CHAPTER II

LITERATURE REVIEW

1. Botanical Aspects of *Belamcanda* spp. and *Dalbergia* spp.

The genus *Belamcanda*, belonging to the family Iridaceae in the order Asparagales, has been described (Yu-tang, 1985) as follows:

Herbs perennial, rhizomatous. Rhizome knobbly. Aerial stem well developed, erect, leafy. Leaves cauline, 2-ranked, oriented edgewise to aerial stem, sword-shaped. Inflorescence a ± dichotomously branched panicle of rhipidia. Perianth tube short; segments ± similar, outer ones somewhat larger than inner. Stamens inserted at base of perianth segments. Style one, slender, 3-lobed at apex. Capsule obovoid or ellipsoid. Seeds black, glossy.

There is only a single species in this genus, *Belamcanda chinensis* (L.) DC. (Figure l), that is distributed in East Asia, North India to Siberia, China and Japan, and probably elsewhere in Southeast Asia.

Belamcanda chinensis (L.) DC. (*Belamcanda punctata* Moench., *Ixia chinensis* L., *Pardanthus chinensis*, ker-Gawl., *Pardanthus dichotomus* sensu Hubotter) or leopard lily, black berry lily, leopard flower; ว่านมีดยับ wan mit yap (Northern); ว่านหางช้าง wan hang chang (Bangkok)(Smitinand., 2001); bunga Kipas (Malay); re quat, xa can, loui dong, co quatphu (Vietnamese); she gon, she gan (Chinese), sagan (Korean), yakan (Japanese). The Text in which first appeared for this plant is Divine Husbandman's classic of the Materia Medica (Bensky and Gamble, 1993).

It is a medium sized seasonal perennial with a persistent rhizome; 0.5-1.5 m high. Leaves 20-60 x 2-4 cm, tapering apex, ensiform, in a distichous fan, secondary nerves parallel to the midrib. The inflorescence is apical, dichotomously branched; each peduncle ends with a cyme of several showy flowers emerging from a pair of bracts. The perianth has 6 petaloid segments, outer segments obovate or elliptic, ca. 2.5 x 1 cm, and is orange or yellow spotted red to purple throughout. Pedicel slender, ca. 1.5 cm; tapal free, unequal, not distinctly clawed, spreading, outer larger, each flower lasts only one day; May-October, filaments free, anthers 1.8 x 2 cm, erect, free.

Figure 1 *Belamcanda chinensis* (L.) DC.

Style slender, equaling perianth segments, exceeding the anthers, tubular, terminating in short apically stigmatic branches bearing short crest-like appendages. Gynaecium consisting of three carpels united into a 3-celled ovary. Fruits ovoid, 3-lobed capsules, 2.5-3 x 1.5-2.5 cm., bearing numerous seeds. Seeds ca. 5 mm. in diam. spherical, testa inflated, blackish (hence the name Blackberry Lily), persisting on the placentas. Rhizome pale brown, horizontal, creeping, much branched and many circular wrinkles, bearing numerous rootlets. It grows near sea level to 2200 m. (Kubitzki, 1998; Wong, 2002)

For the genus *Dalbergia*, this plant belongs to the family Leguminosae-Papilionoideae of order Fabales (Mabberly, 1997). This genus is pantropical consisted of about 100 species. In Thailand, there are 26 spp. which are described as follow (Niyomdham, 2002).

Plants in the genus *Dalbergia* are trees, shrubs, scandent or woody climbers. Leaves alternate, imparipinate; stipules various, often small and usually caduceus; stipels absent; leaflets chartaceous to coriaceous, alternate. Flowers small terminal and, or lateral panicles; bracts and bracteoles usually small, and caduceus. Calyx campanulate, 5-lobed. Corolla ± exserted, white, yellow or purple or violet often fragrant; standard orbicular, oboval ovate to oblong, with well developed claw; wings free, oblong, narrowed or auriculate at base of blade. Stamens 9-10, monadelphous or diadelphous, slit on upper side, sometimes in two lateral bundles of five each, or only the vexillary one free: anthers small, erect, uniform, basifixed, usually twin, rarely single, opening at apex. Ovary stipitate, few-ovuled; style short, usually incurved; stigma small. Pods usually thin, indehiscent, oblong or strap-shaped, distinctly thickened or reticulation nerves more dense over the seed cavity rarely thickened overall. Seeds reniform.

According to Niyomdham (2002), the species of genus *Dalbergia* found in Thailand are a follows:

1. *Dalbergia assamica* Benth.(*D. balansae* Prain., *D. lanceolaria* L.f. subsp. *lanceolaria* var. *assamica*.(Benth.) Thoth.)

Distribution.- Northern: Chiang Mai, Lampang; South-Western: Kanchanaburi; Central: Saraburi.

Vernacular.- Ket dam (เก็ดดำ) (Chiang Mai), ket deang (เก็ดแดง) (Lampang), Kam pi (กำพี้), kra pi, (กระพี้) (Saraburi).

