Taxonomy and ethnobotany of Acmella (Asteraceae) in Thailand

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Abstract. Panyadee P, Inta A. 2022. Taxonomy and ethnobotany of Acmella (Asteraceae) in Thailand. Biodiversitas 23: 2177-2186. Thai toothache plant is an ethno-species, referred to as any species in the genus Acmella of the aster family (Asteraceae). The plants are used commonly in Thailand as vegetables and medicine. However, in earlier phytochemistry and ethnotropical studies, miss scientific names: Acmella olearcea and Spilanthes acmella, were applied to these species. In this study, we have clarified the identity of these ethno-species and related species in the genus Acmella. There were six species of Acmella in Thailand, including two native species and four introduced species. The keys and brief description of these species are provided. In ethnotropical studies, A. oleracea and S. acmella were mentioned as nearly 80% of total use records. These names could be referred to A. paniculata which is one of the native species and most widely distributed. Although there were a reasonable amount of studies on the Thai toothache plant, more comparative studies for their bioactivities are still needed according to the taxonomical confusion of their names.

Keywords: Compositae, ethnomedicine, local vegetable, revision, seasoning, toothache

INTRODUCTION

Phak Phed or Thai toothache plant is one of the most commons vegetable and medicinal plants in Thailand. This ethno-species is referred to as the herbaceous plant in the Asteraceae family with yellow-flowering heads the size of a little fingertip (Royal Institute of Thailand 2009). This referred to plants in the genus Acmella Rich. ex Pers. In Thai photochemistry and ethnotropical studies, two scientific names are widely applied to Acmella olearcea (L.) R.K.Jansen, and Spilanthes acmella (L.) Murray.

Acmella olearacea, commonly known as the ‘toothache plant’, is cultivated species, grown primarily for medicinal and ornamental purposes (Jansen 1985). Its flowering head and root are used for curing pain and stimulating salivary in Latin America (Jansen 1985). This species is characterized by its large yellow discoid head, the diameter is >1 cm. It is believed to be derived through the cultivation of A. alba, a native species of Peru (Jansen 1985). In Asia, it is known only from cultivation in China and Taiwan and escape in weedy habitat (Chen and Hind 2011). According to this restriction of distribution and floristic studies in Thailand (Koyama et al. 2016), we observe that the flowering heads of Thai Acmella spp. are smaller. Then we examine the description and photos of A. olearcea published in Thai ethnotropical research along with the voucher deposited in the herbarium of Queen Sirikit Botanic Garden (QBG), we suppose that this name is misapplied to Phak Phed or Thai Acmella.

In another scientific name, Spilanthes acmella (L.) Murray is now treated as a synonym of Blanvillea acmella (L.) Philipsons (Hassler 2018). This species has white flowers which are not in line with the definition of the Thai toothache plant. The species is native to India and Sri Lanka and has been recorded in northern Africa (Orchard 2012) but not in Thailand. It should be noted that the name S. acmella once was applied to Acmeila paniculata (Wall. ex DC.) R.K.Jansen for long time (Jansen, 1985) based on its basionym Verbesina acmella L. However, the type of V. acmella was lately identified as Blanvillea acmella (Koster and Philipson 1950). Therefore, S. acmella could not be served as the basionym of A. paniculata anymore.

The name S. acmella (L.) Murray could be referred to Acmella paniculata (Wall. ex DC.) R.K.Jansen in ethnotropical and phytochemistry studies in Thailand. Acmella paniculata could be distinguished by its discoid yellow heads. This is one of two native Acmella species in Thailand, and we strongly believe that it is a typical Phak Phed. However, this name is applied to Acmella species with noticeable radate capitula in many research documents. Currently, we have observed that the white discoid head Acmella species is now used and sold in the local markets in northern Thailand. Moreover, it is called Phak Phed as same as the typical species, A. paniculata.

