



# Notes on the Genus *Elettariopsis* Baker (Zingiberaceae) in Thailand

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## Abstract

Five species of the genus *Elettariopsis* Baker (family Zingiberaceae): *E. elan* C. K. Lim, *E. exserta* (Scott.) Bak., *E. slahmong* C. K. Lim, *E. smithiae* Y. K. Kam, and *E. triloba* (Gagnep.) Loes., are enumerated for Thailand in this treatment based on herbarium specimens. The taxonomically controversial taxon, “Pud Sing,” is confirmed to be *E. slahmong* C. K. Lim, not *E. curtisii* Bak. as previously referred to in the Thai literature. The key to and color illustrations of all Thai species are provided. The ethnobotany, chemical constituents, and biological activities of these Thai taxa are also discussed.

**Key words:** genus *Elettariopsis* Baker (Zingiberaceae), Thailand, taxonomy, ethnobotany, chemical constituents, biological activities

## Introduction

The genus *Elettariopsis* Baker is a small plant group in the family Zingiberaceae with 8-15 taxa distributed mainly in Southeast Asia.<sup>1,2</sup> Members of the genus can be distinguished from other genera by their fewer leaves (usually 1-5), loosely clasping or forming a distinct pseudostem, and their separated flowering shoots, either with clustered flowers in a head or with single flowers along a decurrent scape.<sup>3</sup> However, flowers of all recognized taxa are essentially similar in coloration and forms, and resemble some *Amomum* species<sup>3</sup> (e.g. *A. testaceum* Ridl., *A. biflorum* Jack, *A. uliginosum* Koenig). The labella are sometimes trilobed and crenulated, white with a yellow median stripe, and usually more or less flanked by thick red

streaks along the median. The fruits are also similar, usually subglobose to globose with longitudinal ridges.<sup>3</sup> Moreover, other vegetative characters (habit, height, and leaf shape and size) are quite variable<sup>3</sup>.

In Thailand, a taxonomically unknown taxon “Waan Dok Thong” or “Waan Maha Saneh” is popularly grown in front of shops or stores, because it is believed to have a magic power to attract customers. An unidentified taxon of this genus, known in the southern-most provinces of Thailand as “Krachai Lang Kong,” is famous in the Muslim communities as a good hypotensive herb.<sup>5</sup> An edible taxonomically controversial species “Pud Sing” is common in the five southern-most provinces of Thailand<sup>3</sup>. These taxonomic problems have challenged us to work on this genus, with the focus on the Thai-Malay Peninsula taxa.

This paper is aimed at discussing the existing knowledge of the genus *Elettariopsis* Baker in Thailand, as reported in the available scientific literature

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and from our experiences or the information gained from our field work, and to report the information obtained in four main aspects: taxonomy, ethnobotany, chemistry, and biological activities.

### Taxonomy

#### History

The genus *Elettariopsis* was established by Baker in 1892 with three species: *E. curtisii* Bak., *E. exserta* (Scort.) Bak., and *E. serpentina* Bak.<sup>2</sup> In 1907, Ridley listed seven taxa for the Malay Peninsula: *E. exserta* (Scort.) Bak., *E. curtisii* Bak., *E. cyanescens* Ridl., *E. latiflora* Ridl., *E. longituba* Ridl., *E. pubescens* Ridl., and *E. serpentina* Bak.<sup>4</sup> However, later (1924) in his treatment of this genus for the Malay Peninsula, he recognized only five species: *E. exserta* (Scort.) Bak., *E. curtisii* Bak., *E. latiflora* Ridl., *E. longituba* Ridl., *E. pubescens* Ridl.,<sup>5</sup> by transferring *E. cyanescens* Ridl. to *Kaempferia cyanescens* Ridl. and considering *E. serpentina* Bak. conspecific to *E. curtisii* Bak.

Holtum, in 1950, recognized only three species for this genus: *E. curtisii* Bak., *E. exserta* (Scort.) Bak., and *E. triloba* (Gagnep.) Loes.<sup>6</sup> He reverted *E. pubescens* Ridl. to *Amomum biflorum* Jack, recognized *E. latiflora* Ridl. as the same to *E. curtisii* Bak., and transferred *E. longituba* Ridl. to *Elettaria longituba* (Ridl.) Holt.<sup>6</sup> In this treatment he added a Vietnamese

taxon, *E. triloba* (Gagnep.) Loes., as extant to the Malay Peninsula. In 1982 Kam revised the genus for the Malay Peninsula and accepted all Holtum's taxa, adding two new species and one variety, *E. burttiana* Y. K. Kam, *E. smithiae* Y. K. Kam var. *smithiae*, and *E. smithiae* Y. K. Kam var. *rugosa* Y. K. Kam<sup>7</sup>.

