in the national park has increased greatly in recent years since habitat destruction and uncontrolled plant collection have not been solved. One botanically-spectacular stream valley near the national park headquarters where several rare and biologically-unique plants are found are now in danger of destruction. Recently several check dams, now full of silt, have been built along this stream which may have a detrimental effect on the ecology of the area. Furthermore, if the road is ever widened, this will also damage or destroy the habitat. It is obvious that all “development” or “improvement” projects in the national park have not been reviewed by competent biologists and other scientists for possible environmental effects that are never considered by those who wish to exploit the forest.

### **The vegetation from Doi Suthep-Pui National Park included Deciduous Forests**

The lower slopes of Doi Suthep-Pui National Park (established in 1981), that is, from 350-c. 950 m elevation, consists of two kinds of deciduous forests : dipterocarp-oak (savannah) and “mixed” or “closed” deciduous facies.

The dipterocarp-oak kind of association is composed of spaced, usually single-storied, thick-barked and fire-resistant trees dominated by various members of Dipterocarpaceae, e.g., *Dipterocarpus obtusifolius* Teijsm. ex Miq. var. *obtusifolius*, *D. tuberculatus* Roxb. var. *tuberculatus*, and *Shorea siamensis* Miq. var. *siamensis* and Fagaceae, e.g., *Quercus kerrii* Craib var. *kerrii* and *Q. kingiana* Craib. The trees are leafless during the dry season from about late December until May and the ground flora, which has many species of perennial grasses and other herbs, desiccates and frequently burns. The soil is often rocky (granite), is thin and has sparse leaf, etc., litter.

Although this kind of forest seems to be uniform, sparsely-specied, and intolerably hot and dry during the dry season, there are probably as many different kinds of plants, especially herbs, in this kind of forest as in the primary evergreen forested areas at higher elevations. The ground flora is, in some areas, dominated by grasses, e.g., *Arundinella setosa* Trin. var. *setosa*, *Cymbopogon flexuosus* (Nees ex Steud.) Wats. var. *flexuosus*, and *Themeda triandra* Forsk. and thus appearing as a “typical” savannah, or in other places with a profusion of shrubs and herbs without any dominant families or species. Indeed, some of the most colourful herbs are found in this type of forested area, even during the peak of the dry season, when some of the gingers (Zingiberaceae), e.g., *Curcuma ecomata* Craib and *Gagnepainia godefroyi* (Baill.) K. Sch. produce spectacular inflorescences before their leaves develop.

One of the most obvious changes in the deciduous dipterocarp-oak areas since the time of Hosseus and Kerr is the scarcity of epiphytic orchids which were abundant up until recent decades when orchid exploitation became a big business in Thailand.

The deciduous dipterocarp-oak areas often merge with what can be called a “mixed” or “closed” deciduous forest where the predominance of dipterocarps and oaks decreases and an assortment of other deciduous trees which are taller, more closely-spaced, and produce a more-closed canopy increases. Some of the taller trees include *Xylia xerocarpa* (Roxb.) Taub. var. *kerrii* (Craib & Hutch.) Niels. (Leguminosae : Mimosoideae), *Colona flagrocarpa* (Cl.) Craib (Tiliaceae), *Vitex peduncularis* Wall. ex Schauer (Verbenaceae), *Terminalia mucronata* Craib & Hutch. and *T. alata* Hey. ex Roth (Combretaceae). There is a distinct and

varied understory too consisting of, e.g., *Holarrhena antidysenterica* (Roth) Wall. ex A. DC. var. *antidysenterica* (Apocynaceae) and *Stereospermum neuranthum* Kurz (Bignoniaceae), which has many more lianas (e.g., *Millettia extensa* Bth. ex Baker and *Spatholobus parviflorus* (Roxb.) O.K. (both Leguminosae : Papilionoideae)). The ground flora, especially in more shaded areas, often differs from that in the deciduous dipterocarp-oak areas, especially with the presence of various kinds of understory bamboos, e.g., *Bambusa tulda* Roxb. and *Dendrocalamus nudus* Pilg. (Gramineae : Bambusoideae). Herbs such as *Andrographis laxiflora* (Bl.) Lindau and *Asystasia kerrii* Craib (both Acanthaceae), *Desmodium triquetrum* (L.) DC. ssp. *triquetrum* (Leguminosae : Papilionoideae), *Sonerila tenera* Roy. (Melastomataceae) and others, many of which have showy inflorescences/flowers, are typical representatives of the “mixed” deciduous areas.

Both Hosseus and Kerr noted that teak : *Tectona grandis* L. f. (Verbenaceae) and other large deciduous trees, e.g., *Cassia fistula* L. (Leguminosae : Caesalpinioideae) were common in the “mixed” deciduous forest. Now, due to decades of uncontrolled cutting, these trees are far less common and in their place, bamboo and lower-canopy trees are growing.