The misapplication of the names and confusion of various Acmella spp. is common among ethnotropical and phytochemistry reports, local books of traditional vegetable and medicinal plants, and anonymous information sources on the Internet. This erroneous would lead to the chaotic in future ethnomedical studies and other related studies. Moreover, the recent publication of Flora of Thailand for Asteraceae (Koyama et al. 2016) provides only a key description of two native species, namely A. paniculata and A. uliginosa.

According to these facts, the clarification of the ethno-species ‘Thai toothache plant’ (Acmella spp.) in Thailand is
needed. Here, the keys based on Thai specimens, brief description, and diagnostic notes are provided along with their color photographs. Additionally, we investigate their ethnobotanical uses.

**MATERIALS AND METHOD**

**Taxonomical investigation**

We surveyed herbarium collections, visited local markets, and consulted the local people. The field surveys were conducted from 2016 to 2022. Despite the field collection, the main source of information was based on the voucher deposited in the herbarium of Queen Sirikit Botanic Garden (QBG). Each species included a brief description of some easy characters and character states. We followed Jansen (1985) for details of the description.

**Ethnobotanical investigation**

The ethnobotanical data of Phak Phed (Acmella spp. and Spilanthes acmella) were extracted from 107 bibliographical sources (theses and bachelor studies, published journals, proceeding articles, and unpublished reports) from 1993 to 2018. The criteria for selecting these documents were followed Phumthum et al. (2018). The documents must be original research and have scientific names. Among these, the uses of Phak Phed were reported in 44 documents. The details of these documents are provided in supplementary files. The ethnobotanical use was noted as ‘use-record.’

**Definition of Phak Phed and use-records**

The term Phak Phed referred to an ethno-species, including Acmella spp., which was published and occurred in Thailand. Moreover, it also included the scientific name Spilanthes acmella (L.) Murray. The term ‘use-record’ referred to the different uses reported from different ethnic groups from each bibliographical source. For example, Songsangchun (2015) reported that Thai Yuan and Lava people used Acmella paniculata as vegetables. This would count two use records for A. paniculata reported in this study.

**RESULTS AND DISCUSSION**

**Acmella in Thailand**

The genus Acmella is a small herb, consisting of 30 species which is distributed mainly in the tropical and subtropical regions around the world (Jansen 1985). Some of them are now considered weeds in the pantropic (Mabberley 2017). Five species were previously reported in Thailand (Jansen 1985), including two native species, i.e., A. paniculata and A. uliginosa, and the other three introduced species, i.e., A. brachyglossa, A. calva, and A. ciliata. In this study, another introduced species, A. radicans was firstly reported for its naturalization and uses. There is no specimen nor photo to confirm the occurrence of A. olearaceae in Thailand yet. The keys, brief description, diagnostic notes, and ethnobotanical uses of these species are provided below.

**Key to species of Acmella in Thailand**

1. Head discoid (without ray florets)
   2. Pappus absent; achenes glabrous
   3. Floret white, 4 lobed; inflorescences cluster 2–3 heads; achenes lack a corky margin at maturity, surface lack or with few ciliates, often shouldered
   5. A. radicans
   4. A. paniculata

4. Disc florets 4- or 5-merous; phyllaries uniseriate, 5-6; achenes 1.2–1.8 mm long.

6. A. uliginosa

**Taxonomic notes**

**Acmella brachyglossa**

Acmella brachyglossa Cass., Dict. Sci. Nat. (ed. 2) 50: 258. 187; Jansen, Syst. Bot. Monogr. 8: 73. 1985; Chung et al. Bot. Stu. 49: 74. 2008.

Erect, decumbent herb ca 10–30 cm high. Stem glabrous to slightly pilose. Leaves ovate, 2–9 × 1–5 cm, acute to acuminate. Head radiate, terminal or axillary solitary or cluster of 2–3 heads, cone-like, 5–9 mm diam. Phyllaries 2-seriate. Ray florets 5–8, tube ca 1 mm long, limbs 0.5–1.6 mm long, corollas pale yellow. Disc florets ca 2 mm long, 4-5 lobed, pale yellow. Achenes black, ca 2 mm long, strigose, margin densely ciliate without clear cork-like margin; pappus of two subequal bristles.