2. *Dalbergia cana* Grah. Ex Kurz (*D. kerrii* Craib., *D. kurzii* Prain var. *truncate* Craib.)

2a. var.*cana*

Distribution.- Northern: Mae Hong Son, Chiang Mai, Nan, Lampang, Phrae, Sukhothai, Tak, Phitsunulok, Uttaradit; North-Eastern: Phetchabun, Khon Kaen, Loei, Udon Thani; South-Western: Kanchanaburi, Ratchaburi.

Vernacular.- Kra phi (กระพี้), pi phong (บี้พง), pi chan (ปี้จั่น) (Northern); kra phi chan (กระพี้จั่น), kra phi nang nuan (กระพี้นางนวล), kra phi lueang (กระพี้เหลือง) (Phitsanulok); kra phi phun (กระพี้พูน) (Uttaradit); kra phi lueap (กระพี้เหลือบ) (Phetchabun); kaling ping pa (กระลิงปิงป่า) (Ratchaburi); khet khao (เค็ดขาว) (Chiang Mai); chakkachan (จักจั่น) (Loei); pradu talen (ประดู่ตาเหลน) (Sukhothai); i meng bai lek (อิเม็งใบเล็ก) (Udon Thani).

2b. var. *kurzii* (prain) Niyomdham comb.& stat. nov.(D. *kurzii* Prain,)

Distribution.- Northern: Mae Hong Son.

3. *Daibergia candenatensis* (Dennst.) Prain, (*Cassia candenatensis* Dennst., *D. monosperma* Dalz., *D. torta* Grah. Ex Gray, *Drepanocarpus monospermus* (Dalz.) Kurz.

Distribution.- South-Western: Prachup Khiri Khan; South-Eastern: Chon Buri, Trat, Peninsular: Chumphon, Ranong, Surat Thani, Satun, Songkhla, Narathiwat.

Vernacular.- Thao man priang (เถามันเปรียง), thao wan priang (เถาวัลย์เปรียง) (Surat Thani); yan man praing (ย่านมันเปรียง) (Narathiwat); sakkhi (สักขี) (Chumphon).

4. *Dalbergia cochinchinensis* Pierre (*D. cambodiana* Pierre,)

Distribution.- Eastern: Surin, Ubon Ratchathani; Central: Saraburi; South-Eastern: Sa Kaeo, Prachin Buri, Chachoengsao, Chon Buri, Rayong, Chanthaburi, Trat.

Vernacular.- Kra-yong (กระยง), kra-yung (กระยุง) (Khmer-Surin); kha yung (ขะยุง) (Ubon Ratchathani); daeng chin (แดงจีน) (Prachin Buri); pradu tom (ประดู่ตม), pradu nam (ประดู่น้ำ) (Chanthaburi); pradu lai (ประดู่ลาย) (Chon buri); pradu sen (ประดู่เสน) (Trat); pha yung (พะยูง) (General); phayung mai (พยูงไหม) (Saraburi); hua-li-mo (หัวลีเมาะ) (Chinese).

5. *Dalbergia cultrata* Grah. Ex Benth (*D. cultrate* Grah. Ex Benth. Var. *pallida* Craib, *D. fusca.* Pierre)

Distribution.- Northern: Mae Hong Son, Chiang Mai, Chiang Rai, Nan, Lamphun, Lampang, Uttaradit, Tak; North-Eastern: Phetchabun, Loei, Udon Thani, Nakhon Phanom, Khon Kaen; Eastern: Nakhon Ratchasima; South-Western: Ratchaburi; Kanchanaburi; Central: Saraburi.

Vernacular.- Kra phi (กระพี้) (Central); kra phi khao khwai (กระพี้เขาควาย) (Udon Thani, Ratchaburi); ket khao khwai (เก็ดเขาควาย) (Northern); ket deang (เก็ดแดง) (Mae Hong Son, Lampang); ket dam (เก็ดดำ) (Kanchanaburi, Northern); kam phi (กำพี้) ching chan (ชิงชัน) (Phetchabun); kam phi khao khwai (กำพี้เขาควาย), daeng dong (แดงดง) (Loei); chak-chan (จักจัน), wiat (เวียด) (Shan-Chiang Mai); ma kham pa (มะขามป่า) (Chiang Mai); seng-phli-khlae (เส่งพลิแคละ) (Karen-Mae Hong Son); i meng bai mon (อีเม็งใบหม่อน) (Udon Thani).

6. *Dalbergia darlacensis* P.H. Hô & Niyomdham

Distribution.- North-Eastern: Loei.

Vernacular.- Ma kham khruea (มะขามเครือ) (Loei).

7. *Dalbergia entadoides* Pierre ex Gagnep (*D.foliacea* auct. non Wall.; Prain.)