### Primary Evergreen Forests

The deciduous forests grade into primary evergreen forests from about 900-950 m. elevation and extend to the summits of Doi Suthep (c.1,620 m) and Doi Pui (c.1,685 m). Not only is there an almost complete change in species, humidity, temperature and soil, but also in the entire appearance of these higher-elevation associations. The forests consist of a much-higher canopy of massive (up to 50 m tall) trees with several understory levels, considerably more dense ground flora and, in general, more epiphytes, vines and lianas—no part of which is dominated by any particular family or species of plants. While the primary evergreen forest consists of more kinds of trees than the deciduous forests, the ground flora, mainly because it is evergreen, is not as diverse as in other forests.

Giant-canopy trees such as *Dipterocarpus costatus* Gaertn. f. (Dipterocarpaceae), *Sapium baccatum* Roxb. (Euphorbiaceae), and *Michelia champaca* L. (Magnoliaceae) provide shade for understory trees, e.g., *Acronychia pedunculata* (L.) Niq. (Rutaceae), *Baccaurea ramiflora* Lour. (Euphorbiaceae), *Hetadina trichotoma* (Z. & H.) Bakh. f. (Rubiaceae). The usually-dense ground flora includes several species of Zingiberaceae, e.g., *Boesenbergia rotunda* (L.) Mansf. and *Amomum siamense* Craib; *Phrynium capitatum* Willd. (Marantaceae), which is common along streams, numerous ferns, but few grasses and palms. Orchids are common in this kind of forest with both epiphytes and ground species (some of which are saprophytic), however, due to exploitation, the orchid flora has considerably diminished in recent decades.

### Summit Flora

From about 1,450 m elevation, many areas in the primary evergreen forest are less dense, have shorter trees, and include an increase in evergreen oaks (Fagaceae) and other trees that characterise this higher elevation habitat. Since the distribution of this summit flora is uneven and often not uniform, it can be concluded that this change in forest cover is a result of centuries of human disturbance which has altered the original aspect of the summit vegetation. Both Hosseus (1908) and Kerr (1911) briefly noted this feature while the former author listed some of the species that comprised the original summit flora of Doi Pui, now

completely and shamefully removed.

The summit of Doi Suthep is, in most places, a single-storied, mostly evergreen forest with a dense and rich assemblage of epiphytic lichens, mosses, ferns and flowering plants (mostly orchids). Indeed, this facies is very similar in general appearance to the deciduous dipterocarp-oak areas except for the epiphytes. The summit of Doi Pui has been completely destroyed and planted with *Cupressus torulosa* D. Don (Cupressaceae), from the Himalayas, and the native pine *Pinus kesiya* Roy. ex Gard. (Pinaceae). It should be noted that *Pinus kesiya* Roy. ex. Gard. is rarely found out of cultivation in Doi Suthep-Pui National Park now, but was formerly common at elevations above 1,000 m (Hosseus, 1908). It has been depleted because of its value as firewood and planted with the intent to exploit, not to reforest.

### Plant Collection on Doi Sutep, Chiang Mai 1 July 1987 to 17 September 1991

Group of Plant Collection	Families	Species (sp.), Subspecies (ssp.), Varieties (var.)	Topotypes	Cultivated	New Record
<b>Angiosperms :</b>					
Dicotyledons	136	1,389	200	22	10
Monocotyledons	25	493	86	3	1
<b>Gymnosperms :</b>					
Fern Allies	6	6	1	2	0
Ferns	24	156	2	0	0
<b>Total</b>	<b>193</b>	<b>2,044</b>	<b>289</b>	<b>27</b>	<b>11</b>

### ACKNOWLEDGEMENTS

This work was supported by a fund from the Wildlife Centre International (WCI) via Dr. Warren Brockelman of the Department of Biology, Faculty of Science, Mahidol University.

### REFERENCES

- Bailey, L.H. 1975. Manual of cultivated plants. The Macmillan Company, New York.
- Benson, L. 1959. Plant classification. D.C. Heath and Company, Massachusetts.
- Bor, N.L. 1960. The grasses of Burma., India and Pakistan Ceylon ; Pergamon Press, London. 767 pp.
- Craib, W.G. 1911. List of Siamese plants, with descriptions of new species. Bull Misc. Information, Kew (Kew Bull.): 7-61.
- Craib, W.G. 1912. List of Siamese plants, with descriptions of new species. Bull Misc. Information, Kew (Kew Bull.): 397-435.
- Craib, W.G. 1912. Contributions to the flora of Siam : dicotyledones. Univ. of Aberdeen St. 57: 1-210.
- Craib, W.G. 1913. Contributions to the flora of Siam, monocotyledones. Univ. of Aberdeen St. 61: 1-41.

