

**Genus: *Calanthe* Brown**

Chinese name: *Xiaji Lan* (prawn spine orchid)  
 Japanese name: *Ebine*

*Calanthe* are sympodial orchids with short stems and several plicate, elliptical leaves that are spirally arranged, or arranged in two rows, ensheathing the stem. Inflorescences arise at the side or from the base and carry many showy flowers on a short raceme. Approximately 100 species of *Calanthe* are distributed across tropical Asia to the Pacific Islands, tropical and southern Africa. A single species occurs in Central America. They are mainly terrestrial, with a few epiphytic members and occur at low to high elevations. Some species are deciduous, others evergreen. The plant and its flowers turn bluish when they are bruised.

*Calanthe* is the first orchid species to be artificially hybridised by man. Many species have attractive flowers. Indeed, the name, *Calanthe*, was derived from two Greek words, *kalos* (beautiful) and *anthe* (bloom), meaning 'beautiful flower'. The shape of the lip is an important criterion for distinguishing among species.

***Calanthe alismifolia* Lindl.**

*Calanthe nigropuncticulata* Fukuyama

Chinese names: *Zexixiaji Lan* (glossy prawn spine orchid), *Xidiangenjie Lan* (small spots

segmented root orchid); in Taiwan: black-spotted *Calanthe*; white flower *Calanthe*  
 Chinese medicinal name: *Zongyeqi*

Description: Plant is 21–40 cm tall with thick fibrous roots. Pseudobulb is conical-ovoid 15–2 by 1 cm in diameter. Leaves are 3–5 in number, elliptic, and with a short petiole. Flowers are white, tinged with violet, of good form, 1.5 to 2 cm across, arranged in two rows. Individual flowers are closely arranged near the top of the 30-cm-tall scape, with many unopened buds above. Petals and sepals are broadly oval. Lip is deeply trilobed, the side lobes linear and the mid-lobe fanning out towards the apex and deeply cleft at the tip. Several yellow, warty calli are present at the base of the lip (Fig. 9.1). Flowering period is June and July. *C. alismifolia* thrives in dense forests at 800–1700 m. It is distributed from southern Japan and Taiwan to Hubei, Hunan, Sichuan, Yunnan and Xizang in China to northeast India, Sikkim and Nepal (Pearce and Cribb 2002).

Herbal Usage: Plants are harvested in summer and autumn, washed clean and sun-dried for future use. The herb is acrid in taste, slightly bitter and considered to be cool in nature. In Traditional Chinese Medicine (TCM), the whole plant is antipyretic and it detoxifies, removes gas and humidity, reduces stasis of blood, reduces swellings, improves blood circulation, and heals ulcers, scrofula, haematuria and traumatic injuries, the last being its principal



**Fig. 9.1** *Calanthe alismifolia* Lindl. (Photo: E.S. Teoh)

usage. For consumption, decoction is made with 6–12 g of the whole dried plant (Wu 1994; *Zhongyao Bencao* 2000; Ou et al. 2003).

### ***Calanthe alpina* Hook. f. ex Lindl.**

Syn. *Calanthe fimbriata* Franch.

Chinese name: *Liusuxiaji Lan* (tassels prawn spine orchid)

Medicinal names: *Mayaqi* (horse teeth seven)—the name is shared with *Calanthe davidii*; *Jiuxilian* (nine son lotus), *Daxiancao* (large divine herb)

Description: Plant is 30–50 cm tall. Pseudobulbs are small, 7 mm in diameter, conical, and terminating in a short pseudo-stem which is ensheathed by three or four thin, elliptic leaves with undulating margins. Leaves are 11–26 by 3–6 cm. Inflorescence is axillary, erect, 3–12 cm tall. Up to a dozen, nodding, pink flowers are carried on the erect inflorescence. Flowers are 3–4 cm across and are darker-coloured on the dorsal surface than on the under-surface of the petals and sepals. Lip is white or pale yellow veined with purplish-red (Chen et al. 1999; Perner and Luo 2007). Flowering period is June to September.

*C. alpina* is widespread in northern Sichuan in mixed broad-leaved, evergreen forest at 2200–2450 m but it is not common (Rathore 1983; Perner and Luo 2007). The species is distributed in southern Shaanxi, southern Gansu, Sichuan, west Yunnan and southern Xizang to Sikkim, Taiwan and Japan. It occurs in montane forests or on grassy slopes at 1500–3500 m (Chen et al. 1999).

Herbal Usage: The herb is collected in summer from Hebei, Shanxi, Hunan, Hubei, Guizhou, Yunnan and Sichuan (Wu 1994). Roots and stem are used to remove “heat” and toxins, relieve pain, and dispel “wind” or to hasten the disappearance of ecchymosis. *C. alpina* is prescribed for stomach ulcer, acute distension of the stomach, hepatitis, scrofula, toothache, sore throat, common colds, painful joints, fatigue, snake bite, and traumatic and chest injuries (*Zhongyao Da Cidian* 1986; Wu 1994; *Zhonghua Bencao* 2000). It can be used in three ways: (1) by itself in decoction, using 15–30 g fresh herb; (2) to treat chronic pharyngitis, also in decoction, *Mayaqi* (*C. fimbriata*/*C. alpina*) 30 g together with *Ba zhao long* 60 g; and (3) as a paste for external application, just grinding a suitable amount of *Mayaqi*. These prescriptions were originally published in *Shaanxi Chinese Herbs* (*Zhongyao Da Cidian* 1986).

(Illustration: see Flora of China Orchids, p. 136, Fig. 28/29)

### ***Calanthe brevicornu* Lindl.**

Syn. *Calanthe lamellosa* Rolfe

Chinese name: *Shenchunxiaji Lan* (kidney lips prawn spine orchid)

Description: This is a pretty *Calanthe*. Pseudobulb is conical, 2 cm thick, bearing 3 or 4 elliptic, plicate leaves, 10 by 5–11 cm sheathing a pseudo-stem, 5–8 cm in length. Scape is up to 30 cm long with many widely-spaced flowers of white to yellowish-green (brick red in the Indian varieties), 2–3 cm across, well expanded. Lip is trilobed and carries prominent, symmetrical kidney-shaped red patches on its large

mid-lobe. It flowers from May to June. The species is distributed from northeast India, Bhutan and Nepal to Xizang, Yunnan, Sichuan, Hubei and Guangxi in China (Chen et al. 1999). At Huanglong in Sichuan Province, it occurs at 1800–2300 m in open scrub. Flowers in some clones smell of cinnamon (Perner and Luo 2007).

Usage: CHM employs the root to counter ‘heat’, promote diuresis, arrest bleeding, reduce swelling, and to treat nephritis or the presence of blood in the urine. It is used to promote expulsion of an incompletely delivered placenta, recovery after a stillbirth, or to stop abdominal pain caused by ‘poor air flow’ (Wu 1994). There is no mention of the herb in *Zhongyao Bencao* (2000).

### ***Calanthe cardioglossa* Schltr.**

Thai names: *Ueang namton*, *Uang liam*

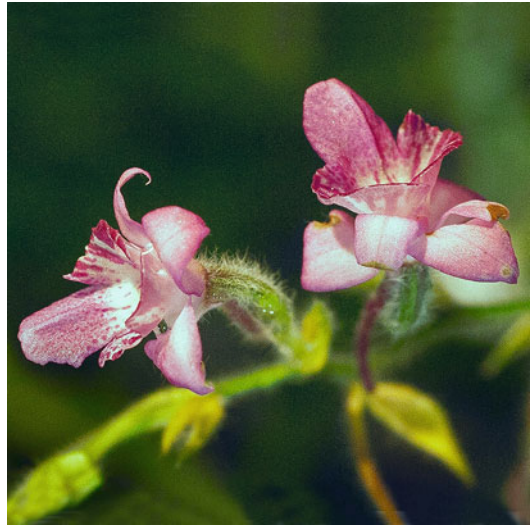
Description: This terrestrial orchid is 7–15 cm tall. Pseudobulbs are shaped like small flasks. Leaves are elliptic, 18–25 by 7–10 cm, deciduous. Inflorescence is erect, 20–40 cm with 10–15 flowers but usually only 2 are open at a time. Flowers are 1.2–1.5 cm across, ranging from white to light lavender to deep rose, changing to orange or yellow before dropping. The trilobular lip is prominent, carries a thin, long spur, and is about half the size of the flower. Side lobes are marked with deep purple blotches and striping (Fig. 9.2). Flowering season is November to February (Vaddhanaphuti 2005; Nanakorn and Watthana 2008). The species is distributed in northern, northeastern, eastern and southern Thailand and in Laos and Vietnam.

Herbal Usage: The stem is used as a tonic in Thailand (Chuakul 2002).

### ***Calanthe ceciliae* Rchb. f.**

Malay name: *Sebueh*

Description: *C. ceciliae* is a large *Calanthe*, 25–40 cm tall. Leaves are elliptic, plicate, up to 40 by 15 cm. Inflorescence is erect, arising from the base of the stem, 1 m tall, 3 cm wide, with



**Fig. 9.2** *Calanthe cardioglossa* Schltr. (Photo: E.S. Teoh)

few, mauve to pale violet flowers that turn a brownish-orange or apricot as they age (Fig. 9.3). Its distinctive feature is an upward pointing, slim, white spur (Rhodehamel 2005). It flowers from August to October in Thailand (Nanakorn and Watthana 2008). The species is distributed in Assam, Thailand, Peninsular Malaysia Sumatra and Java at 500–2000 m (Comber 2001). In lowland forests, it sometimes occurs on limestone (Yong 1990). The white variety is cleistogamous (Handoyo 2010).

Herbal Usage: Burkill (1935) quoting K. Heyne (1927) reported that in Sumatra the flowers were used as a poultice to relieve the pain of ulcers.

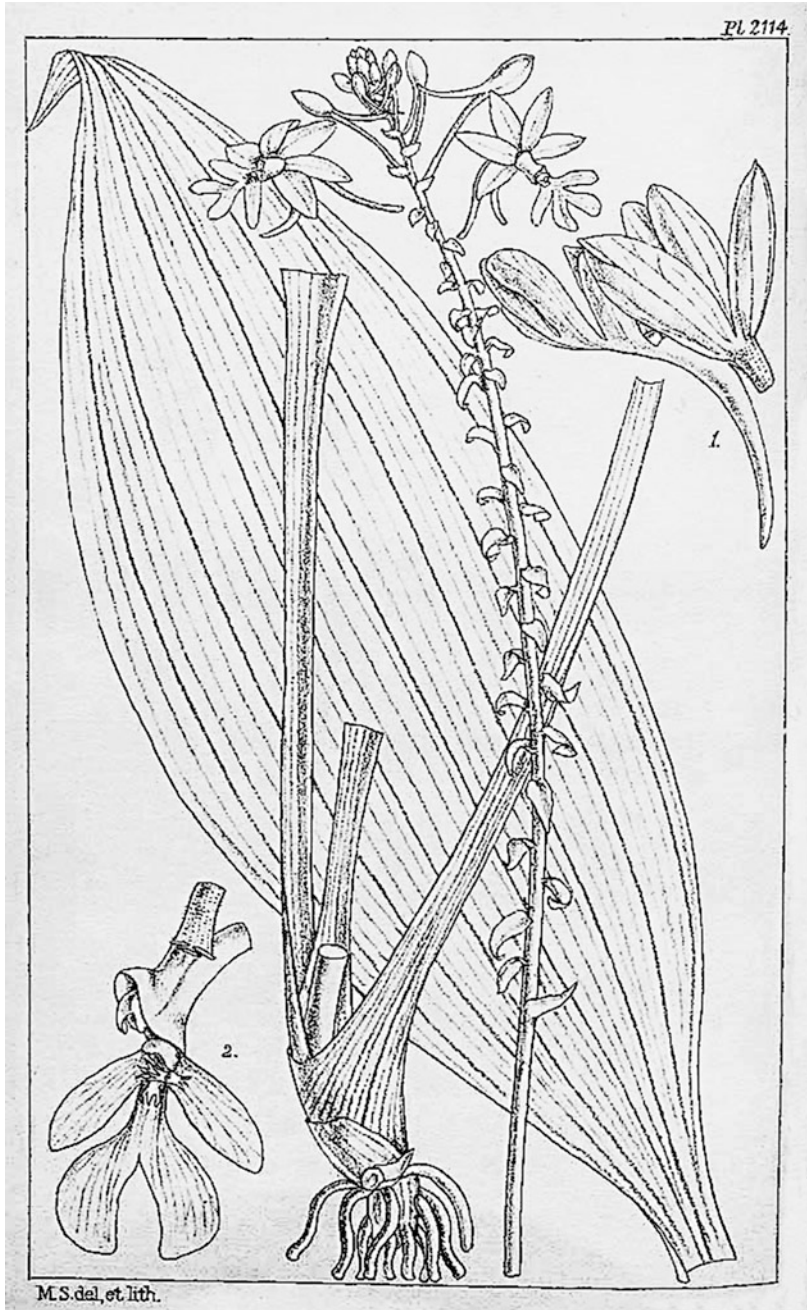
### ***Calanthe davidii* Franch.**

Chinese name: *Jianyexiaji Lan* (sword leaf prawn spine orchid) *Changyegenjie Lan*

Chinese medicinal name: *Mayaqi* (the name is shared with *Calanthe alpina*)

Description: Plant is 30–50 cm tall with 6–10 long and narrow, ensiform or lorate, membranous leaves, 20–60 by 1–4 cm. Inflorescence is 60–80 cm tall but may reach a height of 120 cm (Perner and Luo 2007). Flowers are numerous, crowded, randomly orientated, pale green or

**Fig. 9.3** *Calanthe ceciliae* Rchb. f. (as *Calanthe wrayi* Hook. f.) From: Hooker W.J., Hooker, J.D., *Icones Plsntarum*, vol 22: t. 2114 (1894). Drawing by M. Smith. Courtesy of Missouri Botanical Gardens, St. Louis, USA



white with reflexed petals and sepals. Lip is white, three-lobed, and quite variable in shape and size. *C. davidii* usually flowers in June and July (Chen et al. 2009a).

*C. davidii* is distributed from India across southern China to Taiwan and southern Japan, occurring in forests at 1200–2000 m. However,

the last time it was collected in India was in July 1899 (Rathore 1983). It is probably seriously endangered or extinct in the Himalayas. Perner (2007) found it growing and flowering in between *Cypripedium wardii* at 1620 m in pine forest in Sichuan in late May. Plants were most luxuriant at the grass borders.



Herbal Usage: Herb (*Mayaqi*) refers to both *C. alpina* and *C. davidii* although the vegetative appearance of the two species is dissimilar. They are generally supplied by the same provinces, Hebei, Shanxi, Hunan, Hubei Guizhou, Yunnan and Sichuan. Guangxi also supplies *C. alpina* but does not produce *C. davidii*. Stems and roots of *C. davidii* are used in the same manner and for the same conditions as those of *C. alpina* in Chinese Herbal Medicine (Wu 1994; *Zhongyao Bencao* 2000).

### ***Calanthe densiflora* Lindl.**

Chinese name: *Zhuyegenjie Lan* (bamboo leaf segmented root orchid), *Mihuaxiaji Lan* (prawn spine flower orchid)

Description: A terrestrial herb found in shaded hardwood forests. Rhizomes are long, terete, about 8 mm in diameter, from which arise 7–9 cm tall shoots bearing 2–3 lanceolate or narrowly elliptic leaves of 20–40 by 2.3–6.5 cm, and 5-ribbed. Scape is 20 cm tall, arising from the rhizome adjacent to a mature shoot, and carries a crowded head of yellow flowers at the apex, each about 1.5 cm across. Lip is trilobed: side lobes ovate, middle lobe large, oblong and with two large keels at the base. The species is found in the southern Himalayas, China, Indochina and Japan: in Taiwan, below 1500 m throughout the island. It is the last *Calanthe* to flower in Taiwan, flowering from October to December (Lin 1975).

Herbal Usage: The *Taiwanese Chinese Herbal* states that the whole plant improves blood circulation, and reduces stasis of blood and swellings. It removes gas and humidity and is used to treat rheumatism, backache, pain affecting the lower limbs, running sores and traumatic injuries (Lin et al. 2003).

### ***Calanthe discolor* Lindl.**

Chinese names: *Xiaji Lan* (prawn spine orchid)  
Chinese medicinal names: *Jiuzilianhuancao* (nine united sons flowering herb)—this name also refers to *Calanthe tricarinata*; *zhu chuan*

*zhu* (string of beads); *ye baiji* (night white chicken); *Roulainhuan* (meat in circles); *Jiujiechong* (nine segment bug); *Yichuanniuzi* (string of buttons).

Description: *C. discolor* is a robust *Calanthe*, 40–65 cm tall, with 3 elliptic-oblong leaves, 13–25 by 3–9 cm, not deciduous. Pseudobulbs are small, 1 cm in diameter. Inflorescence is axillary, erect, 20–30 cm tall, densely pubescent bearing 10 round, nodding, purplish-brown to pale maroon flowers with a white lip. Flowers may be clustered or spaced out. They are 2 cm across and appear from April to May. *C. discolor* grows in considerable profusion on the forest floor, preferring sloping terrain, at 700–1500 m in an arc in southeastern China from Guizhou to Guangdong, Fujian and Zhejiang to Japan. It is widespread throughout most of the Japanese islands (Japan Calanthean Society 1987).

Phytochemistry: Calanthoside (a novel indole, *S,O*-bisdesmoside), glucoindican, calaliukiuenoside, calaphenanthrenol, tryptanthrin, indirubin, isatin and indicant were obtained by methanolic extraction of *C. discolor* and *C. liukiensis*. The first four compounds improved blood flow through the skin and promoted hair growth (Yoshikawa et al. 1998).

Acid hydrolysis of calanthoside yielded indirubin and isatin, whereas enzymatic hydrolysis with beta-glucosidase furnished tryptanthrin and small amounts of indirubin and isatin. Judging from their relative concentrations in fresh and dried plants of the two *Calanthe* species, the investigators postulate that calanthoside may be a common, genuine glycoside of tryptanthrin, indirubin and isatin in the plants (Yoshikawa et al. 1998).

Herbal Usage: Herb is obtained from Huadong (in Guangdong Province). It is used to dissolve extravasated blood and improve circulation (Chen and Tang 1982). Entire plant, roots and stem are used to improve blood flow, and to heal abscesses, scrofula, rheumatism, bone pain and traumatic injuries (Wu 1994). It is also used to treat skin ulcers and haemorrhoids (Table 9.1) (*Zhongyao Da*

**Table 9.1** Chinese herbal prescriptions employing *Jiuzilianhuancao* (*Calanthe discolor* or *C. tricarinata*). The latter species is similar to *C. discolor* but it has fewer and slightly bigger flowers) (*Zhongyao Da Cidian* 1986; *Zhonghua Bencao* 2000)

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1. Indication: skin ulcers,
    - (a) Mix *Jiuzilianhuacao* with vinegar and apply three times a day.
    - (b) Cook *C. discolor* 15 g with meat and consume. Additionally, mix *C. discolor* 6 g with chives 3 g for external application.
- 
2. Indication: hemorrhoids and prolapsed piles  
Mix powdered *C. discolor* 15 g in vegetable oil for application.  
(*Quizhou Herbs*)
- 
3. For swelling and pain in the throat, rheumatism, trauma and hepatitis  
Use 9 g *Jiuzilianhuancao* in decoction
- 

*Cidian* 1986). The herb is collected in spring or summer when the plant finishes flowering.

*Calanthe fimbriata* Franch. [see *Calanthe alpina* (Hook. f. ex Lindl.)]

### ***Calanthe graciliflora* Hayata**

Syn. *Calanthe hamata* Hand. Mazz

Chinese names: *Goujuxiaji Lan* (splayed hooks prawn spine orchid), *Xiyegenjie Lan* (fine leaved, segmented root orchid), *Xihuagenjie Lan* (fine flowered, segmented root orchid), *Zhihuagenjie Lan* (brocade flower segmented root orchid), *Goujuxiaji Lan* (hooked prawn spine orchid): in Taiwan: slender flower *Calanthe*

Chinese medicinal name: *Silima*

Description: A robust terrestrial orchid, *C. gracifolia* has tufted, ovoid pseudobulbs, 2 cm in diameter, which bears 3–4 large, lustrous, lanceolate leaves with undulating edges that taper towards the base, 30–50 by 4–7 cm. Inflorescence is slender, 45–60 cm in length, nodding, with 9–20 flowers, 2 cm across, also nodding, and loosely arranged: the petals and sepals are pale maroon dorsally, yellowish ventrally. Lip is white and flat. It flowers in June and July (Chen et al. 2009a).

It is found in shady, moist locations in forests and along ravines at 600–1500 m in southern China from Yunnan and Sichuan in the west to

Zhejiang, Guangdong, Hong Kong and Taiwan in the east (Chen et al. 1999). In Taiwan, it is found in broad-leaf forests at 1000–1500 m (Su 1985).

Herbal Usage: In Taiwan, the entire plant of *C. graciliflora* (syn. *C. hamata*) is used to relieve fever and for detoxification. It boosts *yin* elements, benefits the lungs, improves blood flow, reduces stasis of blood, detumescence, and stops pain and coughing (Ou et al. 2003).

On the mainland, the entire plant of *C. hamata* is used to treat rheumatism, bone pain, traumatic injuries. Herb is obtained from Hunan Province (Wu 1994). Several prescriptions are provided in *Zhonghua Bencao* (2000).

*Calanthe hamata* Hand. Mazz. (see *C. graciliflora*)

*Calanthe lamellosa* Rolfe (see *C. brevicornu*)

### ***Calanthe mannii* Hook. f.**

Local Name: *Xihuaxiaji Lan* (Small Flowers Prawn Spine Orchid)

Description: Plants are 18–35 cm tall with small, conical pseudobulbs and 4–5 thin, narrowly elliptic, 5-veined, plicate leaves, 18–35 by 3–4.5 cm. Inflorescence is axillary. Rachis is erect, many-flowered, the flowers closely arranged all round. Sepals and petals are brownish; lip yellow, trilobed, mid-lobe splaying distally into 2 lobules which are rounded at their apices (Jin et al. 2009). Flowering season is May

in China (Chen et al. 2009a); April to June in Bhutan (Gurong 2006); and April to May in Nepal (Raskoti 2009). *C. manii* is found in the Himalayas, Nepal, Myanmar, southern China, Vietnam and Kyushu Island in Japan in dense, broad-leaved evergreen forests at 600–2600 m (Gurong 2006; Chen et al. 2009a; Raskoti 2009).

Herbal Usage: Herb is obtained from Sichuan, Yunnan and Guizhou. In Chinese herbal medicine, *C. manii* is used for stomach heat, scrofula and abscess (Wu 1994).

### ***Calanthe masuca* (D. Don) Lindl.**

Syn. *Calanthe sylvatica* (Thou.) Lindl.

Chinese names: *Changjuxiaji Lan* (long spur prawn spine orchid), *Zihuaxiaji Lan* (purple flower prawn spine orchid), *Shankala*, *Shanzhizhu* (mountain spider)

Myanmar Name: *Thazin gyi myo kywe*

Nepali Name: *Pakha phul*

Description: The “species is widely known as *C. masuca* in mainland Asia” (Seidenfaden and Wood 1992), but numerous taxonomists working in Asia named the species as *C. sylvatica* (Thou.) Lindl. (Seidenfaden and Wood 1992; Chen et al. 1999; Matthew 1995; Comber 2001; Gurong 2006; Raskoti 2009). However, according to the Kew Monocot List, the Asian species is *C. masuca* (D. Don) Lindl. *C. sylvatica* is distributed in Africa and in some islands in the south of the Indian Ocean but it does not occur in mainland Asia. For the sake of consistency and easy reference, the present volume follows the accepted names given in the Kew Monocot List, so the name of this species is *C. masuca*.

At one time, this pretty, moderate-sized, montane, pink *Calanthe* was a popular orchid in Europe. It has the distinction of being one of the parents of the first hybrid orchid to be bred by man.

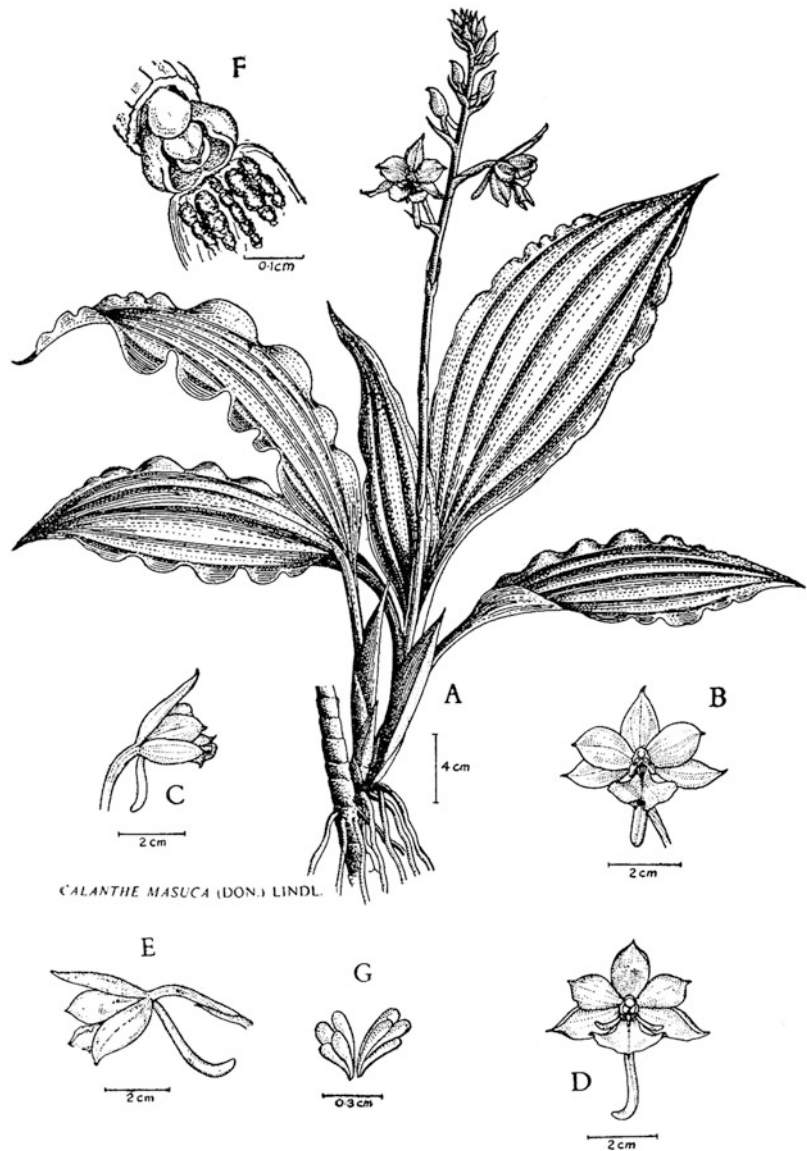
Pseudobulbs are short and stout with annual scars and oval-elliptical leaves, 20–40 by 10 cm. Inflorescence arises from the leaf axil, erect, 45–75 cm tall, and crowded with 10–15 flowers,

2.5–5 cm across, of a delicate mauve or pale rose outlined by a border of purple and accentuated by a solid-coloured purple lip (Fig. 9.4). This is a highly variable species (Liu and Su 1978). Plants from the Chinese mainland are larger, with leaves that are 50 cm long and 15 cm wide (Chen et al. 1999). Flowers are 3–5 cm wide, pale purple to white, and open in succession resulting in a long flowering period. Nepalese plants have flowers of deep violet, 3 cm across (Raskoti 2009) (Fig. 9.5). Flowers in Bhutan are 2–4 cm across, violet to purple. In Thailand, flowers are 2.5–3 cm across. It flowers in July in Thailand (Vaddhanaphuti 2001), from May to July in the Kachin State of Myanmar (University of Myanmar Department of Botany 2004), followed by August to September in India and Bhutan (Bose and Bhattacharjee 1980; Gurong 2006), September in Nepal (Raskoti 2009), and all the time in Kerala (Abraham and Vatsala 1981). The Sri Lankan *C. purpurea*, which differs from the Indian glabrous-leaved *C. masuca* only by having downy leaves, flowers in February, July and August (Jayaweera 1981). In China, *C. sylvatica* enjoys a long flowering period which extends from April to September (Chen et al. 1999).

*C. masuca* enjoys a wide distribution from Japan across southern China (Taiwan, Hunan, Guangxi, Guangdong, Hong Kong, southern Yunnan and southeast Xizang), Bhutan, Nepal, Sikkim, India, Sri Lanka to Madagascar and South Africa. Its northern-most distribution is in a few scattered southern islands at the southern tip of Japan and on Mikurajima Island just below 34°N latitude and south of Tokyo (Japan Calanthean Society 1987). In the south, it is found in Thailand, Malaysia and Indonesia. It occurs at an elevation of 800–2000 m in shaded, moist locations, in broad-leaved low montane forests.

Herbal Usage: Herb is obtained from Fujian, Jiangxi, Yunnan, Hunan, Guangxi, Guangdong and Xizang. The entire plant is used as an anodyne. It also reduces swellings, removes toxins and repairs wounded tissues. It is used in the treatment of abscesses especially if foreign bodies in the body are not surgically removed

**Fig. 9.4** *Calanthe masuca*  
(D. Don) Lindl.  
Reproduced with  
permission from  
*Introductions to  
Orchids* by Abraham and  
Vatsala, Parlole,  
Thiruvananthapuram:  
Tropical Botanic Garden  
and Research Centre  
(TBGRI), 1981



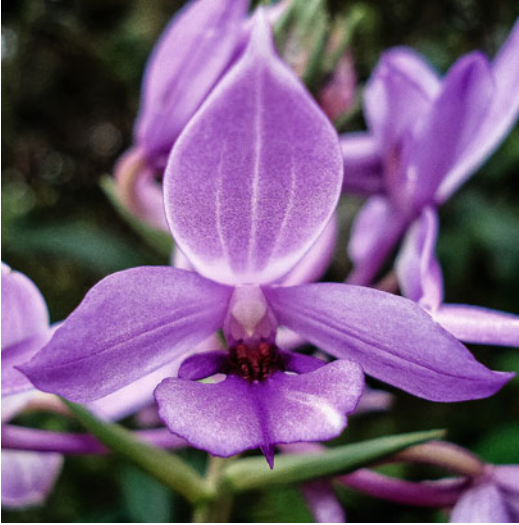
(Wu 1994). In Nepal, a paste made from the stem is applied to treat dislocated bones (Manandhar and Manandhar 2002). The flowers are used to arrest epistaxis (Rao 2004; Singh and Duggal), Pseudobulbs are also used to treat nose bleeds (Baral and Kurmi 2006).

### ***Calanthe plantaginea* Lindl.**

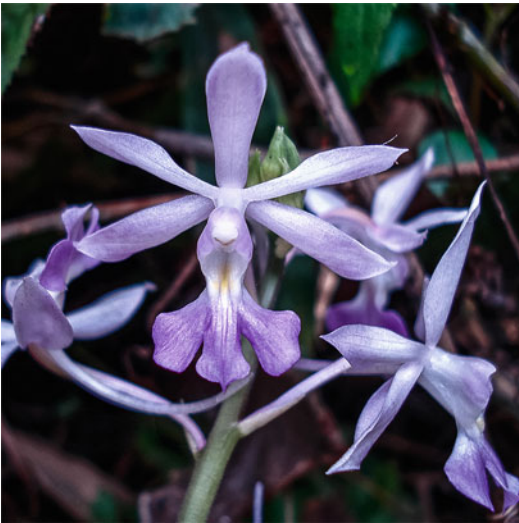
Description: Plants are 40–65 cm tall with conical pseudobulbs 1.5–2 cm in diameter, covered

with 4 sheaths. Leaves, 2–4, are elliptic-lanceolate, plicate, 10–28 by 4–12 cm, with pseudopetiole that forms a pseudostem 20 cm tall. Inflorescence arises from apex of pseudobulb, 30–40 cm with many-flowered rachis. Flowers 12–24, are scented, white to lilac, 3–4 cm across, facing all directions. Sepals and petals are narrow, elliptic to ovate-lanceolate. Lip is trilobed, side lobes erect, mid-lobe splayed into three tongues on its distal half and carrying a faint orange flare at its midpoint (Fig. 9.6). Flowering season is March to April in China





**Fig. 9.5** *Calanthe masuca* (D. Don) Lindl. (syn. *Calanthe sylvatica* (Thou.) Lindl. (Photo: E.S. Teoh)



**Fig. 9.6** *Calanthe plantaginea* Lindl. (Photo: E.S. Teoh)

(Chen et al. 2009a), January to June in Bhutan (Gurong 2006) and April in Nepal (Raskoti 2009). *C. plantaginea* is distributed from Yunnan and Tibet to Sikkhim, Bhutan, Nepal and Kashmir, occurring in broad-leaved, temperate forests at 1500–2500 m (Chen et al. 2009a; Pant and Raskoti 2013) and between 100 and 300 m in Bhutan (Gurong 2006).

**Herbal Usage:** Harvested tubers are washed, sun-dried and rendered into powder form. In

Nepal, the powder is mixed with milk is consumed as a tonic and aphrodisiac (Pant and Raskoti 2013).

### ***Calanthe puberula* Lindl.**

Syn. *Calanthe similis* Schltr.

Chinese names: *Lianxiaji Lan* (sickle lip orchid), *Fanjuangenjie Lan* (counter folding root segment orchid), *Juanegenjie Lan* (folding calyx root segment orchid), *Lianyexiaji Lan* (sickle leaf prawn spine orchid); *Jiaxiaji Lan* (fake prawn spine orchid), *Xiangsixiaji Lan* (similar prawn spine orchid) *Zigenjie Lan* (purple root orchid)

Chinese medicinal name: *Lianxiaji Lan* (sickle lip orchid)

**Description:** *C. puberula* is a beautiful, small to medium-sized, pink *Calanthe* with lovely foliage and attractive pale pink flowers. Raceme bears up to a dozen flowers which are 2–3 cm across. Dorsal sepal is broad, triangular, and curves forward. Petals and lateral sepals are filiform, undulate and bend forward. The inverted trident-shaped lip is distinctive (Fig. 9.7). Flowering period is May to August at Gaolingongshan in



**Fig. 9.7** *Calanthe puberula* Lindl. (Photo: E.S. Teoh)

Yunnan (Jin et al. 2009), July and August elsewhere (Chen et al. 1999; Pearce and Cribb 2002; Misra 2007).

*C. puberula* grows in mixed broad-leaved evergreen forests at 1200–2500 m in western Yunnan and adjacent southeastern Tibet; in Sikkim and northeast India at 2000 m; in Taiwan at 1300–2500 m; and in Vietnam. It is widely distributed in Japan with a northern limit at Okushiri Island (Japan Calanthean Society 1987).

Herbal Usage: Herb is obtained from Yunnan, Guangxi and Guandong. The whole plant is used in Chinese Herbal Medicine (CHM) to treat scrofula, and sores that itch (Wu 1994). It is antipyretic and detoxifies. Used for running sores, it improves blood flow and stops pain. It is used to treat ulcers, scrofula, mange, scarlet fever, amenorrhoea, trauma and dysentery in Taiwan (Ou et al. 2003). *C. puberula* Lindl. and *C. similes* Schltr. are mentioned as separate species by Wu (1994), but botanically they are not different and the first name has precedence.

*Calanthe similis* Schltr. (see *C. puberula* Lindl.)  
*Calanthe sylvatica* (Thou.) Lindl. [see **Calanthe masuca (D. Don) Lindl.**]

### ***Calanthe tricarinata* Lindl.**

Chinese name: *Sanlengxiaji Lan* (triangular prism prawn spine orchid)

Chinese medicinal name: *Jiuzilianhuancao* (nine united sons flowering herb) This name also refers to *Calanthe discolor*; *Roulianhuan*

Description: Stem of this attractive, evergreen *Calanthe* is sheathed in bracts and leaves in its lower half and bears 2–3 elliptic leaves 30 by 7 cm. Flowers are 2.5 cm in diameter, opening widely, and are loosely arranged in the lower part of the raceme. Sepals are greenish, petals white. Lip is rose purple with a white border; large, oblong and trilobed with barely any space between the large middle lobe and the two smaller lateral lobes. It flowers in April to June in Indian Himalaya, Bhutan and at

Gaoligongshan in western Yunnan (Bose and Bhattacharjee 1980; Japan Calanthean Society 1987; Pearce and Cribb 2002; Jin et al. 2009). *C. tricarinata* grows in the shade on the forest floor at an altitude of 2000 m in Pakistan, Kashmir, Sikkim, western China and Japan, being widespread in the Japanese islands.

Herbal Usage: Herb is obtained from Shanxi, Hubei, Sichuan, Yunnan, Guangxi, Guizhou and Xizang. In China, the root is used to stimulate blood circulation, relax muscles and joints, remove wind and stop bleeding. It is used in the treatment of stomachache, arthritis, lumbar muscle degeneration and traumatic injuries. Its use is contra-indicated during pregnancy (Wu 1994; *Zhonghua Bencao* 2000). Leaf paste is used to treat wounds and eczema in Nepal. In that country, leaves and pseudobulbs are valued as aphrodisiacs (Pant and Raskoti 2013). In Uttarakhand, West Himalaya, roots and leaves are used to treat jaundice and typhoid (Maikhuri et al. 2014).