More recently, Lim (2003) published an excellent comprehensive taxonomic note on this genus and listed nine species (adding two new taxa and changing the status of one taxon) in his account: *E. burttiana* Kam, *E. curtisii* Bak., *E. elan* C. K. Lim, *E. exserta* (Scort.) Bak., *E. latiflora* Ridl., *E. rugosa* (Y. K. Kam) C. K. Lim, *E. slahmong* C. K. Lim, *E. smithiae* Y. K. Kam, and *E. triloba* (Gagnep.) Loes.<sup>3</sup> His analyses and discussion on the history and treatment of the genus is exemplary and lucid.

Larsen (1996) listed three species, *E. curtisii* Bak., *E. smithiae* Y. K. Kam, and *E. triloba* (Gagnep.) Loes. in his preliminary checklist of the Zingiberaceae of Thailand<sup>8</sup> and in his book on the *Gingers of Thailand* (2006).<sup>9</sup> The Bangkok Forest Herbarium (BKF) followed Larsen and listed these three species in the famous *Thai Plant Names* and provided Thai name(s) for each taxon: *E. curtisii* Bak., *E. smithiae* Y. K. Kam, and *E. triloba* (Gagnep.) Loes.<sup>10</sup> However, three taxa, *E. curtisii* Bak., *E. exserta* (Scort.) Bak., and *E. triloba* (Gagnep.) Loes. were accounted for by Niyomdham and his colleagues in their report on "Plants of Hala-

**Table 1** Morphological comparison of Pud Sing and *E. curtisii* Bak.

Character	Pud Sing	<i>E. curtisii</i> Bak.
1. Height (cm)	32.7-38.7	6.8-13.2
2. Number of leaf/leaves	3-5	1-2
3. Ligule	2-3 mm long	4-5 mm long
4. Leaf shape	obovate-ob lanceolate	elliptic
5. Leaf apex	acuminate-caudate	acute-acuminate
6. Leaf surface	glabrous, prominently veined	glabrous, not prominently veined
7. Petiole	4.7-12.6 cm	6.3-11.2 cm
8. Inflorescence	clustered in a head	an elongated scape with single flowers
9. Fruit	globose, 6-ridged, 2.0-2.5 cm diameter	not yet seen
10. Scent	gives distinctive odor (from all parts, particularly leaves) of a "stink bug"	gives hardly discernible scent



Fig. 1 *E. curtisii* in its type location on Penang Hill (Malaysia)