**Distribution.** A weedy species commonly found in Central America, northern South America, and the West Indies (Jansen 1985). Also widely cultivated and naturalized in Taiwan (Chung et al. 2008)

**Ecology.** This species is a weedy found in the wasteland and roadside. It also grows in moist places along the ditches and steam.

**Ethnobotanical uses.** Tender shoot and inflorescence are eaten as a vegetable by ethnic people like Karen or Hmong [QBG-44900, 45195, 102375, 102495]. Leaves are used to treat toothache, snake, and scorpion bites by Hmong people [QBG-102495].

**Note.** Acmella brachyglossa is a weedy species, it is found in many areas, especially on the roadside and in abandoned areas. Although the occurrence is indicated in Jansen (1985), without citing any voucher specimen. It
could be said that this is the first time that this species has been officially reported from Thailand. Despite its widespread, there is no report about its invasive status. Comparing the distribution, A. brachyglossa should be considered as the same rank as A. ciliata which was recently approved as invasive species in Thailand (FPCRO, 2019).

This species could be easily distinguished from other Acmella species in Thailand by its pale yellow or greenish head with inconspicuous ray florets (other species with radiate head, i.e., A. ciliata and A. uliginosa have a yellow or orange-yellow head). In dried specimens, these characteristics of achenes are especially useful for identification, i.e., densely ciliate without cork-like margin, a well-developed pappus of 3 or 2 subequal bristles.

_Acmella calva_

_Acmella calva_ (DC.) R.K.Jansen, Syst. Bot. Monogr. 8: 41. 1985

Decumbent, perennial herb 20–30 cm high, sparsely to moderately pilose. Leaves narrowly ovate to ovate, 2.5–6 × 1–3 cm, acute, sparsely to moderately strigose; petioles up to 2 cm. Head disoid, axillary, or terminal solitary, cone-like, 6–8 diam. Phyllaries 2-seriate. Corolla ca 2 mm long, 5 lobed, yellow to orange-yellow. Achenes 1.7–2.2 mm long, glabrous, lacking a cork-like margin; pappus absent.

**Distribution.** China (Yunnan), India, Indonesia, Myanmar, Nepal, Philippines, Sri Lanka

_Ecology._ It grows in weedy habitats, streamsides, marshes, forest margins; 1000–1900 m asl. (Chen and Hind 2011).

**Ethnobotanical uses.** (not recorded)

**Note.** Beside a specimen collected by H.B.G. Garrett in 1931 (H.B.G. Garrett-678, L.2999556, L) from Doi Pa Kao (ดอกปากาอว), Chiang Mai, no other specimen is found. This species could be distinguished by the following combinations, i.e., yellow discoid head; achenes glabrous, without pappus; stem decumbent or repent with rooting at nodes.

_Acmella ciliata_

_Acmella ciliata_ (Kunth) Cass., Dict. Sci. Nat. (ed. 2) 24: 331. 1822; Jansen, Syst. Bot. Monogr. 8: 36. 1985; Chung et al., Bot. Stu. 49: 76. 2008.

Decumbent, perennial herb, 20–60 cm high. Stem unbranched to branched, glabrous to sparsely pilose. Leaves ovate to broadly ovate, 2.0–7 × 1–5 cm, apex acute, glabrous to sparsely pilose; petioles up to 0.7–4 cm, narrowly winged. Head radiate, terminal or axillary solitary or cluster of 2–3 heads, broadly ovate or cone-like, 5–10 diam. Phyllaries 2-seriate. Ray florets 5–10, tube 0.9–2 mm, limb 1–4 mm, yellow-orange. Disc florets ca 2 mm long, 5 lobed, yellow-orange. Achen black, ca 1.8 mm long, margins sparsely to moderately ciliate, with clear cork-like margins; pappus usually absent or of 2 short subequal bristles less than 1 mm long.