Distribution.- Northern: Nakhon Sawan; Eastern: Surin, Si Sa Ket, Ubon Ratchathani; Peninsular: Songkhla.

Vernacular.- Kra phi (กระพี้) (Ubon Ratchathani).

8. *Dalbergia foliacea* Wall. Ex Benth (*D. rimosa* Roxb. var. *foliacea* (Wall. Ex Benth.) Thoth.)

Distribution.- Northern: Chiang Mai, Chiang Rai, Lampang, Tak, Sukhothai, Phitsanulok; North-Eastern: Phetchabun; Eastern: Nakhon Ratchasima; South-Western: Uthai Thani, Kanchanaburi, Ratchaburi; Central: Saraburi; South-Eastern: Chon Buri.

Vernacular.- Kra phi khruea (กระพี้เครือ) (Kanchanaburi, Northern); saphi khruea (สะพี้เครือ) (Phetchabun); thon khruea (ถ่อนเครือ) (Nakhon Ratchasima); pradu laeng (ประดู่แล้ง) (Loei); hang lai thao (หางไหเถา) (Ratchaburi).

9. *Dalbergia glomeriflora* Kurz (*D. lacei* Prain, *D. ovata* Grath. ex Benth. var. *glomeriflora* (Kurz) Thoth.)

Distribution.- Northern: Chiang Mai, Lampang, Nan, Sukhothai; North-Eastern: Udon Thani; South-Western: Kanchanaburi.

Vernacular.- Ket Khao (เก็ดขาว), du roi (ดู่โรย) (Chiang Mai); du khao (ดู่ขาว) (Northern); du daeng (ดู่แดง) (Lampang).

10. *Dalbergia godefroyi* Prain

Distribution.- Northern: Sukhothai; North-Eastern: Udon Thani; Central: Saraburi.

11. *Dalbergai horrida* (Dennst.) Mabberley. *Amerimmon horridum* Dennst., *D. sympathetica* Nimmo, *D. multiflora* Heyne ex Prain,)

var. *glabrescens* (Prain) Thoth. & K.KN. Nair, *D. multiflora* Heyne ex Prain var. *glabrescens* Prain,

Distribution.- Eastern: Ubon Ratchathani.

12. *Dalbergia kinggiana* Prain

Distribution.- Northern: Chiang Mai; North-Eastern: Loei.

13. *Dalbergia lanceolaria* (*Amerimnon lanceolaria* (L.f.) O. Kuntze)

13a. var. *lakhonensis* (Gagnep.) P.H. Hô & Niyomdham (*D. lakhonensis* Gagnep, *D. lakhonensis* Gagnep. var. *appendiculata* Craib, *D. maymyensis* Craib, *D. maymyensis* Craib var. *siamensis* Craib, *D. lanceolaria* L.f. subsp. *paniculata* var. *maymyensis* (Craib) Thoth.)

Distribution.- Northern: Mae Hong Son, Chiang Mai, Chiang Rai, Phitsanulok, Lamphun, Phrae, Sukothai; North-Eastern: Nakhon Phanom, Mukdahan,

Khon Kaen; Eastern: Nakhon Ratchasima, Buri Ram, Surin, Ubon Ratchathani; South-Western: Ratchaburi, Phetchaburi, Kanchanaburi; Central: Saraburi ; South-Eastern: Chon Buri.

Vernacular.- Pradong lueang (ประดงเหลือง) (Mukdahan); kra phi yuak (กระพี้หยวก) (Nakhon Ratchasima); kapi (กะปิ) (Surin); khi mot (ขี้มอด) (Sukhothai); thon (ถ่อน) (Lamphun); i meng (อีเม็ง) (Ubon Ratchathani).

13b. var. *lanceolaria*

Distribution.- Eastern: Nakhon Ratchasima; South-Western: Kanchanaburi.

13c. var. *errans* (Craib) Niyomdham (*D. errans* . Craib)

Distribution.- Northern: Lampang, Uttaradit, Tak; North-Eastern: Loei.

Vernacular.- Chingchan khao (ชิงชันขาว) (Tak); pradong daeng (ประดงแดง); mak lam daeng (หมักล่ำแดง) (Loei); pradu lai (ประดู่ลาย) (Lampang)

14. *Dalbergia menoeides* Prain ex King (*D. marcaniana* Craib.)

Distribution.- Central: Bangkok.

15. *Dalbergia nigrescens* Kurz (*D. paniculata* auct. non Roxb.: Prain, *D. lanceolaria* L.f. subsp. *paniculata* (Roxb.) Thoth.)

15a. var. *anomala* (Pierre) Niyomdham (*D. anomala* Pierre)

Distribution.- Northern: Tak.

Vernacular.- Chanuan (ฉนวน) (Tak).

15b. var. *nigrescens*

Distribution.- Northern: Chiang Mai, Lampang, Phayao, Phrae, Tak; North-Eastern: Loei.