### ***Calanthe triplicata* (Willmet) Ames**

*Calanthe veratrifolia* R. Br. ex Ker Gawl.

Chinese names: *Sanzhexiaji Lan* (three layered shrimp's spine), *Baihe Lan* (white crane orchid), *Shishangjiao* (leaf on the stone), *Roulianhuan* (meaty chain of rings); *Paiwan* (put in order and bend in a stream), embossed banana leaf orchid

Chinese medicinal name: *Shishangjiao* (leaf on the stone)

Japanese name: *Tsuru Ran* (crane orchid)

Thai name: *Ueang Kao Tog*

Indonesian names: *Lau Bawang* in Kalimantan Barat; *Angkrek Popotjongan*, *Ahan Malona* (Amboin); *Bunga Tiga Lapis* (Maluku); *Guru ni Haming* (Batak Toba) *Lumbu Hutan* (Sumatra and Timor); *Seugeundeu* (Gajo Singkut in Batak Karo) *Anggrek bayi tidur* (Sulawesi)

Description: Plant without its inflorescence is about a foot tall. Leaves are 4–6, ovate-

lanceolate, plicate, undulate, furrowed, petiolate and dark green, 30–60 by 5–12 cm. Inflorescence is carried well above the tips of leaves and bears up to 50 beautiful white flowers which are well arranged around the scape. Lip has four lobes and is marked by a vertical, linear, yellow or reddish, wart-like callus (Fig. 9.8). Flowers open successively over an extended period, with up to 12 simultaneously open.

Flowering period is April to September in Singapore–Malaysia (O’Byrne 2001) but the author’s plants in Singapore are still putting out new inflorescences in October, March to September in the Shan state of Myanmar, April to May on the Chinese mainland (Chen et al. 1999), March to July on Hong Kong and Lantau Islands (Wu et al. 2001), June in Thailand (Vaddhanaphuti 2001), April to June at the Western Ghats in southern India (Bose and Bhattacharjee 1980), May to July in southern India (Abraham and Vatsala 1981; Joseph 1982) or May to October (Misra 2007), and April to May and July to December in Bhutan (Pearce and Cribb 2002).

Phytochemistry: Leaves of *C. triplicata* produce indigo when bruised. Alkaloid is present (Luning 1967).



**Fig. 9.8** *Calanthe triplicata* (Willmet) Ames (Photo: E.S. Teoh)

Herbal Usage: Chinese herbalists in Taiwan use the root to treat rheumatism, backache and traumatic injuries including fractures (Ou et al. 2003). The whole plant is a diuretic.

Ananda Rao and Sridhar (2007) reported that in Karnataka the roots are used for diarrhoea and toothache. In Arunachal Pradesh, the roots are an ingredient in a remedy for swollen hands, and, in a separate combination, used for treating diarrhoea. Various parts of the plant are used to treat toothache. Pseudobulbs are a masticatory for a variety of gastro-intestinal disorders while flowers are used to relieve toothache (Rao 2004). Root extract is used to treat diarrhoea and toothache (Das 2004).

Rumphius (late seventeenth century) who lived on the island of Amboin (Sulawesi) observed that the plant was “quite sharp” and cautioned regarding its use. Initially, the taste of the roots is insipid, but suddenly it becomes quite sharp, “like some *Gentiana*, burning the mouth, so that one’s lips will swell, one’s throat gets hoarse, and one even feels this sharpness in the leaves, wherein it differs from all *Angreks*”. The roots were used together with nutmeg, cloves and two types of ginger “rubbed together and tied to” the swollen hands. “The natives have such tough mouths, that they dare to take these sharp roots internally, and chew it along with *pinang* (betel-nut), nutmeg and ginger, against persistent diarrhoea caused by cold or raw dampness” (quotations from Beekman’s translation, 2002) (Rumphius 1741–1750). In Sumatra, the flowers are used to relieve pain from caries (Heyne (1927). In Sulawesi, the rhizome is a cure for toothache (Yuzammi and Hidayat 2002).

### ***Calanthe vestita* Wall ex Lindl.**

Thai name: *Khao Malila*

Myanmar name: *Thazin gyi ahphyu*

Description: *C. vestita* is a terrestrial orchid with above-ground pseudobulbs that are broadly ellipsoid, 7 by 2.5 cm. Leaves arise near apex of pseudobulb, 4 in number, lanceolate-elliptic,

glabrous, plicate petiolated, 40 by 5 cm, and deciduous. Inflorescence is up to 50 cm tall, arching, pale green, covered with short white hairs, and it carries up to a dozen attractive, white to pink flowers, that are marked with a blotch of yellow at the throat. Sepals and petals are lanceolate, spread out, sepals slightly larger than the petals, 2.5 cm long and hairy whereas petals are glabrous (Fig. 9.9). Flowering period is October to February in Thailand (Vaddhanaphuti 2005) and Myanmar (Grant 1895); November to December in the Western Ghats (Abraham and Vatsala 1981); elsewhere, it is after the dry season. Several cultivars were described during the nineteenth century following the introduction of this species into Europe (Grant 1895). This popular *Calanthe* is distributed from Assam to Papua New Guinea. It is found in the limestone areas of Southeast Asia that experience a distinct dry season.

**Phytochemistry:** Leaves of *C. vestita* contain flavone C-glycosides (Williams 1979).

**Herbal Usage:** In Vietnam, crushed bulbs are rubbed over aching bones of people suffering from rheumatism (Petelot quoted by Perry). Six bacterial strains belonging to the genera *Athrobacter*, *Bacillus*, *Mycobacterium* and *Pseudomonas* have been isolated from the



**Fig. 9.9** *Calanthe vestita* Wall ex Lindl. (Photo: E.S. Teoh)

underground roots of *C. vestita* var. *rubrooculata* (Tsavkelova et al. 2001), but whether this impacts on its medicinal usage is unknown.

### Overview

There is discordance between the traditional medical usage and the modern scientific/pharmaceutical interest in this genus of orchids.

In Chinese herbal medicine, 14 *Calanthe* species provide a remedy for a variety of conditions, in particular swellings of different aetiology (abscess, trauma, arthritis), and pain (painful joints, pain at the extremities, toothache, pharyngitis, pain from stomach ulcers or abdominal distension, snake bites and trauma). *Calanthe* reduces stasis of blood, improves blood circulation and detoxifies. A number of species (*C. alismaefolia*, *C. davidii*, *C. gracilifolia*, *C. fimbriata*, *C. lamellose* and *C. puberula*) are said to be anti-pyretic. Several *Calanthe* are used for treating wounds and infected skin (*C. alismaefolia*, *C. densiflora*, *C. discolor*, *C. manii*, *C. mascula*, *C. puberula* and *C. similes*) (Wu 1994; Lin et al. 2003). Among the ways of using the orchid, wine fortified by the roots of some *Calanthe* species was reportedly used in China to treat traumatic injuries and internal bleeding (Hu and Cheo, quoted by Perry and Metzger 1980). Interestingly, use of *C. tricarinata* is contra-indicated during pregnancy (Wu 1994).

*C. vestita* which is common in the limestone areas of Southeast Asia is used in Vietnam to treat rheumatism. This usage is probably derived from a Chinese tradition set during the Chinese Tang Dynasty's (618–907) suzerain over Vietnam (Annam).

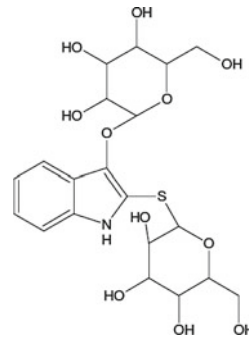
Another common Southeast Asian species, *C. triplicata* (*C. veratrifolia*) has similar uses in Ayurvedic medicine and in Indonesia. It is used to treat rheumatism, backache and trauma. More unique is its alleged ability to correct intractable diarrhoea. In Amboin, the root of *C. triplicata* is a component of a remedy for swollen hands (Rumphius, late seventeenth cent.). In Sumatra, its flowers are used to relieve pain from dental caries (Heyne, quoted by Perry and Metzger 1980).



Contemporary research completely ignores the traditional usage of *Calanthe* and focuses on two areas: (1) a hair-restoring property, and (2) a possible anticancer agent. Both areas have tremendous economic potential but there is no report of any relevant drug trial. Calanthoside, glucoindican, calaliukiuenoside and calaphenanthrenol present in *C. discolor* and *C. liukieensis* (= *C. lyroglossa* var. *lyroglossa*) improved blood flow through the skin and promoted hair growth (Yoshikawa et al. 1998).

Calanquinone A from *C. arisanensis* exhibited potent antitumour activity against lung (A549), prostate (PC-3 and DU145), colon (HCT-8), breast (MCF7), nasopharyngeal (KB) and vincristine-resistant nasopharyngeal (KB-VIN) cancer cell lines. Most exciting was the finding that this compound showed an improved drug resistance profile compared to paclitaxel. (The latter is a highly effective cytotoxic agent from the Pacific yew that has saved so many women suffering from ovarian cancer.) Lee and his co-workers have managed the total synthesis of Calanquinone A (Lee et al. 2008). Calanquinone A induces S-phase arrest and apoptosis of glioblastoma (brain tumour) cell types A172, T98 and U87 by decreasing cellular glutathione. Glioblastoma is resistant to radiotherapy and chemotherapy, so it would be helpful if this action of calanquinone can be translated into anti-glioblastoma therapy (Liu et al. 2014a).

*C. arisanensis* also contains other calanquinones (B and C). Four new 9,10-dihydrophenanthrenes, calanhydroquinones A, B, C and calanphenanthrene A, and several known compounds are also present in *C. arisanensis*. Calanquinones B and C, and calanhydroquinones A, B and C, all showed cytotoxic activity against several human cancer cell lines. Calanquinone B exhibited the highest potency (EC<sub>50</sub> < 0.5 mg/mL) against seven cancer cell lines (human lung A549, prostate PC-3 and DU145, colon HCT-8, breast MCF-7, nasopharyngeal KB and vincristine-resistant nasopharyngeal KBVIN cancer, with the greatest activity against breast cancer MCF-7 cells [EC<sub>50</sub> < 0.02 µg/mL] (Lee et al. 2009). Alkaloids



calanthoside

**Fig. 9.10** Structure of calanthoside. The compound promotes blood flow through the skin and promotes hair growth

are present in *C. triplicata*, *C. vestita* and several other species. Indoles are present in *C. triplicata* and flavone C-glycoside in *C. vestita* (Williams 1979; Veitch and Grayer 2007a).

Germination of mature seeds of *C. tricarinata* in asymbiotic culture has been achieved using a “New Dogashima” medium supplemented with naphthelene acetic acid (NAA) and benzyladenine (BA) (Godo et al. 2010). The process can be used for mass propagation to protect the wild species which is valued as an aphrodisiac in Nepal (Pant and Raskoti 2013) (Fig. 9.10).

## Genus: *Callostylis* Blume

Chinese name: *mei zhu lan*

A small genus with only five or six species distributed from the Himalayan region to China and southwards to Myanmar, Thailand, Indochina, Malaysia and Indonesia, these are epiphytic orchids that were once included under *Eria*. Pseudobulbs are bulbous or terete, with base loosely covered by dry sheaths, leafy on the upper part, and are well spaced along a stout, creeping rhizome. Leaves are leathery, 2–5, arising at or near the apex of the stem. Inflorescence is axillary, with many cream-coloured or yellow flowers. Sepals are covered with brown hairs abaxially.

***Callostylis bambusifolia* (Lindl.)  
S.C. Chen & J.J. Wood**

Syn. *Eria bambusifolia* Lindl.

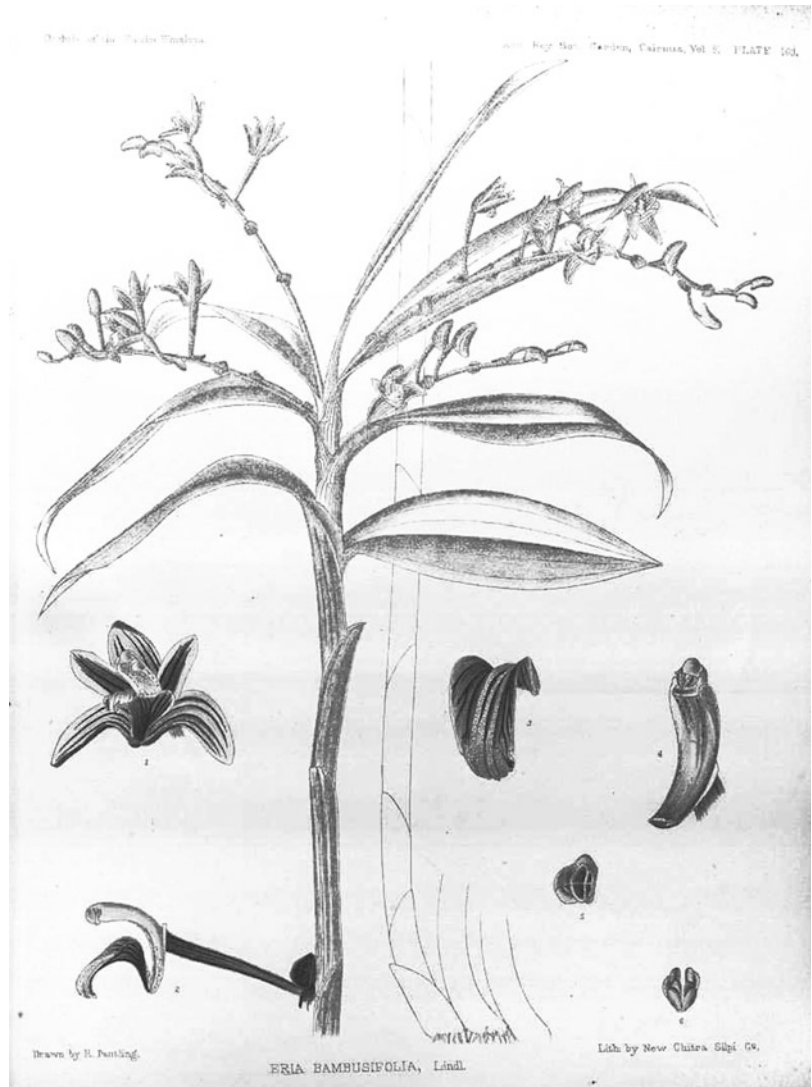
Indian name: *Mundabai*

Description: This is a tall epiphyte with tufted stem, 20–70 (occasionally 90) cm in height and 3–7 mm in diameter with approximately 10 long, lanceolate leaves near the top, measuring 10–22 by 1–3 cm. Inflorescences are axillary, pendulous, appearing a few at a time, with 5–7 flowers

each. Flowers are 1.5–2 cm across, white, striped with purple, and covered with short brown hairs abaxially (Fig. 9.11). Flowering period is November to December. The species is distributed from Vietnam, Thailand, Myanmar and southern Yunnan to northeast India down to Orissa state. It grows on trees in sparse woods at 900–1200 m (Chen et al. 1999; Jin et al. 2009).

Herbal Usage: The entire plant is used to treat stomach upsets in India. A plant of *Callostylis bambusifolia* (syn. *Eria bambusifolia*) and another of *Aegle marmelos* (not an orchid) are

**Fig. 9.11** *Callostylis bambusifolia* S.C. Chen & J.J. Wood. From: *Annals of the Royal Botanic Gardens, Calcutta*. Vol. 8(3): t. 163 (1891). Original drawing by R. Pantling in colour with black and white



separately burnt to ashes in earthen pots, and thereafter their ash is mixed in a 1:1 ratio. Half a tablespoon is administered on an empty stomach twice a day for one week to treat hyperacidity and stomach upsets. This is the practice of the Dongria Kandha hill tribe in the southwest of Orissa State in India (Dash et al. 2008).

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### Genus: *Cephalanthera* Rich.

Chinese name: *Tourui Lan*

*Cephalanthera* is a genus made up by a dozen species of robust, terrestrial orchids generally inhabiting the temperate regions of Eurasia to the Himalayas and North Africa. There is one species in Taiwan (Tang and Su 1978) and another in Laos (Schuiteman and de Vogel 2000). Plants have underground rhizomes and erect stems sheathed with ovate-lanceolate leaves. Inflorescences are terminal and carry several small, resupinate, white, red, or green flowers. Lips are trilobed and do not possess spurs. In some species, the flowers do not open widely (Chen et al. 2009b).

The generic name is derived from the Greek *kephale* (head) and refers to the fanciful impression that its anther is held high like a head. *Cephalanthera* are not present in orchid collections.

### *Cephalanthera erecta* (Thunb.) Blume

Chinese name: *Yin Lan* (silver orchid)

Chinese medicinal name: *Yin Lan* (silver orchid)

Description: *C. erecta* is native to the Eastern Himalaya, China and Japan, growing amidst grasses and low shrubbery. Tubers are paired, irregular and underground. Stems are slender, 30–40 cm tall with 3–4 lanceolate leaves near the apex, 3–6 cm long, plicate and pointed. The Huanglong variety is small, generally only 15 cm tall. Inflorescence is short with up to 8 flowers,

loosely arranged. Flowers are 1–1.2 cm long, green or white, barely opening, and appear in April to June (Hawkes 1965; Perner and Luo 2007; Jin et al. 2009).

This species resembles *C. longifolia* but the plant is smaller. Chin-shaped spur is a prominent characteristic of the flowers (Perner and Luo 2007).

Herbal Usage: Herb is obtained from Shanxi, Hubei, Zhejiang, Jiangxi, Guangdong and Sichuan. Plant is used to treat fever, thirst, urinary infection. It is diuretic (Wu 1994).

### *Cephalanthera falcata* (Thunb.) Lindl.

Chinese names: *Jin Lan* (gold orchid), *Lianyetourui Lan* (pistal above sickle leaf orchid)

Chinese medicinal name: *Jin Lan* (gold orchid)

Description: *C. falcata* is a lowland terrestrial orchid of the temperate zone. Its slender stems arise from slender, creeping rhizomes with numerous roots. Stem is 25–35 cm tall, with 4–6 broadly elliptic or lanceolate, plicate, pointed leaves, 5–8 cm long. Inflorescence is up to 15 cm long, loosely 9–18 flowered. Flowers are 1.6 cm long, a clear golden yellow in Japan, or white or green flushed with white, and are fragrant. The golden Japanese variety is quite handsome (Kanda 1977).

The species is found in Yunnan Province in China, and in Korea and Japan. It flowers in April and May at Gaoligongshan in Yunnan (Jin et al. 2009), appearing a bit later, from May to July, further north (Kanda 1977). Accelerated growth observed when the orchid exists in tripartite symbiosis with Telephoraceae fungi, and *Quercus serrata* in pot culture in Sapporo suggests that under inclement conditions *C. falcata* may become mycoheterotrophic or even purely mixotrophic (Yagame and Yamato 2013).

Herbal Usage: Herb is obtained from Hubei, Hunan, Guangdong, Guangxi, Yunnan and Sichuan. The entire plant is antifever, and relieves fever. It is used to treat sore throat and toothache (Wu 1994).

***Cephalanthera longifolia* (L.) Fritsch.**

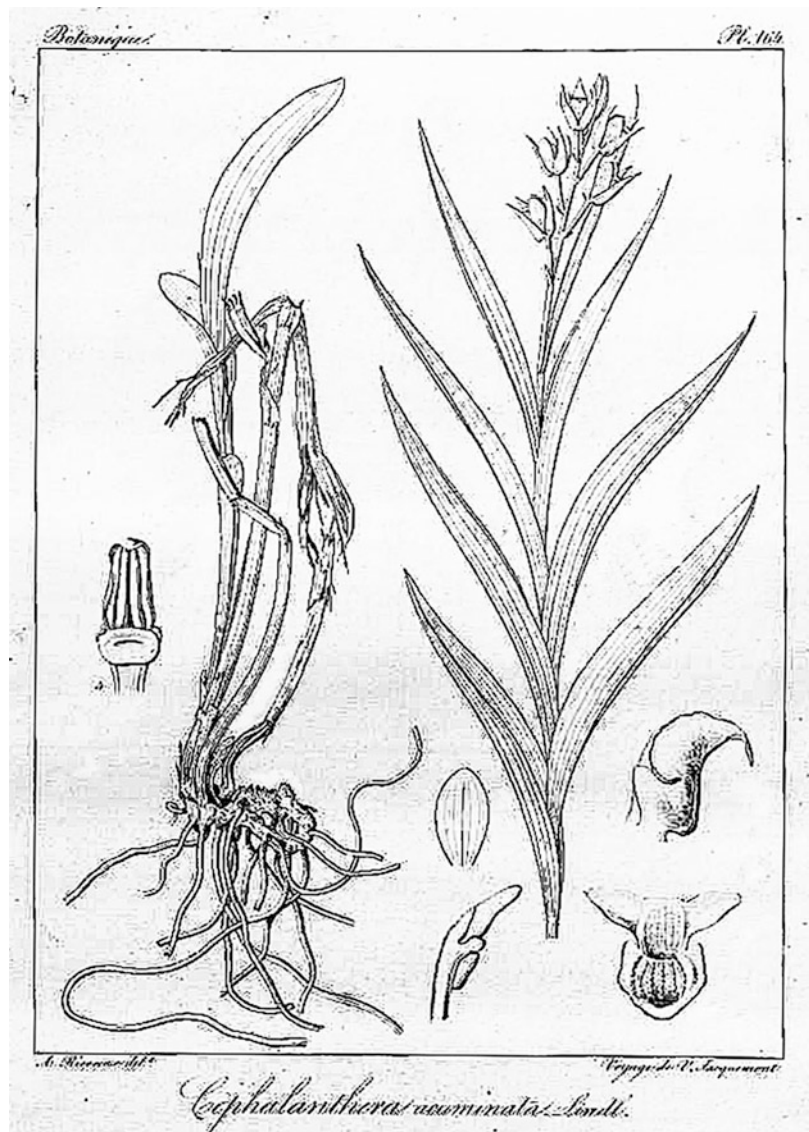
Chinese names: *Changyetourui Lan* (pistal above the long leaf orchid), *Tourui Lan*

Description: A terrestrial inhabiting forests or grassy slopes and shrubberies, *C. longifolia* has an erect stem 20–47 cm tall with 4–7 lanceolate, plicate leaves, 4–13 by 0.5–2.5 cm (Fig. 9.12). Tap root is long and sparsely branched with a few short side roots (Rasmussen 1995). Inflorescence is terminal, 1.5–6 cm long bearing 2–15 white

flowers that do not open widely, about 1.5 cm across (Fig. 9.13). Flowering period is May to June. The species is found in Central China from Shanxi to Xizang (at 2300–3000 m) and is widespread in Northern India, Central Asia, Europe and North Africa (Chen et al. 1999).

Phytochemistry: Alkaloids, quercetin and kaempferol-*O*-glycosides are present in *C. longifolia* (Luning 1967; Williams 1979). *Loroglossin* is present in *C. damasonium* (syn. *C. grandiflora*) and *C. rubra* (Veitch and Grayer 2007b) (Fig. 9.14).

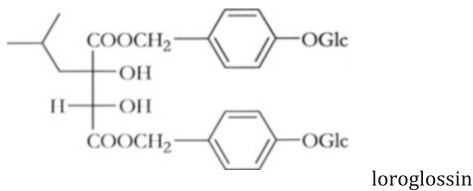
**Fig. 9.12** *Cephalanthera longifolia* (as *Cephalanthera acuminata* Wall. ex Lindl.). From: Jacquemont, V., *Voyage dans l'Inde pendant les années 1828 a 1832*, vol. 4(3): t. 164 (1844). Courtesy of Missouri Botanic Gardens, St. Louis, USA







**Fig. 9.13** *Cephalanthera longifolia* (L.) Fritsch. (Photo: E.S. Teoh)



**Fig. 9.14** Loroglossin, a phytoalexin produced by *Cephalanthera damasonium*

**Herbal Usage:** Roots and stems are used for nocturesis and enuresis in TCM (Wu 1994). In Arunachal Pradesh, roots and rhizomes are valued as tonic (Duggal 1971; Rao 2004).

### Overview

Significant amounts of alkaloid were not detected when a single species of *Cephalanthera* was screened by Luning's Swedish team (Luning 1974a, b). The newly discovered saprophytic species might be more promising as a source of secondary metabolites (Chen and Lang 1986). Antibiotics might be present in the mixotrophic *C. falcata* which is used to treat toothache and sore throat.

*C. longifolia* is on the red list of endangered orchid species (Duffy et al. 2009) and attempts to

germinate the seeds and propagate *C. longifolia* were uniformly unsuccessful (Rasmussen 1995). However, Yamazaki and Miyoshi (2006) succeeded in the asymbiotic germination of *C. falcata* which is reported to be endangered in Japan, using green pod culture 70 days from pollination. They found that after this date the viability of the seeds declined and minimal germination was seen in seeds harvested 100 days post-pollination or later (Yamazaki and Miyoshi 2006).

Recently, it was shown that light intensity is the decisive factor influencing autotrophic versus heterotrophic behaviour in adult *Cephalanthera* plants. When the light intensity is low, for instance during winter, the orchid may switch to strong dependency on fungi for its carbon nutrition (Preiss et al. 2010). *C. falcata* photosynthesises but simultaneously obtains carbon supplies from mycorrhiza (Thelephraceae fungi growing on oak), i.e. it is mixotrophic (Yagame and Yamato 2013). *C. longifolia* obtains 33 % of its carbon and 86 % of its nitrogen from Thelephraceae fungi (Abadie et al. 2006). Tripartate symbiosis should be considered when attempts are being made to conserve terrestrial orchids growing in deep shade or in temperate regions.

## Genus: *Changnienia* Chien

Chinese name: *Duhua Lan* (solitary flower orchid)

*Changnienia* is a recently discovered, monotypic, terrestrial genus which belongs to the subtribe Calypsoeae. It is endemic in China and enjoys a wide distribution in the central provinces at elevations of 400–1500 m. Pseudobulbs are subellipsoid or ovoid, 1.5 cm, cloaked with numerous membranous sheaths. Leaf is apical, solitary, broadly ovate-elliptic to broadly elliptic. Flowers are pink; however, if the soil is alkaline (pH 4.5–5.0), they are blue.

The fleshy, corm-like, subterranean pseudobulb sends up a single elliptic leaf in September. Inflorescence appears in November but the solitary flower does not open until March

or April and fruit is set in May to June. There is considerable variation within the species, allegedly an adaptive mechanism for pollination (Sun et al. 2005). Bumblebees of the species *Bombus trifasciatus* Smithi pollinate the orchid. Visits by other species of insects have also been observed in Shenggongjia, but their visits do not result in pollination (Sun et al. 2003).

The species is named for Chang-nien Chen, a botanical collector of the early twentieth century who worked for the Academia Sinica (now renamed the Chinese Academy of Sciences) in Nanjing.

### ***Changnienia amoena* Chien**

Chinese names: *Duhua Lan* (solitary flower orchid); elder blue\*

Chinese medicinal name: *Changnian Lan*

Description: This terrestrial orchid is found in humus-rich soil in shady spots along ravines at 700–1800 m in southern Shaanxi, Jiangsu, Anhui, Zhejiang, Jiangxi, Hubei, Hunan and Sichuan Provinces in China. Pseudobulbs are subterranean, corm-like, fleshy, ovoid, pale yellowish-white, 1.5–2.5 cm long and 1–2 cm in diameter. It bears a single, terminal broadly elliptic, undulate leaf at the end of a 3.5–8 cm petiole thrust above the humus and ground cover. Leaf is green on its upper surface, reddish-purple on the under-surface, 6.5–11.5 by 5–8 cm. Scape is terminal, 10–17 cm long and carries a single pink flower which is 5–6 cm across. Dorsal sepal and lateral petals are close together and form a hood over the lip. Lateral sepals are linear and well extended at a 160° angle. Lip has three lobes. Side lobes are erect and form a hood over the column; mid-lobe is broad and irregularly undulate, extending backwards into an iron-shaped spur. Lip is white with pink spots on the three keels in the throat and at the edges; spur is long and pointed. Flowers appear in April (Chen et al. 1999).

Herbal Usage: Herb is obtained from Zhejiang, Jiangsu, Hunan and Sichuan. The whole plant together with its roots is regarded

as antiheat and antitoxic. It cools the blood. It is used in the treatment of coughs, blood-streaked sputum, sores and furuncles (Wu 1994). To treat bloody phlegm, a decoction is prepared with 15–30 g of dried or 60–90 g of fresh herb, then sweetened with white sugar and drunk day and night before meals.

To treat sores, a poultice is made by mixing fresh pulverised plant with salt. The dressing is changed at least every day (*Zhonghua Bencao* 2000).

### **Overview**

Only discovered and botanically published in 1935, it is remarkable that it already has a herbal use. The reason being that Chinese herbalists have long recognised *C. amoena* as a distinctive species but botanists were not aware of its existence. A similar explanation exists for many medicinal orchid species long known to tribal people and much later “discovered” and described in journals.

There is no pharmacological information on the species.

Genus: *Cirrhopetalum*

This genus is now included under ***Bulbophyllum***

*Cirrhopetalum andersonii* Hook. f. (see ***Bulbophyllum andersonii* Hook f.**)

*Cirrhopetalum vaginatum* Lindl. (see ***Bulbophyllum vaginatum* (Lindl.) Rchb. f.**)

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### **Genus: *Cleisostoma* Blume**

Chinese name: *Geju Lan*

*Cleisostoma* is a large genus of small to medium-sized epiphytic, monopodial orchids with some 90 members. It enjoys a widespread distribution from Sri Lanka and India through China to Japan and across Southeast Asia to Papua New Guinea and the Pacific Islands. Many species formerly classified as *Sarcanthus* are now in *Cleisostoma*, whereas numerous others formerly in *Cleisostoma* have been moved to other genera

(Seidenfaden and Wood 1992). The epicenter for the genus is Thailand. They are rarely cultivated as garden plants.

Stems may be short or long, erect or pendant, with leaves that are terete, semi-terete or flat. Flowers are small with spreading petals and sepals of equal size. Lip is trilobed, with a spur and the conspicuous callus that distinguishes the species. The name *Cleisostoma* is constituted by two Greek words, *kleistos* (closed) and *stoma* (mouth), referring to the calli blocking the entrance to the spur thus producing a narrowed mouth.

### ***Cleisostoma birmanicum* (Schltr.) Garay**

Syn. *Sarcanthus ophioglossa* Guillaumin

Laotian name: *Ka dam phi*

Description: This is a stout, monopodial epiphyte with an 8- to 9-cm stem carrying several thick leaves 15 by 1.5 cm. Inflorescences are lateral, paniculate, extending beyond the tips of the



**Fig. 9.15** *Cleisostoma birmanicum* (Schltr.) Garay (Photo: E.S. Teoh)

leaves, with 10–12 reddish-maroon flowers with yellow lips whose mid-lobes extend downwards into pairs of thread-like tails (Fig. 9.15). Flowering period is April to May. It occurs in Hainan, Indochina, Thailand and Myanmar (Chen et al. 1999)

Herbal Usage: The orchid was used to treat orchitis in Laos (Vidal 1963).

*Cleisostoma flagelliforme* (Rolfe ex Downie) Garay (see *Cleisostoma fuerstenbergianum* Kraenzl.)

### ***Cleisostoma fuerstenbergianum* Kraenzl.**

Syn. *Cleisostoma flagelliforme* (Rolfe ex Downie) Garay

Chinese name: *Changyegeju Lan* (long leaf separate distance orchid)

Thai names: *Kloi nam thai* in Ubon Ratchathani; *kang pla*

Description: Stems are terete, branching, pendulous, green, 40–60 cm long. Leaves are terete, slim, curved, acute, 12–15 by 0.8 cm. A 12- to 15-cm-long, pendulous inflorescence is produced 180° degrees from (opposite) a leaf. Flowers are 1 cm across, 5–18 in number, well spaced, and have dark brown petals and sepals. Lip is white, turning yellow with age (Fig. 9.16). It flowers in May to June in China (Chen and Wood 2009) and in Chiang Mai, Thailand, August to September (Vaddhanaphuti 2005), and November to February (Nanakorn and Watthana 2008). This is a handsome, steady epiphyte growing on trees in broad-leaved evergreen forests at 700–2000 m in Yunnan, Guizhou, Hainan, Indochina and Thailand

Herbal Usage: Herb is obtained from Hainan and Yunnan. The whole plant is used as a remedy for heat and toxins, sore throat and tonsillitis in China (Wu 1994). Leaves are used to treat diabetes in Thailand (Chuakul 2002).

*Cleisostoma hongkongense* (Rolfe) Garay [see *C. williamsoni* (Rchb .f.) Garay]



**Fig. 9.16** *Cleisostoma fuerstenbergianum* Kraenzl. (Photo: Courtesy of Plant Photo Bank of China)

***Cleisostoma paniculatum* (Ker-Gawl) Garay**

Local names: big centipede orchid; tiger stripes; Taiwan centipede; purple stripes

Description: Its local name is curious, seeing that this species has small yellow flowers only 7 mm across. Plant is 20 cm tall, intermediate in size among medicinal Chinese species of *Cleisostoma*. The slim, erect stem is sometimes branched and carries numerous flat, linear, oblong leaves, 10–25 by 0.8–2 cm. Sepals and petals are yellow-green with brown lines. Lip is yellow with a brownish tinge at the edge of the side lobes. Inflorescence is axillary, branching with 10–15 flowers. Flowering season is June. The species is distributed from Taiwan southwards to Fujian, southern Guangdong, Hong Kong, Guangxi, Hainan, Jiangxi, Sichuan and Xizang; also Vietnam, north-eastern and central Thailand and northeast India (Vaddhanaphuti 2001).

Herbal Usage: The entire plant is used to boost *yin*, treat coughs and to strengthen the lungs in Taiwan (Lin et al. 2003).

*Cleisostoma scolopendrifolium* (Makino) Garay [see *Pelantharia scolopendrifolium* (Makino) Aver.]

***Cleisostoma tenuifolium* (L.) Garay**

Common name: delicate leaved *Cleisostoma*

Old Malabarese name: *Mau Tsjerou Maravara*, *Ambo keli*; *Kolli Tsjerou Mava-maravara*, *Abo-tia*

Description: A rather rare, miniature epiphyte that bears a small, short cluster of brownish flowers with a pale purple lip. The brown on the tepals are overlaid on a green background. Flowers are 5 mm across (Fig. 9.17). It is distributed in southern India, Sri Lanka and Thailand, from sea level to 300 m. Flowering season is August to October in southern India and Sri Lanka (Jayaweera 1981) and December in Thailand (Vaddhanaphuti 2005). In Sri Lanka, it is sometimes found in association with three other orchid species, namely *Bulbophyllum thwaitesii* Rchb. f., *Cymbidium aloifolium* (L.) Sw., *Pholidota pallida* Lindl. and several non-orchidaceous epiphytes (Jayaweera 1981). As this is the only species of *Cleisostoma* that occurs on the Malabar Coast; the drawing of a *Cleisostoma* without flowers and labeled as *Kolli Tsjerou Mava-maravara* or *Abo-tia* in van Rheede's *Hortus Indicus Malabaricus* (1703) may be identified as *C. tenuifolium* (van Rheede 1703).

Herbal Usage: The whole plant was used in western peninsular India to treat kidney disorders, leucorrhoea, gonorrhoea and scalds (van Rheede 1703). Made into a poultice, *Kolli Tsjerou Mava-maravara* was used to reduce pain and swelling of abscesses and to promote their rupture. Plant was also blended in vinegar and administered to expel kidney stones, treat dysuria, gonorrhoea, other forms of white vaginal discharge and heavy menstrual loss (Van Rheede 1703).