**Distribution.** Native to South America; widely naturalized in the south and southeast Asia

_Ecology._ Found mostly in a moist area, marshy; elevation up to 2000 m

**Ethnobotanical uses.** Leaves are eaten raw as a vegetable by people in southern Thailand (Upho 2005, as _Spilanthes paniculata_).

**Note.** Another naturalized and widespread species. One of the invasive species in protected areas of Thailand (FPCRO, 2019). _Acmella ciliata_ is characterized by its radiate, yellow-orange, ovoid head. It is commonly used and sold in the local markets. The plant is commonly mistakenly described under the name _A. paniculata_, which could be found in many textbooks and on the Internet. This species has radiated flower head which clearly differed from _A. paniculata_.

_Acmella paniculata_

_Acmella paniculata_ (Wall. ex DC.) R.K. Jansen, System Bot. Monogr. 8: 67; Chung et al., Bot. Stu. 49: 78. 2008.

Erect, annual herb up to 40 cm high. Stem branched, glabrous to sparsely pilose. Leaves narrowly ovate to ovate, 2–6 × 0.8–4.5 cm, acute to acuminate; sparsely ciliate; petals 0.5–5 cm. Head discoid, axillary or terminal solitary, cone-like, 7–10 diam. Phyllaries 2-seriate. Corolla ca 1.5–2.2 mm long, 4–5 lobed, yellow. Achenes deep brown, 2–3 mm long, sparsely to densely tuberculate, margins moderately ciliate with clear cork-like margins; pappus of 2 subequal bristles.

**Distribution.** India (E India, type), China, Southeast Asia, Sri Lanka

_Ecology._ Wasteland, the agricultural field, roadsides; elevation 800–2000 m

**Ethnobotanical uses.** Leaves and inflorescence used as a vegetable, also used as ‘toothache’ plant. More information in Tables S1 and S2.

**Note.** We believed that _A. paniculata_ is a typical species for the ethno-species Thai toothache plant. It is characterized by the following combined characteristics, i.e., yellow discoid head and achenes with clear cork-like margin, surface with tuberculate ciliate.

The cultivated variety is planted in the Karen rice field of Thailand as a vegetable. It could be eaten as fresh vegetables or pickled. The overall size of the variety is bigger than the common variety, i.e., ca 50 cm high and the head is ca 1–2 cm in diameter. However, the achenes are similar to the common variety.

_Acmella paniculata_ is one of the common vegetables in northern Thailand and some areas of northeastern. It is eaten fresh or as part of curry vegetables. Moreover, it is used as spices for its pungent taste. Medicinally, the crush of the whole plant is used to treat rash (QBQ-105882).

_Acmella radicans_

_Acmella radicans_ (Jacq.) R.K.Jansen, Syst. Bot. Monogr. 8:69. 1985; Maity et al., Nelumbo 59: 54–57. 2017.

Erect herb ca 50 (–90) cm high. Stem little branched to many-branched, sparsely hairy. Leaves ovate or ovate-homboid, 3–8 × 1–4 cm, acute, sparsely hairy; petals up to 2 cm. Head discoid, axillary or terminal cluster of 2–3 (5) heads, cone-like, 4–5 mm diam. Phyllaries 2-seriate. Corolla ca 2 mm long, 4 (5) lobed, white or greenish-white.
Achenes 2–2.7 mm long, moderately to densely ciliate with straight-tipped hairs, often with apical shoulders; pappus of 3 (for the outer series of achenes) or 2 subequal bristles.