Fig. 2 *E. curtisii*, showing the plant habit with an inflorescence



Fig. 3 *E. curtisii*, showing detail of an inflorescence



Fig. 4 A detailed flower of *E. curtisii* showing coloration of the labellum



Fig. 5 Pud Sing, showing the plant habit with an inflorescence

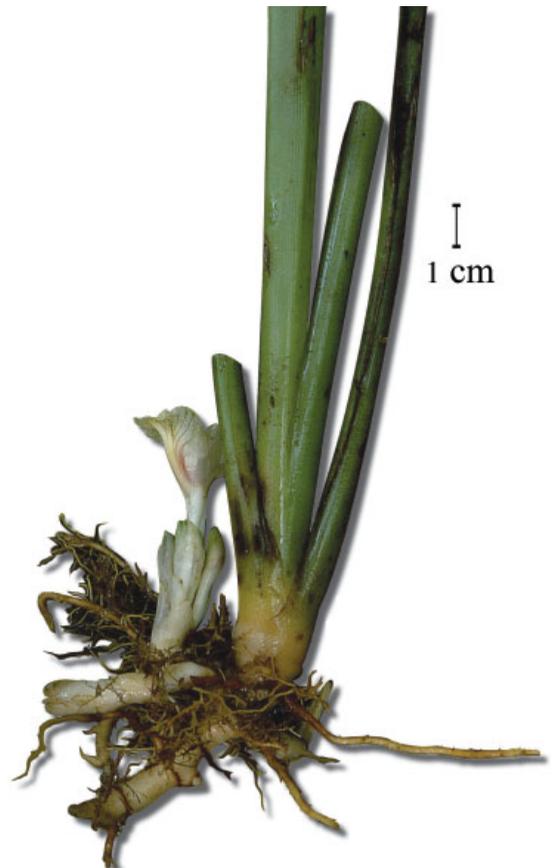


Fig. 6 Pud Sing, showing a clustered inflorescence



Fig. 7 Pud Sing, showing an inflorescence



Fig. 8 Pud Sing, showing a detailed labellum and anther crest

Bala<sup>11</sup>. In Lim's account for the Malay Peninsula, five species of the genus: *E. elan* C. K. Lim, *E. exserta* (Scort.) Bak., *E. slahmong* C. K. Lim, *E. smithiae* Y. K. Kam, and *E. triloba* (Gagnep.) Loes., were mentioned as also occurring in Thailand.<sup>3</sup>

### Taxonomic status of "Pud Sing"

The species known in the five southern-most provinces of Thailand as "Pud Sing" is one of the controversial taxa of the genus *Elettariopsis*. Larsen included *E. curtisii* Bak. in his checklist of this genus

**Table 2** List of the currently known taxa of *Elettariopsis* Bak. in Thailand

Vernacular name	Botanical name	Specimen studied	Collection sites
<b>1. Pud Hom</b> (ปุดหอม)	<i>E. elan</i> C. K. Lim	C.K. Lim L6306, C.K. Lim L3007, C.K. Lim L3055, C.K. Lim L3547, C.K. Lim L6089, PY-CP 0014	Kerunai, Gerik, Perak, Malasia (Type) Cultivated, Penang Botanic Garden, Malaysia Cultivated, Penang Botanic Garden, Malaysia Mahang, Kedah, Malaysia Cultivated, Penang Botanic Garden, Malaysia Hala Forest, Yala Province, Thailand
<b>2. Pee-la-bai</b> (ปีละใบ), Sa-la-da-hong (ชลาดาโฮง)	<i>E. exserta</i> (Scort.) Bak.	Scort. 1947, PY-CP 0008, PY-CP 0014, PY-CP 0036, PY-CP 0036, C.K. Lim L6089	Goping, Kinta, Perak, Malaysia (Type) Khao Bantad, Pattalung, Thailand Khao Maen, Nakhon Si Thammarat, Thailand Tamnang Waterfall, Pang-nga, Thailand Thong Pha Phum, Kanchanaburi, Thailand Phu Khao Thong, Bala Forest, Thailand
<b>3. Pud Sing</b> (ปุดสิงห์)	<i>E. slahmong</i> C. K. Lim	C.K. Lim L6101, C.K. Lim L3797, C.K. Lim L3804, PY-CP 0018, PY-CP 0011, Kam 221, Beltran 116	Belum FR, Perak, Malaysia (Type) Phu Khao Thong, Bala Forest, Thailand Waeng, Narathiwat, Thailand Chulabhorn 7, Yala, Thailand Bala Forest, Su-ngai Kolok, Thailand Taman Negara, Malaysia Templer Park, Perak, Malasia
<b>4. Krachai Lung Kong</b> (กระชายหลังกง), PudKrawan (ปุดกระวาน), Pud Khai Muk (ปุดไข่มุก)	<i>E. smithiae</i> Y. K. Kam	Beltran 110, Beltran 136, Kam 183, Ridley s.n. 7223, C.K. Lim L3209, PY-CP 0013, PY-CP 0047	Cultivated, Selangor, Malaysia (Type) G. Jerai, Kedah, Malaysia G. Jerai, Kedah, Malaysia Hermitage Hill, Malaysia G. Panti, Jahor, Malaysia Than Pliu Waterfall, Songkhla, Thailand Thaleban National Park, Satun, Thailand
<b>5. Pud Nu</b> (ปุดหนู), Tue-pu- tee-ku (ตื้อปุดตี้กู)	<i>E. triloba</i> (Gagnep.) Loes.	C.K. Lim L3257, PY-CP 0022, PY-CP 0039, PY-CP 0041, PY-CP 0052, S. Saensouk 40	Cultivated, Jahor, Malaysia Phu Pan, Sakhon Nakhon, Thailand Phu Pan, Sakhon Nakhon, Thailand Cultivated, Khon Kaen University, Thailand Cultivated, Penang, Malaysia Phu Pan, Sakhon Nakhon, Thailand

\*All Thai specimens collected by "PY-CP" will be deposited at the Bangkok Forest Herbarium (BKF).