***Cleisostoma williamsonii* (Reichb. f.) Garay**

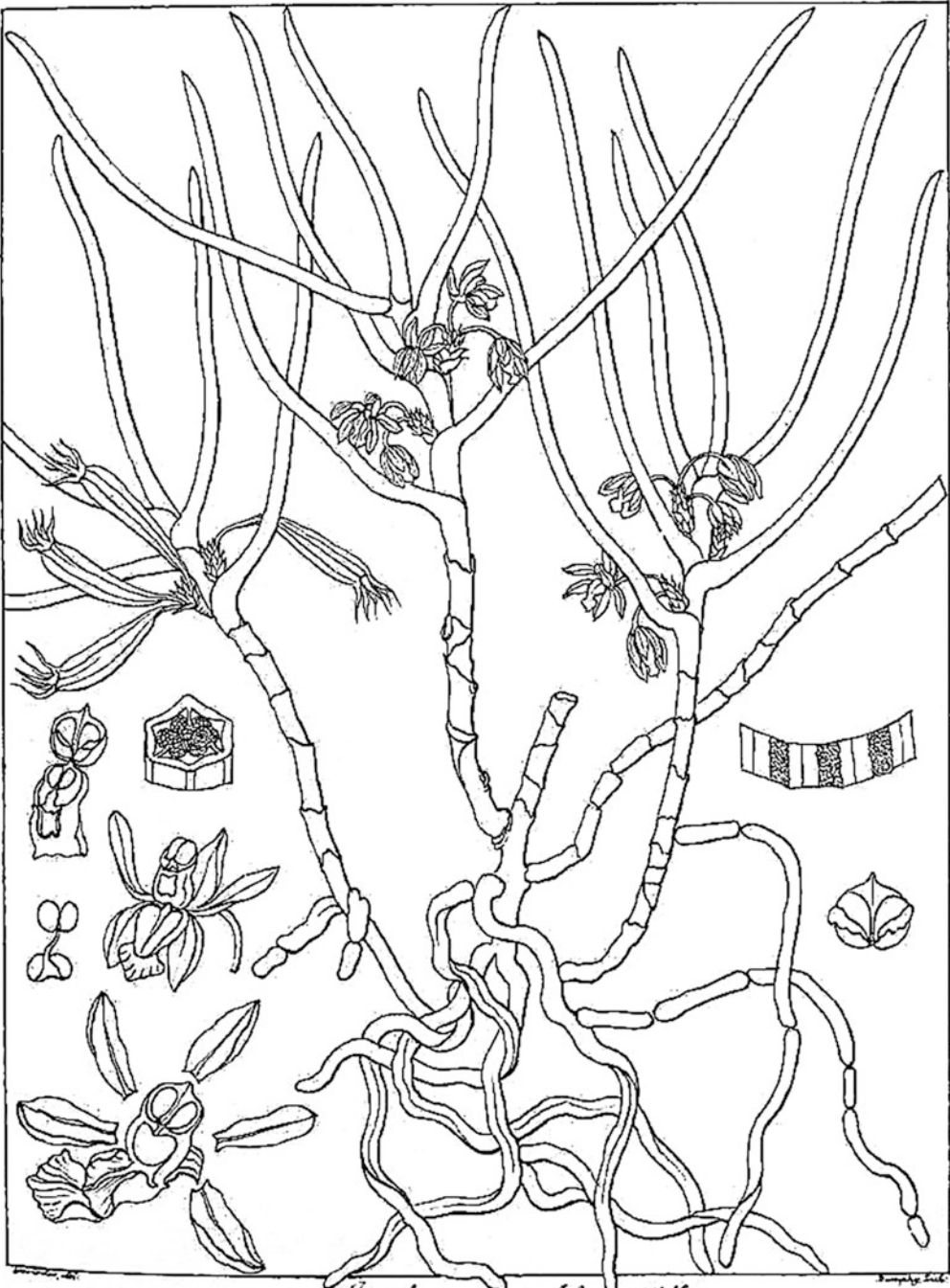
Syn. *Cleisostoma hongkongense* (Rolfe) Garay



*Vandea*

*Orchideae*

1689



*Cymbidium tenuifolium* (Willd.)

**Fig. 9.17** *Cleisostoma tenuifolium* (L.) Garay. From: Wight R., *Icones Plantarum Indiae Orientalis*, vol. 5(1): t. 1689 (1846). Drawing by Govindoo. Courtesy of Missouri Botanical Gardens, St. Louis, USA

Common Name: *Dianmiangeju Lan* (Yunnan - Myanmar separate distance orchid)  
 Chinese medicinal name: *Longjiaocao*

Description: Stems are fleshy, 30–70 cm long, 3 mm thick, with slim, terete leaves up to 18 cm long, 2.5 cm in thickness. Inflorescence is usually simple, with 20–25, well-spaced flowers of pale olive green with a contrasting purple lip (Fig. 9.18). Flowering season of *C. williamsonii* is from April to June in China (Chen et al. 1999), July to August in the Shan state of Myanmar (Grant 1895) and September in Thailand (Vaddhanaphuti 2005). Seidenfaden (1985) listed a dozen synonyms for the species which enjoys a distribution from Bhutan to Hong Kong and Hainan, and southwards through Thailand, northern Peninsular Malaysia (Perlis and Langkawi) to Sumatra, Java and Kalimantan. In China, it is epiphytic or saxicolous in forests and along valleys at 300–2000 m in Yunnan, Guizhou, Guangxi, Guangdong, Hong Kong and Hainan.

Herbal Usage: The Chinese herb is obtained from Guangdong, Guangxi and Yunnan. Plants

can be harvested throughout the year, washed and sun-dried. Taste is mildly sweet and sour, and it is neutral in nature. The whole plant is used to improve blood circulation, relax muscles and joints, clear phlegm and stop coughs. It is used in treating pulmonary tuberculosis, viral encephalitis, stroke, polio, backache and indigestion in children (Wu 1994).

The herb may be harvested at any time during the year and the entire plant is sun-dried for future use. It is mildly sweet and sour in flavour, neutral in nature. It stimulates circulation, relaxes muscles and joints, stops coughing and is an expectorant. A Guangxi Materia Medica mentioned that it was used during epidemics of encephalitis B and to treat patients with tuberculosis or paralysis resulting from stroke or poliomyelitis, and malnourished children. A simple decoction is prepared by boiling 9–15 g of the herb. Alternatively, a soup may be prepared by boiling 9–15 g of *Lionjiaocao* (*C. williamsonii*), 9 g of *Zanthoxylum bungeanum* Maxim. (Chinese prickly ash, Sichuan pepper) root bark and lean pork. The preparation can alternatively be turned into a stew (Zhaoyao Bencao 2000).



Fig. 9.18 *Cleisostoma williamsonii* (Reichb. f.) Garay  
 (Photo: Peter O'Byrne)

### Overview

In *A Concise Edition of Medicinal Plants in China*, Wu Xiu Ren listed *C. hongkongense* as a separate species from *C. williamsonii* and the two are given different Chinese names; *Honghuageju Lan* (red flower separate distance orchid) for *C. hongkongense* and *Dianmiangeju Lan* for *C. williamsonii* with *Longjiaocao* as the medicinal name for the latter. Botanically, however, these two species are identical. There may be varietal differences between the two, but both herbs are reported to be obtained from Guangdong, Guangxi and Yunnan. Furthermore, the fact that the 'two' *Cleisostoma* are similar in their usage shows that Chinese herbalists do recognise that they are one and the same species.

Although a widespread genus, *Cleisostoma* does not appear to have a medicinal use outside China, apart from some limited usage in the region of the Western Ghats during the early seventeenth century (van Rheede 1703). In the

latter region, it was not mentioned again when Caius compiled his description of medicinal plants in the region of Bombay (Mumbai) in 1936. Most Chinese medicinal books make no mention of the orchid, and it is only in Wu's (1994) extensive listing that some species are listed and their usage described. There is much overlap and confusion over taxonomic identification, but the different species appear to have a similar usage in a wide spectrum of unrelated illnesses.

The earliest search for medicinally active compounds focused on alkaloids (Luning 1974a, b, 1980; Slaytor 1977), those bitter compounds produced by plants, the most famous one of which is possibly quinine. Five *Cleisostoma* species were screened for alkaloids and none were found to have at least 0.1 % alkaloid content which was designated as the diagnostic criterion for classification as an alkaloid-accumulating species. However, several non-medicinal species (*C. appendiculata*, *C. discolor*, *C. racemiferum*, *C. subulatum*) contained small amount (0.01–0.1 % dry weight) of alkaloid (Luning 1974a, b).

*Coelogyne viride* Hartm. [see *Dactylorhiza viridis* (Linn.) R.M. Bateman, Pridgeon and M.W. Chase]

## Genus: *Coelogyne* Lindl.

Chinese name: *Beimu Lan* (pearl shell orchid)

The genus *Coelogyne* is constituted by more than 200 epiphytic species, of which about 80 are in cultivation. They are distributed from northern India and southern China across Southeast Asia to the Pacific, in lowland and montane forests. Introduced by John Lindley in 1822, the name is derived from Greek, *koilos* (hollow) and *gyne* (female), possibly referring to the deep stigmatic cavity. Many species bear pendulous inflorescences with flowers that open simultaneously resulting in spectacular displays, but in some species single flowers open in succession on a short inflorescence. Flowers of most species



**Fig. 9.19** *Coelogyne occultata* Hook. f. From Engler, H. G.A., *Das Pflanzenreich, Orchidaceae—Monoandreae—Coelogyneinae*, vol. 50 (II.B.7.): (Hef 32), p. 58, Fig. 19, 1907. Courtesy of University of Toronto Library, Canada

short-lived, usually lasting less than a week. Pseudobulbs are prominent and carry one or two plicate leaves which do not sheath the pseudobulb (Fig. 9.19).

Six Chinese species and two Thai species are used for medicinal purposes, while *C. ovalis* is used in India as *Jeevanti* (a substance which promotes life). Eight species from Nepal are medicinal (Pant and Raskoti 2013).

**Table 9.2** Prescriptions employing *Feng Lan* (*Coelogyne barbata* Lindl. ex Griff.) Reference: *Zhonghua Bencao* 2000

Preparation: for decoction, use 15–30 g *Feng Lan* (*C. barbata*)

For external use: an appropriate amount, pulverise and apply

1. Indications: Cough with “lung heatiness”

Decoction with Plantain 30 g

2. Indication: sore throat

Decoction with Plantain 30 g, Prunella 15 g

3. Indication: Pain associated with hernia or scrotal swelling

Decoction with Plantain 30 g, Tangerine seed 15 g

4. Indication: Bruises and Sprains

Prepare paste with *C. barbata* and Plantain, and apply fresh to wounded part

5. Indication: Chapped hands and feet.

Prepare paste with equal amounts of *C. barbata* and Plantain and apply to wounds.

(Source: Xizang Chinese Materia Medica)

### ***Coelogyne barbata* Lindl. ex Griff.**

Local name: *Xuchunbeimu Lan* (beard and lip pearl shell orchid), *Ranmaobeimu Lan*

Chinese medicinal name: *Fengjian*

Description: Plants are epiphytic or lithophytic. Pseudobulbs are clustered, pale green, almost round, up to 10 cm in diameter, and carry 2 leathery, narrowly lanceolate, stalked leaves; up to 45 by 6 cm. Inflorescence is arching with few, crowded, white, musk-scented flowers, 5–7.5 cm across. Lip is white and bears three deep sepia-brown, fringed crests at the centre: it is fringed around the distal third with similarly coloured projections. Flowering season is autumn to winter. The species is distributed in Nepal, Bhutan, the Khasia Hills in Bangladesh, Myanmar and Gaoligongshan in Yunnan (Hawkes 1965; Jin et al. 2009).

Herbal Usage: Herb obtained from Sichuan and Yunnan may be harvested without regard to season. After collection, plant is washed and dried, then further sun-dried for storage. It is sweet in taste and cool in nature. In TCM, the whole plant is valued for its ability to counter ‘heat’, relieve thirst, and stop coughs and lessen pain. It is used to treat sore throat, pain at hernias, swelling of the scrotum, chappy extremities, traumatic injuries and

‘lung-heat’ (Wu 1994; *Zhonghua Bencao* 2000). Some prescriptions on the usage of the herb are shown in Table 9.2 (*Zhonghua Bencao* 2000).

### ***Coelogyne corymbosa* Lindl.**

*Pleione corymbosa* (Lindl) Kuntze

Chinese name: *Yanbanbeimu Lan* (eye spotted pearl shell orchid), *Beimu Lan* (pearl shell orchid), *Zhixueguo* (haemostatic fruit); *Shibajiao* (stone palm leaves); *Duiyeguo* (fruit with a pair of leaves); *Xiaoluji* (small green Chinese elder)

Chinese medicinal name: *Beimu Lan* (pearl shell orchid); *Guoshangye* (leaves above the fruit)

Newari name: *Tuyu kenbu swan*

Description: *C. corymbosa* is a small, pretty, epiphytic or terrestrial orchid with clustered pseudobulbs, 1–4.5 cm in length, each with a pair of oblong, coriaceous leaves of 4.5–15 cm length. Raceme is curved or drooping and bears two to four white or greenish-tinged flowers with a distinctively decorated lip. Tepals are lanceolate, concave and pointed. There are four large yellow patches (or “eyes”) bordered with orange-red on the upper half of the pointed lip, a feature that earned the orchid its local name (Fig. 9.20). In China it flowers from May to July (Chen et al. 1999). In Bhutan, it flowers from February to June (Gurong 2006). Flowering season is shorter in Nepal, March to May (Raskoti 2009).

*C. corymbosa* is distributed from Yunnan to southern Tibet into Myanmar, Sikkim, Bhutan, Nepal and northern India. It is epiphytic on the tree trunks at the edge of forests and wet cliffs at 1300–3100 m.

Herbal Usage: Herb is obtained from Yunnan and Xizang. It may be collected at any time of the year. Pseudobulbs or entire plant are used to treat fractures and soft tissue injuries. The herb is used as a haemostatic and to relieve pain. It reduces heat, stops coughs, and is taken for coughs, flu and bronchitis. Four prescriptions are reproduced in Table 9.3 (*Zhonghua Da Cidian* 1986; *Zhonghua Bencao* 2000; Wu 1994).





**Fig. 9.20** *Coelogyne corymbosa* Lindl. (Photo: E.S. Teoh)

**Table 9.3** Four prescriptions employing *Coelogyne corymbosa* (Zhongyao Da Cidian 1986; Zhonghua Bencao 2000)

- |  |
|--|
| 1. Indication: bronchitis, flu<br>Use entire plant 15–30 g in decoction<br>(Source: Yunnan Selected Chinese Herbs)   |
| 2. Indication: soft tissue injuries<br>Use sheaths from base of pseudobulbs. Apply as powder or paste externally.<br>(Source: Yunnan Selected Chinese Herbs)   |
| 3. Indication: fractures<br>Grind <i>Coelogyne corymbosa</i> 100 g with Pteris multifidapoir 1 g<br>Apply to site of fracture after reduction and splinting. Then add Man Shan Xiang powder to wound directly and apply another layer of the mixture.<br>Change medicine daily or on alternate days<br>(Source: Quan Zhan Selected Chapters) |
| 4. Indication: bleeding from external wounds<br>Apply powdered, or a paste of grounded, fresh <i>Coelogyne corymbosa</i> to the wound<br>(Source: Wen Shan Chinese Herbs)  |

In India and Nepal, paste made with pseudobulbs is applied on the forehead to relieve headaches (Manandhar and Manandhar 2002; Baral and Kurmi 2006; Pant and Raskoti 2013). Juice of pseudobulbs is applied on wounds for pain relief and to treat burns (Das 2004; Baral and Kurmi 2006; Pant and Raskoti 2013).



**Fig. 9.21** *Coelogyne cristata* Lindl. (Photo: Bhaktar B. Raskoti)

### ***Coelogyne cristata* Lindl.**

*Coelogyne speciosissimum* D. Don

Chinese name: *Beimu Lan* (pearl shell orchid).  
Note that this name does not distinguish it from the preceding species.

Indian name: *Hadjojen* (bone joiner)

Nepali names: *ban maiser*, *jhyanpate* in Chepang dialect; *chandi gabha* (Nepali), *syabal* (Tamang)

Description: *C. cristata* is an epiphytic or saxicolous orchid. Pseudobulbs are oblong, 2.5–4 by 1–1.7 cm, spaced 1.5–3 cm apart, and each carries two sessile, lanceolate leaves. Leaves are linear-lanceolate, 10–17 by 0.7–1.9 cm. Inflorescence is 8–12 cm long with 2–10 flowers. Flowers are white, large and fragrant, sepals and petals with undulating borders that fold backwards in parts (Fig. 9.21). Flowering period is February and March in India, May in China.

Distributed throughout Nepal, Bhutan and northern India at 1000–2000 m (Manandhar and Manandhar 2002), Bangladesh and Myanmar, it is found on large rocks in southern Tibet at 1700–1800 m (Chen and Clayton 2009).

**Phytochemistry:** Ethanolic extract of *C. cristata* is strongly bacteriostatic against *Staphylococcus aureus* and moderately against *Escherichia coli* (Marasini and Joshi 2012), a property which supports its usage in animal husbandry. Coelogin and coeloginin, and two novel 9,10-dihydrophenanthrene derivatives, coeloginanthridin and coeloginanthrin, were isolated from air-dried, finely-ground whole plant of *C. cristata* by Majumder's group (Majumder et al. 1982a, 2001). The four compounds possess the biological activities of phytoalexins and endogenous plant growth regulators. Sensitivity testing of soil and other bacteria to individual phytoalexins should be performed to determine which compounds, if any, could be reasonable remedies for superficial infections, but such data are not available.

Ethanolic extract of *C. cristata* also restored trabecular bone without producing uterine changes when fed to mice rendered oestrogen-deficient by oophorectomy. Coelogin promoted surrogate markers of osteoblastic differentiation and activity in vitro (elevated alkaline phosphatase; increased calcium nodule formation). Together, they support the notion that the folk tradition of using *C. cristata* to treat fractured bones in the Kumaon region of Uttarakhand may have a rational basis. Perhaps there might be a role for compounds present in *C. cristata* for managing post-menopausal osteoporosis (Sharma et al. 2014).

**Herbal Usage:** *Hadjogen* (Indian, bone joiner; *C. cristata*) is used in the Himalaya to treat fractured bones in animals (Jaiswal et al. 2004). It is used to treat dysentery and diarrhoea in Myanmar (Naing et al. 2010) whereas in Nepal an infusion of pseudobulbs is used to correct constipation. Nepalese also use this orchid as an aphrodisiac (Pant and Raskoti 2013). Fresh juice or paste made with *Coelogyne cristata* is consumed to relieve headache, fever and indigestion (Subedi et al. 2013). Juice squeezed from the

pseudobulbs is applied to boils and to wounds on the hooves of animals (Manandhar and Manandhar 2002).

*Coelogyne elata* Lindl. [see *Coelogyne stricta* (D. Don) Schltr.]

### ***Coelogyne fimbriata* Lindl.**

Chinese name: *Liusubeimu Lan* (tassels pearl shell orchid)

Myanmar name: *Ngwe hnin phyu myo kywe*

**Description:** Epiphytic on trees growing in the edge of forests, or lithophytic in shady spots in ravines, at 500–2300 m in China, *C. fimbriata* is a single-flowered or sometimes two-flowered *Coelogyne* with pale yellow flowers. Pseudobulbs are ovoid-ellipsoid, 2.5–6 by 0.8–1.5 cm with 2 leaves at the apex. Leaves are oblong-elliptic, 6–14 by 1.2–2.4 cm. Flowers are 3 cm across, yellow with a distinctive lip. Lip is large, with fimbriate margins, and heavily marked with brown (Fig. 9.22). Some racemes bear two flowers which open in succession. It flowers from March to October in Hong Kong and August to October on the mainland (Chen and Clayton 2009); in Bhutan, flowering season



**Fig. 9.22** *Coelogyne fimbriata* Lindl. (Photo: E.S. Teoh)

is June to November (Gurong 2006). The species is distributed across southern China from Hainan, southern Jiangxi and Guangdong, Hong Kong, across Yunnan and Xizang to India, and southwards through Indochina and Thailand to Malaysia, Sumatra and Kalimantan.

**Herbal Usage:** Herb is obtained from Hainan, Guangdong, Yunnan and Xizang. In Chinese herbal medicine, the whole plant is used to reduce heat (Wu 1994).

### ***Coelogyne flaccida* Lindl.**

Chinese names: *Lilinbeimu Lan* (chestnut scales pearl shell orchid), *Guishangye* (the leaf above fruits)

Chinese medicinal name: *Jidatui*

Nepali name: *Thur gava*

**Description:** An impressive, epiphytic or saxicolous *Coelogyne*, plants in bloom carry a long spray of pendulous, pale, straw-coloured flowers. Pseudobulbs are conical to ovoid-cylindrical, spaced 2–3 cm apart, 6–12 cm long and 1.5–3 cm broad bearing two coriaceous, lanceolate leaves, 13–19 by 3–4.5 cm. Inflorescences arise from young, leafless pseudobulbs reaching a length of 20 cm and bear 8–12 loosely arranged, pale-coloured flowers with yellow to brownish markings on the lip. Flowers are 3–5 cm across (Fig. 9.23). It flowers in March in China (Chen et al. 1999); April to May in South India (Abraham and Vatsala 1981); April in Nepal (Raskoti 2009); February to May in Bhutan (Gurong 2006). *C. flaccida* occurs at 1600 m in Guangxi, Guizhou, Yunnan, Laos, Myanmar, Sikkim and Nepal.

**Phytochemistry:** Phenanthrenes and stilbenoids have been isolated from this species: flaccidin in 1988 (Majumder and Maiti 1988), and softlaccidin and isooxoflaccidin in 1991 (Majumder and Maiti 1991). Callosin originally isolated from the orchid, *Agrostophyllum callosum*, was discovered in *C. flaccida* in 1995 (Majumder et al. 1995; Kovacs et al. 2007).

**Herbal Usage:** Herb is collected from Guizhou and Yunnan. Known as *Guoshangye*,



**Fig. 9.23** *Coelogyne flaccida* (Photo: E.S. Teoh)

*C. flaccida* is a popular medicine among the minority tribes in both provinces. In China, the whole plant is used to clear heat, counter dryness, promote the production of body fluids, and to clear phlegm and stop coughs (Wu 1994; *Zhonghua Bencuo* 2000). Pseudobulbs are made into a paste in Nepal and applied to the forehead to treat headache, while the juice treats indigestion (Manandhar and Manandhar 2002). The paste is also used for boils (Baral and kurmi 2006).

*Coelogyne flavida* Hook. f. (see *Coelogyne prolifera* Lindl.)

### ***Coelogyne fuscescens* Lindl.**

Chinese name: *Hechunbeimu Lan*

Thai names: *Sing to, phaya rat, phao hin*

**Description:** Pseudobulbs are clustered, narrowly sub-oblong, 2–3 cm long and 5–7 mm in diameter, with two elliptic leaves, 12 by 1.5–2 cm (Chen and Clayton 2009). In Bhutan, *C. fuscescens* Lindl. var. *fuscescens* is much larger. Pseudobulbs are 8–14.5 by 1–3.2 cm (Pearce and Cribb 2002; Gurong 2006). Inflorescence carries only one or two pale yellow flowers which are 5 cm across, with golden brown edges



at the sidelobes of the lip and three golden brown keels on the mid-lobe. It flowers in December in Thailand (Vaddhanaphuti 2001), October to November in Nepal (Raskoti 2009), June in Yunnan (Chen and Clayton 2009). This epiphytic or saxicolous species is found in northern and northeastern Thailand, Laos, Vietnam, Myanmar, southern Yunnan Sikkim, Bhutan and Nepal at 1300 m. It is lithophytic in Yunnan.

**Herbal Usage:** The whole plant is a Thai aphrodisiac. When the plant was shown to ten Thai herbalists, three stated that it was an aphrodisiac, but seven did not. Stems are also used to treat burns and otitis media (Chuakul 2002). In Nepal, abdominal pain is treated with juice extracted from pseudobulbs or a poultice made with it (Baral and Kurmi 2006; Pant and Raskoti 2013).

### ***Coelogyne leucantha* W.W. Sm.**

Chinese name: *Baihuabeimu Lan* (white flower pearl shell orchid)

**Description:** Pseudobulbs are ovoid-oblong, 1.5–5 cm long and 8–15 mm in diameter, spaced 1–2 cm apart. Two leaves at the apex are oblong-lanceolate, 5–15 by 1.1–3 cm wide, with a long, narrow petiole. Inflorescence is apical, on matured pseudobulbs, erect, 15–20 cm tall, with 3–11 slightly droopy flowers on raceme. Flowers are 3–5 cm across, not fully opened, white with yellow blotch on the lip. Petals are filiform (Chen et al. 1999). Flowering season is May to July in China (Chen and Clayton 2009).

*C. leucantha* is epiphytic or saxicolous in broad-leaved evergreen forests below 2500 m in south and northwest Yunnan, southwest Sichuan, Myanmar and Vietnam. In the Gaoligongshan area, it is found on so many trees that, from May to June when the *Coelogyne* is in bloom, the trees are beautifully garlanded with their white flowers (Yang et al. 1998).

**Herbal Usage:** Herb is obtained from Yunnan. Pseudobulbs and sometimes the entire plant is used to lessen heat, stop coughs, improve blood flow, reduce pain, promote the union of fractured bones and repair torn tendons (Wu 1994).

### ***Coelogyne nitida* (Wall ex D. Don) Lindl.**

Syn. *Coelogyne ochracea* Lindl.

Chinese name: *Mijingbeimu Lan*

Nepali names: Silver Orchid in English, *bhyan pat* (Chepang), *Salida*, *Sanit* (Gurung), *Chandi gabha*, *para phul* (Nepali)

**Description:** An small epiphytic orchid with oblong pseudobulbs, 1.5–3 cm long and 1–1.5 cm in diameter, carrying a pair of lanceolate, leathery leaves, 7 by 1.5 cm, and white to pale yellow flowers with a dark brown centre on lax racemes (Fig. 9.24). It flowers in March in China (Chen and Clayton 2009); May in northern Thailand (Vaddhanaphuti 2005); January to June in Bhutan (Gurong 2006); April to June in Nepal (Raskoti 2009). It is found in northern India, Bangladesh, Nepal, Bhutan and Myanmar, the adjacent part of Yunnan at 1300–2400 m, Indochina and Thailand.

**Phytochemistry:** Ochrolide, a phenanthropyrene, and Ochrone A, a novel 9,10-dihydro-1,4-phenanthraquinone together with coelonin are present in *C. ochracea* (= *C. nitida*) (Bhaskar et al. 1989, 1991). Ochrolic, a monomeric phenanthrene derivative and a



**Fig. 9.24** *Coelogyne nitida* (Wall ex D. Don) Lindl. (Photo: E.S. Teoh)



precursor to phenanthropyrones, was isolated from *C. nitida* (Anuradha et al. 1994).

Herbal Usage: Juice of the pseudobulb is recommended for stomach ache in Nepal (Manandhar and Manandhar 2002; Baral and Kurmi 2006).

### ***Coelogyne occultata* Hook. f.**

*Pleione occulta* (Hook f.) Kuntze

Chinese name: *Luanyebeimu Lan* (ovate leaf pearl shell orchid)

Chinese medicinal names: *Luanyebeimu Lan* (ovate leaf pearl shell orchid); *Youguashihu* (squashed epiphyte)

Description: Plant has small pseudobulbs 1.5–5 cm by 0.5–1.5 cm with two ovate, coriaceous leaves at the apex, 1.5–6 by 1–2.5 cm. Flowers are relatively large, 5–6 cm across; white with two large yellow eyes connected by a transverse band on the proximal half of the lip whose side lobes are streaked with brown veins. It grows on tree trunks or cliffs at 1300–3000 m in Yunnan, Tibet, Myanmar, Sikkim and Bhutan. Flowering season is June to August (Chen et al. 1999; Chen and Clayton 2009).

Usage: Herb is obtained from Yunnan and Xizang. It nourishes *yin*, protects the kidney, nourishes the stomach and promotes the production of body fluids. Plant is used to treat hot flushes, fever, nocturnal emission, backache, anorexia and gastritis (Wu 1994; *Zhonghua Bencao* 2000). Decoction is prepared with 6–9 g of the herb for consumption to promote *yin*, relieve thirst and dry throat, or to treat tuberculosis, night sweats, chronic gastritis, lack of gastric acid, anorexia, nocturnal emission, waist pain, fatigue and haemorrhoids (*Zhongyao Da Cidian* 1986). It helps digestion (Chen and Tang 1982).

*Coelogyne ochracea* Lindl. [see *Coelogyne nitida* (Wall ex D. Don) Lindl.]

### ***Coelogyne ovalis* Lindl.**

Chinese name: *Changlinbeimu Lan*

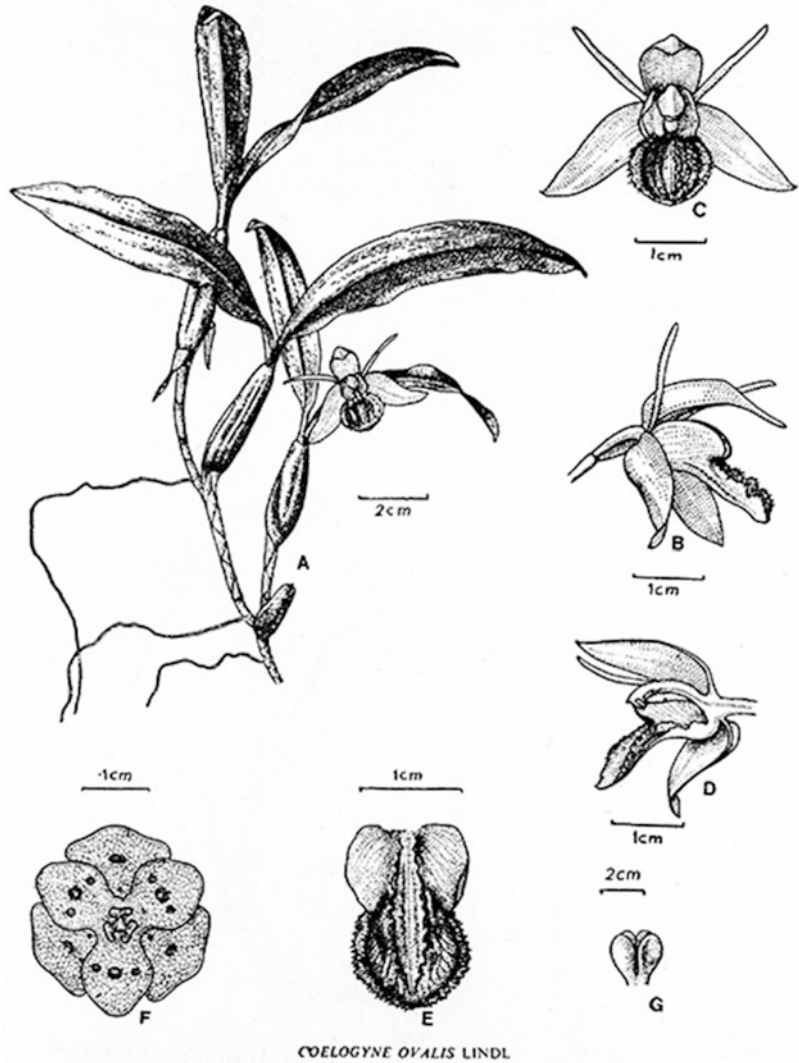
Indian name: *Jeevanti*

Description: *C. ovalis* is a few-flowered, epiphytic or saxicolous species. Pseudobulbs are fusiform, 4–9 by 1.5–2 cm. Leaves are elliptic-oblong, 9–17 by 2.5–4 cm. Inflorescence arises from apex of pseudobulb, 1–5 flowered. Flowers are 3–4 cm across, with linear petals, pale buff brown sepals and a lip that is marked with dark brown and is hirsute at the edges (Fig. 9.25). It flowers from September to November in Yunnan (Yang et al. 1998) and January in Thailand (Vaddhanaphuti 2005); October to December in South India (Abraham and Vatsala 1981), April to July in Bhutan (Gurong 2006) and September to December in Nepal (Raskoti 2009). *C. ovalis* is distributed across the western Himalaya to Tibet, Yunnan, Myanmar, Thailand and Vietnam at 1750–2000 m, and in Nilgiris and Mysore in South India.

Phytochemistry: 2,7-dihydroxy-3,4,6-trimethoxy-9,10-dihydrophenanthrene, coelogenin, coelogenin, flavidin, flavidin, batatasin III, imbricatin, beta-sitosterol and its glycoside and a new bibenzyl compound, 3'-*o*-methylbatatasin III, are present in *C. ovalis* (Majumder and Iaha 1981; Majumder et al. 1982c; Majumder 1984; Sachdev and Kulshreshtha 1986). An alcoholic extract of the orchid pseudobulbs which contained flavidin and coelogenin showed spasmolytic activity. Flavidin produced 50 % and 90 % inhibition of barium chloride-induced spasm of the guinea pig ileum at 1.0 and 2.0 mcg/ml doses. Coelogenin showed 50 and 51 % activity at 0.5 and 1.0 mcg/ml (Sachdev and Kulshreshtha 1986).

Herbal Usage: It is known as *Jeevanti* which means 'promoting life', and in this respect it is used as a tonic. In Nepal, pseudobulbs are regarded as aphrodisiacs (Pant and Raskoti 2013), hence the name *Jeevanti*. However, *Jeevanti* may also refer to other popular "aphrodisiac" orchids, *Flickingeria fugax* (= *Dendrobium*

**Fig. 9.25** *Coelogyne ovalis* Lindl. Reproduced with permission from *Introductions to Orchids* by Abraham and Vatsala, Parolde, Thiruvananthapuram: Tropical Botanic Garden and Research Centre (TBGRI), 1981



fugax) and *Flickingeria fimbriata* (= *Dendrobium plicatile*) in eastern India, or to *Leptadenia reticulata* in northern India and *Holostemma annulare* in southern India, these last two being plants that are not orchids (Sarin 1995). Baral and Kurmi (2006) reported that paste made with pseudobulbs is used as aphrodisiac!

The entire plant of *C. ovalis* is also used in western and southern India to treat coughs, urine infections and eye disorders (Rao 2004).

### ***Coelogyne prolifera* Lindl.**

Syn. *Coelogyne flavida* Hook. f.

Chinese name: *Huanglubeimu Lan*

Nepali names: *Liso* in Gurong dialect, *Thurgaujo* (Nepali)

Description: An epiphytic orchid, its pseudobulbs are spaced 2.5–4 cm apart and measure 2.2–3.7 long and 1 cm in diameter. Leaves are paired, oblong to lanceolate, 8–13 by 1.6–2.1 cm, with a 2–2.5 cm long petiole. Inflorescence is borne apically on leafy pseudobulbs, 10–15 cm long with 4–6 greenish-white to yellow green flowers, 1 cm in diameter. Sepals are oblong, petals linear. Flowering period is June in China (Chen et al. 1999; Jin et al. 2009), January in Thailand (Vaddhanaphuti 2005), April to June

in Nepal (Raskoti 2009), March to July in Bhutan (Pearce and Cribb 2002; Gurong 2006) and May to June in South India (Abraham and Vatsala 1981). *C. prolifera* is found on rocks and trees at 1100–2200 m in west and southern Yunnan, Myanmar, Thailand, Laos, Bangladesh, Sikkim, Bhutan and Nepal.

Phytochemistry: Flavidin, a novel 9,10-dihydrophenanthrene derivative, has been isolated from *C. flavida* Hook. f. (syn. *C. prolifera* Lindl.). This phytoalexin also occurs in two other Himalayan orchids, namely *Pholidota articulata* and *Otochilus fuscus* (Majumder et al. 1982b). Four related compounds, flavidin and oxoflavidin (Majumder and Datta 1982), a 9,10-dihydrophenanthropyran named flaccidin (Majumder and Maiti 1988) and imbricatin are also present in the orchid. The last compound had earlier been isolated from *Pholidota imbricata*: hence its name (Majumder and Sarkar 1982).

Herbal Usage: Paste made with pseudobulbs of *C. prolifera* is rubbed on the back to relieve backache (Manandhar and Manandhar 2002) and to treat boils in Nepal (Pant and Raskoti 2013).

### ***Coelogyne punctulata* Lindl.**

Description: Pseudobulbs are contiguous on a stout, rigid rhizome. They are oblong, 2.5–4 by 0.7–1.3 cm, bright yellow when dried. There are 2 leaves at the apex and papery sheaths at the base. Leaf is lanceolate, 8–14 by 1.3–2.5 cm, petiolated. Inflorescence is 8–15 cm long, carrying 2–4 white flowers 4 cm across. Lip is trilobed and bears a central white keel. A bright yellow patch outlined with a thin, orange rim is present on either side of the keel and on the medial aspect of the side lobes. Flowering season is November in China (Chen and Clayton 2009). *C. punctulata* is distributed from central Himalaya to Bangladesh, Myanmar, Thailand, southeastern China (SE Xizang and West Yunnan), Thailand and Vietnam. It is epiphytic or lithophytic in forests at 100–2900 m.

Usage: Pseudobulbs are dried and made into powder for use to treat wounds and burns in northern India (Das 2004). It is used to treat dry coughs and bleeding resulting from trauma in Vietnam (Hung 2014).

### ***Coelogyne stricta* (D. Don) Schltr.**

*Coelogyne elata* Lindl.

Indian name: *Harjojan*

Description: *C. elata* is an epiphyte with cylindrical to narrowly ovoid pseudobulbs, 15 by 2.5–6.5 cm, carrying 2 lanceolate, leathery leaves marked by prominent veins, 18–30 by 4–7 cm. Inflorescence is erect, up to 60 cm long with 4–10 flowers. Flowers are fragrant, 2.5–6 cm across, white, with a forked yellow central band on the lip. It flowers in March to June in Bhutan (Pearce and Cribb 2002; Gurong 2006), rarely also in October to November (Gurong 2006) and in Nepal, April to June (Raskoti 2009). *C. stricta* is found between 1100 to 2000 m in Yunnan, Myanmar and Indochina (Chen and Clayton 2009), 1400 and 2000 m in Nepal (Raskoti) and over a wide range of elevations, from 500–3300 m, in Bhutan (Pearce and Cribb 2002; Gurong 2006).