Vernacular.- Kra phi (กระพี้) (Northen), cha nuan (ฉนวน) (General).

15c. var. *saigonensis* (Pierre) Gagnep (*D. saiganensis* Pierre.)

Distribution.- Northern: Chiang Mai, Lampang, Nakhon Sawan; North-Eastern: Loei, Udon Thani; Eastern: Chaiyaphum, Nakhon Ratchasima; South-Western: Uthai Thani, Kanchanaburi; South-Eastern: Chanthaburi.

Vernacular.- Kra phi (กระพี้) (Lampang); kra phi phrong (กระพี้โพรง) (Ratchaburi); cha nuan (ฉนวน), sa nuan (สนวน) (Central).

16. *Dalbergia oliveri* Gamble ex Prain (*D. bariensis* Pierre, *D. dongnaiensis* Pierre, *D. duperreana* Pierre, *D. mammosa* Pierre.)

Distribution.- All over the country.

Vernacular.- Krasip (กระซิบ), pradu sap (ประดู่สับ), (Surat Thani); ket (เก็ด), ket dam (เก็ดดำ) (Chiang Mai); ket daeng (เก็ดแดง) (Chiang Mai); kam phi ton (กำพี้ต้น) (Petchabun); du lai (ดู่ลาย) (Lampang); du sa daen (ดู่สะแดน) (Northern); chingchan (ชิงชัน), pradu chingchan (ประดู่ชิงชัน) (Central); phayung klaep (พยุงแกลบ) (Saraburi); phayung daeng (พยุงแดง) (Phisanulok); phayung hin (พยุงหิน), anchan (อัญชัน) (Phetchabun); yun (ยูน) (Chanthaburi).

17. *Dalbergia ovata* Grah. Ex Benth (*D. floribunda* Craib, *D. forbesii* auct. non Prain: Gagnep.)

Distribution.- Northern: Chiang Rai, Nan, Lamphun, Lampang, Phare, Uttaradit, Phitsanulok; North-Eastern: Phetchabun, Udon Thani, Loei; South-Western: Kanchanaburi; Central: Saraburi; South-Eastern: Chon Buri, Trat.

Vernacular.- Kam phi (กำพี้) (Uttaradit, Chiang Rai); khra yum (คร่ำหยุม) (Lampang); du khao (ดู่ขาว) , dudong (ดู่ด้อง) (Phrae, Nan, Lampang); du daeng (ดู่แดง) (Lampang), du laeng (ดู่แล้ง) (Udon Thani); pradu talen (ประดู่ตะเลน), pradu bai khao (ประดู่ใบขาว) (Central).

18. *Dalbergia phyllanthoides* Blume ex Miq.

Distribution.- Peninsular: Phatthalung, Trang, Songkhla, Narathiwat.

19. *Dalbergia pinnata* (Lour.) Prain (*Derris pinnata* Lour, *Amerimnon pinnatum* (Lour.) O. Kuntze, *D. tamarindifolia* Roxb.)

Distribution.- South-Western: Ratchaburi; South-Eastern: Chon Buri; Peninsular: Ranong, Phangnga, Phuket, Krabi, Nakhon Si Thammarat, Satun, Pattani, Narathiwat.

Vernacular.- Kham (ขาม), Kham khruea (ขามเครือ), Kham khruea lek (ขามเครือเล็ก) (Peninsular).

20. *Dalbergia rimosa* Roxb (*D. discolor* Blume ex Miq, *D. curtisii* auct. non Prain: Gagnep, *D. volubilis* Roxb. var. *latifolia* Gagnep)

Distribution.- Northern: Chiang Mai, Phrae.

21. *Dalbergia rostrata* Grah. ex Prain

Distribution.- Peninsular: Ranong, Phangnga, Nakhon Si Thammarat, Satun, Songkhla.

22. *Dalbergia stipulacea* Roxb.

Distribution.- Northern: Chiang Mai, Chiang Rai, Lampang, Phrae, Tak, Phitsanulok; North-Eastern; Loei, Nakhon Phanom, Kalasin; Eastern: Nakhon Ratchasima; Central: Saraburi, Nakhon Nayok; South-Eastern: Prachin Buri, Chanthaburi.

Vernacular.- Kham khruea (ขามเครือ), khi mot (ขี้มอด), pi am (ปี้อ้ม), thao pidam (เถาปี้ดำ), (Chiang Mai); kom maep (คมแมบ) (Prachin Buri); kruea kra phi khao khwai (เครือกะพี้เขาควาย), ma kham khruea (มะขามเครือ) (Nong Khai, Chanthaburi); Taeng me (แตงเม), Mak-phaen (มักแฝ้น) (Yao-Chiang Mai).

23. *Dalbergia suthepensis* Niyomdtham.

Distribution.- Northern: Chiang Mai.