- Core, E.L. 1955. Plant taxonomy. Prentice Hall, Inc, Eaglewood Cliffs N.J.
- Don, D. 1825. Prodrumus florum nepalensis. J. Gale, London. 256 pp.
- Esau, K. 1977. Anatomy of seed plant. John Wiley and Sons, New York.
- Flore du Cambodge, du Laos, et du Vietnam. 1960-1990. 25 vols. Museum National D'Histoire Naturelle, Paris.
- Gagnepain, F. (ed) 1907-1943. Flore generale de l' Indo-Chine. 7 vols. Masson & Co., Paris.
- Geesink, R., A.J.M. Leeuwenberg, C.E. Ridsdale, and J.F. Veldkamp. 1981. Thonner's analytical key to the families of flowering plants. Leiden Univeristy Press, The Hague. 231 pp.
- Hooker, J.D. 1875-1897. The flora of British India. 7 vols. L. Reeve & Co., London.
- Hosseus, C.C. 1907. Die aus Siam bekannten acanthaceen. Bot. Jahr. 41: 62-73.
- Hosseus, C.C. 1908. Beitrage zur flora des Doi-Sutap, etc. Bot. Jahr. XL, 93: 92-99.
- Hosseus, C.C. 1910. Beitrage zur flora Siams. bot. centrabl. Beih. 27(2): 455-507.
- Hosseus, C.C. 1911. Die botanisches ergebnisse meiner expedition nach Siam. Bot. Certrabl. Beih. 28(2): 357-457.
- Hutchinson, J. 1967. Key to the families of flowering plants of the world. Clarendon Press, Oxford. 117 pp.
- Jackson, B. D. 1971. Glossary of botanical term. Gerald Duck Worth. Co. Ltd., New York.
- Jones, S.B., and A.E. Luchsinger. 1979. Plant systematics. McGraw-Hill Book Company, New York.
- Keng, H. 1969. Orders and families of Malayan seed plants. University of Malaya Press, Kuala Lumpur.
- Kerr, A.F.G. 1911. Sketch of the vegetation of Chiang Mai. Bull. Misc. Info. Kew (Kew Bull.): 1-6.
- Kuchler, A.W., and J.O. Sawyer, 1967. A study of the vegetation near Chiang Mai, Thailand. Trans. Kansas Acad. Sci. 70(3): 281-347 + map.
- Lawrence, H.M. 1971. Taxonomy of vascular plants. The Macmillan Company, New York.
- Maxwell, J.F. 1988. The Vegetation of Doi-Suthep-Pui National Park, Chiang Mai Province, Thailand. Tigerpaper (FAO), XV (4): 6-14.
- Nabhitabhata, J. 1987. Wildlife in Doi Suthep-Pui National Park, Kog-Ma Watershed. Bulletin (48): 1-41.
- Poster, C.L. 1967. Taxonomy of flowering plants. W.H. Free man and Company, San Francisco.
- Putiyanan, Somporn. 1986. Dictionary of Thai medicinal plant names vol.I. Faculty of Pharmacy, Chiang Mai University, Chiang Mai. 517 pp.
- Putiyanan, Somporn. 1993. Identification of medicinal plants vol. I. Krung Siam Press, Bangkok. ISBN 974-565-628-3.
- Putiyanan, Somporn, and J.F. Maxwell. 1998. Survey and herbarium specimens of medicinal vascular flora of Doi Suthep-Pui, research book. Faculty of Pharmacy, Chiang Mai University, Chiang Mai.
- Radford, A.E., William C. Dickison, Jimmy R. Massey, and C. Ritchie Bell. 1974. Vascular plant systematics. Haper & Row Publishers, New York.
- Round, P. 1984. The status and conservation of the bird community in Doi Suthep-Pui National Park, north-west Thailand. Nat. Hist. Bull. Siam Soc. 32(1) : 21-46.

- Sawyer, J.O., and C. Chermisrivathana. 1969. A flora of Doi Suthep-Doi Pui, Chiang Mai, North Thailand. *Nat. Hist. Bull. Siam Soc.* 23: 99-132.
- Seidenfaden, G., and T. Smitinand. 1959-1965. The orchids of Thailand. A Preliminary List. 4 vols. The Siam Society, Bangkok. 870 pp.
- Smitinand, Tem. 1980. Thai plant names : Botanical names vernacular names. Funny Publishing Limited Partnership, Bangkok.
- Smitinand, T., and K. Larsen (eds) 1970-1990. Flora of Thailand. Vols 2,4,5. The Forest Herbarium, Royal Forest Department, Bangkok.
- Tagawa, M., and K. Iwatsuki. 1979-1989. Flora of Thailand, pteridophytes. 3 : 1-4. The Forest Herbarium, Royal Forest Department, Bangkok. 639 pp.