Phytochemistry: A 9,10-dihydrophenanthropyron was isolated from *C. elata* (correct name: *C. stricta*) and *C. nitida* (Majumder et al. 1982c), and a 9,10-dihydrophenanthrene named coelonin was obtained from *C. elata* (= *C. stricta*) (Majumder and Datta 1984). The phytoalexins exhibit bacterostatic and fungistatic activities (Marasini and Joshi 2012).

Usage: In northeast India, it is used to promote healing of bones and is applied externally to fractured limbs (Trivedi, Dixit and Lal 1980). Poultice made with pseudobulbs is applied to relieve headache and fever in Nepal (Baral and Kurmi 2006; Pant and Raskoti 2013).

### ***Coelogyne trinervis* Lindl.**

Thai name: *Ueang mak*

Description: Pseudobulbs are ovoid, 9 cm long, yellow green, with two narrow leaves, 40 by 3.5 cm that taper to a stalk towards the base. There are 5–6 white to creamy, fragrant flowers, 4–6 cm across, on the inflorescence. Tepals are narrow, 2.2 cm by 2.5 mm. Lip is marked with brown lines and three keels on the mid-lobe. Flowering period is November (Seidenfaden and Wood 1992; Vaddhanaphuti 2001). *C. trinervis* is found throughout Thailand, in Assam, Myanmar, Indochina, Peninsular Malaysia, Java and Maluku at 700–1000 m (Handoyo 2010).

Herbal Usage: In Thailand, the tuber is used to treat fractures and sprains (Chuakul 2002).

#### **Overview**

*Coelogyne* is a huge genus with a wide distribution, and it is surprising that only the few species in China, Nepal and Thailand, at the periphery of its distribution, should find medicinal usage, whereas in Malesia, where the genus has the most number of species, there is not much medicinal application. *C. asperata* is sacred in some parts of Indonesian Borneo (Kalimantan) and here it was believed that the abundance of the rice harvest could be predicted by seasonal profusion of its flowers (Lawler 1986).

*C. cristata* is used to treat dysentery and diarrhoea in Myanmar whereas infusion of its pseudobulbs is used to treat constipation or indigestion in Nepal (Pant and Raskoti 2013; Subedi et al. 2013). This apparent paradox suggests that the pseudobulbs of the orchid may contain heat-labile and heat-stable compounds with opposing actions, as is the well-known case with *Angelica sinensis*. *C. cristata* contains coelogin (a 9,10-

dihydrophenanthrene derivative) which has been shown to reduce intestinal spasms (Sachdev and Kulshreshtha 1986). The observation supports the Burmese herbal usage of the orchid.

*C. cristata* is sometimes used to treat headache and fever in Nepal (Subedi et al. 2013). Three species of *Coelogyne* are regarded as aphrodisiacs: *C. cristata* and *C. ovalis* in Nepal (Pant and Raskoti 2013) and *C. fuscescens* Lindl. var. *brunnea* Lindl. in Thailand (Chuakul 2002). This usage is probably not widespread because the three species are still not endangered.

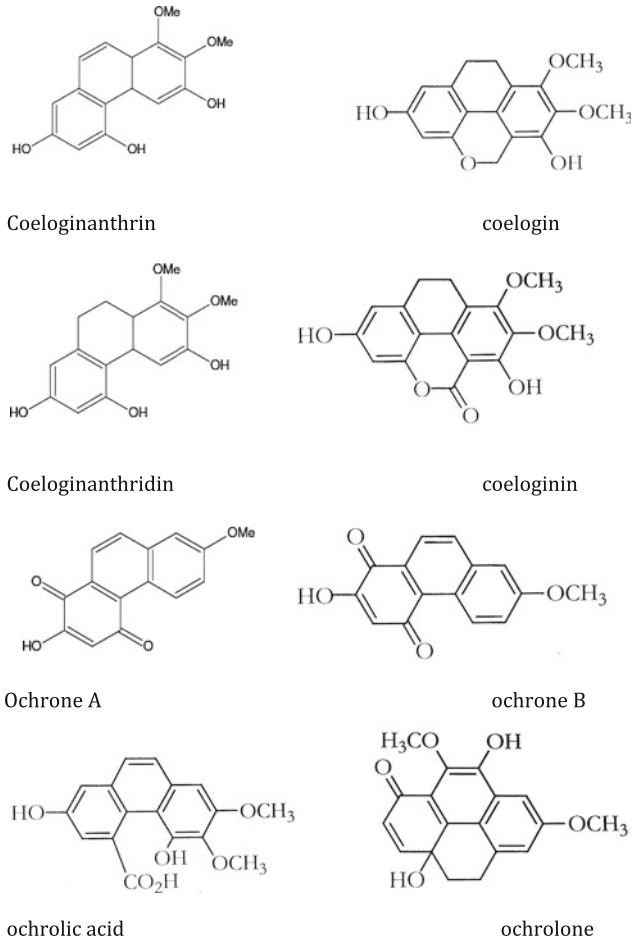
Majumder's group in India have been most active in the investigating the chemical constituents of *Coelogyne*. In 1982, they reported the isolation of coelonin and coeloginin, two 9,10-dihydrophenanthrenes from *C. ochracea* (= *C. nitida*) and *C. elata* [= *C. stricta* (D. Don) Schltr.] known in Chinese as *Shuangzhebeimu Lan*] (Majumder et al. 1982c). *C. nitida* had not been reported as a medicinal plant at that time, and the isolation of coelonin in both *C. nitida* and *C. stricta* demonstrates the value of examining many species when searching for pharmacologically active compounds within a genus. This is standard practice.

Uniflorin, a steroidal ester, was isolated from *C. uniflora* [= *Panisea uniflora* (Lindl.) Lindl], another Himalayan orchid without medicinal usage (Majumder and Pal 1985, 1990) Later, his group found four phenanthrene derivatives, coelogin, coeloginin, coeloginanthridin and coeloginanthrin, in *C. cristata* (Majumder et al. 2001). The last four compounds possess the biological activities of phytoalexins and endogenous plant growth regulators (Fig. 9.26).

Micropropagation of *C. cristata* with the intent of conserving this medicinal plant for Myanmar was achieved through the assistance of a scientific team led by Ki Byung Lim in Korea (Naing et al. 2010).



**Fig. 9.26** Phenanthrenes and stilbenoids from *Coelogyne*



### Genus: *Conchidium* Griff.

*Conchidium* are dwarfed, epiphytic herbs that were until fairly recently listed under *Eria*. There are ten species distributed from the Himalayas to southern China, Japan, and continental Southeast Asia excluding Peninsular Malaysia. Plants are epiphytic or saxicolous, often forming mats on tree trunks or rocks (caespitose). Pseudobulbs have a single internode and bear 1–4 obovate, lanceolate leaves at the apex. Inflorescence is terminal with a few or a single white, pale green or yellow flower.

### *Conchidium muscicola* (Lindl.) Rausch.]

Syn. *Eria muscicola* (Lindl.) Lindl.

Sanskrit Name: *Jivanti*

Description: A dwarf epiphyte with oval, flattened pseudobulbs, 1 by 0.5 cm, crowded together on a creeping rootstalk. It carries 2–3, oval to lanceolate, dark green leaves on the side, never at the top. Leaves are petioled and measure 0.4–2 by 0.3–0.7 cm. A zig-zag rachis carries 3–6 tiny, greenish-white flowers that are 2–3 mm in diameter (Fig. 9.27). Flowering period is July to



**Fig. 9.27** *Conchidium muscicola* (Lindl.) Rausch. (Photo: Bhaktar B. Raskoti)

November with maximum flowering in November. Common near watercourses up to 2000 m in Sri Lanka, its distribution extends northward into east and northeast India, Nepal, Bhutan and Myanmar (Jayaweera 1981; Karthikeyan et al. 1989; Gurong 2006), the Andaman Islands, Thailand, Laos and Vietnam.

Herbal Usage: Lawler (1984) reported that the Sanskrit name for this orchid is *Jivanti*, a name that is more commonly applied to *Flickingeria fimbriata* (*Dendrobium plicatile*). The Sanskrit word *Jiva* means 'life' and the term *Jivanti* is used for many herbs which are considered to be powerful tonics possessing rejuvenating and life-prolonging properties. They also act as aphrodisiacs. For comparison, some members of the contemporary medical fraternity assign a similar role to testosterone. Apart from this usage, the pseudobulbs of *Eria muscicola* are used in India to treat diseases of the heart and lungs, disorders of the nervous system, eye, ear and skin, facial tumours, fever and rabies (Hoernle, quoted by Lawler 1984). Usage in Nepal is fairly similar: it is used to treat heart, lungs and psychiatric disorders (Baral and Kurmi 2006).

## Genus: *Corymborkis* Thouars.

Chinese name: *Guanhua Lan*

The generic name is derived from the clustering of the flowers which appear like a ready-made bouquet – Greek *corymbos* (cluster of flowers) and *orchis* (orchid). Flowers are short-lived. *Corymborkis* are tall, sympodial orchids, usually exceeding a metre, with short rhizomes and stout, broad-leaved stems. Leaves are plicate, glabrous, persistent, sheathing at the base. Flowers are numerous, medium-sized, arranged in a panicle on a lateral inflorescence, and all species have white flowers (Fig. 9.28). The five species in this genus are widely distributed in the lowlands throughout the tropics. They are rarely cultivated because their flowers are ephemeral.

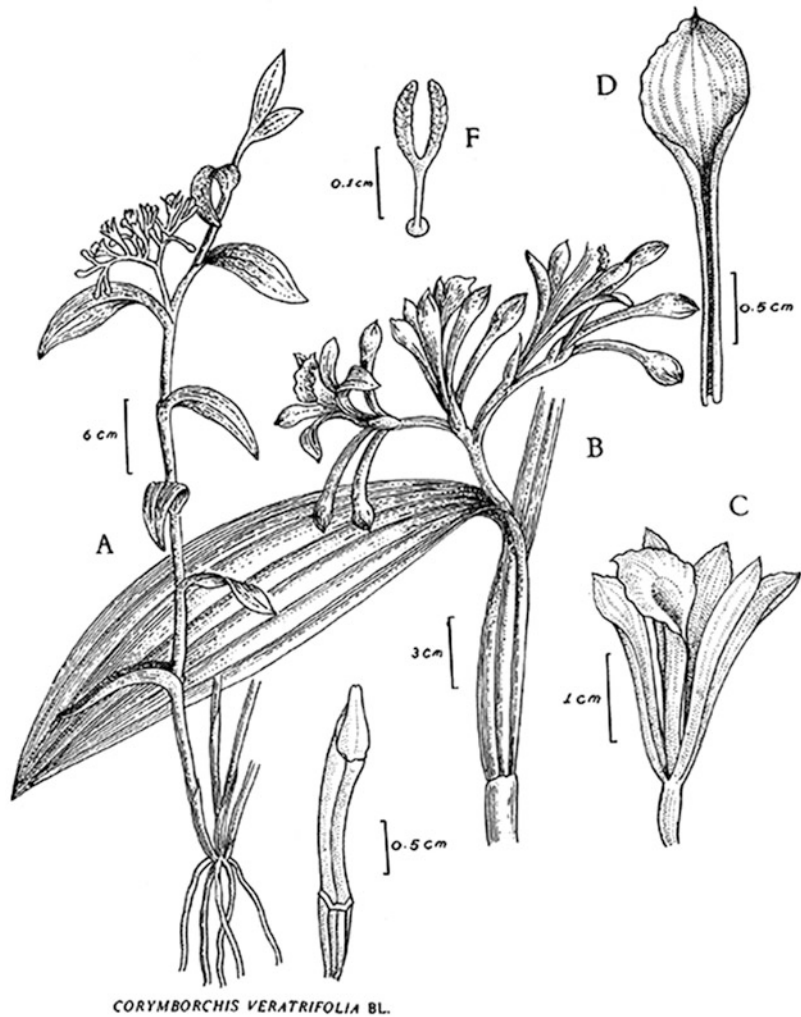
## *Corymborkis veratrifolia* (Reinw.) Blume

Chinese name: *Guanhua Lan*

Malaysian name: *Kayu Hok* in aboriginal Semang

Description: *C. veratrifolia* is a beautiful, shade-loving, tall, terrestrial orchid. Stems are erect, unbranched, 60–300 cm tall, sheathed by large, elliptic, lanceolate, plicate, dark green leaves up to 45 by 15 cm. Inflorescences are axillary, numerous, branching, up to 17 cm long, and many-flowered. Flowers are white, 5 cm long and 3 cm across, facing all directions (Fig. 9.29). They do not open widely. The species occurs in the lowlands and up to 1000–1300 m, the mountain variety bearing smaller flowers (Seidenfaden and Wood 1992). It is distributed from the Himalayas to Myanmar (Andaman Islands), southern China (southern Yunnan, southwest Guangxi and Taiwan), the Ryukyu Islands, Thailand, Malaysia, Indonesia, northern Australia and the Pacific Islands (Seidenfaden and Wood 1992; Comber 2001; Chen et al. 1999). It has also been found in the Western Ghats but is rare there, and in Sri Lanka (Jayaweera 1981).

**Fig. 9.28** *Corymborchis veratrifolia* Blume.  
Reproduced with permission from *Introductions to Orchids* by Abraham and Vatsala, Parode, Thiruvananthapuram: Tropical Botanic Garden and Research Centre (TBGRI), 1981



**Phytochemistry:** Alkaloid is present in *Corymborkis veratrifolia* (Lawler and Slaytor 1969).

**Herbal Usage:** In 1906, Ridley received a specimen of *Corymborkis veratrifolia* with a note from Dr. J.D. Gimlette who was the British Resident Physician in Kelantan, the most north-eastern state of the Malay Peninsula. The note read: "Collect the green leaves; bruise them in quantity; administer the juice either alone or with fine scrapings of *Akar Bertak* (which is not an orchid). It will cause vomiting. Use for ague (*Demum kura*), especially in children. No water to be mixed with juice. It is customary to cultivate a plant for the occasion" (Ridley 1906;

Gimlette and Thomson 1939). In India, juice freshly extracted from the leaves is used as an emetic (Rao 2007). It is used to treat cuts on the feet in the British Solomon Islands (Henderson and Hancock 1988).

### Overview

The instruction given by Gimlette recalls Li Shizhen's prescription for *Artemesia*. Since *C. veratrifolia* is also used to treat ague (malaria or some other illness characterised by fever and rigors, perhaps dengue), it might be worthwhile to test the orchid against *Plasmodium falciparum*. It should be remembered that artemisinin (Chinese *Qinghaosu*) is heat-labile



**Fig. 9.29** *Corymborkis veratrifolia* (Reinw.) Blume. (Photo: E.S. Teoh)

and any active ingredient in *C. veratrifolia* may also be destroyed by heat. There are currently no published pharmacological data on this orchid.

### Genus: *Cremastra* Lindl.

Chinese name: *Dujuan Lan* (Azalea orchid)

*Cremastra* are sympodial terrestrial orchids with creeping rhizomes and partially subterranean, tuberous pseudobulbs that bear single large long-petioled, plicate, lanceolate leaves. The distinctive feature is the tall, erect, many-flowered inflorescence that bears many elongated, droopy, partially opened flowers and looking much like a floral standard (Fig. 9.30). There are only a handful of species found in open montane forests from Nepal, Bhutan, across China, Thailand and Indochina to Japan.

The generic name is derived from Greek *kremastra* (flower stalk) which is the conspicuous feature of the genus.

#### ***Cremastra appendiculata* (D. Don) Makino**

Syn. *Cremastra variabilis* (Blume) Nakai; *Cymbidium wallichiana* Lindl.

Chinese name: *Mabian Lan* (horse whip orchid), *Dujuan Lan* (Azalea orchid); *Shancigu* (kind mountain lady), *Maocigu* (kind furry lady), *Sandangu* (three layer hoop)

Japanese: *Sai-hai ran* (purple orchid standard), *Sanjiko*

Korean: *Sanjago*, *Yaknancho*

Medicinal names: The Chinese *Shancigu* also refers to *Pleione bulbocoides*. It is *Sanjiko* in Japanese, and *Sanjago* in Korean (Kimura et al. 2001). Their similarity denotes a ancient common origin.

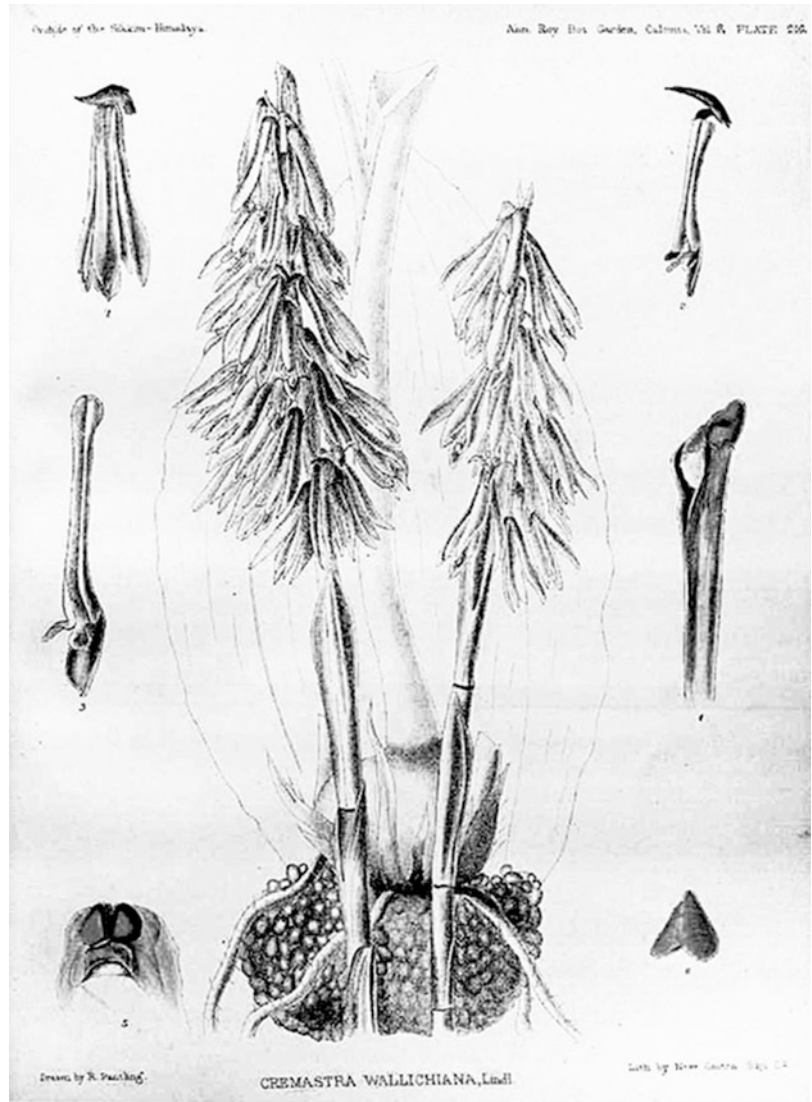
Description: *C. appendiculata* is a terrestrial herb with tuberous, clustered pseudobulbs, each of which bears a single, large, plicate, three-ribbed, long-petioled, elliptical leaf, 20–30 by 4–6 cm. Floral scape arises from the side of the tuber and carries a dozen floppy, scented, tubular flowers each up to 4 cm long rather like lilies, which do not open widely, together looking rather like a standard. Flowers are yellow to orange with a white lip. Lip and petals are spotted with bluish-violet (Fig. 9.31). Flowering period is May and June. It is a variable species distributed from the Himalayas across most of China south of the Yellow River, Thailand, Vietnam and Japan, in forests at 300–2900 m.

*C. appendiculata* is endangered because of habitat disturbance. At the Guizhou Biotechnology Institute, in vitro methods are being developed for mass propagation of the orchid from seed and meristems (Mao et al. 2007).

Phytochemistry: 5,7-dihydroxy-3-(3-hydroxy-4-methoxybenzyl)-6-methoxychroman-4-one is the homoisoflavanone isolated from the pseudobulbs of *C. appendiculata* by Shim et al. (2004) of Korea (Fig. 9.32). It inhibits basic fibroblast growth factor (bFGF)-induced, in vitro and in vivo angiogenesis of the chorioallantoic membrane of the chick embryo, without demonstrating any toxicity. It also inhibits inflammatory and allergic response in mast cells, and ultraviolet beam-induced skin inflammation (Hur and Kim 2009a, b) by reducing cyclooxygenase-2-expression and NF-kappa B nuclear localisation (Hur et al. 2010). *C. appendiculata* extract up-regulates tyrosinase activity in vitro (Yan et al. 2002). Tyrosinase is the enzyme that promotes melanin



**Fig. 9.30** *Cremastra appendiculata* (D. Don) Makino (as *Cremastra wallichiana* Lindl.). From: *Annals of the Royal Botanic Gardens, Calcutta*, vol. 8(3): t. 246 (1891) Drawing by R. Pantling. Courtesy of Missouri Botanic Garden, St. Louis, USA

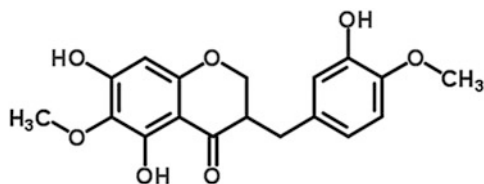


formation, darkening of skin and UV protection. Xue et al. (2005) from the Institute of Materia Medica in Beijing's Chinese Academy of Medical Sciences isolated and identified six compounds from the "corm" of *C. appendiculata*: isohircinol, flavanthrinin, *p*-hydroxyphenylethyl alcohol, 3,4-dihydroxyphenylethyl alcohol, daucosterol and beta-sitosterol. A few months later, they reported the isolation of eight compounds from the "tubers" (pseudobulbs) of *C. appendiculata*: cirrhopetalanthrin, 7-hydroxy-4-methoxyphenyl-1- $\beta$ -D-glucoside, 4-(2-hydroxyethyl)-2-methoxyphenyl-1- $\beta$ -D-glucopyranoside, tyrosol 8- $\beta$ -D-glucopyranoside, vanilloside, *p*-hydroxybenzyl

aldehyde, sucrose and adenosine (Fig. 9.33). Except for cirrhopetalanthrin which showed non-selective moderate cytotoxicity, none of the other compounds showed any cytotoxicity against human colon cancer (HCT-8), human hepatoma (Bel77402), human stomach cancer (BGC-823), human lung adenocarcinoma (A549), human breast cancer (MCF-7) and human ovarian cancer (A2780) cell lines (Xia et al. 2005). Next, employing ethanol as a solvent, they recovered six new phenanthrene derivatives from the pseudobulbs of the orchid which consisted of three monophenanthrenes, two biphenanthrenes and one triphenanthrene. The compounds were



**Fig. 9.31** *Cremastra appendiculata* (D. Don.) Makino (Photo: Liu Ming)



**Fig. 9.32** Chemical structure of Cremastranone, a homoisoflavanone with anti-angiogenesis properties isolated from *Cremastra appendiculata*

screened for possible cytotoxicity but they tested negative (Xue et al. 2006). They also managed to isolate two new terpenoids, cadinane sesquiterpene and ent-kaurane diterpene diglycoside, together with a known triterpene with 32 carbon atoms. The triterpene with 32 carbon showed selective cytotoxicity against human breast cancer cell line (MCF-7) in vitro but not against other human cancer cell lines, while the two terpenoids tested negative throughout (Li et al. 2008). A new pyrrolizidine alkaloid, cremastrine, was isolated from the pseudobulbs by Ikeda et al. (2005) at Mitsubishi Pharma Corporation in Osaka (Fig. 9.34). Seven compounds isolated with silica gel, reverse-phase silica gel, and Sephadex column

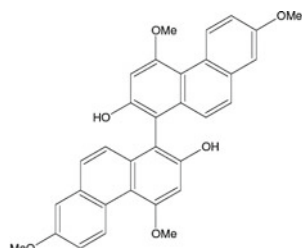
chromatography were identified by Liu et al. (2008) as 5-methoxybibenzyl-3,3'-di-*O*-beta-D-glucopyranoside, militarine, loroglossin, protocatechuic acid, succinic acid, gastrodin and daucosterol. Compound 1 is new and the others were isolated from *C. appendiculata* for the first time. At least one of these compounds has a neuroprotective effect, but the effect of extracts of *C. appendiculata* on the nervous system has not been fully studied. Subsequently, another 14 compounds were isolated from petroleum ether and ethyl acetate extracts of *Shancigu*, namely: 4,4'-dimethoxy-9,9', 10,10'-tetrahydro-(1,1'-biphenanthrene)2,2', 7,7'-tetrol; 4,4', 7,7'-tetrahydroxy-2,2'dimethoxy-1,1'-biphenanthrene; 3,5-dihydroxy-2,4-dimethoxyphenanthrene; physcion; chrysophanol; emodin; genkwanin; quercetin; quercetin3'-*O*-beta-D-glucopyranoside; 3-methoxy-4-hydroxyphenylethanol; syringic acid; vanillin; and *p*-hydroxybenzaldehyde (Liu et al. 2014b). Seven compounds were isolated from an ethyl acetate extract of *Cremastra appendiculata* and identified as fumaric acid, dimethylhexyl phthalate, L-pyroglutamic acid, 2-furoic acid, vanillic acid, *p*-coumaric acid and protocatechuic acid (Zhang et al. 2011).

Recently, an additional 11 new and 23 known compounds were isolated from *C. appendiculata*. They include 20 phenanthrene or 9,10 dihydrophenanthrene derivatives, five bibenzyls, seven glucosides, adenosine and gastrodin. When tested for cytotoxic activity, only one compound showed moderate activity against A549 tumour cell line (Wang et al. 2013).

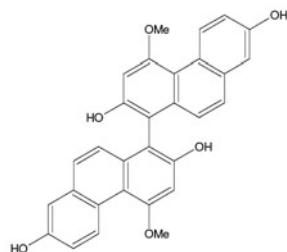
In the hexosan present in tubers of *C. variabilis* [= *C. appendiculata* var. *variabilis* (Bl.)I.D. Lund], the ratio of D-mannose to D-glucose is 3:1 (Ernst and Rodriguez 1984).

Herbal Usage: *C. wallichiana* (= *C. appendiculata*) was first listed as a medicinal herb in Chen Can Qi's *Ben Cao Shi Yi (Omissions from the Medica Medica)* compiled around 720 during the Tang Dynasty. Stem was used to treat impotence, tuberculosis, fever, frostbite, snake bites and poisoning in general. It was also used to treat abscesses and swellings. Paste made with the pseudobulb was spread over a boil to heal it. Pseudobulbs are

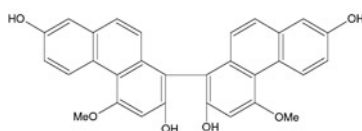
**Fig. 9.33** Bibenzyls from *Cremastra appendiculata*. Cirrhopetalantrin possesses moderate cytotoxic activity



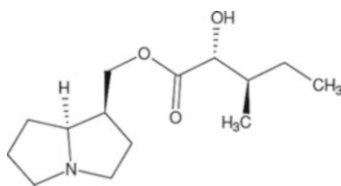
2,7,2',7',2''-pentahydroxy-4,4',4'',7''-tetramethoxy-1,8,1'1''-triphenanthrene



cirrhopetalantrin



cirrhopetalantrin



Cremastrine

**Fig. 9.34** Alkaloids from *Cremastra appendiculata*

harvested in May and June, detached from the leaves and roots, washed clean, cut into slices, and sun-dried before use. Several Chinese herbal prescriptions are listed in Table 9.4 (*Zhongyao Da Cidian* 1986; *Zhonghua Bencao* 2000). In Japan, the Ainu chew on a pseudobulb of *C. appendiculata* to relieve a toothache. They also use it to treat snake bites and insect bites (Lawler 1984).

### Overview

Neovascularisation (an overgrowth of new blood vessels) in the eye is the commonest cause of

blindness. It occurs in premature retinopathy, diabetic retinopathy, age-related macular degeneration and sickle cell anaemia. Jeong Hun Kim and his colleagues found that, in a rat model, the compound, a homoisoflavanone, extracted from *C. appendiculata* significantly reduces retinal neovascularisation. The scientists proposed that the compound might be useful for the treatment of vaso-proliferative retinopathies (Kim, Kim, Kim et al. 2007; Kim et al. 2008). A synthetic isomer of this homoisoflavanone code-named SH-11052 exhibits antiproliferative activity against human umbilical vein endothelial cells and human retinal microvascular endothelial cells. Although it did not induce apoptosis, it might be able to complement existing anti-angiogenic drugs used in the treatment of neovascular eye diseases (Basavarajappa et al. 2014). An ethanol extract of *Dendrobium chrysotoxum* was also found to be capable of alleviating retinal angiogenesis in

**Table 9.4** Prescriptions employing *Shancigu* (*Cremastra wallachii* or *Pleione bulbocodioides* or *Pleione yunnansis*) (Source: *Zhongyao Da Cidian* 1986; *Zhonghua Bencao* 2000)

1. For reduction of swelling, dissolution of phlegm, detoxification, carbuncle, tuberculous lymphadenitis, throat numbness, swelling and pain, snake bites, and (?) rabies: Wen Ha (a species of frog?) 90 g, Cremastra. variabilis (Shan Ci Gu) 60 g, Moschus moschiferus 900 mg, Qian Jin Zi 30 g, Euphorbia Perkinensis 45 g. Cook with glutinous rice and make 40 tablets. Take one tablet each time. Original Source: Essentials of External Diseases
2. For carbuncle, jaundice: Grind Cremastra. variabilis with roots and Can Er Cao, Mix and take with wine, 9 g each time. Original Source: Qiankun Sheng Yi
3. For ulcers, sores, scrofula, snake bite Shancigu 9–15 g in decoction for oral consumption and also applied to affected part
4. For malignant sores and jaundice (a) Shancigu with roots <i>Xanthium sibiricum</i> (Siberian cocklebur) Pulverise. Mix the two ingredients with wine; filter. Filtrate is the medication. (b) Render into powder Shancigu. Add 9 g to wine for consumption
5. For cracked skin Pulverise the sheath of the stems and apply to affected part
6. Cough Decoction made with 9–15 g of Shancigu
7. To treat cancer of the oesophagus Shancigu 9 g Cloves 9 g Diospyros kaki (persimmon) 5 Boil and drink.

streptozotocin-induced diabetic rats (Gong et al. 2014), but the identity of the compounds with this property was not defined.

Homoisoflavonoids exhibit a broad range of bioactivities that include antimicrobial, antimutagenic, anti-oxidant, immunomodulatory, antidiabetic, cytotoxic, anti-angiogenesis, vaso-relaxant, anti-inflammatory and anti-allergic effects (Lin, Liu, Ye 2014; Lee et al. 2014a, b; Basavarajappa et al. 2015). Therefore, there is still much about *C. appendiculata* that could be explored. Perhaps homoisoflavanone would also find a use in the treatment of tumours. There is a

single case report of a 74-year-old patient with metastatic bladder cancer who refused chemotherapy and was treated with oral and nebuliser Korean herbal therapy which included *C. appendiculata* tubers. Serial X-rays showed diminution of the multiple metastatic nodules in the lungs and his symptoms disappeared. The herbal remedy is complex and, besides *C. appendiculata*, it contained *Cordyceps militaris*, *Panax ginseng radix*, *Commiphora myrrha*, *Calculus bovis*, margarita, *Boswellia carteri*, *Panax notoginseng radix*; the nebuliser solution was made with wild ginseng and *Cordyceps sinensis* distillate (Lee, Kim, Seong, et al. 2014). The Korean team is also studying other compounds from herbs with similar properties, for instance decursin extracted from roots of the non-orchidaceous plant, *Angelica gigas* Nakai (Kim, Kim, Lee, et al. 2009).

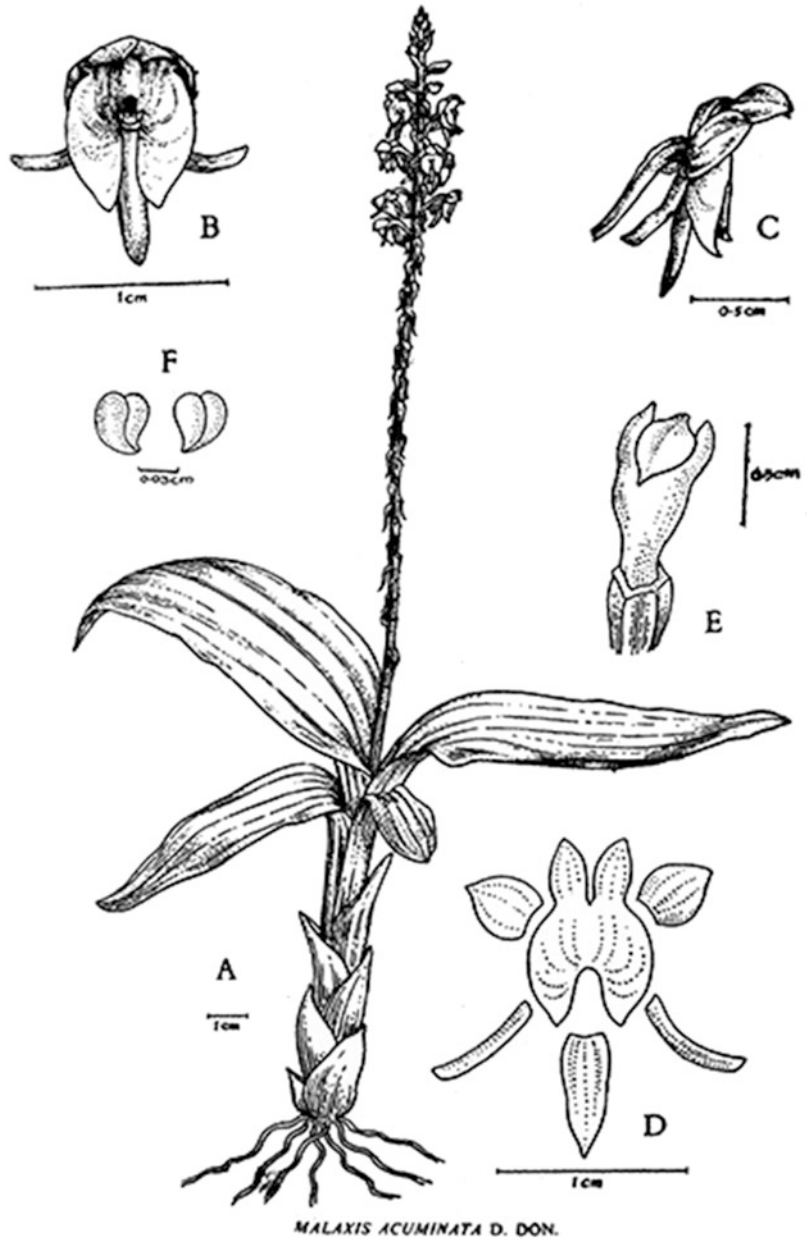
The anti-angiogenic homoisoflavanone, cremastranone, has now been synthesised. This synthetic compound was shown to inhibit proliferation, migration and tube formation of human retinal microvascular endothelial cells (Basavarajappa et al. 2014; Lee et al. 2014a).

In Japan, *C. appendiculata* is mixotrophic. Plants usually occur on the heavily shaded forest floor which rather limits their capacity for photosynthesis despite the presence of green leaves. However, the cortical cells of its underground rhizomes are heavily colonised by fungi (*Coprinellus*, Psathyrellaceae) which supply the orchid with additional carbon (Yagame et al. 2013). Orchids which associate with saprobic mycobionts like *Gastrodia elata* have been shown to contain neuroprotective compounds. Gastrodin has been isolated from *C. appendiculata*, but such therapeutic possibilities of the orchid for neuroprotection have not been explored.

*Pleione bulbocodioides* (Franch.) Rolfe and *Pleione yunnansis* Rolfe are substitutes for *C. wallachii* when the term *Shancigu* is used (*Zhonghua Bencao* 2000; Bensky, Clavey, Stoger, Gamble 2004). Japanese and Korean medicinal names for *C. appendiculata* are derived from the Chinese. *Shancigu* entered the *Chinese Pharmacopoeia* around 720 during the height of the Tang Dynasty (618–907), a period which saw an active transfer of Chinese learning



**Fig. 9.35** *Crepidium acuminatum* (D. Don) Szlach. (as *Malaxis acuminata* D. Don). Reproduced with permission from *Introductions to Orchids* by Abraham and Vatsala, Parlode, Thiruvananthapuram: Tropical Botanic Garden and Research Centre (TBGRI), 1981



and culture to Korea and thence to Japan. The similar sounding Korean and Japanese names, *Sanjaco* and *Sanjiko*, respectively, for the medicine reflect the timing of *C. appendiculata*'s entry into Korean and Japanese herbal medicine.

### Genus: *Crepidium*

Syn. Genus: *Seidenfia* Szlach.