24. *Dalbergia velutina* Benth (*D. abbreviate* Craib, *D. pierreana* Prain)

24a. var. *succirubra* (Gagnep. & Craib) Niyondtham (*D. succirubra* Gagnep. & Craib.)

Distribution.- Northern: Chiang Mai, North-Eastern: Phetchabun, Loei.

24b. var. *velutina*

Distribution.- Northern: Chiang Mai, Lampang; North-Eastern: Loei, Mukdahan; Eastern: Chaiyaphum, Surin, Ubon Ratchathani; South-Western: Kanchanaburi; Central: Sara Buri; South-Eastern: Chanthaburi, Trat; Peninsular: Ranong, Surat Thani, Phangnga,Trang, Satun, Nakhon Si Thammarat.

Vernacular.- Khruea khang khwai (เครือคางควาย) (North-Eastern); khruea pi (เครือปี้) (Chiang Mai); tan khamoi (ตาลขโมย) (Surat Thani); hang lai (หางไหล) (Trat).

24c. var. *verrucosa* (Craib) Niyomdtham (*D. verrucosa* Craib)

Distribution.- Northern: Nan.

25. *Dalbergia volubilis* Roxb.

Distribution.- Northern: Chiang Mai, Chiang Rai, Phrae, Tak; North-Eastern: Nakhon Phanom, Nong Khai; South-Western: Kanchanaburi; Central: Saraburi; Peninsular: Surat Thani.

Vernacular.- Khruea maet (เครือแมด), phi phong khruea (พี้พงเครือ) (Northern); krung khon (กรุงขน) (Nkhon Ratchasima); kam maet (กำแมด), khruea am ai (เครืออำไอ) (Nakhon Phanom); wo-wi (โว้วี) (Karen-Kanchanaburi); ki kam (คีกำ) (Surat Thani).

26. *Dalbergia parviflora* Roxb. (*Drepanocarpus cumingii* Kurz non Benth.) has local name as Khri (Figure 2). It is a scandent shrub up to 10 m. high; young shoot and inflorescence puberulous, later glabrous. Leaves 10-20 cm long , 5-7(-9) leaflets; petioles 1.5-3 cm long; rachis (3-)4-6 cm long, glabrous; stipules small, caduceus. Leaflets elliptic, oblong to obovate-oblong, 4-12 by 2-6 cm, glabrous on both surfaces; petiolules 3-5 mm long. Inflorescence a panicle, terminal and in upper leaf axils, 5-10 cm long. Bracts ovate-acute, ca. 1 by 0.5 mm, persistent. Bracteoles oblong-obtuse, 1.5 by 1 mm, caduceus. Pedicel ca. 1.5 mm long. Calyx ca. 3 mm long, glabrous. Corolla white; limb of standard petal obovate-emarginate, ca. 2.5 by 2 mm, claw ca. 0.5 mm long; wings ca. 2 by 0.8 mm, claw ca. 0.5 mm long: keel ca. 2 by 1 mm, claw ca. 0.2 mm long. Stamens 10, in 1 bundle. Ovary hairy along the sutures; ovules 2-4, Pod falcate, 3-5 by 1.8-2 cm, 1-2(-4)-seeded. Seeds renifrom, ca.10 by 14 mm, reddish-brown. Flowering from May to August.

Distribution.- Peninsular: Surat Thani, Phatthalung, Songkhla, Narathiwat, Myanmar, Malaysia and Indonesia.

Ecology.- Freshwater and brackish swamp forest, near sea level.

Vernacular.- Krasik (กระชิก) (Peninsular), Khri (ขรี้,คริ้), Sari (สรี้) (Surat Thani), Sakkhi (สักขี) (Narathiwat).

Figure 2 *Dalbergia parviflora* Roxb.

2. Chemical Constituents of *Belamcanda chinensis*

A number of compounds have been isolated from *Belamcanda chinensis*. They are classified as flavonoids, triterpenoids, steroids and miscellaneous substances (Table 1-3)

Table 1 Distribution of flavonoids in *Belamcanda chinensis*

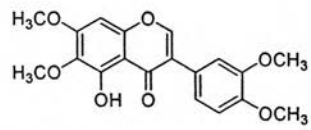
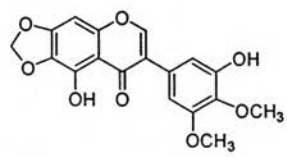
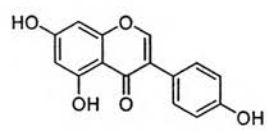
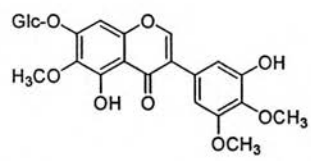
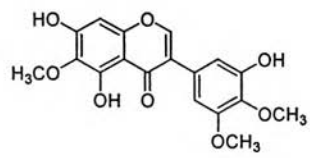
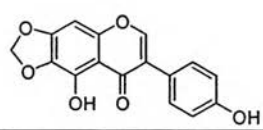
Plant and chemical compound	Plant part	Reference
Belamcandin **[1]** 	Not specified	Yamaki *et al* .,1990 Huang *et al.*, 1997
Dichotomitin **[2]** 	Rhizome	Lee *et al.*, 1989
Genistein **[3]** 	Rhizome	Ji *et al.*, 2001
Iridin **[4]** 	Rhizome	Lee *et al.*, 1989 Cui *et al.*, 1993 Ma *et al.*, 1996 Lin *et al.*, 1998 Zhou *et al.*, 2001
Irigenin **[5]** 	Rhizome	Zhou *et al.*, 1996 Hu *et al.*, 1982 Wu *et al.*, 1992 Lu *et al.*, 1987 Ma *et al.*, 1996 Lee *et al.*, 2001
Irilone **[6]** 	Rhizome	Ji *et al.*, 2001 Kachroo *et al.*, 1990 Khar *et al.*, 1973