**Distribution.** America, Bangladesh, Mexico, recently recorded as a weed in eastern India (Maity et al. 2017)

**Ecology.** Waste areas, cultivated fields or along the roadside, and the stream. Flowering all year round.

**Ethnobotanical uses.** Karen people, occasionally, eat the leaves as a vegetable. It is occasionally sold in the local market in northern Thailand along with other *Acmella* spp. Another variety, var. *debilis* (Humboldt, Bonpland & Kunth) R.K. Jansen, is distributed in South America (Jansen 1985) and India (Jagtap and Bachulkar 2015).

**Note.** This species grows as a weed in waste areas. It is easy to recognize by the white discoid heads, with exclusively 4-merous white or greenish-white florets. Its inflorescence is an axillary or terminal cluster of 2–3 heads.

*Acmella uliginosa*

*Acmella uliginosa* (Sw.) Cass., Dict. Sci. Nat. (ed.2) 24: 331. 1882; Jansen, Syst. Bot. Monogr. 8: 55. 1985; Chung et al., Bot. Stu. 49: 79. 2008.

Erect or decumbent, annual herbs, 10–20 (–40) cm high. Stem one to several from base, glabrous to moderately pilose. Leaves lanceolate, narrowly ovate or ovate, 1.5–3 × 0.4–2.3 cm, apex acute to acuminate; petioles 0.5–1.5 cm. Head radiate, terminal solitary or cluster of 2–3 heads, ovoid, 4–6 diam. Phyllaries are uniseriate. Ray florets 4–7, tube ca 1 mm long, limb 1–2 mm long, yellow to yellow-orange. Disc florets 1.5–3 mm long, 4 lobed, yellow-orange. Achenes black, 1.2–1.5 mm long, margin ciliate; pappus of 2 sub- or unequal bristles.

**Distribution.** Native to tropical regions in Africa, America, and Asia. The species has now become invasive in the wet area of Pacific islands (Chung et al. 2008).

**Ecology.** Moist areas, rice field, roadside, elevation 400–1200 m

**Ethnobotanical uses.** It is occasionally sold in the local market as a vegetable like other *Acmella* spp. It is less preferred than other species because of its small habit.

**Note.** *Acmella uliginosa* is easily recognized by its small head with short ray florets and 4-merous disc florets. It is another native species which is a pantropical weed.
Figure 3. *Acmella paniculata* (Wall. ex DC.) R.K.Jansen. A-B. Cultivated plant; A. Habit, B. Inflorescence; C. Inflorescence of wild species

Figure 4. *Acmella radicans* (Jacq.) R.K.Jansen: A. Inflorescence, B. Plant habit

Figure 5. *Acmella uliginosa* (Sw.) Cass.: A. Inflorescence, B. Plant habit
Ethnobotany of Thai toothache plant

A total of 88 use records from 44 ethnobotanical studies were recorded for the uses of the Thai toothache plant (Tables S1 and S2). Six scientific names were reported, i.e., Acmella brachyglossa, A. ciliata, A. oleracea, A. paniculata, A. uliginosa, and Spilanthes acmella. The use-records of A. oleracea contributed to more than 50% of total use-records (49 out of 88). Spilanthes acmella was second highest use-records, ca 27%. As previously mentioned, these two species are not found in Thailand yet. Although S. acmella could be referred to A. paniculata, there is no rigid proof. The name could also refer to A. oleracea (Barbosa et al. 2016). Moreover, most of the studies lack the voucher for further confirmation of corrected species. Therefore, it is worth considering these species as one ethno species.

Thai toothache plant is commonly used as vegetable or medicines with 56% and 42% of total use-records, respectively. Besides these, it was used to feed the pigs, combined with other vegetables (Srisanga 1993; Panyadee 2012). Young shoot and inflorescence were the most preferred plant parts. It could be eaten raw or added to a vegetable curry. More information is provided in Table S1.