*Crepidium* (syn. *Seidenfia* Szlach) is an Indo-Sri Lankan genus with 280 species of terrestrial

herbs with hairy roots that were generally classified under *Malaxis* or *Liparis*. Six species are present in Peninsular India, and there is one in Seychelles. The genus was named by Blume and revived by Szlachetko.

Stems are cylindrical to pseudobulbous, leaves 2 or several, petiolated, sheathing the stem, plicate, membranous or fleshy. Inflorescence is erect with persistent floral bracts. Flowers usually non-resupinate, green to yellow and purple, with an erect, relatively large, prominent, flat lip (Chen and Wood 2009) (Fig. 9.35).

### ***Crepidium acuminatum* (D. Don.) Szlach.**

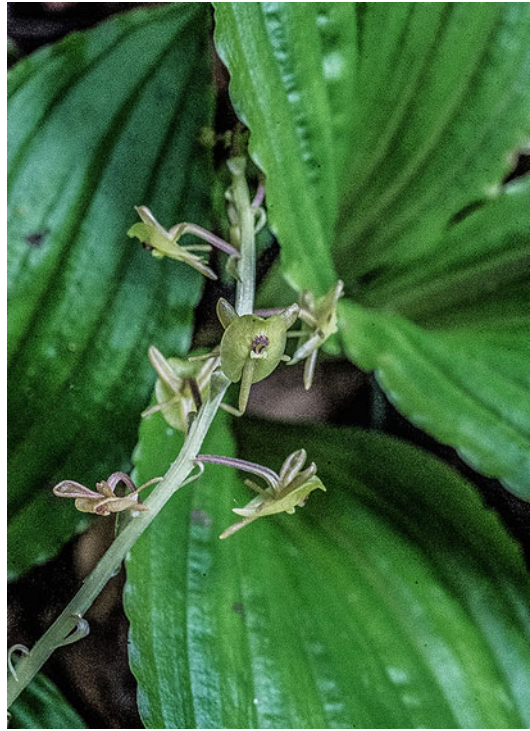
Syn. *Malaxis acuminata* D. Don., *Microstylis wallichii* Lindl.

Indian names: *Jeevak* in Hindi, *Jivak* (Tamil), *Jivakam* (Malayalam), *Jivakam* (Tekugu), *Jivakamu* (Kannada), *Jivaka* (Sanskrit): *Lahsunia* (vernacular name in Kumaun Himalaya)

Ayurvedic names: *Jivak*, *Rishvak*, *Rishbhaka*, *Bandhura*, *Dhira*, *Durdhara*, *Gopati*, *Indraksa*, *Kakuda*, *Matrika*, *Visani*, *Vrisa*, *Vrisnabha*

Description: *C. acuminatum* is a variable, robust, terrestrial herb. Stem is succulent, 10 cm tall without inflorescence (Abraham and Vatsala 1981); shoot with inflorescence is 16–27 cm tall (Joseph 1982), with round pseudobulbs, and 1–4 unequal, ovate sessile leaves, 3–14 by 1.3–4 cm. Inflorescence is 10–25 cm long, with pale, yellow to green, or pink to dull purple flowers (Fig. 9.36). In India, it flowers from July to September depending on location (Abraham and Vatsala 1981; Joseph 1982; Matthew 1995).

The preceding description fits the Indian variety. In Thailand, leaves are lanceolate-elliptic, thin, plicate, 5–9 by 2–3 cm, 4–6 leaves per plant. Thai flowers are 1 cm across (Nankorn and Watthana 2008). The orchid is also found at Gaoligongshan in western Yunnan where it blooms from May to July (Jin et al. 2009).



**Fig. 9.36** *Crepidium acuminatum* (D. Don) Szlach. (Photo: E.S. Teoh)

*C. acuminatum* is widely distributed from the southern Himalayas to Myanmar, Thailand, southern China (Xizang, Yunnan, Guizhou, Guangdong and Taiwan), Indochina and the Philippines to Australia at 300–2100 m. It is found mostly in pine or oak forests in the Himalayas (Jain 2003). Considered a medicinal plant and a protected species which is seriously threatened in India, it was discovered growing in the Haat Kali sacred grove in Uttarakhand in Central Himalaya (Singh 2010), and at 1800–2300 m in Garhwal (Dhayani et al. 2011).

Herbal Usage: *C. acuminatum* (syn. *Malaxis acuminata*) is one of eight component of *ashtavarga* (Dhayani et al. 2011). It is one of several herbs that could be considered as *Jivak*, another being *Pueraria tuberosa* (Indian name: *kudzu*) which is not an orchid (Puri 1970a). In Ayurvedic classification, it is sweet in taste (as a matter of fact, it is slightly bitter), cold in potency, pacifies *vata* and aggravates *kapha*. It

is cooling, thus causing fever to abate, and promotes sperm formation. It is administered to men whose wives are unable to conceive. Pseudobulbs are used to treat bleeding disorders, fever, tuberculosis and a sensation of heat, emaciation, dysentery, rheumatism and insect bites (Pushpa et al. 2001). Sometimes, they are substituted with *Pueraria tuberosa* (Singh and Duggal 2009). Pseudobulbs of *Crepidium acuminatum* (syn. *Microstylis wallichii*) were considered to be simultaneously a tonic and an aphrodisiac (Duggal 1971). Dried pseudobulbs of *C. acuminatum* are incorporated into the Ayurvedic tonic “*Chyavanprash*”, a popular herbal preparation for promoting health and preventing illness (Lawler 1984; Bhattacharjee 1998; Cheruvathur et al. 2010). It is a diuretic in addition to being a tonic (Pandey et al. 2003). In Bangladesh, it is used as a tonic to treat tuberculosis (Musharof Hossain 2009).

*Jeevak* or *Jivak* (*C. acuminatum*) features in the following formulations: *Astavargha churna*, *Chyanprash rasayan*, *Chitrakadi taila*, *Vachadi taila*, *Mahakalyan ghrita*, *Mahamayura ghrita*, *Mahapadma taila*, *Jivaniya ghrita*, *Vajkaran ghrita*, *Brahini gutika* and *Himvana agada*. *Malaxis cylindrostachya* (Lindl.) Kuntze and *Malaxis mackinnoni* (Duthie) Ames are sometimes used when *C. acuminatum* is not available. Other substitutes are *Pueraria tuberosa* (*Vidara kand*), *Centaurea behen* (*Safed behmen*), *Centaureum roxburghii* (D. Don) Druce (or *Lal behmen*) and *Tinospora cordifolia* (*Guruchi*). The last four herbs are not orchids (Chinmay et al. 2011; Balakrishna et al. 2012).

In Ayurvedic practice, to prepare the tonic for increasing sperm production and improving the reproductive tissues, 1 g of powdered *C. acuminatum* pseudobulb is mixed with the powdered *Malaxis monophyllos* (syn. *Malaxis muscifera*) pseudobulb, *Lilium polyphyllum* bulb, *Fritillaria roylei* bulb and *Asparagus racemosus*. This is consumed in the morning (Dhayani et al. 2011). *Crepidium acuminatum* has become

rare in Kamaun Himalaya due to overexploitation (Jain 2003).

### ***Crepidium resupinatum* (G. Forst.) Szlach.**

Syn. *Seidenfia rheedii* (Sw.) Szlach. (see *Liparis rheedii* Sw.); *Seidenfia versicolor* Marg. & Szlach.

Description: This is a variable, terrestrial herb with stems 8–21 cm long, 1.5–2 cm in diameter, with pseudobulbs along its length supporting 2–3 sessile, thin, lanceolate, plicate leaves 6–10 by 3–5.5 cm, and 7 veined. Inflorescence is erect and carries numerous small greenish-yellow to orange or purple flowers, 3.4 mm across. It continues to lengthen and produces new flowers which open successively over a long period. Flowers are non-resupinate. Lip is large, semicircular, with dentate margin, the teeth long and pronounced in some varieties, and barely visible in others (Abraham and Vatsala 1981). Plants are found in shaded locations between 400 and 1800 m (Jayaweera 1981).

The colour of the plant and flowers is influenced by light intensity: pure green in bright light, deep purple in the shade, and yellowish in between. It is because of this variation in colour that Lindley gave the species the epithet *vesicolor* (Santapau and Kapadia 1966). It was formerly referred to as *Microstylis vesicolor*, then as *Seidenfia rheedii*, and now as *C. resupinatum*. The species occurs in southern India (Karnataka, Kerala and Tamil Nadu) and in Sri Lanka.

Phytochemistry: Pseudobulb of *C. acuminatum* contains an alkaloid, glycosides, flavonoids, beta sitosterol, piperitone, 0-methylbatatasin, 1,8-cineole, citroenelal, eugenol, glucose, rhamnose, coline, limonene, *p*-cymene and ceryl alcohol (Pushpa et al. 2001; Balakrishna et al. 2012).

Herbal Usage: In the western part of the Indian peninsula, a potion made with the plant

is used to treat fever, biliousness and infantile epilepsy (Delgado, quoted by Lawler 1984).

### Overview

*C. acuminatum* is an ingredient of the popular Indian rejuvenating tonic, *Asthavarga* in Uttarakhand in the western Himalayas and in many other parts of the country (Jalal et al. 2008). On account of its popularity as an ingredient in such Ayurvedic preparations and its rapid disappearance from its natural Indian habitat, Cheruvathur et al. (2010) undertook to propagate *C. acuminatum* in tissue culture by inducing adventitious shoots in cultured internodal explants. Meanwhile, Deb and Temjensangba (2006) succeeded with in vitro immature seed germination of another threatened terrestrial Indian *Crepidium* species, *C. khasianum* (Hook f.) Szlach. [syn. *Malaxis khasiana* (Hook f.) Kuntz.]. The plantlets showed 65 % survival under field conditions. Although this is not a medicinal species, it would appear that the medicinal *C. acuminatum* could also be seed-germinated.

Pseudobulb extracts of *C. acuminatum* contain polyphenols which possess anti-oxidant activity. This has been successfully exploited for the green synthesis of gold nanoparticles which will have applications in nanobiodevices, pharmaceuticals, catalysis, and other applications of nanoscience (Gopal et al. 2014). However, they neither explain nor support the herbal usage of *Crepidium acuminatum* as a tonic and aphrodisiac.

An alkaloid, grandifoline, isolated from *C. grandifolium* (Schltr.) Szlach. (syn. *Malaxis grandifolia* Schltr.) is a glycosidic derivative of nervogenic acid esterified with laburnine (Lindstrom et al. 1971). Grandiflorine has also been isolated from *Delphinium geyeri* (low larkspur). It is closely related to the neurotoxin methyllycaconitine, and it has comparable neurotoxicity in mouse bioassays, whereas its synthetic monoacetate is significantly less toxic (Manners et al. 1998). Grandiflorine is one of several alkaloids in low larkspurs which are sometimes fatally ingested by cattle in the western USA (Gardner and Pfister 2009).

### Genus: *Cymbidium* Sw.

Chinese name: *Lan* (orchid)

*Cymbidiums* are epiphytic or terrestrial orchids with extremely short rhizomes and pseudobulbs which carry many long, often arching, lanceolate, duplicate leaves which ensheath the pseudobulb at their base. Inflorescence arises laterally and carries several to numerous, showy, medium-sized to large flowers. *Cymbidium* is distributed in tropical East Asia from India eastwards to China, Japan and Southeast Asia in lowland and montane forests. Its hybrids play an important role in the cut flower industry but they are not grown extensively in Southeast Asia because the large, showy types require cool temperatures to initiate flowering. Approximately 68 species have been described, with 49 occurring in China. The generic name is derived from Greek *kymbos* (boat-shaped cup), alluding to the lip of the flower.

### *Cymbidium aloifolium* (L.) Sw.

Syn. *Cymbidium pendulum* (Roxb) Sw.

Chinese name: *Wenban Lan* (stripe petal orchid), *Yingyediao Lan* (stiff leaf hanging *Cymbidium*), *Chuihuadiao Lan* (pendulant flower *Cymbidium*), *Diao Lan* (hanging *Cymbidium*), *Dabi Lan* (lean-on-the-wall *Cymbidium*)

Chinese medicinal name: *Yingyediao Lan* (stiff leaf hanging *Cymbidium*)

Thai name: *Ka Re Ka Ron*

Vietnamese Name: *Kim bien*

Laotian names: *Lung khao*, *Huan so pet*, *Kin loun*, *Khi mot top*

Indian name: *Supurn* in Orissa State, boat orchid; *panaipulluruvi* (Valaiyans in Tamil Nadu)

Myanmar name: *Thit tet lin nay*

Nepalese name: *Harjor* in Tharu

English name: boat orchid

Description: Pseudobulbs are small, slightly flattened, bearing 4–5 rigid, thick, coriaceous leaves,





**Fig. 9.37** *Cymbidium aloifolium* (L.) Sw. (Photo: E.S. Teoh)

40–90 cm in length and 4–5 cm wide. Scape is lateral, pendulous, bearing 15–35 (in Yunnan, 25–48) well-spaced, lightly scented flowers 3–4 cm across, of pale yellow or buff with broad maroon central striping (Fig. 9.37). Flowering period does not vary greatly throughout its distribution: March to April in Trivandrum, Kerala State in southern India (Abraham and Vatsala 1981), in May in Mumbai only slightly north in the adjacent state the west Deccan (Santapau and Kapadia 1966), April to May in Nilgiris, Tamil Nadu (Joseph 1982), March and April in Sri Lanka (Jayaweera 1981), March to June in Myanmar (Grant 1895), March to May in Thailand (Vaddhanaphuti 2005) and April to May in China (Chen et al. 1999).

This tough, epiphytic *Cymbidium* occurs as clumps on trees in sparse forests and on cliffs in ravines at 100–1100 m across northeast India, southern India, Sri Lanka, southern China, Myanmar and the Andaman Islands, Thailand, Vietnam, Peninsular Malaysia, Sumatra and Java (Chen and Tsi 1998; Comber 2001). It has been reported as very common on *Borassus flabellifer* L. in northern Sri Lanka, but also occurs on many host plants which include *Albizia falcata*, *Wormia triquetra*, *Artocarpus nobilis*, *Artocarpus heterophyllus*, *Cassia*



**Fig. 9.38** *Cymbidium aloifolium* (L.) Sw. Palm tree trunks are a favourite perch for thick-leaved *Cymbidium* plants; here in the grounds of a Buddhist temple in Chiang Mai, Thailand (Photo: E.S. Teoh)

*nodosa*, *Samanea saman*, *Eugenia* sp., *Garcinia* sp., *Mangifera indica* and *Terminalia arjuna* (Jayaweera 1981). In Thailand and Peninsular Malaysia, it is epiphytic on palms (Fig. 9.38).

Santapau and Kapadia (1966) highlighted the confusion between this species and *C. pendulum* and with *C. bicolor*. *C. aloifolium* is sometimes confused with *C. paucifolium* in China, but the latter is distinguishable by its shorter, broader leaves and few flowers (usually 6–11), and also with *C. manni*, but in the latter the leaves are thinner and the two lamellae of the lip are not broken in the middle (Liu et al. 2006). There is also confusion between this species and *C. finlaysonianum* Lindl., a common lowland orchid in Malaysia and Indonesia (Du Puy and Cribb 2007). The latter has pendulous scapes which commonly reach 90–100 cm in length with widely spaced flowers.

Phytochemistry: *C. aloifolium* contains several phenanthrenes: aloifol I and II, coelonin and 6-methoxycoelonin (Juneja et al. 1987), cymbinodin A (Barua et al. 1990), cymbinodin B (Ghosh et al. 1992), a novel polyoxygenated phenanthrene derivative designated pendulin, and a 3,7-dihydroxy-2,4,8-trimethoxyphenanthrene named denthysinin, the last which had earlier been isolated from *Eulophia nuda* and *Dendrobium thysiflorum* (Majumder and Sen 1991). An ethanolic extract of *C. aloifolium* leaves produced an anti-inflammatory and analgesic effect in mice (Howlader et al. 2011). It would be good to know which of any of the six phenanthrenes isolated so far have anti-inflammatory, analgesic or haemostatic effects.

Pendulin, a polyoxygenated phenanthrene derivative, was isolated from *C. pendulum* (Majumder and Sen 1991). Unfortunately, the publication did not permit specific identification of the species because the orchid name might refer to any of the following: *C. pendulum* (Roxb. Sw. [= *C. aloifolium* (L.) Sw.]; *C. pendulum* var. *atropurpureum* Lindl. [= *C. atropurpureum* (Lindl.) Rolfe]; *C. pendulum* var. *brevilabre* Lindl. [= *C. finlaysonianum* Lindl.] or *C. pendulum* var. *purpureum* W. Watson [= *C. crassifolium* Herb.].

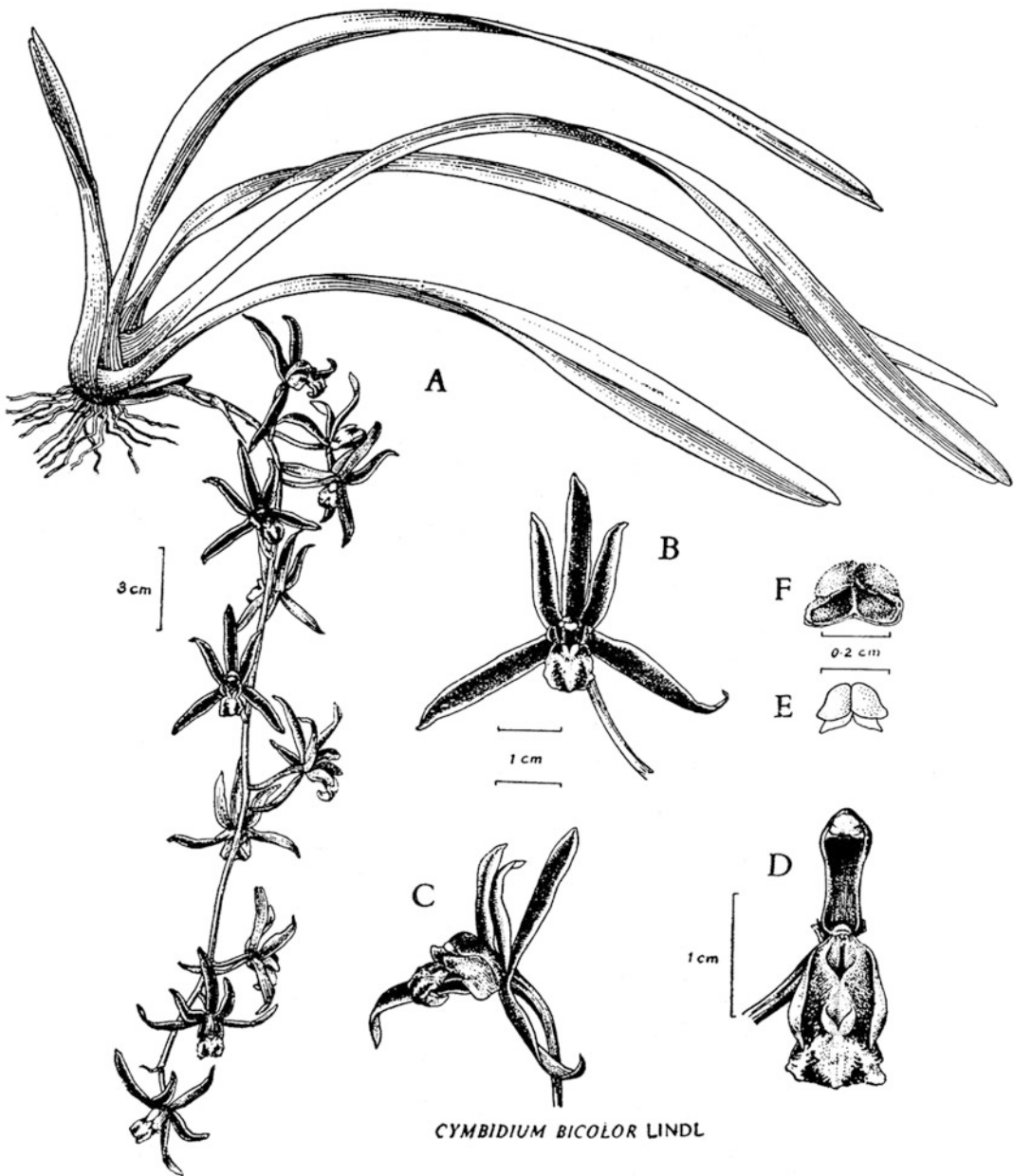
Herbal Usage: In Indian traditional medicine, juice is extracted from the whole plant by pounding it with ginger and a small amount of water is used to induce vomiting and diarrhoea (Caius 1936), or to cure chronic illness, weakness of the eyes, vertigo and paralysis (Lawler 1984). Reddy et al. (2005) who researched the region of the Eastern Ghats found that aboriginal Konda reddis of East Godavari district used the aerial roots of the orchid to make a paste for treating cracks on the feet, whereas aboriginal Koyas of Khammam district used a similar preparation for setting fractures. On the other side of the Deccan in the Uttara Kannada district, roots of *C. aloifolium* are added to tubers of a common terrestrial orchid, *Zeuxine strataeumatica*, to prepare a tonic (Rao 2004). Tribal residents at Kudremukh National Park in Karnataka use the mucilage extracted from the orchid leaves to stop bleeding from

leech bites, as the sap is said to promote blood coagulation. Powdered pseudobulb is made into a drink to cause vomiting and purging by the same tribes (Rao 2007). *C. aloifolium* also forms an ingredient of medicinal oil that is used to treat both benign and malignant tumours. To treat paralysis, the Dongria Kandha tribe in Southwestern Orissa uses a twice-daily dose of a mixture of cow's milk with powdered root of the orchid, ginger and black pepper for a period of 2 months (Dash et al. 2008). Santapau and Kapadia (1966) reported that the leaf sap had styptic properties. This useful medicinal property caused the plant to be collected to such an extent that it disappeared from some areas. Crushed leaves are used to stop bleeding from leech bites (Rao and Sridhar 2007). It is sometimes used as a vegetable aphrodisiac or as *salep* in India (Puri 1970b, c). Valaiyans living in the Vellimalai Hills of Tamil Nadu heat the leaves over a fire and administer the hot juice into the ear to relieve earache (Ganesan and Kesaavan 2003).

*C. aloifolium* is a constituent of a Sri Lankan oily embrocation used in the treatment of tumours (Soyas, quoted by Lawler 1984). In Indochina, a decoction of the plant is used as a medicinal bath for sickly children, or to treat women suffering from irregular menstruation (Petelot, quoted by Perry and Metzger 1980). Pseudobulbs are also used to treat cuts, sores and burns in Luang Prabang (Spire 1907, quoted by Vidal 1963). In Thailand, the leaves are used to treat ear infection while the root is used for kidney disorders (Chuakul 2002). In Myanmar, pseudobulbs are used to treat earache, stomach ache and dysentery, whereas leaves are used for fractures (Kurzweil and Lwin 2014).

In Nepal, a country which has imbibed many Indian traditions, the plant is used as an emetic, purgative and demulcent. It is also used in the form of a paste to treat dislocated bones (albeit many other orchids are also used for such purposes; see *Calanthe masuca*) (Manandhar and Manandhar 2002; Baral and Kurmi 2006; Pant and Raskoti 2013).

Chinese herbalists use the whole plant and its seeds to improve the condition of the lungs, stop



**Fig. 9.39** *Cymbidium bicolor* Lindl. Reproduced with permission from *Introductions to Orchids* by Abraham and Vatsala, Parlole, Thiruvananthapuram: Tropical Botanic Garden and Research Centre (TBGRI), 1981

coughs, establish regular menstruation, and to treat haemetemesis, discharge and bleeding from injuries. The medicinal plants are collected from Guangdong, Guangxi, Guizhou and Yunnan (Wu 1994).

***Cymbidium bicolor* Lindl.**

Sri Lankan name: *Visa Dhooli* (Poison Dust); *Beyudhuru* (not specific; also used for *Pholidota imbricata*)

Description: *C. bicolor* is a hardy, strap leaf, low-land, epiphytic *Cymbidium*. Plant resembles *C. finlaysonianum* vegetatively but leaves of this species, measuring 45 by 1.5 cm, are smaller than those of *C. aloifolium* (Abraham and Vatsala 1981; Seidenfaden and Wood 1992). Inflorescence is pendulous, up to 25 cm, arises from the base of the pseudobulb and carries numerous flowers, spaced 2–3 cm apart. Flowers also resemble *C. finlaysonianum* but are less full and are marked by a broad, central, deep purple stripe along the length of the sepals and petals. Edges of sepals and petals are pale green or buff. Lip is yellow spotted with purple. Column is dark purple at the back, yellow with purple spots in front (Seidenfaden and Wood 1992) (Fig. 9.39 and Fig. 9.40). It is distributed from India, Sri Lanka, the Andaman and Nicobar Islands to Sumatra, Malaysia, Kalimantan, Philippines and Sulawesi.

Herbal Usage: Leaves are used for treating fractures in southern China (Wu 1994).

### ***Cymbidium crassifolium* Herb.**

Syn. *Cymbidium mannii* Rchb.

Chinese name: *Rouye Lan* (tender leaf *Cymbidium*)



**Fig. 9.40** *Cymbidium bicolor* Lindl. (Photo: Bhaktar B. Raskoti)

Description: This epiphytic orchid has thick, duplicate, coriaceous leaves 20–90 cm by 1–3 cm. sheathing at the base. Inflorescence is lateral, pendulous with 10–20 flowers, 3–4.5 cm across, well spaced on the raceme. Sepals and petals are narrow, whitish or a pale yellow to brown, with a broad central streak of crimson. Petals are not well extended. Lip is trilobed, crimson with two longitudinal, yellow-coloured lamellae. It flowers in March and April in China, January to May in Thailand (Vaddhanaphuti 2005) and April to May elsewhere. The species is distributed from Yunnan eastwards across Guizhou and Guangxi to Guangdong and Hainan, southwards to Myanmar, Thailand, Indochina and Indonesia, and westwards to Nepal, Bhutan and Bangladesh, from 100 to 1600 m. It thrives in sunny locations, on trees in forests or in thickets. The medicinal plant is collected from Guangxi and Yunnan.

Herbal Usage: Leaves of *C. bicolor* are used for treating fractures (Wu 1994).

### ***Cymbidium devonianum* Paxton**

Chinese name: *Fu Lan*

Nepali name: *Thir gava*

Vietnamese name: *Gam ngu sac*

Description: A striking, handsome, epiphytic or saxicolous *Cymbidium* of moderate size, up to 30 cm tall, with inflorescences of up to 45 cm with numerous (20–40), closely well-arranged, star-shaped, flat flowers, 3.5 cm across of variable colour, reddish-yellow, olive green to pale brown, sometimes speckled or streaked with red. Lip is purple with darker blotches on the side lobes. Leaves are suberect, oblong to oblanceolate, coriaceous, 22–27 by 3–4 cm, 2 to 4 arising from a short subcylindrical pseudobulb 1.5–2.5 by 1 cm diameter (Fig. 9.41). It flowers from March to June, depending on location. The species is distributed in Nepal, Bhutan and Bangladesh, southeast Yunnan, Myanmar, Thailand and Vietnam at 1500–1600 m, in exposed locations, on mossy rocks and trees.

Herbal Usage: In Nepal, a paste of the root is applied on boils. Plant is decocted until the liquid





**Fig. 9.41** *Cymbidium devonianum* Paxton (Photo: E.S. Teoh)

volume is reduced to half, salt is added and the decoction is consumed in small amounts three times a day for coughs and colds. Proportions are not stated (Manandhar and Manandhar 2002).

### ***Cymbidium elegans* Lindl. var. *elegans***

Syn. *Cymbidium longifolium* D. Don.

Chinese name: *Suocao Lan*

Description: Plants are epiphytic or saxicolous. Pseudobulbs are ovoid, laterally compressed, 4–9 by 2–3 cm, enclosed by persistent leaf bases. Leaves are numerous, linear, 45–80 by 1–1.8 cm. Inflorescence usually pendent or arching with pendulous rachis, arising from lower portion of pseudobulb, 40–50 cm long. Rachis carries over 20–35 nodding, bell-shaped, cream-coloured flowers. Sepals and petals are lanceolate 3–4 cm long. Lip is oblong-lanceolate, 3–4 cm long, trilobed; in some plants, spotted



**Fig. 9.42** *Cymbidium elegans* Lindl. (Photo: Bhaktar B. Raskoti)

with red (Fig. 9.42). Flowering season is October to December in China, September to November in Nepal, and September to December in Bhutan (Chen et al. 1999; Raskoti 2009; Gurong 2006). It occurs in forests at 1700–2800 m in Sichuan, Xizang and Yunnan in China (Liu et al. 1969), at 1000–2500 m in Bhutan (Gurong 2006) and at 1500–2500 m in Nepal (Raskoti 2009). In the last country, it is localised and threatened by deforestation and overexploitation as an ornamental plant (Raskoti 2009).

This species varies from the type in having more numerous flowers on the rachis. Lamellae on the lip are without any appendages (Chen and Cribb 2009).

Herbal Usage: *Salep* made with the plant is used as demulcent or emetic in India (Das 2004; Jalal et al. 2010). Fresh juice extracted from the leaves is used to arrest bleeding, especially from deep wounds (Baral and Kurmi 2006).

### ***Cymbidium ensifolium* (L.) Sw.**

Chinese names: *Lan* (orchid), *Guo Lan* (National Orchid), *Gog Lan* (Nation's Orchid), *Jian Lan* (Jian orchid), *Dajing Lan* (large, lush orchid), *Jinbaolisuxin Lan* (golden centered, quietly elegant orchid), *Suxin Lan* (quietly elegant heart orchid), *Guanlanhua* (official orchid flower), *Lancao* (orchid herb, orchid grass), *Shanlanhua* (mountain orchid flower), *Kienlan* (Fukien or Fujian Orchid), four season orchid, rock orchid, etc.

Medicinal names: *Jian lan hua* (famous orchid flower); *Jian lan gen*; *Qiu Lan* (autumn *Cymbidium*); *Ba Yue Lan* (Eighth month *Cymbidium*); *Guan Lan* (official *Cymbidium*)

Thai name: *Chu lan*

Description: This is the popular, fragrant *Cymbidium* which many oriental scholars identified with Confucius when he likened the company of good friends to a room full of fragrant orchids. It is frequently featured in Chinese paintings of the orchid that suggest grace and contentment. A standard advice to aspiring Chinese artists is to “Paint *Cymbidium ensifolium* when you are happy; bamboo when you are angry.”

*C. ensifolium* has numerous Chinese names (not including those of prized cultivated varieties). It is referred to as the National Orchid (*Guo Lan*) in Taiwan (Ou et al. 2003). However, it is not China's national flower (*Guo hua*)—that is the peony (*Paeonia*).

Pseudobulbs are cylindrical, up to 2.5 cm in length with 2–6 narrow leaves 30–60 cm by 1.5 cm, erect to suberect, curving in the middle. Scape is lateral 20–30 cm in length with 3–9 fragrant flowers of variable coloration, usually beige to pale yellow-green, marked with purple. Lip is three-lobed, often marked with red to purple and the central lobe curling backwards (Fig. 9.43). Flowering period is variable, but commonly June to October. There are over a hundred named varieties of this popular, widespread, floriferous species which is easy to cultivate (Fung 1999), with numerous peloric forms.



**Fig. 9.43** *Cymbidium ensifolium* (L.) Sw. (Photo: E.S. Teoh)

The species is widely distributed throughout subtropical Asia, China south of the Yangzi, Japan, Indochina, Thailand, Malaysia, Philippines and Sri Lanka at 500–1800 m. It favours sparsely wooded, grassy slopes and open, hardwood forests which are not too humid.

Herbal Usage: The herb is collected in autumn. TCM states that its taste is acrid; neutral. For internal use, it is decocted or made into a tea. The entire plant is used to reinforce the body fluids, nourish blood (*yin*), ‘smooth the lungs’, reduce phlegm and stop coughing. It also stops pain, especially dysmenorrhoea, and corrects amenorrhoea, leucorrhoea (vaginal discharge), giddiness, coughing and haemoptysis in tuberculosis. It

helps to heal burns. It is diuretic. Flowers brighten the eyes if consumed over a long period, and relieve coughs, chest pain, glaucoma and cataract. Decoction of the root was formerly used in China to treat gonorrhoea (*Zhongyao Da Cidian* 1986; Wu 1994). To treat bronchitis, it is recommended that two leaves be boiled and the decoction consumed. For chronic coughs, juice is extracted from 30 g of fresh root and mixed with rock sugar for a dose of medicinal syrup. For leucorrhoea, 30–60 g of fresh root is cooked with lean pork and served as a soup. The plant is freshly mashed up to prepare a poultice for application to boils and abscesses (Li 1994). A decoction made with the roots and rhizome of *C. ensifolium* was mixed with rice wine (fermented glutinous rice) and eaten as a remedy for stomach ache (Hu 1971). Regular consumption of a tea made with *C. ensifolium* is a method used to correct stagnation of qi. The orchid is also used for the induction of labour (*Zhonghua Bencao* 2000). Examples of Fujian and Sichuan prescriptions employing *C. ensifolium* are illustrated in Table 9.5. Given the place of these two provinces in the history of Late Tang (ninth century CE), they may date from that period.

**Table 9.5** Three Fujian and Two Sichuan Prescriptions employing *Cymbidium ensifolium* (Source: *Zhongyao Da Cidian* 1986; *Zhonghua Bencao* 2000)

1. Indication: chronic cough, Prepare decoction with 14 flowers of Jian Lan Hua (Xiamen New Treatment and Selected Chapters of Chinese Herbs)
2. Indication: tuberculosis with cough and haemoptysis Squeeze juice from fresh Jian Lan Gen and cook with rock sugar. Take 15–24 g each time. (Quanzhou Herbs)
3. Indication: hematuria or dysuria Boil Jian Lan Gen 45 g, onion 3–5 bulbs, and take with brown sugar (Quanzhou Herbs)
4. Indication: leucorrhoea Cook Jian Lan Gen, Tian Dong, Liliun brownii, Bai Jie Ou with chicken (Records of Sichuan Chinese Medicine)
5. Indication: feminine ‘dryness’ Cook Jian Lan Gen, Bai Jie Ou, Shi Zhu Gen, and Polygonatum chinense with pork (Records of Sichuan Chinese Medicine)

In Indochina, the flowers were used as an ophthalmic wash, leaves as a diuretic, and roots for chest ailments (Petelot, quoted by Perry and Metzger 1980). Decoction of the flowers has a similar usage in Indonesia (Usher 1971), and to treat sore eyes in India (Das 2004). Also in India, rhizomes are boiled and the extract is consumed to treat gonorrhoea (Das 2004).

### ***Cymbidium faberi* Rolfe**

Chinese names: *Jiuhua Lan* (nine flower orchid), *Yijingjiuhua* (nine splendour flower), *Tubaibu* (wild hundred steps); *Taiwanyijingjiuhua* (Taiwan Jiuhua blossom), *Hui Lan* (pure heart orchid), *Changye Lan* (long leaf orchid), *Huaqi Lan* (clearing gas orchid). In Taiwan: multi-flowered orchid

Medicinal name: *hua qi lan*

Description: *C. faberi* is a large terrestrial herb with inconspicuous pseudobulbs and 6–10 linear, grass-like leaves, 60–90 cm long and 8–12 mm wide with serrated margins. Raceme carries 12–18 loosely arranged, fragrant flowers of pale green or yellow tinged with light purple, with purplish-red patches on the lip (Liu et al. 2006). Some varieties are very fragrant. Flowering period is February to May. In cultivation, it likes dampness but a well-drained medium. *C. faberi* occurs south of the Yellow River in China, in Taiwan, and in Nepal, Bhutan and northeast India, in sunny grassland or sparse forests at 700–3000 m, often in association with *Miscanthus* spp. (a perennial grass) or the Bhutan white pine, *Pinus bhutanica* (Gurong 2006).

Herbal Usage: Herb is collected in autumn. After washing, leaves and roots are removed from the pseudobulbs which are sun-dried for storage. The root is bitter, sweet, mild and slightly poisonous. *C. faberi* is used for the relief of headache or coughs, and to destroy insects, worms and lice. A decoction is taken for headache, while 6 g in decoction is consumed with white wine once a day to relieve coughs. To clear the bowel of *ascaris* (round worms), 500 g of *C. faberi* pseudobulb is added to wheat powder



and made into buns. These are consumed over 3 days (*Zhongyao Da Cidian* 1986).

### ***Cymbidium finlaysonianum* Lindl.**

Malay name: *Sepuleh*

Thai name: *Ka Re ka Ron Pak Pet*

Description: A common lowland orchid in Southeast Asia, it is tolerant of strong sunlight, often growing as large clumps on trees or rocks near the roadside. Pseudobulbs are short and carry thick, leathery, strap leaves that measure 75 by 4 cm. The pendulous, metre-long inflorescence bears 20–24, well-spaced, yellow to chocolate-coloured flowers that are streaked with red. Lip is white with purple on the side lobes and it carries a crescent-shaped patch on its curled tip (Fig. 9.44). Flowering season is May.