Table 1 (continued)

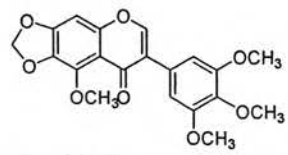
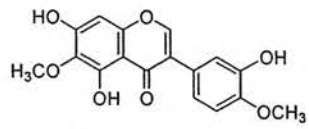
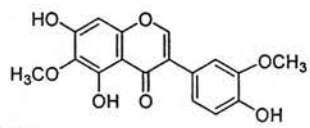
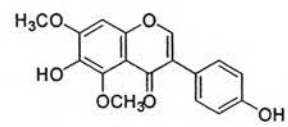
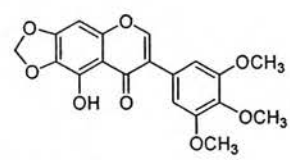
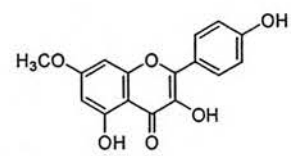
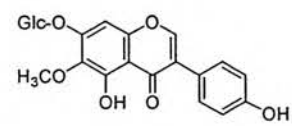
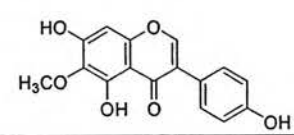
Plant and chemical compound	Plant part	Reference
Irisflorentin **[7]** 	Rhizome	Eu *et al.*, 1991 Yamaki *et al* .,1990
Iristectorigenin A **[8]** 	Rhizome	Eu *et al.*, 1991 Lee *et al.*, 2004 You *et al.*, 1999
Iristectorigenin B **[9]** 	Entire plant Rhizome	You *et al.*, 1999 Eu *et al.*, 1991
Muningin **[10]** 	Rhizome	Eu *et al.*, 1991
Noririsflorentin **[11]** 	Rhizome	Woo *et al.*, 1993
Rhamnocitrin **[12]** 	Rhizome	Woo *et al.*, 1993 Ito *et al.*, 2001
Tectoridin **[13]** 	Rhizome	Lu *et al.*, 1987 Ito *et al.*, 2001 Cui *et al.*, 1993 Shin *et al.*, 1999 Lin *et al.*, 1998
Tectorigenin **[14]** 	Rhizome	Lu *et al.*, 1987 Seidlova-wuttke *et al.*, 2004 Sin *et al.*, 1999 Oh *et al.*, 2001

Table 1 (continued)

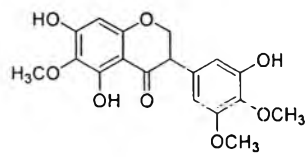
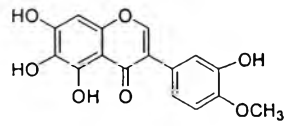
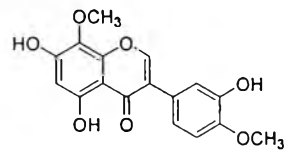
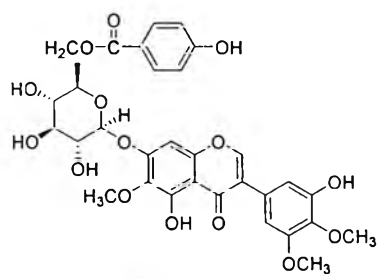
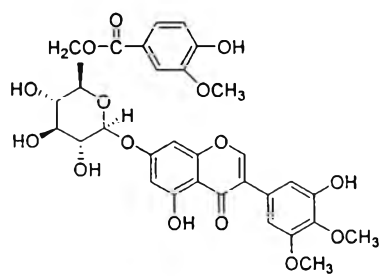
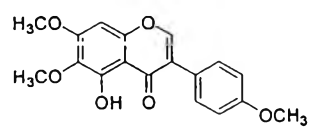
Plant and chemical compound	Plant part	Reference
2,3-Dihydroirigenin **[15]** 	Rhizome	Ito *et al.*, 2001
5,6,7,3′-Tetrahydroxy-4′-methoxyisoflavone **[16]** 	Rhizome	Ito *et al.*, 2001
5,7,3′-Trihydroxy-8,4′-dimethoxyisoflavone **[17]** 	Rhizome	Woo *et al.*, 1993
6″-*O*-*p*-Hydroxybenzoyliridin **[18]** 	Rhizome	Ito *et al.*, 2001
6″-*O*-Vanilloyliridin **[19]** 	Rhizome	Ito *et al.*, 2001
7-*O*-Methylirisolidone **[20]** 	No specified	Yamaki *et al.*, 1990