Fig. 9 *E. elan* in its natural habitat (type location)



Fig. 10 *E. elan*, showing a detailed labellum and anther crest



Fig. 11 *E. elan*, showing a clustered inflorescence



Fig. 12 *E. exserta*, showing an elongated inflorescence



Fig. 13 *E. exserta*, showing a detailed labellum and anther crest



Fig. 14 *E. exserta*, showing an inflorescence and a young fruit crest



Fig. 15 *E. smithiae*, showing the plant habit



Fig. 16 *E. smithiae*, showing an inflorescence



Fig. 17 *E. triloba*, showing the plant habit with an inflorescence



Fig. 18 *E. triloba*, showing a detailed flower

for Thailand<sup>8,9</sup> based on his judgement on the identity of “Pud Sing.” Sirirugsa,<sup>12</sup> Niyomdham,<sup>11</sup> and the Bangkok Forest Herbarium (BKF)<sup>10</sup>, all followed Larsen, and listed “Pud Sing” as *E. curtisii* Bak. However, in 2003, Lim, who lives on Penang Hill, next door to the type location of *E. curtisii* Bak., pointed out that this Penang taxon is not the same as “Pud Sing.” He recognized “Pud Sing” as a new taxon and named the species “*Elettariopsis slahmong* C. K. Lim”. The specific epithet recognizes the Temiar name of the plant meant “the smelly leaves.”

From our field observation and investigation of the plant specimens on both “Pud Sing” and *E. curtisii* Bak., we did find morphological differences between these two species (see Table 1 and Figures 1-4). Also, the scent of crushed leaves of the two taxa is rather distinguishable. “Pud Sing” is a strongly aromatic herb with the distinctive odor (from all parts, particularly the leaves) of the “stink bug,” whereas *E. curtisii* Bak. gives off hardly any discernible scent, confirming that “Pud Sing” is a different taxon, i.e. *E. slahmong* C. K. Lim. Figures 5-8 and *E. curtisii* Bak. may be endemic and confined only to Penang Island. We, therefore, consider our “Pud Sing” as *E. slahmong* C. K. Lim, and not *E. curtisii* Bak.

### Preliminary checklist for Thailand

From our intensive fieldwork throughout Peninsular Malaysia, Thailand and Laos, we have collected more than 15 presumably different taxa, some of which are under investigation both *ex situ* and *in situ*. Since

the flowers of all the species are similar in form and coloration, the main differences are the inflorescence morphology, either with single flowers on an elongated scape or with clustered flowers in a head, and the vegetative morphology. However, for the locals the scent of crushed leaves can, in some species, be distinguishable among folk taxa. The difference in scent reflects the difference in volatile chemical composition, mainly monoterpenoids and sesquiterpenoids. Therefore, we are presently working on volatile oil analyses and a molecular study of all Thai taxa. The result of these studies will be included in our comprehensive treatment of the genus for Thailand in the near future.

However, for the purpose of setting up baseline information for our future report on the studies of this genus, we confirmed five taxa as mentioned in Lim’s report.<sup>3</sup> The list of these five species with the herbarium specimens studied and their locations are given in Table 2. The key to all currently known Thai taxa is given in Box 1. Color illustrations of all five taxa are also provided (Figures 5-18).

### Ethnobotany

Ethnobotany is a multidisciplinary study on the direct interrelationships between humans of any race or ethnicity and plants in their environments. This interrelationship includes the uses of plants for food, medicine, clothing, dwelling, art and culture, and beliefs.<sup>13-15</sup> Based on our field studies, some taxa of the genus *Elettariopsis* Bak. in Thailand are associ-

#### Box 1. Key to species of the *Elettariopsis* Bak. in Thailand

- |  |                          |
|--|--------------------------|
| 1. Scape with clustered flowers in a head  | ..... 2.                 |
| 1. Scape with single flowers along a decurrent axis                                    | .....4.                  |
| 2. Leaves prominently veined, strongly aromatic with distinctive “stink bug” odor..... | <b>E. slahmong</b>       |
| 2. Leaves not prominently veined, strongly aromatic or discernibly scented             | ..... 3.                 |
| 3. Leaves 3-4, not discernibly scented   | ..... <b>E. triloba</b>  |
| 3. Leaves 2-5, strongly aromatic   | ..... <b>E. elan</b>     |
| 4. Leaves 3-5(-6), lanceolate, glabrous and shiny                                      | ..... <b>E. smithiae</b> |
| 4. Leaves (1-)2-3, elliptic, coriaceous and dull, strongly plicate                     | ..... <b>E. exserta</b>  |

ated with food, medicine, and beliefs.