**Fig. 9.44** *Cymbidium finlaysonianum* Lindl. (Photo: E.S. Teoh)

Phytochemistry: 7-*O*-glycosides of vitexin and isovitexin was identified from *C. finlaysonianum* (Williams 1979).

Herbal Usage: Burkhill and Haniff (1930) reported that the Malay medicine men used it to remove bewitchment in Telok Anson, in the northwest of Peninsular Malaysia. At that time, malevolent spirits were thought to be the cause of numerous serious illnesses. Such employment of *C. finlaysonianum* and other orchids in the Malay magical approach to treating illness is indicated by their common Malay name, *sepuleh* which translates as “restorative”, i.e. restoring to health.

*Cymbidium flaccidum* Schltr. (see: *Cymbidium crassifolium* Herb.)

### ***Cymbidium floribundum* Lindl.**

Syn. *Cymbidium floribundum* Lindl. var. *pumilum* (Rolfe) Y.S. Wu et S.C. Chen; *Cymbidium pumilum* Rolfe

Local name: *Duohua Lan* (many flowered *Cymbidium*)

Description: Pseudobulbs are ovoid and a little flattened, 2.5–3.5 cm long, carrying 5 or 6 thin, coriaceous leaves, 50 by 0.8–1.8 cm. Inflorescence is suberect, lateral, with numerous flowers on the raceme. Flowers are well arranged and displayed, 3–4 cm across, of variable coloration, reddish-brown to green or brownish-grey with a white lip that is spotted with red. Flowering season is April to August. A large clump is very handsome when it produces numerous sprays of reddish flowers (Liu et al. 1969, 2006).

This epiphytic, occasionally terrestrial or saxicolous *Cymbidium* is widely distributed through central and southern China (Zhejiang, Jiangxi, Fujian, Taiwan, Guangdong, Guangxi, Hunan, Guizhou, Hubei, Sichuan, Yunnan and Xizang) at 100–3300 m. Plants are found in forests, at the edge of forests or on sunny cliffs and along ravines, and very rarely on rocky soil.

Herbal Usage: Herb is obtained from Huadong (Gouangdong Province), Huanan



(Heilongjiang Province) and Tibet. Entire plant is used in the same manner as *C. ensifolium* (Zhongyao Da Cidian 1986; Wu 1994).

Japanese honey bees (workers, drones, queens and absconding bees) are attracted by fragrances emitted by *C. floribundum* which resemble compounds present in their mandibular glands. These are a mixture of 3-hydroxy octanoic acid and 10-hydroxy (E)-2-decenoic acid (Sugahara et al. 2013). Shiseido markets a perfume that contains the scent of *Cymbidium*. The French perfume *Diorissimo*<sup>®</sup> attracts *Euglossine* bees in South America (Pijl and Dodson 1966) but we are not able to determine whether Shiseido's perfume attracts Japanese honey bees.

*Cymbidium floribundum* Lindl. var. *pumilum* (Rolfe) Y.S. Wu et S.C. Chen (see *Cymbidium floribundum* Lindl.)

This variety is given different species status in the *Chinese Materia Medica* (2000), but it is not separated from *C. floribundum* Lindl. in *Flora of China* (Liu et al. 1969). Its medicinal usage is similar to that of *C. floribundum* (Zhongyao Da Cidian 1986; Wu 1994).

### ***Cymbidium goeringii* (Rchb. f) Rchb. f.**

Local names: *Chun Lan* (spring orchid), *Riben Chun Lan* (Japanese spring orchid), *Diolaohua* (hanging orchid flowers); *Cao Lan* (grass orchid); *Shan Lan* (mountain orchid); *Shuangfeiyan* (twin flying sparrow)  
Japanese: *Hokuro* (black seeds/age spots); *Jiji-baba* (grandpa and grandma)

Description: This is a terrestrial orchid with an inflorescence that carries a single fragrant flower, rarely two. Pseudobulbs are small, ovoid 1–2.5 by 1–1.5 cm. and enclosed by leaf bases. Leaves are 4–7, slender, lorate, 20–40 cm by 0.5–1 cm, slightly serrated on the margins. Inflorescence arises near the base of the pseudobulb, is obliquely erect, short, 2–5 cm, and usually 1-, occasionally 2-flowered. Typical varieties are green or a straw-coloured, with a white lip stippled with maroon spots (Fig. 9.45). It flowers from January to March.



**Fig. 9.45** *Cymbidium goeringii* (Rchb. f.) Rchb.f. ((Photo: E.S. Teoh)

Widely distributed throughout most of China (excluding the very northern provinces in Manchuria, Inner Mongolia, Xinjiang and Xizang), it is also found in Bhutan (at 500–3000 m with *Pinus bhutanica*, *P. roxburghii*, *Quercus lanata* and in mixed broad-leaved forests), in India, Korea and Japan (Liu and Nakayama 2007). It prefers stony habitats, shrubby slopes or sparse forests, at 300–2200 m. The southern regions of Korea represent its northernmost distribution, and here the clumps face south where they are exposed to wind speeds of 3 m/s. The swift wind cools the leaves in summer. In winter, wind blowing from the south maintains leaf temperature above minus 6 °C. Elsewhere in Korea, these conditions are not met and *Cymbidium goeringii* can barely survive in the wild (Cho and Beyoung 1995).

Phytochemistry: Cymbidine A, a monomeric peptidoglycan-related compound isolated from *C. goeringii*, possesses diuretic and hypotensive activities (Watanabe et al. 2007). Gigantol isolated from whole plants of *C. goeringii* by Won et al. (2006) exhibits inhibitory effects of LPS-induced nitric oxide and prostaglandin E2 (PGE2) production in macrophages. It is a potent inhibitor of tumour necrosis factor-alpha (TNF-alpha), interleukin-1beta (IL-1beta) and interleukin-6 (IL-6) release, and it influences

mRNA expression of these cytokines in a dose-dependent manner. These effects are produced through its ability to block nuclear factor kappa B (NF-kappaB) activation (Won et al. 2006).

Three new diketopiperazines were recently isolated from the fungus *Chaetomonium cochliodes* 88194 recovered from *C. goeringii* collected from Xinning in Hunan Province, China in 2008. Of the three compounds, only chaetocochin G arrested cell proliferation and induced apoptosis of MCF-7 human breast cancer cells in vitro. The other two compounds did not exhibit cytotoxicity (Wang et al. 2015).

*C. goeringii* is admired for its faint floral fragrance. This is constituted by a blend of methyl-cis(z)-dehydrojasmonate, (E) neroldol, 1,2,4-trimethoxybenzene, 1,2,3,5-tetramethoxybenzene and other jasmonates (Kaiser 1993).

**Herbal Usage:** According to TCM, roots improve blood flow, cool the blood and detoxify. The herb is used to treat traumatic injuries, bleeding from such injuries, and fractures, clear heat in the lungs, and relieve coughs and sore throat, stop the production of blood streaked phlegm, and treat haematuria and rabies. The entire plant is used to treat fever, large round worm infestation (ascariasis), abdominal colic associated with worm infestation, poor health, weak kidneys, dizziness, backache, sweating and piles (*Zhongyao Da Cidian* 1986).

### ***Cymbidium hookerianum* Rchb. f.**

Chinese name: *Hutou Lan*

Chinese medicinal name: *Hutou Lan*

**Description:** *C. hookerianum* is an attractive, saxicolous or epiphytic *Cymbidium* with strongly fragrant (Chinese variety only slightly fragrant) flowers of apple green with a contrasting cream-coloured lip spotted or blotched with maroon, 5–7 cm across. The inflorescence is arching, 30–40 cm long, and carries 6–15 flowers. The species forms large clumps each pseudobulb carrying 4–6, occasionally 8 narrow, long, flat, arching sometimes slightly twisted, dark green



**Fig. 9.46** *Cymbidium hookerianum* Rchb.f. (Photo: E.S. Teoh)

leaves measuring 35–60 by 1.4–2.3 cm (Fig. 9.46). It is found on trees or steep banks in dense forests and evergreen oak forests at 1660–2330 m in Bhutan (Pearce and Cribb 2002), in eastern Nepal, northeast India and southwest China (Yunnan and the adjacent portions of its neighbouring states only), at 1100–2700 m) (Chen and Tsi 1998; Chen et al. 1999). It flowers from February to May in Bhutan; January to April in China.

**Herbal Usage:** Seeds are applied on cuts and injuries as a haemostatic in India (Rao 2004). The Chinese herb which consists of the whole plant obtained from Yunnan is used to treat fractures and traumatic soft tissue injuries (Wu 1994).

### ***Cymbidium iridioides* D. Don**

Syn. *Cymbidium giganteum* Wall ex Lindl.

Chinese name: *Huang chan Lan*

**Description:** Plant is epiphytic or saxicolous. Pseudobulbs are ovoid, with 6–10 linear-lanceolate leaves 70–90 by 2–4 cm, pointed at the tips. Inflorescence is suberect, raceme laxly

many-flowered. Flowers are reddish-brown, 7.5 cm across, lasting for months on the plant. Flowering season is September to December in Nepal (Raskoti 2009), August to December in China (Liu et al. 1969). *C. iridioides* is distributed in a narrow band from central and eastern Nepal (at 1500–2800 m) to northern Vietnam across Bhutan, Sikkim, Myanmar, SE Xizang, SW Sichuan, NW and SE Yunnan and SW Guizhou at 900–2800 m (Liu et al. 1969).

Phytochemistry: *C. iridioides* contains a triterpene glucoside, cymbidoside (Dahmen and Leander 1978) and a taraxerane triterpenoid, taraxerone, gigantol and sitosterol (Juneja et al. 1985). Taraxerone was inactive against leukaemia, or renal and ovarian cancer cell lines (Pub Chem CID 392170).

Herbal Usage: In Nepal, juice from the leaves of *C. iridioides* is used as a haemostatic on wounds (Baral and Kurmi 2006; Pant and Raskoti 2013). In the Khasi Hills in India, leaf juice is used to stop bleeding from wounds and for diarrhoea (Jalal et al. 2010).

### ***Cymbidium kanran* Makino**

Local Name: *Han lan* (frigid *Cymbidium* orchid), winter orchid, *Cao Lan* (grass orchid)

Description: This olive-green, scented *Cymbidium* is characterised by very narrow petals and sepals and very long (40–85 cm), thin (1–1.8 cm broad), elegant leaves. Pseudobulbs are ovoid, 2–4 by 1–1.5 cm, enclosed by leaf bases. There are several colour variants, from light apple green to dark olive green, some with striping, and brown (Liu et al. 2006) (Fig. 9.47). It grows in rocky but moist soils along ravines or forests with light shade at 400–2400 m in southern China to Anhui and Zhejiang, and also in Taiwan (in mountainous regions at 800–1500 m in broad-leaved forests near the ridges on the southeast slopes), Korea and Japan. It flowers from August to January but mostly in December and January.



**Fig. 9.47** *Cymbidium kanran* Makino (Photo: E.S. Teoh)

This magnificent species enjoys much popularity among Chinese growers on account of its elegant form and strong fragrance.

(line drawing, Chen and Tsi 1998)

Herbal Usage: Herb is obtained from Huadong, Huanan and Yunnan. Chinese herbalists employ the entire plant to “purify the heart”, smooth the lungs, or to stop coughs and asthma. Roots are used for treating gastroenteritis and ascariasis (infestation of large intestinal round worms) (Wu 1994).

### ***Cymbidium lancifolium* Hook.**

Chinese names: *Soushan Hu* (searching mountain tiger), *Zhupo Lan* (bamboo and pine

*Cymbidium* orchid): *Tuer Lan* (rabbit ear orchid); *Diqingmei* (green floor plum); *Xuli Cao* (Through-the-ages herb, everlasting Herb). In Taiwan: white bamboo-leaf orchid.

Indonesian name : *Ki Adjag* in Sunda

Description: *C. lancifolium* is a small, terrestrial or saxicolous, and sometimes epiphytic, species found at low to moderate elevations (at 300–2200 m) throughout China south of the Yangzi and in Southeast Asia. It also occurs in southern Japan, south-eastern Tibet, Bhutan and northeast India. It is found in open forests, broad-leaved forests, bamboo forests, on the edge of forests and on humus-rich rocks along valleys.

Pseudobulbs are fusiform, naked, 5–15 by 0.5 to 1.0 cm, and carry 2–4 leaves on its apex. Leaves are oblong-elliptic to oblong-lanceolate, 6–35 by 2–5.5 cm. When not in bloom, it may be identified by the minute teeth along the upper margins of the leaves. The lateral, erect, short scape bears 2–8 flowers, each 4 cm across, with narrow, pointed petals and sepals of white to pale green, and with purple-maroon markings on the lip (Fig. 9.48). It



**Fig. 9.48** *Cymbidium lancifolium* Hook. (Photo: E.S. Teoh)

flowers in April in Hong Kong and from May to August on the Chinese mainland. In Southeast Asia, its flowers may be seen throughout the year, with peak flowering from August to December after the period of heavy rains. This is possibly the least attractive species in *Cymbidium*.

Phytochemistry: Saponins are present in *C. lancifolium*. Alkaloids are absent (Boorsma 1902).

Herbal Usage: In China, the entire plant is used to relieve rheumatism, improve blood flow, and to treat traumatic injuries (Wu 1994).

*Cymbidium longifolium* D. Don (see *Cymbidium elegans* Lindl. var. *elegans*)

*Cymbidium mannii* Rchb. f. (see: *Cymbidium crassifolium* Herb.)

*Cymbidium pendulum* (Roxb) Sw. [see *Cymbidium aloifolium* (Linn) Sw.]

*Cymbidium pumilum* Rolfe (see *Cymbidium floribudnum* Lindl.)

### ***Cymbidium macrorhizon* Lindl.**

Description: *C. macrorhizon* is a holomycotrophic species which has no green leaves. It lives underground and can only be detected when it sends out flowering inflorescences. Rhizomes are subterranean, fleshy, white, slightly hairy, 5–10 by 0.3–0.7 cm, branched and with short roots of up to 1 cm length. Inflorescence is usually apical, 11–18 cm, peduncle purplish-red at the base, green above, with 2–5 flowers, 3–4 cm across. Floral segments white or yellow with purplish-red markings. It flowers in June to August (Fig. 9.49). It occurs along riversides, at forest margins or on open grassy slopes from southern China, Vietnam and Thailand to Myanmar and the southern Himalayas up to Pakistan (Liu et al. 1969).

Herbal Usage: In northern India, rhizomes of *C. macrorhizon* are used as diaphoretic and febrifuge, and also to treat boils and rheumatism (Lawler 1984; Oudhia 2013).





**Fig. 9.49** *Cymbidium macrorhizon* Lindl. (Photo: Hubert Kurzweil)

### ***Cymbidium sinense* (Jacks.) Willd.**

Syn. *Cymbidium chinense* Heynh.

Chinese names: *Baisui Lan* (New Year Greeting Orchid, Pay a New Year's Call Orchid), *Baosui Lan* (Congratulations for the New Year), *Chun Lan* (spring orchid), *Mo Lan* (dark orchid)

**Description:** This is a large terrestrial species with ovoid pseudobulbs, 2.5–6 by 1.5–2.5 cm that carry 3–4 lustrous, dark green, coriaceous, linear, lanceolate leaves, 60–90 by 2–3.5 cm. The tall, erect inflorescence bears 10–20 or more deep purple or purplish-brown flowers, that are strongly fragrant. They smell like violets (Nakamura, Tokuda and Omata 1990). Sepals and petals are narrow and pointed. Lip is cream, striped with red on the side lobes, and splashed with a border of red on the mid-lobe. It grows in shady, moist, well-drained soil in forests and along ravines at 300–2000 m. Its distribution extends from India to Myanmar, northern Thailand, Vietnam and east China to the Ryukyu Islands of Japan. In China, it

has a long flowering period that extends from October to March (Chen et al. 1999) or to May (Chen, Liu, Chu, et al. 2009) with a peak around Chinese New Year, but in Thailand the chartreuse-coloured variety flowers in August (Vaddhanaphuti 2001) and the dark purplish-brown variety flowers from October to December (Nanakorn and Watthana 2008).

The typical Chinese variety is known as the var. *sinense*. *C. sinense* var. *albo-juncundissimum* (Hayata) Masamune, the Ink Orchid, is native to Hong Kong, occurring at Tai Mo Shan and Sunset Peak (Wu et al. 2002). The var. *haematodes* which has a more southerly distribution which extends to Sri Lanka, Indonesia and Papua New Guinea has broader leaves and scapes that are longer than the leaves. The floral morphology is similar, with red or green forms. Chinese and Japanese collectors admire *Cymbidium* for the shape of its leaves, and they are fascinated by the dark green leaves which carry fine yellow or white lines. Such Golden Thread Orchids are worth a king's ransom. Peloric floral forms also occur.

**Herbal Usage:** The whole plant or just the roots may be used. Roots are collected in autumn and sun-dried for storage. They purify the heart and lungs, and stop coughs and asthma. A decoction prepared with 30 g of the herb is used to treat dry coughs (Li 1994).

### ***Cymbidium wilsonii* (Rolfe ex De Cock) Rolfe**

Chinese names: *Duanyechutou Lan* (short leaf tiger head orchid), *Diannanhutou Lan*

**Description:** This epiphytic *Cymbidium* has ovoid, flattened pseudobulbs 4–6 by 2.5–3.5 cm. Leaves are slim, pointed, 70–100 by 1.3–3.2 cm. Inflorescence is 25–70 cm long and arching, with 5–15 chartreuse flowers, 9–10 cm across. Petals and sepals are narrow and pointed. Lip is cream, with chestnut stripes on the side lobes and purplish blotches along the edges of the mid-lobe. The lip becomes purplish-red after pollination. Flowering season is

February to April. It is found in southern Yunnan and Vietnam at 2000 m (Liu et al. 2006).

**Herbal Usage:** Herb is collected from Yunnan. Roots used to treat weak lungs, coughs, bronchitis, tonsillitis and body ache (Wu 1994).

### Overview

*C. goeringii* is the first orchid to receive the attention of mankind. It was mentioned in the *Book of Odes* (collated in the sixth century BC) under its ancient Chinese name “Wild Grass”. Confucius likened the character of gentlemen to the nature of *Cymbidium*—simple in its needs, modest, discreet, Spartan, resilient, reclusive and disdainful of honours, noble. When Kubulai Khan conquered China and instituted the most horrendous genocide, Zhen Xuxiao (1250–1300) expressed his grief by painting uprooted *C. goeringii*. This painting is now in the National Palace Museum in Taipei, but there are similar paintings in the collection of the Osaka Municipal Museum. It is one of the four seasonal flowers, and represents spring (Teoh 1982). Although many writers make the mistake of linking *C. ensifolium* with spring, that species flowers from June to October. *Chun Lan* (Spring Orchid) is the Chinese name for *C. goeringii*.

*Cymbidiums* have been cultivated as house plants in the Far East for more than 2000 years. In the course of time, new varieties have appeared, possessing variegated leaves, multiple flowers and various colour forms, such as narrow central purple streaks along the dorsal sepal and petals, or an orange-coloured flower (the variety *Takahime* or Martial Princess in Japan). Every one of the popular cultivated species (*C. goeringii*, *C. ensifolium*, *C. kanran*, *C. faberi*, *C. tortisepalum*, *C. sinense*, *C. serratum*, *C. cyperifolium*, *C. hookerianum*, *C. floribundum*) have produced mutations and there are several books in the Chinese language dedicated to describing such mutations. However, in so far as the aesthetic appreciation of *Cymbidium* emphasises simplicity and gracefulness of form and delicacy of fragrance, this should immediately disqualify most of the mutants.

Hybrids of *Cymbidium* enjoy a favoured position in the orchid cut flower trade because of the flower’s thick texture and longevity. Classified into four coloured groups, pink, yellow, green and white, their pigmentation is strongest in the lip, and even white forms carry a trace of pigment there. Six anthocyanins were isolated from 8 *Cymbidium* hybrids of four colours by Wang et al. 2014 working in New Zealand. The anthocyanins are: cyanidin-3-*O*-glucoside; cyanidin-3-*O*-rutinoside; peonidin-3-*O*-glucoside; peonidin-3-*O*-rutinoside; cyaniding-3-*O* (malonyl)-glucoside; and peonidin-3-*O* (malonyl)-glucoside. Anthocyanin, which is responsible for the lip coloration, is also present in high concentration in the tepals of pink flowers, but only trace to small amounts occur in flowers of other hues. Chlorophyll and its green breakdown products, pheophytin *a* and *b* responsible for the colour of green flowers, are also present in small amounts in yellow flowers. Yellow flowers carry beta-carotenoid and some additionally contain lutein. Three flavonols, glucosides of kaempferol, quercetin and isohamnetin, are present in all flowers. They are co-pigments that determine the final colour in association with anthocyanins (Wang et al. 2014).

Shiseido offers a perfume, *Tentatrice*, which carries the scent of *Cymbidium*. Ten aromatic glycosides were isolated from fresh flowers of the hybrid *Cymbidium* Great Flower ‘Marie Laurencin’, and two of these were new discoveries, namely marylaurensinosides D and E (Yoshikawa et al. 2014). Methyl cis(*Z*) dehydrojasmonate and related compounds are responsible for the fragrance of *C. goeringii* (Kaiser 1993), the orchid whose pleasant scent was used as a simile for friendship.

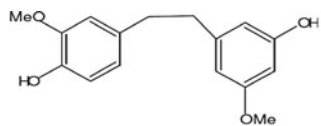
When a *Cymbidium* is used medicinally in TCM, the following names apply:

*Lanhua* refers to *C. ensifolium*, *C. goeringii*, *C. faberi*, *C. floribundum* and *C. kanran*;

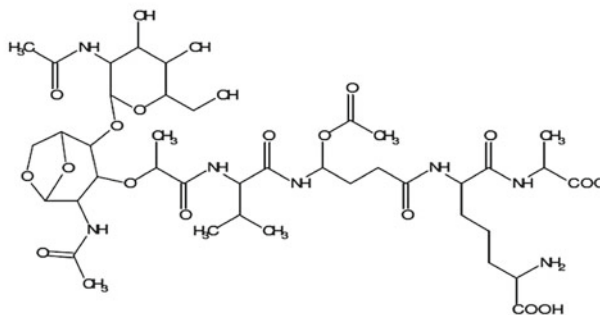
*Lanhuaye* and *Lanhuagen* refer to *C. ensifolium*, *C. kanran* and *C. floribundum* var. *pumilum*;

*Huaqilan* and *Huishi* refer to *C. faberi*;

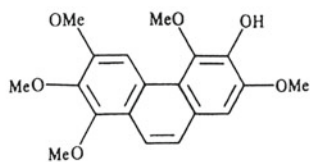
**Fig. 9.50** Some compounds isolated from *Cymbidium*



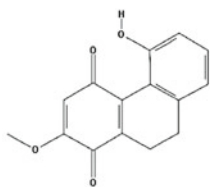
gigantol



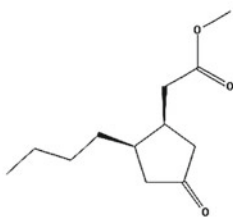
cymbidine A



pendulin



ephemeroanthroquinone B



methyl cis dihydrojasmonate

*Niujiiaosanqi* refers to *C. floribundum*;  
*Hutoulan* refers to *C. hookerianum*;  
*Yingyediaolan* refers to *C. pendulum*.

Although coughs and tummy upsets are common conditions for which various *Cymbidium* species are a traditional medicinal remedy, there is no actual extensive usage of *Cymbidium* in TCM. This is probably due to the ready availability of many alternative remedies that have a longer history of usage, are less fancy, cheaper, and perhaps more efficacious. Four strains of mycorrhiza isolated from wild strains of *C. goeringii* showed strong inhibitory activity when tested against two pathogenic bacteria, *Escherichia coli* and *Sarcina lutea* (Min et al. 2012), but presently, mycorrhiza have not been used as probiotics.

Whereas *C. aloifolium* with its more southerly distribution enjoys many medicinal usages in the Indian sub-continent and Myanmar, it is totally ignored in TCM despite the orchid being present in several Chinese provinces (Yunnan, Guizhou, Guangxi, Guangdong and Hong Kong). Two Australian *Cymbidium* species are used by Queensland aborigines. Delicate children are reared on the readily available *C. canaliculatum* when accidents deny alternative supplies. The Australian aboriginal name for this useful plant is “*dampy-ampy*”. White Australians call it “native arrowroot” (Hedley 1888). Seeds of *C. madidum* are used as an oral contraceptive. The aborigines also chew on bulbs of any *Cymbidium* when afflicted by dysentery (Lawler and Slaytor 1970).

Ephemeranthroquinone B derived from a *Cymbidium* hybrid, *Cymbidium* Great Flower Marie Laurencin, inhibits *Bacillus subtilis* and has moderate cytotoxicity on lung promyelocytic leukaemia (HL60) cells in vitro (Yoshikawa et al. 2012). Two new phenanthrenes, marylaurencinols C and D, and a new phenylpropanoid, ephemeranthoquinone, were isolated from *Cymbidium* Great Flower “Marylaurencin” and tested for antimicrobial activity against *Bacillus subtilis*, *Klebsiella pneumonia* and *Griphophyton rubrum* (Yoshikawa et al. 2014a).

Gigantol present in *C. goeringii* also occurs in *Dendrobium draconis*, *Dendrobium nobile*,

*Dendrobium densiflorum* and in several medicinal orchids from Meso-America; there, it was demonstrated to possess anti-inflammatory, analgesic, phytotoxic and spasmolytic activities (Fig. 9.50). Several analogues of gigantol have been synthesised with a view to developing new antitumour, anaesthetic, antidepressant, antipsychotic and spasmolytic agents (Reyes-Ramirez et al. 2011). Gigantol isolated from *Dendrobium nobile* was shown to possess antimutagenic activity (Miyazawa et al. 1997). Gigantol induces apoptosis in non-small cell lung cancer (H460) in vitro (Charoenrungruang et al. 2014).

An interesting group of compounds in *Cymbidium* are the lectins, a conceptually new class of antivirals which bind to N-linked oligosaccharide elements of enveloped viruses (van de Meer et al. 2007). Test tube experiments showed that mannose-specific lectins from a *Cymbidium* hybrid and *Epipactis helleborine* prevent human immunodeficiency (AIDS) viruses (HIV-1 and HIV-2) and cytomegalovirus (CMV) from reproducing themselves. The 50 % effective concentration of the *Cymbidium* hybrid agglutinin (CA) and *Epipactis helleborine* agglutinin for HIV ranged from 0.04 to 0.08 mcg/ml, which is about 3 orders of magnitude below their toxic threshold (Balzarini et al. 1992). This suggests that they would not be poisonous when administered at the proper therapeutic dosage. However, they would need to be tested on laboratory animals and later on human volunteers before they can be medicine.

Large-scale National Cancer Institute (NCI) screening of 20,000 plant extracts for possible anti-HIV activity showed that approximately 5 % of organic plant extracts tested positive (Cragg and Boyd 1996). Some agents which show promise in vitro may not be usable because either they are not bio-available by oral administration, are only effective in high/near-toxic concentrations, or they possess serious side effects.

Nevertheless, the team from the Rega Institute for Medical Research at Ghent in Belgium and their associates have repeatedly stated that the properties of the plant lectins, which include *Cymbidium* agglutinin, among others, should be



taken into consideration in the eventual choice of moving microbiocide candidate drugs into the clinical setting (Balzarini et al. 2004; Turville et al. 2005; Balzarini 2007; Balzarini et al. 2007; Pollicita et al. 2008; Auwerx et al. 2009).

Perhaps more importantly, *Cymbidium* agglutinin (CA) and a number of plant lectins strongly inhibited coronaviruses (transmissible gastroenteritis virus, infectious bronchitis virus, feline coronaviruses serotypes I and II, mouse hepatitis virus), arteriviruses (equine arteritis virus and porcine respiratory and reproductive syndrome virus) and torovirus (equine Berne virus) (van de Meer et al. 2007). Scientists at Utrecht University in the Netherlands used three antiviral tests based on different evaluation principles to study the plant lectins: (1) cell viability (MTT-based colorimetric assay); (2) the number of infected cells (immunoperoxidase assay); and (3) the amount of viral protein expression (luciferase-based assay). These findings are important because there are no antivirals to combat infection with the Nidovirales (the Order grouping which includes the toroviruses, arteriviruses, roniviruses and coronaviruses). A coronavirus was the cause of the sudden SARS outbreak that caused numerous deaths and brought havoc to the Far East in 2002–2003. In their review, World Health Organization (WHO) experts on SARS from the Centre for Disease Control (CDC) concluded that, after they had examined 54 SARS treatment studies, “it was not possible to determine whether treatments benefited patients during the SARS outbreak. Some may have been harmful” (Stockman et al. 2006). Finding an effective antiviral agent is important. Can *Cymbidium* lectins provide an answer?

*Cymbidium macrorhizon*, being a holomycotrophic geophyte, should contain some interesting compounds. Unfortunately, published data have not appeared. There are altogether 170 species of holomycotrophic orchids within Asia (including eastern Russia) and the western Pacific (Campbell 2014) which can provide enormous opportunities for new discoveries. Chaetocochin, a diketopiperazine produced by

*Chaetomium cochliodes*, isolated from *C. goeringii*, was recently shown to possess cytotoxic activity against breast cancer cells in vitro (Wang et al. 2015).

Epiphytes absorb nutrients from the atmosphere. *C. aloifolium* growing in the environment of Kaiga, on the southwest coast of India where two nuclear power reactors were being constructed in 2001, contained elevated levels of the radionuclide  $^{137}\text{V}$ . Higher fallout occurred when it rained (Karunakara et al. 2001). *Cymbidium* and other orchids may therefore be useful for monitoring the effects of environmental pollution: epiphytes for atmospheric contamination of radioactive elements, terrestrials for soil pollution of heavy metals and radioactive compounds. The findings further suggest that medicinal herbs harvested in contaminated localities might contain undesirable compounds.

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## Genus: *Cypripedium* Linn.

Chinese name: *Shao Lan*

The generic name is derived from *Cyprus* and *pedium* (Latin, slipper), the slipper of Cyprus. In Greek mythology, Cyprus (alternatively referred to as Paphos; hence *Paphipedilum*) is the island home of Aphrodite who is most beautiful among Greek goddesses.

Plants are small to large, herbaceous, generally terrestrial, sometimes saxicolous, and rarely epiphytic. Stems are unbranched, obscure or erect if long, and leafy. Roots are numerous, thick and fibrous. Inflorescence is terminal: rachis hairy, glandular or glabrous with single or several flowers. Flowers are showy. Dorsal sepal forms a hood over the lip. Petals are free, spreading or droopy. Lip is shaped like a pouch or slipper. Pollen is powdery or viscid (Chen and Cribb 2009). An ancient genus, *Cypripedium* is distributed predominantly in temperate Eurasia and North America, with China as the centre of biodiversity (Fig. 9.51).

**Fig. 9.51** *Cyripedium cordigerum* D. Don From: Jacquemont, V., *Voyage dans l'Inde pendant les années 1828a 1832*, vol. 4 (3): t. 166 (1844). Courtesy of Missouri Botanical Garden, St. Louis, USA



### ***Cyripedium cordigerum* D. Don**

Chinese name: *Baichunshao Lan*

Nepali Name: *Jibri*

Description: A large terrestrial herb, plant is 50–80 cm tall. Stem is stout, sheathed by elliptic-lanceolate plicate leaves, 7–15 by 5–10 cm. Flower is solitary, 10 cm across. Petals are droopy. Dorsal sepal and petals greenish-yellow, lip white (Fig. 9.52). It is in flower in

May to August in Bhutan (Gurong 2006), July and August in Nepal (Raskoti 2009), June to August in Tibet (Chen et al. 1999).

*Cyripedium cordigerum* occurs in grassland, meadows and pine forests at 2800–3800 m in central and western Nepal, southern Tibet, Bhutan, Kashmir and Pakistan (Chen and Cribb 2009; Pant and Raskoti 2013).

Herbal Usage: Roots are used as a tonic in Nepal (Pant and Raskoti 2013). Young leaves of *Cyripedium cordigerum* D. Don are cooked and



**Fig. 9.52** *Cypripedium cordigerum* D. Don (Photo: E.S. Teoh)

eaten as a vegetable (Manandhar and Manandhar 2002).

*Cypripedium corrugatum* Franch. (see *Cypripedium tibeticum* King ex Rolfe)

### ***Cypripedium debile* Reichb. f.**

Chinese names: *Duiyeshao Lan* (two leafed spoon orchid), *Xiaoxipuxie Lan* (small Xipu shoe orchid), *Shuangyeshao Lan* (two leaf spoon orchid), *Erye Lan* (two leaf orchid)

Description: A small terrestrial herb, it is probably the least impressive *Cypripedium*. Stem is thin, 8–15 cm tall. Leaves 2, directly opposite each other, small, 2.5–4 by 1–2 cm. A slim, 3-cm-long scape arises from the apex and curls downwards from the weight of the single, 2-cm, pale green flower of typical *Cypripedium* form. Lip is marked with maroon stripes. Flowering season is May to July. It grows on the forest floor in humus or litter-rich soil at 2000–3000 m, and has a restrictive distribution, being found only in southern Gansu, west and northeast Sichuan,

western Hubei, at Mount Shenmachten in Taiwan and in Japan (Chen et al. 1999).

Herbal Usage: The entire plant is used in Taiwan. It improves blood flow, reduces swelling, relieves pain and is diuretic (Ou et al. 2003).

### ***Cypripedium elegans*, Rchb. f.**

Chinese name: *Yazhishao Lan*

Description: *Cypripedium elegans* is a small plant, 10 cm tall with an erect stem that is densely covered with fine, white hairs. Plant bears 2 sub-opposite, sessile, ovate, apple-green, spreading leaves, 4–5 cm by 3–3.5 cm, laxly pubescent on both surfaces, and marked by 3 prominent veins underneath. Inflorescence is erect, 3–4 cm tall, with a single small flower, 1.5–2 cm long by 0.6–1.0 cm across. Petals and sepals are yellow-green, striped with maroon. Lip is white to yellowish-green and striped with crimson. Flowering period is June to July. It is found in humus-rich habitats on the edge of forests or in thickets at 3600–3700 m in north-west Yunnan and south to southeast Xizang, Nepal, Bhutan, Sikkim and northeast India (Chen et al. 1999)

Herbal Usage: In India, the root is used to treat disorders of the nervous system (Vij 1995). It is used as a nerve tonic and also in hysteria, spasms, fits, insanity, and epilepsy, and in rheumatism in the Himalayan region (Duggal 1971; Das 2004; Baral and Kurmi 2006; Jalal et al. 2010; Pant and Raskoti 2013).

### ***Cypripedium fasciolatum* Franch.**

Chinese name: *Dayezhuo Lan* (big leaf spoon orchid)

Chinese medicinal name: *Wugongqi*

Description: Plant is robust 35–40 cm tall with a few, well-spaced, cordate, plicated leaves that measure 15–20 by 6–12 cm. Flowers are the

largest among the Chinese *Cypripediums*, 10–12 cm across, of a cream to yellow colour, and marked by longitudinal reddish stripes over the synsepalum, petals and pouch. They have a sweet scent when newly open, but the smell becomes pungent when they age (Perner and Luo 2007). Flowering period is May to July. *Cypripedium fasciolatum* is endemic to China and has a small distribution in Sichuan, Hebei and Shanxi, growing in grassland and scrub or in forests at 1650–2100 m.

**Herbal Usage:** Herb is collected from Sichuan, Hebei and Shanxi. Roots and stems are diuretic and they are used to reduce swelling, improve blood flow, clear phlegm and stop pain, in particular joint pains. It is often used to treat generalised oedema, swelling of the lower extremities, fractures and other traumatic injuries (Wu 1994).

### ***Cypripedium formosanum* Hayata**

Chinese name: *Taiwanshao Lan* (Taiwan spoon orchid), *Taiwanpuxie Lan* (Taiwan ordinary shoe orchid), *Yidianhong* (One Spot of Red), *Taiwanjiapuxie Lan* (Taiwan ordinary shoe orchid)

**Description:** Plant is 30–40 cm tall. Stem is erect, clothed at the base by the sheath of paired fan-shaped, plicate, finely hirsute, membranous leaves, 8–11 cm wide, and resembling a fan palm. Single, pale pink flowers finely spotted with red, and pubescent towards the base and peduncle, about 8 cm across, are borne on a 10-cm-long peduncle decorated by a few leafy bracts. Lip is pink, dotted with red spots. Flowering season is April to May (Chen and Cribb 2009). *Cypripedium formosanum* is found in forests of the Central Range of mountains in Taiwan (formerly known as Formosa) at 2500–3000 m, in moist sunny locations (Su 1985). It is an endemic, terrestrial species.

**Herbal Usage:** The entire plant improves blood flow, regulates the menses, expels gas, stops pain and relieves itching. The root and stem also expel gas, improve blood flow, and

they are used to treat malaria, snake bites, traumatic injury and rheumatism (Lin et al. 2003).