Table 2 Distribution of triterpenoids in *Belamcanda chinensis*

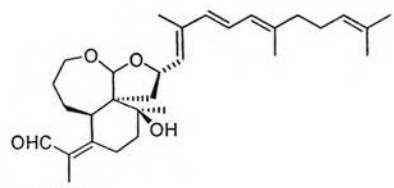
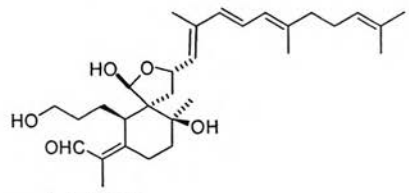
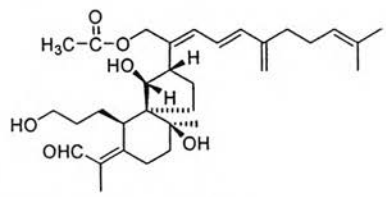
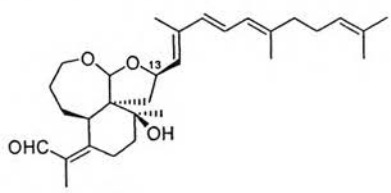
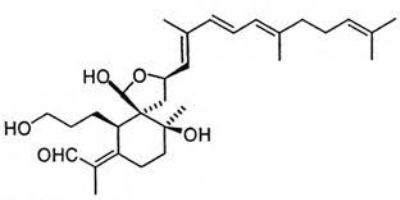
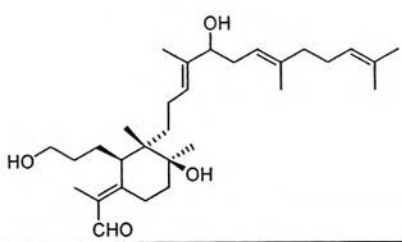
Plant and chemical compound	Plant part	Reference
Anhydrobelchinal **[21]** 	Rhizome	Ito *et al.*, 1999
Belachinal **[22]** 	Rhizome	Ito *et al.*, 1999 Takahashi *et al.*, 2000
Belamcandal **[23]** 	Rhizome	Abe *et al.*, 1991
Epianhydrobelachinal **[24]** 	Rhizome	Ito *et al.*, 1999
Epibelachinal **[25]** 	Rhizome	Ito *et al.*, 1999
Iridobelamal A **[26]** 	Rhizome	Takahashi *et al.*, 1991

Table 2 (Continued)

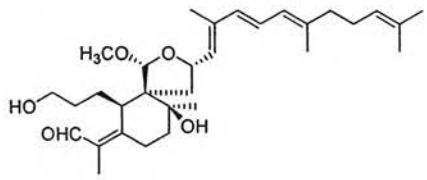
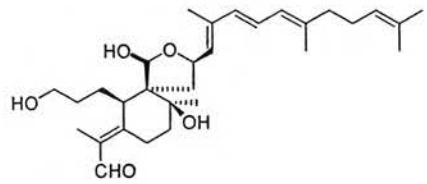
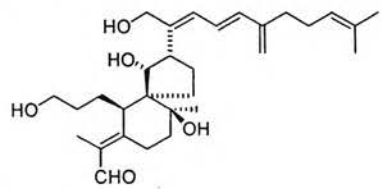
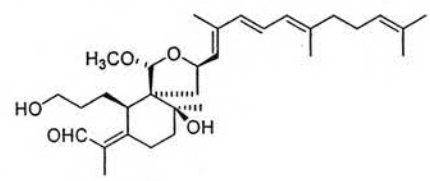
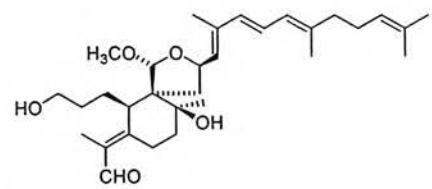
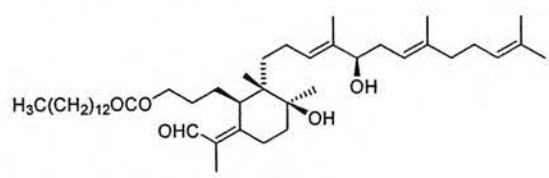
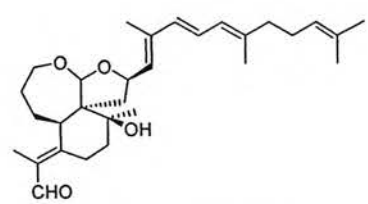
Plant and chemical compound	Plant part	Reference
Iridobelamal B **[27]** 	Rhizome	Takahashi *et al.*, 2002
Iridotectoral A **[28]** 	Rhizome	Takahashi *et al.*, 2000
Iridotectoral B **[29]** 	Rhizome	Takahashi *et al.*, 2000
Iridotectoral C **[30]** 	Rhizome	Takahashi *et al.*, 2000
Iridotectoral D**[31]** 	Rhizome	Takahashi *et al.*, 2000
Iristectorene B **[32]** 	Rhizome	Ito *et al.*, 1999
Isoamhydrobelachinal **[33]** 	Rhizome	Ito *et al.*, 1999