A total of 37 use records for the medicinal purpose were documented from 44 ethnobotanical studies (Table S2). The Thai toothache plant was used to treat various ailments but mostly to treat toothache (54%). Acmella oleracea has been wildly cited for its use as a folk remedy for treating toothache. By chewing its caputula, the mouth will numb and temporarily relieve dental and oral pain (Jansen 1985; Hind and Biggs 2003). This has resulted from the analgescic effect of spilanthen (Barbosa et al. 2016). Spilanthes is a bioactive compound that can be found in many Acmella species (Paulraj et al. 2013; Barbosa et al. 2016). Therefore, it is not surprising if the plant is also commonly used to treat toothache in Thailand.

In conclusion, Phak Phed or Thai toothache plant is a common vegetable and medicinal plant in Thailand. This ethno species referred to plants in the genus Acmella. Previously, two scientific names were widely applied to this ethno species, i.e., Acmella oleracea and Spilanthes acmella. Both of them are proved as invalid names of Phak Phed. The confusion of the names applied for Phak Phed would also lead to chaos in further phytochemistry and ethnopharmacological study because it did not confirm which species were tested. This problem could be easily solved if the voucher specimens are made. Unfortunately, this is not common in past studies. Therefore, further comparative studies of Acmella spp. for their bioactivities are still needed.

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**Figure 6.** Comparing seeds of Acmella in Thailand. A. A. Paniculata, B. A. Radicans, C. A. Brachyglossa, D. A. Uliginosa, E. A. ciliata (scale = 1 mm)
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Table S1. The use of the ethno-species “Phak Phed” as food reported in Thai ethnobotanical studies