The leaves of *E. slahmong* C. K. Lim, known as “Pud Sing” in Thai or as “Slahmong” in Temiar nomenclature, are considered delectable, and are used in native cuisine, in particular in cooking fish.<sup>3</sup> In southern Thailand, the leaves of this plant are also eaten as a vegetable with different types of chilli dippings. The Thai name “Pud Sing” refers to the plant group and the shape of the flowers. The word “pud” in the southern Thai dialect means “pop up” indicating the habit of this plant group which will “pop up” in the rainy season. The Thai word “sing” literally means “lion;” it refers to the shape of the flowers, which somewhat resemble a lion.

One of the *Elettariopsis* species, known in Thai as “Krachai Lang Kong,” is used in southern Thailand in an hypotensive remedy.<sup>16</sup> The plant habit resembles that of “Krachai [*Boesenbergia rotunda* (L.) Mansf.]” but the leaves are drooping; hence, the name “Krachai Lang Kong.” From our taxonomic study of this taxon, we identified this species as *E. smithiae* Y. K. Kam.

The unknown taxon, *Elettariopsis* aff. *triloba* (Gagnep.) Loes., known locally in the northeastern region of Thailand as “Waan Dok Thong” or “Waan Maha Saneh,” is believed to possess a magical power, and therefore, it is used as a good-luck charm. The Thai names of this taxon imply magical seductive power. This plant is grown in pots, and put in front of shops in the belief that they will help to attract customers, especially when the plant is in bloom (usually at the end of March or in early May). The rhizomes of this taxon are also used as one of the ingredients for making “magical herbal charming oil” or “magical charming lip balm,” in the belief that after applying it to one’s body (oil) or lips (lip balm), it will help to attract the targeted opposite sex, particularly women.<sup>17,18</sup>

## Chemistry

Essential oil is the major chemical constituent of all parts of the *Elettariopsis* species. It is volatile at room temperature; hence the name “volatile oil” or “ethereal oil”. Terpenes, particularly monoterpenes and sesquiterpenes, are the major constituents of an essential oil. Members of the genus *Elettariopsis* Baker

yield different scents due to the different compositions and amounts of these terpenes.

The essential oils from leaves, rhizomes, and roots of *E. elan* C. K. Lim have been reported.<sup>3</sup> Based on capillary GC and GC-MS analysis, 28 compounds have been identified from the leaf oil, among which monoterpenoids predominate and the most abundant component is geraniol (71.6%). The rhizomes and roots also yield oils rich in monoterpenoids, but with a distinctly different odor, with camphene (28.6%), fenchyl acetate (8.6%) and  $\alpha$ -phellandrene (8.4%) as the major components.<sup>19</sup>

Hydrodistillation of the leaves, rhizomes, and roots of *E. smithiae* Y. K. Kam yields volatile oils. The oils of *E. smithiae* Y. K. Kam are dominated by monoterpenoids; the major components being geraniol (38.1%) and neral (29.1%) in the leaf oil, and camphene (22.9%) and  $\alpha$ -fenchyl acetate (15.7%) in the oils from the rhizomes and roots.<sup>20</sup> However, terpenoid components in the oil of *E. slahmong* C. K. Lim that characterized the species are predominantly 2-octenal (46%) and 2-decenal (29%).<sup>3</sup>

Essential oils of *E. triloba* (Gagnep.) Loes. from two different sources, Rimba Ilmu Botanic Garden (RIBG) and the Botanical Research Garden (BRG), have been compared chemically.<sup>21</sup> The volatile components of *E. triloba* (Gagnep.) Loes. from RIBG were found to be more than those from BRG. A total of 36, 36 and 37 components were identified in the leaves, roots and rhizomes of samples from RIBG, respectively, while only 10, 19 and 28 components were identified in the sample from BRG. The major components of the leaves of the plant from RIBG were  $\beta$ -citral (16.16%) and  $\alpha$ -citral (14.13%), whereas the major components of the rhizomes were limonene (9.68%), heptan-2-ol-acetate (9.68%), 2-carene (9.05%). The major constituents of the root oil of the plant from BRG were identified as  $\alpha$ -terpinyl acetate (3.73%),  $\alpha$ -fenchyl acetate (3.64%),  $\alpha$ -phellandren (3.63%).<sup>21</sup>