### ***Cypripedium franchetii* Rolfe**

Chinese name: *Maozhuo Lan* (hairy spoon orchid), *Maoshao Lan*

Chinese medicinal name: *Wugongqi*

**Description:** A pink to purplish-red *Cypripedium* endemic to China, plant is 20–35 cm tall with elliptical leaves 10–16 by 4–6.5 cm, lightly pubescent over the veins on both surfaces. The single flower on the inflorescence is 9–10 cm across, with prominent deep purplish veins on both surfaces of the sepals and petals but lighter markings on the pouch. It flowers in May to July (Chen et al. 1999).

*Cypripedium franchetii* occurs in humid, humus-rich soil on shrubby slopes and sparse woods at 1500–3700 m in Sichuan and southern Gansu eastwards to southern Shaanxi, southern Shanxi, western Henan and western Hubei (Chen and Cribb 2009).

**Herbal Usage:** Herb is collected from Shaanxi, Shanxi, Gansu, Henan, Hubei and Sichuan (Wu 1994). It is credited with the ability to regulate the flow of vital energy (*qi*) to eliminate obstruction to its flow, and improve blood circulation (Chen and Tang 1982). It is used to stop coughs, relief pain, “wind stagnation”, chest and epigastric pain (Wu 1994). Roots and stems are used in the same manner as *Cypripedium fasciolatum* (*Zhonghua Bencao* 2000).

### ***Cypripedium guttatum* Sw.**

Chinese name: *Zidianshao Lan*

Chinese medicinal name: *Banhuashaolan*

**Description:** Plant is 15–25 cm tall, with slender creeping rhizome and an erect, pubescent, glandular stem bearing several sheaths at the base. Leaves, are 2–3, usually two, elliptic or ovate-lanceolate, 5–12 by 2.5–4.5 cm, green, turning black when dried. The small pink flowers are



2.5 cm tall, borne single on a pubescent inflorescence. They appear from May to July (Chen et al. 1999). *Cypripedium guttatum* enjoys the greatest distribution among *Cypripediums* being present in eastern Europe, northern Asia through Japan and North America. It is a small herb which is distributed throughout northern China (except Xinjiang) and southwest China except Guizhou, in forests, scrub and marshes at 1000–4100 m (Yang, Zhang, Feng, et al. 1993). It can be found in both open and shady habitats over a wide geographical range because of a greater efficiency in photochemical utilisation of absorbed light energy and a lower non-photochemical dissipation of excess light energy, but does best with 45 % sunlight (Zhang, Hu, Xu, et al. 2007).

**Herbal Usage:** The roots and leaves of this orchid have been used in eastern Russia and Siberia to treat epilepsy (Gmelin 1747, Dragendorff 1898, and Hawkes 1944, all quoted by Lawler 1984)

### ***Cypripedium henryi* Rolfe**

Chinese names: *Luhuazhuo Lan* (green flower spoon orchid);

Chinese medicinal name: *Longshejian* (dragon tongue sword); *Jinlongqi* (gold dragon seven)

**Description:** Stem is erect, pubescent, 30–60 cm tall, carrying 4–5 broadly elliptical leaves near its tip, 10–18 cm by 6–8 cm. Inflorescence is terminal, 30–70 cm tall, with 2–4 yellowish-green flowers, 6–7 cm across, with narrow petals and sepals and a smooth surfaced, pouched lip. Flowers have the scent of spicy honey and attract a small black wasp, *Lasioglossum sauterum* (Perner and Luo 2007). Flowers appear in April and May.

*Cypripedium henryi* is an elegant, endemic, terrestrial herb found in open scrub in the Chinese highlands. It thrives in damp humus-rich soil in fairly open places at 800–2800 m from northwest Yunnan towards the northeast to Sichuan, southern Shaanxi, Guizhou and western Hubei.

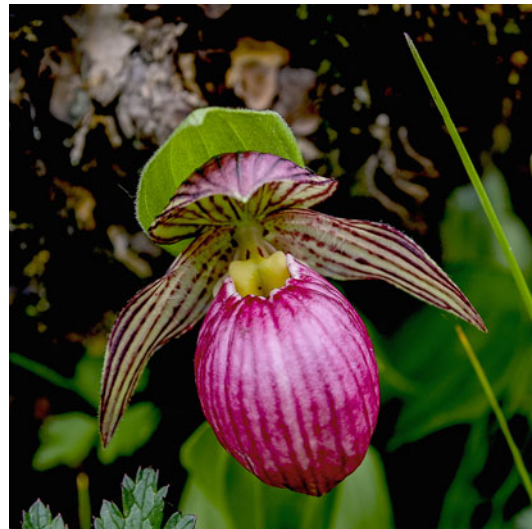
**Herbal Usage:** Herb is collected from Shanxi, Gansu, Hubei and from China's southwest (Wu 1994). Roots are used to improve *qi* and blood circulation, reduce swelling and pain, "cold in the stomach", pain around the waist and thighs and pain resulting from injury. A decoction is prepared by boiling 6–9 g of the orchid roots. A standard dose contains 0.3–0.6 g of the roots (*Zhongyao Da Cidian* 1986)

### ***Cypripedium himalaicum* Rolfe**

Chinese name: *Xiaezhuo Lan* (narrow calyx spoon orchid), *Gaoshanshao Lan*

Nepali name: *Khujukpa*

**Description:** *Cypripedium himalaicum* is 30–45 cm tall, with uneven broadly elliptical leaves, 5–10 by 2.5–4 cm, and fragrant flowers with lips which are 2–2.5 cm across. Base colour of frontal aspect of the synsepalum is white or greenish-yellow densely marked with purplish-brown, longitudinal stripes; the dorsal surface is a dull purple and striped. Lip is pink to maroon marked with darker stripes (Fig. 9.53). Flowering season is June to August in Nepal, June to July in China. It is widely distributed



**Fig. 9.53** *Cypripedium himalaicum* Rolfe (Photo: Nima Gyeltshen)

from the western Himalayas through Nepal, Bhutan, Sikkim, Tibet and northern Burma at rather high altitudes: 3000–4800 m in Nepal, and 3600–4000 m in China (Raskoti 2009; Chen and Cribb 2009). It is usually found in association with dwarf scrub (particularly *Rhododendron*) but has also been discovered growing on grass-clad limestone in association with *C. tibeticum* (Pradhan 1975).

**Herbal Usage:** *Cypripedium himalaicum* is used in CHM to treat female infertility, hernia and pain at the waist in women (Wu 1994). In Nepal, juice extracted from fresh plants or a drink made with dried plants are used (Subedi et al. 2013). In Nepal, it is used to treat difficulty in passing urine, urinary stones, heart and lung disease and coughs (Baral and Kurmi 2006; Pant and Raskoti 2013).



**Fig. 9.54** *Cypripedium japonicum* Thunb. (Photo: Courtesy of Plant Photo Bank of China)

### ***Cypripedium japonicum* Thunb.**

Chinese name: *Shanmaishao Lan*

Chinese medicinal name: *Shanziqi*

Japanese name: *Kumagiso*

**Description:** Plant is 35–55 cm tall, erect with 2–3 sub-opposite leaves and several sheaths below. Leaf is broadly fan-shaped with radiating veins, 10–16 by 10–20 cm, glabrous and slightly hirsute. Inflorescence is terminal, single-flowered, the flower pendulous, 9–10 cm across. Sepals and petals are lanceolate, greenish-yellow spotted with purple. Lip is yellowish-green to white or pale pink, with red spots and veins. Pouch is shaped like a teardrop or egg (Fig. 9.54). Flowering season is April to May. It is found in southern Shaanxi, southern Gansu, Sichuan, Hubei, Guizhou, Hunan, Jiangxi and Anhui, and also in Japan and Korea, in humus-rich soils in forests, thickets, forest margins and shaded slopes at 1000–2000 m (Chen et al. 1999).

**Herbal Usage:** The herb is said to dispel wind, remove toxins, moderate *qi*, improve blood circulation and relieve pain. It is used in the treatment of tertian malaria, menstrual irregularities,

**Table 9.6** Chinese Herbal Prescriptions employing *Cypripedium japonicum* (*Zhongyao Da Cidian* 1986; *Zhonghua Bencao* 2000)

1. Indication: Tertian malaria Pulverize 1.5 g of roots for consumption with cold water 1 h before onset of symptoms. Caution: Abstain from warm wine and rice for half a day.
2. Indication: pruritic rash Boil whole plants to clean the skin
3. Indication: swellings of unknown etiology Grind whole plants and mix with vinegar for application.
4. Indication: snake bite (a) Fresh roots of <i>Cypripedium japonicum</i> 9–12 g Goodyera sp. (Banye Lan) 6 g Jinbuhuaogen, fresh roots, 60–90 g Boil the three ingredients and add to warm wine. Consume three times a day (b) For application, 60–90 g of <i>Cypripedium japonicum</i> mixed with wine and rendered into a paste.
5. Indication: Low backache <i>Cypripedium japonicum</i> 6 g decocted and added to wine

pain arising from physical injuries and pruritus (*Zhongyao Da Cidian* 1986; Wu 1994). Prescriptions for its use are mentioned in *Shaanxi Chinese Herbs* (Table 9.6).

***Cypripedium macranthos* Sw.**

spoon orchid), *Dakoudaihua* (large pocket orchid)

Chinese names: *Qilaixipuxie Lan* (big flowered spoon orchid), *Dahuashao Lan* (big flowered

Chinese medicinal name: *Dunshengcao*, *Wugongqi*  
Japanese name: *Atsumoriso*

**Fig. 9.55** *Cypripedium macranthos* Sw. (as *Cypripedium speciosum* Rolfe). From: *Curtis Botanical Magazine* vol. 137 (ser. 4, vol. 7): t. 8386 (1911) original, a colour drawing by M. Smith. Courtesy of Missouri Botanical Garden, St. Louis, USA

8386

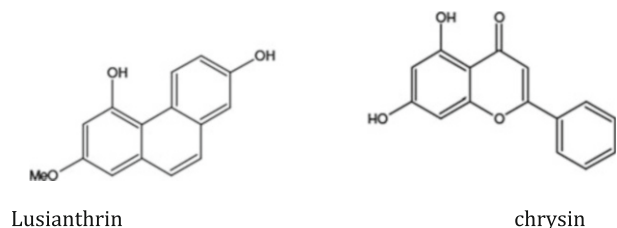


Description: Plant is 25–50 cm tall, carrying alternate elliptic or elliptic-ovate, plicate, pubescent leaves, 15 by 6–8 cm, and a terminal inflorescence with a single flower. The 8-cm-broad, deeply pouched, well-rounded lip reminiscent of the ideal Song porcelain shape is surrounded by the striped, dorsal sepals and petals which curl around it. Holger Perner (2007) found populations of exclusively white forms near Vladivostok. Elsewhere, the colour of the flowers varies from a light pink to deep red or purple. It flowers in June and July (Fig. 9.55). Natural hybrids with *C. calceolus* are common; the resultant natural hybrid, *Cypripedium* × *ventricosum* has been described by many authors and so far bestowed with 14 different names. In Japan, the paler forms are known as var. *speciosum* (Rolfe) Koidzumi, of which the white form is known as var. *speciosum* (Rolfe) Koidzumi f. *albiflorum* (Makino) Ohwi. The yellow form, var. *rebuense* (Kudo) Miyabe et Kudo, occurs only in Rebut Island northeast of Hokkaido.

A large, beautiful, northern Lady Slipper Orchid, *C. macranthos*, occurs in large populations in alpine meadows and scrub land across northern Asia from eastern Russia to the Kamchatka Peninsula, northeastern China (Heilongjiang, Jilin, Liaoning, Nei Mongolia, Hebei and Shandong), Korea and Japan, at 500–2400 m, overlapping with the same distribution as *C. calceolus*, but, unlike the latter species, it does not extend to North America.

A miniature *C. macranthos* is present in Taiwan, *C. macranthos* var. *taiwanianum* (Masamune) F. Maekawa, (= *C. segawai* Masamune) or *Ch-lai Cypripedium*. This plant is 20 cm tall with leaves 6 by 3 cm, and flowers 6 cm across. It occurs in the Central Mountains at 3000 m, on ridges and rocky cliffs in the company of dwarf junipers (Perner 2007).

**Fig. 9.56** Lusianthrin and chrysin, two phytoalexins from *Cypripedium macranthos* with anti-fungal properties



Phytochemistry: Lusianthrin and chrysin were isolated from seedlings of *C. macranthos* that had developed shoots (Fig. 9.56). Lusianthrin was present in minute amounts in aseptically cultured protocorms but levels increased dramatically when protocorms were challenged with *Rhizoctonia* species, its natural symbiont (Shimura et al. 2007, 2009). Chrysin was not present in the infected protocorms. This suggests that lusianthrin maintains a symbiotic balance during germination whereas chrysin protects the adult plant (Shimura et al. 2007). Lusianthrin and chrysin are antifungal compounds.

Herbal Usage: Chinese Herbals state that roots and stem promote diuresis, reduce swelling, clear ecchymosis, expel gas, stop pain and improve blood flow. The orchid is used to treat generalised oedema, swelling of the lower limbs, oliguria, leucorrhoea, gonorrhoea, rheumatism, traumatic injuries, dysentery and illness resulting from overwork (*Zhongyao Da Cidian* 1986; Wu 1994; Ou et al. 2003). Pulverised, dried flowers are used to stop bleeding from wounds. For oral consumption, the decoction is prepared with 6–9 g of the orchid plant and consumed with, or without, wine (*Zhongyao Da Cidian* 1986).

### ***Cypripedium margaritaceum* Franch.**

Chinese names: *Banyeshao Lan*;

Chinese medicinal name: *Lanhuashuangyecaio*

Description: This short, Chinese *Cypripedium* has a 10-cm, erect stem wrapped by two tubular sheaths and carrying two rounded ovate dark green leaves which are heavily spotted with blackish-purple on the superior surface. The leaves are held horizontally across the forest floor. A single flower, 3–4 cm across, appears



terminally from May to July. Sepals are yellow with red spots and stripes; the petals and pouch white and similarly marked. The dorsal surfaces of the tepals are hairy while the anterior surface of the pouch is warty.

An endemic species, *C. margaritaceum*'s distribution is limited to grassy slopes at 2500–3600 m in southwest Sichuan and northwest Yunnan (Chen and Cribb 2009). It grows in deep shade (Puy and Cribb 1991).

Herbal Usage: *C. margaritaceum* is used when there is a need to nourish the liver and kidneys. It moderates *qi* (vital energy) and blood, promotes diuresis and relieves oedema, and improves blurred vision or night blindness. A commonly used folk herb in Yunnan, decoction is prepared by boiling 9–15 g of the herb (Zhongyao Da Cidian 1986).

### ***Cypripedium tibeticum* King ex Rolfe**

*Cypripedium corrugatum* Franch.

Chinese name: *Xizang Zhuolan* (Tibetan scoop orchid); *Zhoushao Lan* (crepe spoon orchid)



**Fig. 9.57** *Cypripedium tibeticum* King ex Rolfe (Photo: Nima Gyeltshen)

Chinese medicinal name: *Wugongqi*; *Zhoushao Lan* (crepe spoon orchid)

Description: *C. tibeticum* bears large, nodding, maroon flowers up to 12 cm across with a prominent pouch with a white rim at the mouth. Stem is erect, 15–30 cm tall, carrying three elliptical leaves, 8–16 cm by 3–9 cm, and a terminal inflorescence that has a single flower and a bract-like leaf above the bloom. Flowers are crimson with livid crimson stripes over a light crimson base (Fig. 9.57). Those from Yunnan differ from those of the typical *C. tibeticum* in having brownish-red stripes over a white base, and this feature is important to Chinese herbalists who find a different usage for the Yunnan variety. In Indian Himalaya, *C. tibeticum* rarely exceeds 20 cm in height, and this short stature is a feature which distinguishes it from other *Cypripedium* species when the plant is not in bloom. It flowers from May to August.

*C. tibeticum* occurs in open forests and on grassy or rocky slopes and at 2300–4200 m from southern Gansu to western Sichuan, Tibet, Sikkim and Bhutan. It is numerous in open scrub, on humus pockets in the central and lower valley of Huanglong, the famous scenic spot in Sichuan (Perner 2002).

Herbal Usage: Herb is collected from Yunnan. Roots of *C. tibeticum* are thought to be anti-inflammatory and capable of preventing pain. They are used to increase urine output, relieve painful swellings, or to improve blood circulation and to treat menstrual disorders. Roots of *C. tibeticum*, 6–9 g in decoction, is consumed in Tibet to treat rheumatism, leg oedema, external injuries, gonorrhoea and leucorrhoea (Zhongyao Da Cidian 1986; Wu 1994). With the low boiling point of water at the high altitude of Tibet which can be as low as 56 °C, extraction of the ingredients of any plant would not be as efficient as in the lowlands. This could affect the potency of a decoction.

Phytochemistry: Cypitibetquinone A and B are two new phenanthraquinones isolated from *C. tibeticum*. They are 7-hydroxy-2-methoxy-1,4-phenanthraquinone and 7-hydroxy-2,10-

dimethoxy-11-4-phenanthraquinone, respectively (Liu et al. 2005).

### Overview

*Cypripediums* are now attracting attraction from taxonomists, gardeners and biochemists. At the Institute of Medicinal Plant Development in Beijing and the Peking Union Medical College (PUMC), Liu et al. (2005) managed to isolate two new phenanthraquinones, cypritibetquinones A and B, from *C. tibeticum*. Cypridediquinone-A isolated from *C. macranthum* in 2000 (Ju et al. 2000) has been synthesised by oxidative coupling using MoC15 (Trosien and Waldvogel 2012), but its medicinal usage, if any, has not been described.

*Cypripedium* has been used medicinally in western medicine in Europe and in North America. Many *Cypripedium* species are distributed in North America, and American Indians used roots of *C.s* as sedatives and antispasmodics, as well as to treat hysteria and chorea (Griffith 1847). Cherokees prepared root tea with roots of *C. acaule* or *C. calceolus* to treat worms, stomach ache, flu and neuralgia (Hamel and Chiltoskey 1975). *Fluidextractum Cypripedii*, U.S.P. or extract of *C. parvifolium* and *C. pubescens* (sic) was official in the *United States Pharmacopeia* and included in the *British Pharmaceutical Codex* just a hundred years ago. The extract was used to treat nerve disorders and sometimes used as an aphrodisiac. It is interesting to note that, in India, there is a similar usage for *C. elegans*, the root of which is used to treat such disorders of the nervous system as hysteria, spasms, fits, madness and epilepsy (Duggal 1971).

Contact dermatitis occurred in a high percentage of subjects who came into contact with the glandular hairs of *C. spectabile* and *C. pubescens* (MacDougal 1894), but this has not been reported with the Asian species. Contact dermatitis following contact with *Cypripediums* is caused by exposure to quinines and oxalate. Taken internally, overdose of *Cypripedium* induces hallucinations (Wilson 2007).

The employment of *C. japonicum* by Chinese herbalists to treat bouts of malaria that recurs every other day (tertian malaria) is interesting

and bears further investigation. There are three types of tertian malaria, each caused by a different parasite. Benign tertian malaria produces bouts of high fever with chills and rigours occurring every other day, and is caused by *Plasmodium vivax*. As its name denotes, it only weakens the patient and results in anaemia but is not fatal. Numerous antimalarial drugs like quinine, chloroquine and doxycycline work well for benign tertian malaria. Malignant tertian malaria is quite a different matter. The causative parasite, *Plasmodium falciparum*, does not provoke a high fever response but is capable of infecting the brain, and when it does the disease is often fatal (Hunter 1956). Common antimalarial drugs do not work on *falciparum* malaria but the parasite is killed by artemisinin, which is derived from an ancient Chinese herbal remedy for malaria, *Artemisia annua*. Thus, it would be important to know which type of malaria responds to *C. japonicum*, but that information is not available.

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### Genus: *Cyrtosia* Blume

Chinese name: *Rou guo lan*

*Cyrtosia* is a small genus of achlorophyllous, mycotrophic orchids constituted by five Asian species, three of which are found in China. Rhizomes are stout, simple or branched, with fleshy roots and scales at the nodes. Raceme is hairy and many-flowered. Flowers do not open fully and sepals are hairy on their dorsal surface (Chen and Cribb 2009).

*C. septentrionalis* has the largest seeds among orchids: they weigh 22 mcg each, which is ten times the weight of *Goodyera repens* seed that weigh only 2 mcg each (Rasmussen 1995). Seeds are winged.

### *Cyrtosia septentrionalis* (Rchb. f.) Garay

Syn. *Galeola septentrionalis* Rchb. f.

Chinese name: *Xue hong rou guo lan*

Chinese medicinal name: *Shanshanhu*

Japanese name: *Tsuchi-akebi, Dutuusoo*

Description: This is a large, cool-growing species found in southwest Anhui, and western Henan, Hunan and Zhejiang in China, spreading to Korea, Japan and the Ryukyu Islands. It grows in forests at 1000–1300 m. Its persistent, stout



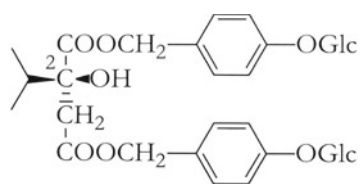
**Fig. 9.58** *Cyrtosia septentrionalis* (Rchb. f.) Garay (Photo: Courtesy of Wikimedia Commons)

1–2 cm diameter, horizontal rhizome occurs 0.5 m below the soil surface and possesses a perennial root system, which reaches upwards to a depth of 5–15 cm below the surface. Each of the 20 main roots is about 1 m long when they are young but eventually they may reach up to 5 m. They produce short secondary roots, many of which establish permanent symbiotic relationships with mycorrhiza, *Armillaria mellea* (Honey Mushroom) or *Armillaria tabescens*, on which the orchid is dependent for its carbon supply (Rasmussen 1995). Inflorescence is up to 90 cm tall with peach-coloured flowers that carry a yellow lip (Fig. 9.58). Flowers appear in late spring and summer (May to July). Fruit is banana red. The aerial portion of the orchid is also achlorophyllous.

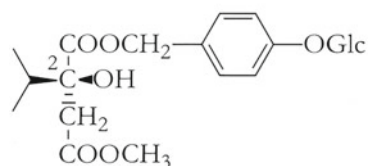
In the shaded and sparse understory of forests where *C. septentrionalis* occurs, insect pollinators are limited and the orchid has adapted by developing an effective self-pollinating system. Fruit set following autogamous and xenogamous pollinations were both recorded in central Japan (Suetsugu 2013).

Phytochemistry: Several glycosides were isolated from *C. septentrionalis* (Rchb. f.) Garay in Japan by Inoue et al. (1984). Subsequently, a Chinese team reported the isolation of eight phenolic derivatives from *C. faberi* Rolfe, a related species that occurs in China,

**Fig. 9.59** Two phenolic compounds from *Cyrtosia*



Bis[4(beta-D-glucopyranosyloxy)-benzyl](S)-(-)-2-isopropylmalate



Bis[4(beta-D-glucopyranosyloxy)-benzyl](S)-(-)-2-isopropylmalate methyl ether

Nepal and Sumatra (Li et al. 1993a, b) (Fig. 9.59). The eight phenolic derivatives were:

2,4-bis(4-hydroxybenzyl) phenol

Bis[4(beta-D-glucopyranosyloxy)-benzyl](S)-

(-)-2-isopropylmalate

Bis[4-(beta-D-glucopyranosyloxy)benzyl](S)-

(-)-2-sec-butylmalate

4-hydroxybenzylaldehyde

4,4'-dihydroxydiphenyl-methane

4-hydroxybenzylalcohol

4-(beta-D-glucopyranosyloxy)benzyl alcohol or gastrodin

5-methoxy-3-(2-[phenyl-E-ethenyl]-2,4-bis

(4-hydroxybenzyl)phenol

Herbal Usage: Indications for use of this parasitic orchid mentioned in the *Zhonghua Bencao* are to use the root, 30 g in decoction, to treat stiffness or spasm of the muscles; a paste made with the whole plant and vegetable oil for sores and fungal infection of the skin with ulceration; and fruit with liquorice and prepared in decoction for treating gonorrhoea. Another method of preparing the paste for external application to sores, used in Zhejiang, is to fry the plant to dryness and render it as powder before mixing with vegetable oil (*Zhonghua Bencao* 2000). Decoction of the root of *Galeola septentrionalis* was formerly used in Japan to treat gonorrhoea. Ash produced by burning the plant was used as a hair tonic for diseases of the scalp (Lawler 1984).

## Overview

In its natural environment in Japan, *C. septentrionalis* was observed not to be capable of attracting pollinators despite its striking flowers, but the species manages to set fruit through autogamy (Suetsugu 2012). It is also not particular about its mycorrhizal association, albeit it is commonly associated with *Armillaria mellea* (Merckx 2012). Germination occurs in sawdust-based medium containing one of four fungal species, *Armillaria gallica*, *Armillaria mellea*, subsp. *Nipponica*, *Armillaria tabescens* and *Xylobolus annosus*; germination even occurred in the absence of direct seed–mycobiont contact (Umata et al. 2012). *C. septentrionalis* is therefore quite different from *Gastrodia elata* in

its requirements for germination: *Mycena osmundicola* supports germination of *Gastrodia elata* whereas *Armillaria mellea* is required for its subsequent growth.

It is interesting to note that *Cyrtosia* (*Galeola septentrionalis*) has a permanent relationship with either Honey Mushroom (*Armillaria mellea*) or *Armillaria tabescens*, and that gastrodin is present in the tubers of *C. septentrionalis*. *Armillaria mellea* is responsible for many of the medicinal compounds derived from *Gastrodia elata* (Chinese herbal name: *Tianma*) which is so highly regarded by Chinese herbalists who use it to treat nerve disorders, in particular to promote recovery from stroke (see *Gastrodia elata* in this Chapter). It would not be surprising if either or both of these two achlorophyllous *Cyrtosia* species should share some similar pharmacological properties with *Tianma*. Nevertheless, presently, *C. septentrionalis* is not used in TCM to treat disorders of the nervous system nor hypertension.

Meanwhile, eight phenolic derivatives have been isolated from *C. faberi* Rolfe (reported as *Galeola faberi*) (Li et al. 1993a, b) (Fig. 9.58). Several compounds found in *C. faberi* were also present in *Gastrodia elata*, e.g. gastrodin, 4-hydroxybenzaldehyde, 4-hydroxybenzylalcohol (Yang et al. 2007), which is not unexpected since both orchids parasitise on *Armillaria mellea* (Baumgartner et al. 2011). It would not be surprising if similar compounds are present in *C. septentrionalis*.

## References

- Abadie JC, Puttsepp U, Gebauer G (2006) *Cephalanthera longifolia* (Neottieae, Orchidaceae) is mixotrophic: a comparative study between green and non-green photosynthetic individuals. *Can J Bot* 84(9):1462–1477
- Abraham A, Vatsala P (1981) Introduction to Orchids, with illustrations and descriptions of 150 South Indian Orchids. TPGRI, Trivandrum
- Anuradha V, Prakasa Rao NS, Bhaskar MU (1994) Ochrolic acid, a precursor to phenanthropyrones from *Coelogyne ochracea*. *Phytochemistry* 36:1515–1517



- Auwerx J, Francois KO, Vanstreels E et al (2009) Capture and transmission of HIV-1 by the C-type lectin L-SIGN (DC-SIGNR) is inhibited by carbohydrate-binding agents and polyanions. *Antivir Res* 83 (1):61–70
- Balakrishna A, Srivastava A, Mishra R et al (2012) Astavarga plants – threatened medicinal herbs of the North-west Himalaya. *Int J Med Arom Plants* 2 (4):661–676
- Balzarini J (2007) Carbohydrate-binding agents: a potential future cornerstone for the chemotherapy of enveloped viruses? *Antivir Chem Chemother* 18(1):1–11
- Balzarini J, Neyts J, Schols D, Hosoya M, Van Damme E, Peomans W, De Clercq E (1992) The mannose-specific plant lectins from *Cymbidium* hybrid and *Epipactis helleborina* and the (N-acetylglucosamine)n-specific plant lectin from *Urtica dioica* are potent and elective inhibitors of human immunodeficiency virus and cytomegalovirus replication in vitro. *Antiviral Res* 18 (2):191–207
- Balzarini J, van Laethem K, Jitse S et al (2004) Profile of resistance of human immunodeficiency virus to mannose-specific plant lectins. *J Virol* 78 (19):10617–10627
- Balzarini J, Van Herrewege Y, Vermeire K et al (2007) Carbohydrate-binding agents efficiently prevent dendritic cell-specific intercellular adhesion molecule-3-grabbing nonintegrin (DC-SIGN)-directed HIV-1 transmission to T lymphocytes. *Mol Pharmacol* 71(1):3–11
- Baral SR, Kurmi PP (2006) A compendium of medicinal plants in Nepal. Mrs Rachana Sharma and IUCN, Kathmandu
- Barua AK, Ghosh BB, Ray S, Patra A (1990) Cymbinobin-A, a phenanthraquinone from *Cymbidium aloifolium*. *Phytochemistry* 29:3046–3047
- Basavarajappa HD, Lee B, Fei X et al (2014) Synthesis and mechanistic studies of a novel homoisoflavanone inhibitor of endothelial cell growth. *PLoS One* 9(4), e95694. doi:10.1371/journal.pone.0095694
- Basavarajappa HD, Lee B, Lee H et al (2015) Synthesis and biological evaluation of novel homoisoflavonoids for retinal neovascularization. *J Med Chem* 58 (12):5015–5027
- Baumgartner K, Coetzee MP, Hoffmeister D (2011) Secrets of the subterranean pathosystem of *Armillaria*. *Mol Plant Pathol* 12(6):515–534
- Bensky D, Clavey S, Stoger E, Gambie A (2004) *Herbal medicine materia medica*, 3rd edn. Eastland Press, Seattle, WA
- Bhaskar MU, Rao LJM, Rao NSP, Rao PRM (1989) Ochrolide, a phenanthropyrene from *Coelogyne ochracea*. *Phytochemistry* 28(12):3545–3546
- Bhaskar MU, Rao LJM, Rao NSP, Rao PRM (1991) Ochrone A, a novel 9,10-dihydro-1,4-phenanthraquinone from *Coelogyne ochracea*. *J Nat Prod* 54:386–389
- Bhattacharjee SK (1998) *Handbook of medicinal plants*. Pointer Publishers, Jaipur
- Boorsma WG (1902) *Pharmakologische Mitteilungen* I. *Bull de l'Institut Botanique de Buitenzorg* 14:1–39
- Bose TK, Bhattacharjee SK (1980) *Orchids of India*. Naya Prokash, Calcutta
- Burkhill IH, Haniff M (1930) *Malay village medicine*. *Gard Bull Straits Settl* 6:165–321
- Burkill IH (1935) (1966 reprint, 2nd edn, with contributions by Birtwistle W, Foxworthy FW, Scrivenor JB, Watson IG). *A dictionary of economic products of the Malay Peninsula*, vol II. Crown Agents for the Colonies, London. Ministry of Agriculture & Co-operatives, Kuala Lumpur
- Campbell F (2014) A summary of holomycotrophic orchids. *MIOS J* 15(4):6–17
- Caius JF (1936) The medicinal and poisonous plants of India. *J Bombay Nat Hist Soc* 38(4):791–799
- Charoenrungruang S, Chanvorachote P, Sritularak B, Pongrakhananon V (2014) Gigantol, a bibenzyl from *Dendrobium draconis*. Inhibits the migratory behavior of non-small cell lung cancer cells. *J Nat Prod* 77 (6):1359–1366
- Chen XQ, Clayton D (2009) *Coelogyne*. In: Chen XQ, Zj L, Zhu GH et al (eds) *Flora of China – Orchidaceae*. Science Press, Beijing, pp 315–325
- Chen XQ, Cribb PJ (2009) *Cyrtosia*. In: Chen XQ, Zj L, Zhu GH et al (eds) *Flora of China – Orchidaceae*. Science Press, Beijing, pp 168–169
- Chen SC, Lang KY (1986) *Cephalanthera calcarata*, a new saprophytic orchid from China. *Acta Bot Yunnanica* 8:271–274
- Chen SC, Tang T (1982) A general review of the orchid flora of China. In: Arditti J (ed) *Orchid biology. Reviews and perspectives II*. Cornell University Press, Ithaca
- Chen SC, Tsi ZH (1998) *The orchids of China. Native cymbidiums of China*. Wanhai Books, Beijing
- Chen SC, Tsi ZH, Luo YB (1999) *Native orchids of China in colour*. Science Press, Beijing
- Chen XQ, Wood JJ (2009) *Cleisostoma blume*. In: Chen XQ, Zj L, Zhu GH et al (eds) *Flora of China – Orchidaceae*. Science, Beijing, pp 458–463
- Chen XQ, Cribb PJ, Gale SW (2009a) *Calanthe* R. Brown In: Chen XQ, Liu Zj, Zhu GH, et al (eds) *Flora of China - Orchidaceae*. Science Press, Beijing, pp 292–309
- Chen XQ, Gale SW, Cribb PJ, Ormerod P (2009b) *Cephalanthera*. In: Chen XQ, Liu ZJ, Zhu GH et al (eds) *Flora of China – Orchidaceae*. Science, Beijing, pp 174–175
- Chen XQ, Zj L, Zhu GH et al (eds) (2009) *Flora of China – Orchidaceae*. Science, Beijing
- Cheruvathur MK, Abraham J, Mani B, Thomas TD (2010) Adventitious shoot induction from cultured internodal explants of *Malaxis acuminata* D. Don, a valuable terrestrial medicinal orchid. *Plant Cell Tissue Organ Cult* 101(2):163–170
- Chinmay R, Suman K, Bishnupriya D et al (2011) *Phyto-Pharmacognostical studies of two endangered species*

- of Malaxis (Jeevak and rishibhak). *Pharmacogn J* 3 (26):77–85
- Cho KH, Beyoung HK (1995) Significance of some environmental factors in the natural distribution of *Cymbidium goeringii* growing wild in Korea and the consideration for cultural practice. Proceedings of 5th Asia Pacific Orchid Conference and Show, Fukuoka, Japan
- Chuakul W (2002) Ethnomedical uses of thai orchidaceous plants. *Mohidol Univ J Pharm Soc* 29(3-4):41–45
- Comber JB (2001) Orchids of Sumatra. Natural History Publications (Borneo), Kota Kinabalu
- Cragg GM, Boyd MR (1996) Drug development at the National Cancer Institute. In: Balick MJ, Elisabetsky E, Laird SA (eds) Medical resources of the tropical forest: biodiversity and its importance. Columbia University Press, New York
- Dahmen J, Leander K (1978) Amotin and amoenin, two sesquiterpenes of the picrotoxane group from *Dendrobium amoenum*. *Phytochemistry* 17 (11):1949–1952
- Das SP (2004) Indian orchids in indigenous medicine system. In: Britto SJ (ed) Orchids diversity and conservation. The Rapinat Herbarium, St John's College, Tiruchirappalli
- Dash PK, Sahoo S, Bal S (2008) Ethnobotanical studies on orchids of Niyamgiri Hill ranges, Orissa, India. *Ethnobot Leaflets* 12:70–78
- Deb CR, Temjensangba (2006) In vitro propagation of threatened terrestrial orchid, *Malaxis khasiana* Soland ex Swartz through immature seed culture. *Indian J Exp Biol* 44(9):762–766
- Dhayani A, Nautiyal BP, Nautiyal MC (2011) Importance of Astavarga plants in traditional systems of medicine in Garhwal, Indian Himalaya. *Int J Biodiv Sci Ecosyst Serv Manage* 6(1–2):13–19
- Du Puy D, Cribb PJ (2007) The Genus *Cymbidium*. Kew Publishing, Royal Botanic Gardens, Kew
- Duffy KJ, Kingston NE, Sayers BA et al (2009) Inferring national and regional declines of rare orchid species with probabilistic models. *Conserv Biol* 23 (1):184–185
- Duggal SC (1971) Orchids in human affairs (a review). *Pharm Biol* 11(2):1727–1734
- Ernst R, Rodriguez E (1984) Carbohydrates of the Orchidaceae. In: Arditti J (ed) Orchid biology. Reviews and perspectives III. Cornell University Press, Ithaca
- Fung TK (1999) *Cymbidium ensifolium*. Proceedings of the 16th World Orchid Conference, pp 314–319
- Ganesan S, Kesaavan L (2003) Ethnomedicinal plants used by the ethnic group Valaiyans of Vellimalai Hills (Reserve Forest), Tamil Nadu, India. In: Singh V, Jain AP (eds) Ethnobotany and medicinal Plants of India and Nepal. Scientific Publishers (India), Jodhpur, pp 754–760
- Gardner DR, Pfister JA (2009) HPLC-MS analysis of toxic norditerpenoid alkaloids: refinement of toxicity assessment of low larkspur (*Delphinium* spp.). *Phytochem Anal* 20(2):104–113
- Ghosh BB, Ray S, Bhattacharyya P et al (1992) Cymbinodin B, a phenanthraquinone from *Cymbidium aloifolium*. *Indian J Chem* 31B:557–558
- Gimlette JD, Thomson HW (1939) A dictionary of Malayan medicine. Oxford University Press, London
- Godot T, Komori M, Nakaoki E et al (2010) Germination of mature seeds of *Calanthe tricarinata* Lindl., and endangered terrestrial orchid, by asymbiotic culture in vitro. *Vitro Cell Dev Biol Plant* 46(3):323–328
- Gong CY, Yu ZY, Lu B et al (2014) Ethanol extract of *Dendrobium chrysotoxum* Lindl. ameliorates diabetic retinopathy and its mechanism. *Vascul Pharmacol* 62 (3):134–142
- Gopal BB, Shankar DS, Kumar PS (2014) Study of antioxidant property of the pseudobulb Extract of *Crepidium acuminatum* (Jeevak) and its use in the green synthesis of gold nanoparticles. *Int J Res Chem Environ* 4(3):133–138
- Grant B (1895) The Orchids of Burma. Hanthawaddy Press, Rangoon
- Griffith RE (1847) Medical botany of descriptions of the more important plants used in medicine, with their history, properties and mode of administration. Lea and Blanchard, Philadelphia
- Gurong DB (2006) An illustrated guide to the orchids of Bhutan. DSB Publications, Thimphu
- Hamel PB, Chiltoskey MU (1975) Cherokee plants – their uses. A 400 year history. Self published.
- Handoyo F (2010) Orchids of Indonesia, vol 1. Indonesian Orchid Society, Jakarta
- Hawkes AD (1965) Encyclopaedia of Cultivated Orchids. Faber & Faber, London
- Hedley C (1888) Uses of Queensland plants. *Proc R Soc Queensland* 5:10–13
- Henderson CP, Hancock IR (1988) A guide to the useful plants of Solomon Islands. Research Department, University of Agriculture and Lands, Honiara, Solomon Is
- Heyne K (1927) De nuttige planten van Nederlandsche Indie, vol 1, pp 508–513. Uitgave van het Departement van Landbouw, Nijverheid & Handel in Nederlandsche-Indie
- Howlader MA, Alam M, Ahmed Kh T et al (2011) Antinociceptive and anti-inflammatory activity in an ethanolic extract of *Cymbidium aloifolium* (L.). *Pak J Biol Sci* 14(19):909–911
- Hu SY (1971) Orchids in the life and culture of the Chinese people. *Chung Chi J* 10:1–26
- Hung T (2014) Lan Thanh Dam – Coelogyne: được tinh (Thanh Lan – Coelogyne: pharmacology). [www.hoalanvietnam.org](http://www.hoalanvietnam.org)
- Hunter D (ed) (1956) Price's textbook of the practice of medicine, 9th edn. Oxford University Press, London
- Hur S, Kim T (2009a) Homoisoflavanone, an extract from *Cremastra appendiculata* Makino, inhibits inflammatory and allergic response in mast cell. *J Invest Dermatol* 129(Suppl 1):S125
- Hur S, Kim T (2009b) Homoisoflavanone, an extract from *Cremastra appendiculata* Makino, inhibits UVB-induced skin inflammation. *J Invest Dermatol* 129(Suppl 1):S23