| Use                              | Ethnicity         | Part of uses                      | Reference                             | Scientific name in Reference                  |
|----------------------------------|-------------------|-----------------------------------|---------------------------------------|-----------------------------------------------|
| Cooked for pungent flavoring     | Hmong             | Entire leaf                       | Srithi (2012)                         | Acmella oleracea (L.) L.                      |
|                                  | Lawa              | Entire leaf                       | Songsangchun (2015)                   | Acmella paniculata (Wall. ex DC.) R.K.Jansen  |
|                                  | Thai Yuan         | Entire leaf                       | Songsangchun (2015)                   | Acmella paniculata (Wall. ex DC.) R.K.Jansen  |
| Part of vegetable curry          | Htin              | Leaf sheath                       | Tangtragoon (1998)                    | Acmella oleracea (L.) L.                      |
|                                  | Karen             | Inflorescence, leaf sheath        | Tovararonte (2003)                   | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   | Inflorescence, young shoot        | Trisonthi et al. (2007)              | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   | Leaf sheath                       | Kamwong (2010)                       | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   | Young shoot                       | Johnsson & Grivetti (2002)           | Acmella paniculata (Wall. ex DC.) R.K.Jansen  |
|                                  | Khamu             | Entire leaf                       | Srithi (2012)                         | Acmella oleracea (L.) L.                      |
|                                  |                   | Leaf sheath, young shoot          | Srithi (2012)                         | Acmella oleracea (L.) L.                      |
|                                  |                   | Young shoot                       | Srithi (2012)                         | Acmella oleracea (L.) L.                      |
|                                  | Lahu              | Inflorescence, young shoot        | Chanklom (2006)                      | Acmella oleracea (L.) R.K.Jansen              |
|                                  | Lawa              | Leaf sheath                       | Tangtragoon (1998)                   | Acmella oleracea (L.) L.                      |
|                                  |                   | Young shoot                       | Yaso (2000)                          | Acmella oleracea (L.) L.                      |
|                                  | Lisu              | Flower, young shoot               | Boonkorn (1997)                      | Acmella oleracea (L.) L.                      |
|                                  | Luu               | Young shoot                       | Srithi (2012)                         | Acmella oleracea (L.) L.                      |
|                                  | Mien              | Young shoot                       | Tovararonte (1998)                   | Acmella oleracea (L.) L.                      |
|                                  | Shan              | Inflorescence                     | Pongamornkul and Muangyen (2012)     | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   | Inflorescence, young shoot        | Sriboonpoom (2011)                   | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   | Leaf sheath                       | Pongamornkul and Muangyen (2012)     | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   | Young shoot                       | Panyadee (2012)                      | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   |                                  | Tangtragoon et al. (2004)            | Acmella oleracea (L.) L.                      |
|                                  | Tai Lue           | Aerial parts                      | Tovararonte (1998)                   | Acmella oleracea (L.) L.                      |
|                                  |                   | Entire leaf, young shoot          | Muangyen (2013)                      | Acmella oleracea (L.) R.K.Jansen              |
|                                  | Thai              | Aerial parts                      | Turrera-Garcia et al. (2017b)        | Acmella paniculata (Wall. ex DC.) R.K.Jansen  |
|                                  | Thai Yuan         | Inflorescence, leaf sheath        | Trisonthi et al. (2007)              | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   | Inflorescence, young shoot        | Kruesan (1998)                       | Acmella oleracea (L.) L.                      |
|                                  |                   |                                  | Muangyen (2013)                      | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   |                                  | Tovararonte (2001)                   | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   | Leaf sheath                       | Songsangchun (2015)                  | Acmella oleracea (L.) L.                      |
|                                  | Yunnan Chinese    | Young shoot                       | Ponpim (1996)                        | Acmella oleracea (L.) L.                      |
| Side dish vegetables of chili paste | Akha              | Young shoot                       | Thatsaneyakorn (1997)                | Acmella oleracea (L.) R.K.Jansen              |
|                                  | Karen             | Inflorescence, young shoot        | Khamfacuhoa (2008)                   | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   |                                  | Sansupub (2010)                      | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   | Leaf sheath                       | Winjichaiyong (1995)                 | Acmella paniculata (Wall. ex DC.) R.K.Jansen  |
|                                  |                   | Young shoot                       | Pongamornkul and Muangyen (2013)     | Acmella oleracea (L.) R.K.Jansen              |
|                                  | Kayah             | Aerial parts                      | Trisonthi et al. (2007)              | Acmella oleracea (L.) R.K.Jansen              |
|                                  | Khamu             | Inflorescence, young shoot        | Supawanmolpan (2011)                 | Acmella oleracea (L.) R.K.Jansen              |
|                                  |                   | Young shoot                       | Pongamornkul (2006a)                 | Acmella oleracea (L.) R.K.Jansen              |
|                                  | Lawa              | Young shoot                       | Inta et al. (2011)                   | Acmella oleracea (L.) R.K.Jansen              |
|                                  | not mention specifically | Leaf sheath                       | Srithi et al. (2017)                | Acmella oleracea (L.) R.K.Jansen              |
|                                  | Shan              | Inflorescence, young shoot        | Inta et al. (2011)                   | Acmella oleracea (L.) R.K.Jansen              |
|                                  | Tai Lue           | Inflorescence, young shoot        | Inta (2008)                          | Acmella oleracea (L.) R.K.Jansen              |
|                                  | Thai Yuan         | Young shoot                       | Penpanassak and Inta (2018)          | Acmella oleracea (L.) R.K.Jansen              |
Table S2. The use of the ethno-species “Phak Phed” as medicines reported in Thai ethnobotanical studies