## Biological Activities

The methanolic extract of the whole plant of *E. smithiae* Y. K. Kam in a study showed a broncho-dilating effect and demonstrated a positive inotropic

effect in low dose.<sup>16</sup> Crude methanolic extract and crude dichloromethane extract of this taxon also illustrated antioxidant activity.<sup>22</sup> Volatile oils from both the leaves and the rhizomes showed potent antibacterial activities against *Bacillus subtilis*, *Escherichia coli*, *Staphylococcus aeruginosa* and *Sarcina* spp.<sup>22</sup>

## Conclusion

This paper combined the results from our field work on plant collection and ethnobotany with a literature review on the genus *Elettariopsis* Baker in Thailand. Currently, five taxa were enumerated for Thailand, namely *E. elan* C. K. Lim, *E. exserta* (Scort.) Bak., *E. slahmong* C. K. Lim, *E. smithiae* Y. K. Kam, and *E. triloba* (Gagnep.) Loes. The key to all species found in Thailand is also provided. In this paper, we clarify, for the first time, the taxonomic status of the previously confusing taxon, "Pud Sing" and the formerly unknown plant "Krachai Lang Kong", as *E. slahmong* C. K. Lim and *E. smithiae* Y. K. Kam, respectively. We also formally added a newly recorded taxon for Thailand, *E. elan* C. K. Lim, from the Bala and Hala Forests. Moreover, we also provided additional existing information on ethnobotany, chemistry, and biological activities of all five Thai species for anyone interested in carrying on further research on these aspects of this plant group.

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### บทคัดย่อ

พืชสกุลว่านดอกทอง (*Elettariopsis* Baker) ในประเทศไทย

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พืชสกุลว่านดอกทอง (สกุล *Elettariopsis* Baker) เป็นพืชวงศ์ขิง (Zingiberaceae) สกุลเล็ก ๆ สกุลหนึ่ง เดิมมีรายงานว่าพบในประเทศไทยเพียง ๓ ชนิดเท่านั้น. แต่จากการศึกษาตัวอย่างพืชสกุลนี้ที่พบในธรรมชาติและตัวอย่างพรรณไม้แห้งในเบื้องต้นพบว่าพืชสกุลนี้ในประเทศไทยอย่างน้อย ๕ ชนิด ได้แก่ ปุดหอม (*E. elan* C. K. Lim), ปี่ละใบ หรือชลาดาโสง [*E. exserta* (Scort.) Bak.], ปุดสิงห์ (*E. slahmong* C. K. Lim), กระชายหลังง หรือปุดกระวาน หรือปุดไข่มุก (*E. smithiae* Y. K. Kam), และปุดหนู หรือต้อปุดี้ (*E. triloba* (Gagnep.) Loes.). ในรายงานนี้ได้ยืนยันชื่อพฤกษศาสตร์ของปุดสิงห์ว่าเป็น *E. slahmong* C. K. Lim ไม่ใช่ *E. curtisii* Bak. ดังที่เคยเข้าใจกัน. นอกจากนี้ จากการศึกษายังพบพืชสกุลนี้ในประเทศไทยอันเป็นพืชที่อาจเป็นชนิดที่พบในประเทศไทยเป็นครั้งแรก, หรือพืชชนิดใหม่, อีกหลายชนิด เช่น ว่านดอกทอง. ในรายงานนี้ยังได้เสนอรูปวิธานจำแนกชนิด (key to species) ของพืชสกุลนี้ที่พบในประเทศไทยทั้ง ๕ ชนิด พร้อมภาพสีประกอบ. นอกจากนี้ยังได้รายงานข้อมูลเชิงพฤกษศาสตร์พื้นบ้าน, องค์ประกอบเคมี และฤทธิ์ทางชีวภาพของพืชสกุลนี้ที่พบในประเทศไทย โดยข้อมูลด้านพฤกษศาสตร์พื้นบ้านนั้น นอกจากจะได้ประมวลจากเอกสารต่าง ๆ แล้ว ยังได้จากการศึกษาภาคสนาม. ส่วนข้อมูลด้านองค์ประกอบเคมีและฤทธิ์ทางชีวภาพเป็นข้อมูลที่ประมวลจากเอกสารรายงานการวิจัยต่าง ๆ เท่าที่มีรายงาน.

คำสำคัญ: พืชสกุลว่านดอกทอง, ประเทศไทย, อนุกรมวิธาน, พฤกษศาสตร์พื้นบ้าน, องค์ประกอบเคมี, ฤทธิ์ทางชีวภาพ