- Hur SG, Lee YS, Yoo H et al (2010) Homoisoflavanone inhibits UVB-induced skin inflammation through reduced cyclooxygenase-2-expression and NF-kappa B nuclear localization. *J Dermatol Sci* 59 (3):163–169
- Ikeda Y, Nonaka H, Furumai T, Igarashi Y (2005) Cremastrine, a pyrrolizidine alkaloid from *Cremastra appendiculata*. *J Nat Prod* 68(4):572–573
- Inoue S, Wakai A, Konishi T, Kiyosawa S, Sawada T (1984) Studies on *Galeola septentrionalis* Reichb. fil. I. Isolation and structure of the constituents of "Dotuusoo". *Yakugaku Zasshi* 104(1):42–49
- Jain SP (2003) An inventory of threatened medicinal and aromatic plants of northwestern India. In: Singh V, Jain AP (eds) *Ethnobotany and medicinal Plants of India and Nepal*. Scientific Publishers (India), Jodhpur, pp 908–913
- Jaiswal S, Singh SV, Singh B, Singh HN (2004) Plant used for tissue healing of animals. *Nat Prod Rad* 3:284–292
- Jalal JS, Kumar P, Pangtey YPS (2008) Ethnomedicinal Orchids of Uttarakhand. *Western Himalayas Ethnobot Leaflets* 12:1227–1230
- Jalal JS, Kumar P, Tewari L, Pangtey YPS (2010) Orchids: uses in traditional medicine in India. In: National Seminars on Medicinal Plants of Himalayas. Regional Research Institute, Himalaya, India, Tarikat Japan Calanthean Society (1987) Brochure, 12th World Orchid Conference, Tokyo
- Jayaweera DMA (1981) A revised handbook of the flora of Ceylon, vol II. A.A. Balkema, Rotterdam
- Jiangsu College of New Medicine (1986) *Zhongyao Da Cidian* (Encyclopaedia of Chinese medicine. First class award winner, Vol I and II). Shanghai Science and Technology Publishers
- Jin XH, Zhao XD, Shi XC (2009) Native orchids from Gaoligongshan mountains China. Science Press, Beijing
- Joseph J (1982) Orchids of Nilgiris. Records of the botanical survey of India, Vol XXII, 1982. Botanical Survey of India (Department of Environment), Howrah
- Ju JH, Yang JS, Li J, Xiao PG (2000) Cypripediquinone A, a new phenanthraquinone from *Cypripedium macranthum* (Orchidaceae). *Chinese Chem Lett* 11(1):37
- Juneja RK, Sharma SC, Tandon JS (1985) A substituted 1,2-diarylethane from *Cymbidium giganteum*. *Phytochemistry* 24:321–324
- Juneja RK, Sharma SC, Tandon JS (1987) Two substituted bibenzyls and a dihydrophenanthrene from *Cymbidium aloifolium*. *Phytochemistry* 26:1123–1125
- Kaiser R (1993) The scent of orchids: olfactory and chemical investigations. Editions Roche, Basel
- Kanda K (1977) The native orchids of Japan. Seibundo-Shinkosha, Tokyo
- Karthikeyan S, Jain SK, Nayar MP, Sanjappa M (1989) *Flora Indica Enumeratio: Monocotyledonae*. Botanical Survey of India, Calcutta
- Karunakara N, Somashekarappa HM, Narayana Y et al (2001) 137C concentration in the environment of Kaiga of southwest coast of India. *Health Phys* 81 (2):148–155
- Kim JH, Kim KH, Kim JH et al (2007) Homoisoflavanone inhibits retinal neovascularization through cell arrest with decrease of cdc2 expression. *Biochem Biophys Res Commun* 362(4):848–852
- Kim JH, Kim JH, Yu SH et al (2008) Inhibition of choroidal neovascularization by homoisoflavanone, a new angiogenesis inhibitor. *Mol Vis* 14:556–561
- Kim JH, Kim JH, Lee YM et al (2009) Decursin inhibits retinal neovascularization via suppression of VEGFR-2 activation. *Mol Vis* 15:1868–1875
- Kimura T, But PPH, Guo JX, Sung CK (eds) (2001) International collation of traditional and folk medicine, Northeast Asia Part 1. World Scientific, Singapore, New Jersey, London & Hong Kong
- Kovacs A, Vasas A, Hohmann J (2007) Natural phenanthrenes and their biological activity. *Phytochemistry* 69:1084–1110
- Kurzweil H, Lwin S (2014) A guide to orchids of Myanmar. Natural History Publications (Borneo), Kota Kinabalu
- Lawler LJ (1984) Ethnobotany of the orchidaceae. In: Arditti J (ed) *Orchid biology reviews and perspectives*, vol 3. Cornell University Press, Ithaca
- Lawler LJ (1986) Orchid ethnobotany in the ASEAN area. In: Rao AN (ed) *Proceedings of the 5th ASEAN orchid congress*. Parks & Recreation Department, Ministry of National Development, Singapore, pp 42–45
- Lawler LJ, Slaytor M (1969) The distribution of alkaloids in New South Wales and Queensland Orchidaceae. *Phytochemistry* 8:1959–1962
- Lawler LJ, Slaytor M (1970) Uses of Australian orchids by aborigines and early settlers. *Med J Aust* 2:1259–1261
- Lee CL, Nakagawa-Goto K, Yu D, Liu YN, Bastow KF, Morris-Natschke SL, Chang FR, Wu YC, Lee KH (2008) Cytotoxic calanquinone A from *Calanthe arisanensis* and its first total synthesis. *Bioorg Med Chem Lett* 18(15):4275–4277
- Lee CL, Chang FR, Yen MH et al (2009) Cytotoxic phenanthrenequinones and 9,10 dihydrophenanthroquinones from *Calanthe arisanensis*. *J Nat Prod* 72 (2):210–213
- Lee B, Basavarajappa HD, Sulaiman RS et al (2014a) The first synthesis of the antiangiogenic homoisoflavanone, cremastranone. *Org Biomol Chem* 12(39):7673–7677
- Lee YS, Hur S, Kim TY (2014b) Homoisoflavanone prevents mast cell activation and allergic responses by inhibition of Syk signaling pathway. *Allergy* 69 (4):453–462
- Lee DH, Kim SS, Seong S et al (2014) A case of metastatic bladder cancer in both lungs treated with Korean medicine therapy alone. *Case Rep Oncol* 7 (2):534–540
- Li YM, Zhou ZL, Hong YF (1993a) Studies on the phenolic derivatives from *Galeola faberi* Rolfe. *Yao Xue Xue Bao* 28(10):766–771
- Li YM, Zhou ZL, Hong YF (1993b) New phenolic derivatives from *Galeola faberi*. *Planta Med* 59 (4):363–365

- Li L (1994) Chinese medicinal herbs of Hong Kong, vol 6, 198. Hong Kong Chinese Medical Research Institute, Hong Kong
- Li S, Xue Z, Wang SJ, Yang YC, Shi JG (2008) Terpenoids from the tuber of *Cremastra appendiculata*. *J Asian Nat Prod Res* 10(7–8):685–691
- Lin TP (1858) *Calanthe Dominii* (Hybrida): Gardeners' Chronicle
- Lin TP (1975) Native orchids of Taiwan, vol 1. Southern Materials Center Inc., Taipei
- Lin IH, Chang YS, Chen IS, Hsieh WC (2003) The catalogue of medicinal plant resources in Taiwan. China Press, Kuala Lumpur, p 153
- Lin LG, Liu QY, Ye Y (2014) Naturally occurring homoisoflavonoids and their pharmacological activities. *Planta Med* 80(13):1053–1066
- Lindstrom B, Luning B, Sirirala-Hansen K (1971) Studies on the Orchidaceae alkaloids XXVI. A new glycosidic alkaloid from *Malaxis grandifolia* Schltr. *Acta Chem Scand* 25:1900–1903
- Liu YFP, Nakayama H (2007) *Cymbidium goeringii* in Japan. *AOS Orchids* 76:450–456
- Liu ZJ, Chen XQ, Cribb PJ (1969) *Cymbidium Swartz*. In: Chen XQ, Zj L, Zhu GH et al (eds) *Flora of China - Orchidaceae*. Science Press, Beijing, pp 260–280
- Liu TS, Su HJ (1978) *Flora of Taiwan*, vol 5. National University of Taiwan, Taipei
- Liu D, Ju JH, Zou ZJ et al (2005) Isolation and structure determination of cypritibetquinone A and B, two new phenanthraquinones from *Cypripedium tibeticum*. *Yao Xue Xue Bao* 40(3):255–257
- Liu ZJ, Chen SC, Ru ZZ, Chen LJ (2006) The genus *cymbidium* in China. [www.sciencepub.com](http://www.sciencepub.com)
- Liu J, Yu ZB, Ye YH, Zhou YW (2008) Chemical constituents from the tuber of *Cremastra appendiculata*. *Yaoxue Xuebao* 43(2):181–184
- Liu FL, Hsu JL, Lee YJ et al (2014a) Calanquinone A induces anti-glioblastoma activity through glutathione-involved DNA damage and AMPK activation. *Eur J Pharmacol* 73:90–101
- Liu L, Ye J, Li P, Tu PF (2014b) Chemical constituents from tubers of *Cremastra appendiculata*. *Zhongguo Zhong Yao Za Zhi* 39(2):250–253
- Luning B (1967) Studies on the Orchidaceae alkaloids IV. Screening of species for alkaloids 2. *Phytochemistry* 6:857–861
- Luning B (1974a) Studies on Orchidaceae alkaloids. IV. Screening of species for alkaloids 2. *Phytochemistry* 6:857–861
- Luning B (1974b) Alkaloids of the Orchidaceae. In: Withner CL (ed) *The orchid. Scientific studies*. Wiley, New York, pp 347–382
- Luning B (1980) Alkaloids of the Orchidaceae. In: Sukshom Kashemsanta MR (ed) *Proceedings of the 9th World Orchid Conference, Bangkok*
- MacDougal DT (1894) Poisonous influence of various species of *cypripedium*. *Med Plants Nat Hist Bull* 9:450–451
- Maikhuri RK, Phodani PC, Rao KS et al (2014) Ethnobiology and traditional knowledge of medicinal plants in health care system. In: Uniyal PL, Chamda BP, Semwal DP (eds) *The plant wealth of Uttarakhand*. Jagdamba Publishing Co., New Delhi
- Majumder PL, Maiti DC (1991) Isoflaccidin and Isooxoflaccidin, stilbenoids from *Coelogyne flaccida*. *Phytochemistry* 30(3):971–974
- Majumder PL, Datta N (1982) Structures of flavidin and oxoflavidin, two new modified 9,10-dihydrophenanthrenes of the orchid, *Coelogyne flaccida*. *Indian J Chem* 21B:534–536
- Majumder PL, Datta N (1984) Structure of Oxoflavidin, a 9,10-dihydrophenanthropyron from *Coelogyne elata*. *Phytochemistry* 23:671–673
- Majumder PL, Laha S (1981) Occurrence of 2,7-dihydroxy-3,4,6-trimethoxy-9,10-dihydrophenanthrene in *Coelogyne ovalis*, a high altitude Himalayan orchid: application of C-13 NMR (nuclear magnetic resonance) spectroscopy in structure elucidation. *J Indian Chem Soc* 58:928–929
- Majumder PL (1984) Structure of Oxoflavidin, a 9,10-dihydrophenanthropyron from *Coelogyne elata*. *Phytochemistry* 23:671–673
- Majumder PL, Maiti DC (1988) Flaccidin, a 9,10-dihydrophenanthropyran derivative from the orchid, *Coelogyne flaccida*. *Phytochemistry* 27(3):899–901
- Majumder PL, Pal S (nee Roy) (1985) A steroidal ester from *Coelogyne uniflora*. *Phytochemistry* 29(8):2717–2720
- Majumder PL, Pal (Nee Roy) S (1990) A steroidal ester from *Coelogyne uniflora*. *Phytochemistry* 29(8):2717–2720
- Majumder PL, Sarkar AK (1982) Imbricatin, a new modified 9,10-dihydrophenanthrene derivative of the orchid *Pholidota imbricata*. *Indian J Chem* 21B:829–831
- Majumder PL, Sen RC (1991) Pendulin, a Polyoxygenated phenanthrene derivative from the orchid, *Cymbidium pendulum*. *Phytochemistry* 30(7):2432–2434
- Majumder PL, Bandyopadhyay D, Joardar S (1982a) Coelogenin and Coelogenin: Two novel 9,10-dihydrophenanthrene derivatives from the orchid *Coelogyne cristata*. *J Chem Soc I*:1131–1136
- Majumder PL, Datta N, Sarkar AK, Chakraborti J (1982b) Flavidin, a novel 9,10-dihydrophenanthrene derivative of the orchids *Coelogyne flaccida*, *Pholidota articulata* and *Otochilus fusca*. *J Nat Prod* 45(6):730–732
- Majumder PL, Laha S, Datta N (1982c) Coelonin, a 9,10-dihydrophenanthrene from the orchids *Coelogyne ochracea* and *Coelogyne elata*. *Phytochemistry* 21:478–480
- Majumder PL, Banerjee S, Maiti DC, Sen S (1995) Stilbenoids from the orchids *Agrostophyllum callosum* and *Coelogyne flaccida*. *Phytochemistry* 39:649–653
- Majumder PL, Sen S, Majumder S (2001) Phenanthrene derivatives from the orchid *Coelogyne cristata*. *Phytochemistry* 58(4):581–586
- Manandhar NP, Manandhar S (2002) *Plants and people of Nepal*. Timber, Portland
- Manners GD, Panter KE, Pfister JA et al (1998) The characterization and structure-activity evaluation of



- toxic norditerpenoid alkaloids from two *Delphinium* species. *J Nat Prod* 61(9):1086–1089
- Mao TF, Liu T, Liu ZY, Zhu GS, Huang YH (2007) Rapid propagation of *Cremastra appendiculata* in vitro. *Zhong Yao Cai* 30(9):1057–1059
- Marasini R, Joshi S (2012) Antibacterial and antifungal activities of medicinal orchids growing in Nepal. *J Nepal Chem Soc* 29:104–109
- Matthew KM (1995) An excursion flora of Central Tamilnadu, India. A.A. Balkema, Rotterdam
- Merckx V (2012) Mycoheterotrophy: the biology of plants living on fungi. Springer (eBook)
- Min CC, Wang XJ, Liu WB (2012) Preliminary study on isolation of endophytic fungi from *Cymbidium goeringii* and its antimicrobial activity. *Xibei Zhiwu Xuebao* 32(3):596–599
- Misra S (2007) Orchids of India a glimpse. Bishen Singh Mahendra Pal Singh, Delhi
- Miyazawa M, Shimamura H, Nakamura S, Kameoka H (1997) Antimutagenic activity of gigantol from *Dendrobium nobile*. *J Agric Food Chem* 45(8):2849–2853
- Musharof Hossain M (2009) Traditional therapeutic uses of some indigenous orchids of Bangladesh. *Med Arom Plant Sci Biotechnol* 3:100–106
- Naing AH, Myint KT, Hwang YJ et al (2010) Micropropagation and conservation of the wild medicinal orchid, *Coelogyne cristata*. *Hort Environ Biotechnol* 51(2):109–114
- Nakamura S, Tokado K, Onata A (1990) Japan prize fragrance competition. *Am Orchid Soc Bull* 59:1031–1036
- Nanakorn W, Watthana S (2008) Queen Sirikit Botanic Garden (Thai Native Orchids 1 and 2). Wanida Press, Chiang mai
- O'Byrne P (2001) A to Z of South East Asian Orchid Species. Orchid Society of South East Asia, Singapore
- Ou JC, Hsieh WC, Lin IH, Chang YS, Chen IS (eds) (2003) The catalogue of medicinal plant resources in Taiwan. Department of Health, Executive Yuan, Taipei
- Oudhia P (2013) Medicinal orchid *Cymbidium macrorhizon* Lindl. based herbal formulations used in Rheumatism in Indian traditional healing: Pankaj Oudhia's Ethnobotanical Surveys 1990–2012
- Pandey NK, Joshi GC, Mudaiya RK et al (2003) Management and conservation of medicinal orchids of Kumaon and Garhwal Himalaya. In: Singh V, Jain AP (eds) *Ethnobotany and medicinal plants of India and Nepal*. Scientific Publishers (India), Jodhpur, pp 114–118
- Pant B, Raskoti BB (2013) Medicinal orchids of Nepal. Himalayan Map House (P) Ltd, Kathmandu
- Pearce NR, Cribb PJ (2002) The orchids of Bhutan. Royal Botanic Gardens/Royal Government of Bhutan, Edinburgh/Thimpu
- Perner H (2002) Orchids and eco-tourism: the world natural heritage and biosphere reserve, Huanglong. Proceedings of the 17th World Orchid Conference, Shah Alam, Malaysia, pp 158–164
- Perner H (2007) *Cypripediums* in China Part IV. *Orchids* 76(4):291–292
- Perner H, Luo Y (2007) Orchids of Huanglong. Huanglong National Park, Sichuan Province, China
- Perry LM, Metzger J (1980) Medicinal plants of east and southeast asia: attributed properties and uses. MIT Press, Cambridge, MA
- Pollicita M, Schols D, Aquaro S et al (2008) Carbohydrate-binding agents (CBAs) inhibit HIV-1 infection in human primary monocyte-derived macrophages (MDMs) and efficiently prevent MDM-directed viral capture and subsequent transmission to CD4+ T lymphocytes. *Virology* 370(2):3822–3891
- Pradhan UC (1975) The Himalayan *Cypripediums*. In: Senghas K (ed) Proceedings of the 8th world orchid conference, Frankfurt, 10–17 Apr 1975, German Orchid Society, Frankfurt am Main, 199–204
- Preiss K, Adam IKU, Gabauer G (2010) Irradiance governs exploitation of fungi: fine-tuning of carbon gain by two partially myco-heterotrophic orchids. *Proc R Soc Biol Sc Ser B* 277(1686):1333–1336
- Puri HS (1970a) Indian medicinal plants used in elixirs and tonics. *Quart J Crude Drug Res* 10:1555–1566
- Puri HS (1970b) Vegetable Aphrodisiacs of India. *Quart J Crude Drug Res* 11:1742–1748
- Puri HS (1970c) Salep – the drug from Orchids. *Am Orchid Soc Bull* 39(1):723
- Pushpa S, Nipunar M, Pankaj G et al (2001) *Malaxis acuminata*. A review. *Int J Res Ayurveda Pharm* 2(2):422–425
- Puy DD, Cribb PJ (1991) The genus *Cymbidium*. Batsford, Dunfermline
- Rao AN (2004) Medicinal orchid wealth of Arunachal Pradesh. *Newslett ENVISNODE Indian Med Plants* 1(2):1–7
- Rao TA (2007) Ethno botanical data on wild orchids of medicinal value as practised by tribals at Kudremukh National Park in Karnataka. *Orchid Newslett* 2(2):1–7
- Rao TA, Sridhar S (2007) Wild Orchids in Karnataka. A pictorial compendium. Institute of Natural Resources Conservation, Education, Research and Training (INCERT), Bangalore
- Raskoti BB (2009) The orchids of Nepal. Bhakta Bahadur Raskoti and Rita Ale, Kathmandu
- Rasmussen HN (1995) Terrestrial orchids from seed to mycotrophic plant. Cambridge University Press, Cambridge
- Rathore SR (1983) Endemic and rare Species of *Calanthe* R. Br. (Orchidaceae) in India. In: Jian SK, Rao RR (eds) *An assessment of threatened plants of India*. Botanical Survey of India, Delhi
- Reddy KN, Raju GV, Reddy CS, Raju VS (2005) Ethno-orchidology of orchids of Eastern Ghats of Andhra Pradesh. *EPRTI Newsl* 11(3)
- Reyes-Ramirez A, Leyte-Lugo M, Figueroa M et al (2011) Synthesis, biological evaluation, and docking studies of gigantol analogs as calmodulin inhibitors. *Eur Med Chem* 46:2699–2708
- Rhodehamel WA (2005) *Calanthe ceciliae*. *Orchids* 74(12):900–902
- Ridley HN (1906) *Malay Drugs*. Agricultural Bull. Straits Settlements and Fed Malay Staes 5, 245 and 277

- Rumphius GE (1741–1750, posthumus). *Amboinsch Kruidboek (The Amboinese Herbal, Vol. 1–6)*. Translated and annotated into English, with an introduction by EM Beekman (2011). Yale University Press, New Haven and London
- Sachdev K, Kulshreshtha DK (1986) Phenolic constituents of *Coelogyne ovalis*. *Phytochemistry* 25 (2):499–502
- Santapau H, Kapadia Z (1966) *The Orchids of Bombay*. Government of India Press, Calcutta
- Sarin YK (1995) Ethnopharmacological perspectives of ayurvedic drugs having controversial botanical identity. In: Pushpangadan P, Nyman U, George V (eds) *Glimpses of Indian ethnopharmacology*. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, pp 179–184
- Schuiteman A, de Vogel EF (2000) *Cac Ci Ho Lan (Orchidaceae) Cua Thai Lan, Lao, Campuchia Va Viet Nam*. *Orchid Genera of Thailand Laos, Cambodia and Vietnam*. (Vietnamese-English edition). Leiden: National Herbarium Nederland
- Seidenfaden G (1985) Contributions to the Orchid Flora of Thailand. XII. *Dendrobium Sw*. *Opera Botanica* 83, Copenhagen
- Seidenfaden G, Wood JJ (1992) *The orchids of Peninsular Malaysia and Singapore*. Olsen & Olsen, Fredensborg
- Sharma C, Mansoori MN, Dixit M et al (2014) Ethnolic extract of *Coelogyne cristata* Lindley (Orchidaceae) and its compound coelogenin promote osteoprotective activity in ovariectomized oestrogen deficient mice. *Phytomedicine* 21(12):1702–1707
- Shim JS, Kim JH, Lee JY et al (2004) Anti-angiogenic activity of a homoisoflavanone from *Cremastra appendiculata*. *Planta Med* 70(2):171–173
- Shimura H, Matsuura M, Takada N, Koda Y (2007) An antifungal compound involved in symbiotic germination of *Cypripedium macranthos* var. *ruenense* (Orchidaceae). *Phytochemistry* 68(10):1442–1447
- Shimura H, Sadamoto M, Matsuura M et al (2009) Characterization of mycorrhizal fungi isolated from the threatened *Chrpedium macranthos* in a northern island of Japan: two phylogenically distinct fungi associated with the orchid. *Mycorrhiza* 19 (8):525–534
- Singh H (2010) *Haat kali sacred grove, central himalaya, Uttarakhand*. *Curr Sci* 98:290
- Singh A, Duggal S (2009) Medicinal orchids: an overview. *Ethnobot Leaflets* 13:351–363
- Slaytor MB (1977) The distribution and chemistry of alkaloids in the Orchidaceae. In: Arditti JA (ed) *Orchids biology reviews and perspectives*, vol 1. Cornell University Press, Ithaca and London
- Stockman LJ, Bellamy R, Garner P (2006) SARS: systematic review of treatment effects. *PLoS Med* 3(9), e343
- Su, HJ (1985) *Native orchids of Taiwan*. Revised Third Ed. Harvest Farm Magazine, Taipei
- Subedi A, Kunwar B, Choy Y et al (2013) Collection and trade of wild harvested orchids in Nepal. *J Ethnobiol Ethnomed* 9:64–73
- Suetsugu K (2012) Autogamous fruit set in mycoheterotrophic orchid *Cyrtosia septentrionalis*. *Olant Syst Evol* 299(3):481–486
- Sugahara MI, Kazunari I, Nishimura Y, Sakamoto F (2013) Oriental Orchid (*Cymbidium floribundum*) attracts the Japanese honey bee (*Apis cerana japonica*) with a mixture of 3-hydroxyoctanoic acid and 10-hydroxy-(E)-2-decanoic acid. *Zool Sci* 30 (4):99–104
- Suetsugu K (2013) Autogamous fruit set in a mycoheterotrophic orchid *Cyrtosia septentrionalis*. *Plant Syst Evol* 299:481–486
- Sun HQ, Liu YB, Song GE (2003) A preliminary on pollination of an endangered orchid, *Changnienia amoena* in Shennongjia. *Acta Bot Sin* 45(9):1019–1023
- Sun HQ, Li A, Ban W, Zheng XM, Ge S (2005) Morphological variation and its adaptive significance for *changnienia amoena*, an endangered orchid. *Biodiv Sci* 13(05):376–386
- Tang SL, Su HJ (1978) *Flora of Taiwan*, vol 5. Department of Botany, Taiwan National University, Taipei
- Teoh ES (1982) *A joy forever*. *Vanda Miss Joaquim*. Singapore's National Flower. Singapore: Times (reprinted 2008. Singapore: Marshall Cavendish)
- Trosien S, Waldvogel SR (2012) Synthesis of Highly functionalized 9,10-phenanthrenequinones by oxidative coupling using MoC15. *OrganLett* 14(12):2976–2979
- Tsavkelova EA, Cherdyntseva TA, Lobakova ES et al (2001) Microbiota of the orchid rhizoplane. *Mikrobiologiya* 70(4):567–573
- Turville SG, Vermeire K, Balzarini J, Schols D (2005) Sugar binding proteins potentially inhibit dendritic cell human immunodeficiency virus type-1 (HIV-1) infection and dendritic –cell directed HIV-1 transfer. *J Virol* 79(21):13519–13527
- Umata H, Ota Y, Yamada M et al (2012) Germination of the fully-mycoheterotrophic orchid *Cyrtosia septentrionalis* is characterized by low fungal specificity and does not require direct seed-mycobiont contact. *Mycoscience* 54(5):343–352
- University of Yangon Department of Botany (undated, possibly 2004). *Myanmar Native Orchids*
- Usher G (1971) *A dictionary of plants used by man*. Constable, London
- Vaddhanaphuti N (2001) *A field guide to the wild orchids of Thailand*, 3rd edn. Silkworm Books, Chiang Mai
- Vaddhanaphuti N (2005). *A field guide to the wild orchids of Thailand*, Fourth and Expanded Edition. Silkworm Books, Chiang Mai
- van de Meer FJ, de Haan CA, Schuurman NM et al (2007) Antiviral activity of carbohydrate agents against Nidovirales in cell cultures. *Antiviral Res* 76(1):21–29
- van der Pijl L, Dodson CH (1966) *Orchid flowers and their pollination*. University of Miami Press, Coral Gables
- van Rheede HA (1703) *Hortus Indicus Malabaricus*, vol 12. Dutch East India Company, Kerala
- Veitch N, Grayer R (2007a) *Calanthe*. *Phytochemistry*. In: Pridgeon AM, Cribb PJ, Chase MW (eds) *Genera Orchidacearum*, vol 4, Epidendroideae (Part One). University Press, Oxford, pp 126–127

- Veitch N, Grayor R (2007b) Cephalanthera. Phytochemistry. In: Pridgeon AM, Cribb PJ, Chase MW (eds) Genera Orchidacearum, vol 4, Epidendroideae (Part Two). University Press, Oxford, pp 500–501
- Vidal J (1963) Les plantes utiles Du Laos. Cryptograms – Gymnospermes – Monocotyledones. Museum National d'Historie Naturelle, Paris
- Vij SP (1995) Orchid genetic diversity in india: conservation and commercialization. In: Proceedings of the 5th Asia Pacific orchid conference and Show, Fukuoka, pp 20–39
- Wang Y, Guan SH, Meng YH et al (2013) Phenanthrenes, 9,10-dihydrophenanthrenes, bibenzyls with their derivatives, and malate or tartrate benzyl ester glucosides from tubers of *Cremastra appendiculata*. *Phytochemistry* 94:268–276
- Wang L, Albert NW, Zhang HB et al (2014) Temporal and spatial regulation of anthocyanin biosynthesis provide diverse flower colour intensities and patterning in *Cymbidium* orchid. *Planta* 240(5):983–1002
- Wang FQ, Tong QY, Ma HR (2015) Indole diketopiperazines from endophytic *Chaetomium* sp 88194 induce breast cancer cell apoptotic death. *Sci Reports* 5: Article 9294: 1–9
- Watanabe K, Tanaka R, Sakurai H et al (2007) Structure of Cymbidine A, a monomeric peptidoglycan-related compound with hypotensive and diuretic activities, isolated from a higher plant, *Cymbidium goeringii* (Orchidaceae). *Chem Pharm Bull (Tokyo)* 55 (5):780–783
- Williams CA (1979) The leaf flavonoids of the Orchidaceae. *Phytochemistry* 18:803–813
- Wilson MF (2007) Medicinal plant fact sheet. *Cypripedium*: Lady slipper orchids. A collaboration of the IUCN Medicinal Plant Specialist Group, PCA Medicinal Plant Working Group, and the North American Pollinator Protection Campaign. Arlington, Virginia. <http://www.pollinator.org/Resources/Cypripedium.draft.pdf>
- Won JH, Kim JY, Yun KJ et al (2006) Gigantol isolated from the whole plants of *Cymbidium goeringii* inhibits the LPS-induced iNOS and COX-2 expression via NF-kappaB inactivation in RAW 264.7 macrophages cells. *Planta Med* 72(13):1181–1187
- Wu XR (1994) A concise edition of medicinal plants in China. Guangdong Higher Education Publication House, Guangdong (in Chinese)
- Wu TL, Hu QM, Xia NH, Lai PCC, Yip KL (2001) Check list of Hong Kong plants 2001. Agriculture, Fisheries and Conservation Department, Hong Kong
- Wu TL, Hu QM, Xia NH, Lai PCC, Yip KL (2002) *Check List of Hong Kong Plants 2001*. Agriculture, Fisheries and Conservation Department Bulletin 1 (Revised), Hongkong
- Xia WB, Xue Z, Li S, Wang SJ, Yang YC, He DX, Ran GL, Kong LZ, Shi JG (2005) Chemical constituents from the tuber of *Cremastra appendiculata*. *Zhongguo Zhong Yao Za Zhi* 30(23):1827–1830
- Xue Z, Li S, Wang SJ, Yang YC, He DX, Ran GL, Kong LZ, Shi JG (2005) Studies on the chemical constituents from the corm of *Cremastra appendiculata*. *Zhongguo Zhong Yao Za Zhi* 30(7):511–513
- Xue Z, Li S, Wang S, Wang Y, Yang Y, Shi J, He L (2006) Mono-, Bi-, and triphenanthrenes from the tubers of *Cremastra appendiculata*. *J Nat Prod* 69(6):907–913
- Yagame T, Yamato M (2013) Mycoheterotrophic growth of *Cephalanthera falcata* (Orchidaceae) in tripartite symbiosis with Thelephoraceae fungi and *Quercus serrata* (Fagaceae) in pot condition. *J Plant Res* 126(2):215–222
- Yagame T, Funabike N, Nagasawa E et al (2013) *Identification and symbiotic ability of Psathyrellaceae fungi isolated from a photosynthetic orchid, Cremastra appendiculata (Orchidaceae)*. *Am J Bot* 100 (9):1823–1830
- Yamazaki J, Miyoshi K (2006) In vitro asymbiotic germination of immature seed and formation of protocorm by *Cephalanthera falcata* (Orchidaceae). *Ann Bot (Lond)* 98(6):1197–1206
- Yan J, Li C, Chen S et al (2002) The effects of twenty one traditional Chinese medicines on tyrosinase. *Zhang Yao Cai* 25(10):724–726
- Yang ZH, Zhang QT, Feng ZZ, Lang KY, Li H (1998) English edition translated by ZR Xiong (ed.) *Orchids*. Beijing: China Esperanto Press
- Yang XD, Zhu J, Yang R et al (2007) Phenolic constituents from the rhizomes of *Gastrodia elata*. *Nat Prod Res* 21:180–186
- Yong HS (1990) *Orchid Portraits*. Tropical Press Sdn Bhd, Kuala Lumpur
- Yang ZH, Zhang QT, Feng ZZ, Lang KY, Li H (1993) English edition: *Orchids* (trans: Xiong ZR). China Esperanto, Beijing
- Yoshikawa M, Murakami T, Kishi A, Sakurama T, Matsuda H, Nomura M, Matsuda H, Kubo M (1998) Novel indole S, O-bisdesmoside, calanthoside, the precursor glycoside of tryptanthrin, indirubin and insatin, with increasing skin blood flow promoting effects, from two *Calanthe* species (Orchidaceae). *Chem Pharm Bull (Tokyo)* 46(5):886–888
- Yoshikawa K, Ito T, Iseki K et al (2012) Phenanthrene derivatives from *Cymbidium* great flower marie laurencin and their biological activities. *J Nat Prod* 75(4):605–609
- Yoshikawa K, Baba C, Iseki K et al (2014a) Phenanthrene and phenylpropanoid constituents from the roots of *Cymbidium* Great Flower “Marylaurencin” and their antimicrobial activity. *J Nat Med* 68(4):743–747
- Yoshikawa K, Okahuji M, Iseki K et al (2014b) Two novel aromatic glucosides, marylaurencinosides D and E from the fresh flowers of *Cymbidium* Great Flower “Marlaurencin”. *J Nat Med* 68 (2):455–458
- Yuzammi and Hidayat S (eds) (2002) The unique, endemic and rare Flora of Sulawesi. Centre for Plant Conservation, Bogor Botanic Gardens, Institute of Indonesian Sciences, Bogor
- Zhang Y, Huang B, Zhao Z, Zhou Y (2011) Study on the chemical constituents from the ethyl acetate tracts of

- Cremastra appendiculata. Zhong Yao Cai 34 (12):1882–1883
- Zhang SB, Hu H, Xu K et al (2007) Flexible and reversible responses to different irradiance levels during photosynthetic acclimation of *Cypripedium guttatum*. Plant Physiol 164(5):611–620
- Zhonghua Bencao (eds) (2000) Health Department and National Chinese Management Office. Shanghai Science and Technology, Shanghai
- Zhongyao Da Cidian (1986) Jiangsu New Medical College (eds). Shanghai Science and Technology, Shanghai