| Use as/to treat | Part of uses | Preparation/application | Ethnicity | Reference | Scientific name in Reference |
|-----------------|--------------|-------------------------|-----------|-----------|-----------------------------|
| Anthelmintics   | Entire plant | #NA                     | Karen     | Kantasrila (2016) | Acmella oleracea (L.) R.K.Jansen |
|                 | Flower, young shoot | Eaten raw | Karen | Kaewsangsai (2016) | Acmella paniciulata (Wall. ex DC.) R.K.Jansen |
| Aphthous ulcer  | Leaf sheath  | Chewing                | Lisu      | Panta (2015)    | Acmella oleracea (L.) R.K.Jansen |
| Blood tonic     | Entire plant | Decoction/Drink         | Shan      | Pongamornkul and Muangyen (2012) | Acmella oleracea (L.) R.K.Jansen |
| Enhance appetite| Entire plant | Eaten raw               | Shan      | Pongamornkul and Muangyen (2012) | Acmella oleracea (L.) R.K.Jansen |
| Fever           | Entire plant | Decoction/Bath          | Shan      | Pongamornkul and Muangyen (2012) | Acmella oleracea (L.) R.K.Jansen |
| Flatulence      | Inflorescence | Decoction (part of formular) | Thai | Neamsuvan et al. (2013a) | Acmella oleracea (L.) R.K.Jansen |
| Hemorrhoids     | Entire plant | Decoction/Drink         | Lawa      | Pongamornkul (2006a) | Acmella oleracea (L.) R.K.Jansen |
| Laxative        | Entire plant | Decoction/Drink         | Shan      | Pongamornkul and Muangyen (2012) | Acmella oleracea (L.) R.K.Jansen |
| Muscular pain   | Aerial parts | #NA                    | Thai      | Turreira-Garcia et al. (2017b) | Acmella paniciulata (Wall. ex DC.) R.K.Jansen |
|                 | Entire plant | Steam (part of formular) | Lawa   | Pongamornkul (2006a) | Acmella oleracea (L.) R.K.Jansen |
|                 | Root         | #NA                    | Karen     | Kamwong (2010)    | Acmella oleracea (L.) R.K.Jansen |
|                 | Leaf sheath  | Decoction/Bath          | Khamu     | Srithi (2012)     | Spilanthes acmella (L.) L. |
|                 | Leaf sheath  | Pounded/Poultice        | Khamu     | Tangtragoon (1998) | Spilanthes acmella (L.) L. |
|                 | Leaf sheath  | Eaten raw               | Karen     | Kantasrila (2016) | Acmella oleracea (L.) R.K.Jansen |
|                 | Entire plant | Keep in mouth           | Karen     | Trisonthi and Trisonthi (2009) | Spilanthes acmella (L.) L. |
|                 | Inflorescence | Pounded with salt/Poultice | Thai Yuan | Tovaranonte (2001) | Acmella oleracea (L.) R.K.Jansen |
|                 |             | #NA                    | Hmong     | Nuammee (2012)    | Acmella ciliata (Kunth) Cass. |
|                 | Leaf sheath  | Pounded/Poultice        | Hmong     | Srithi (2012)     | Spilanthes acmella (L.) L. |
|                 |             | Put in steamed egg      | Hmong     | Nuammee (2012)    | Acmella ciliata (Kunth) Cass. |
|                 |               |                       | Shan      | Pongamornkul and Muangyen (2012) | Acmella oleracea (L.) R.K.Jansen |
|                 | Root         | Decoction/Drink         | Karen     | Kaewsangsai (2016) | Acmella paniciulata (Wall. ex DC.) R.K.Jansen |
|                 |             | Put in chicken soup     | Hmong     | Nuammee (2012)    | Acmella ciliata (Kunth) Cass. |
|                 |             |                       | #NA       | Karen (2010)      | Acmella oleracea (L.) R.K.Jansen |
|                 |             |                       |          | Songsangchun (2015) | Acmella paniciulata (Wall. ex DC.) R.K.Jansen |
|                 | Stem        | Keep in mouth          | Thai Yuan | Songsangchun (2015) | Acmella oleracea (L.) R.K.Jansen |
|                 | Unspecified | Chewing               | Thai      | Neamsuvan et al. (2012a) | Acmella oleracea (L.) R.K.Jansen |
|                 | Wounds      | Entire plant           | Thai      | Neamsuvan and Bunmee (2016) | Acmella oleracea (L.) R.K.Jansen |
|                 | Leaf sheath | Pounded/Poultice       | Kayah     | Trisonthi et al. (2007) | Acmella oleracea (L.) R.K.Jansen |