Table 2 (Continued)

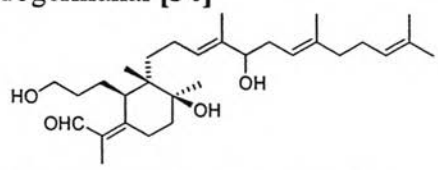
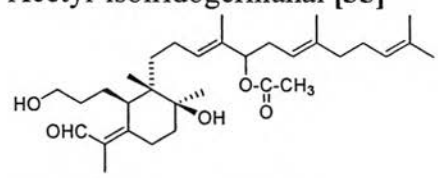
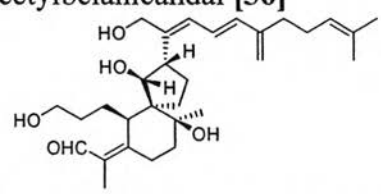
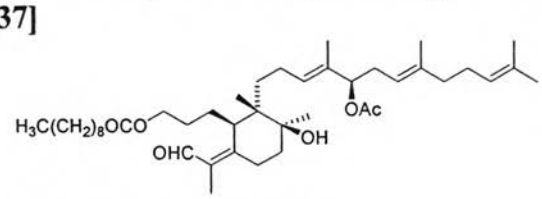
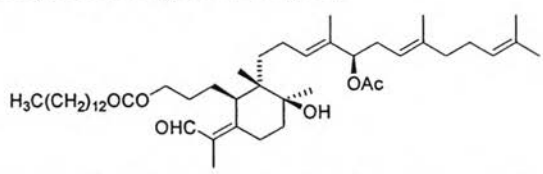
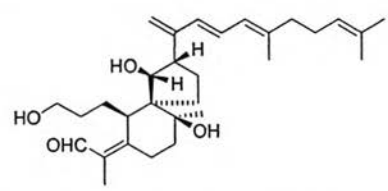
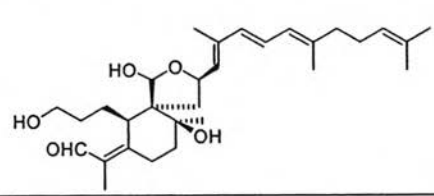
Plant and chemical compound	Plant part	Reference
Isoiridogermanal **[34]** 	Rhizome	Takahashi *et al.*, 2002
16-*O*-Acetyl-isoiridogermanal **[35]** 	Rhizome	Takahashi *et al.*, 2002
28-Deacetylbelamcandal **[36]** 	Rhizome	Abe *et al.*, 1991
3-*O*-Decanoyl-16-*O*-acetylisoiridogermanal **[37]** 	Rhizome	Ito *et al.*, 1999
3-*O*-Tetradecanoyl-16-*O*-acetylisoiridogermanal **[38]** 	Rhizome	Ito *et al.*, 1999
(+)-(6*R*,10*S*,11*S*,14*S*,26*R*)-26-Hydroxy-15-methylidenespiroirid-16-enal **[39]** 	Rhizome	Abe *et al.*, 1991
(6*R*,10*S*,11*R*)-26*S*-Hydroxy-(13*R*)-oxaspiroirid-16-enal **[40]** 	Rhizome	Takahashu *et al.*, 2000

Table 3 Distribution of miscellaneous in *Belamcanda chinensis*

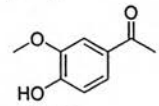
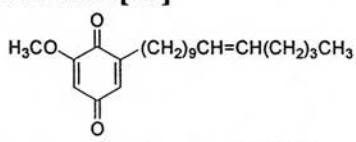
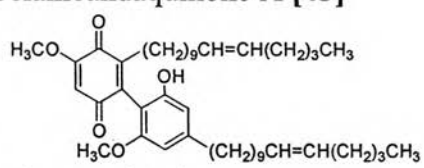
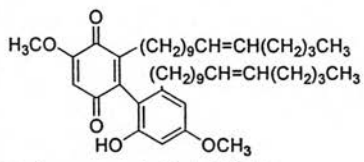
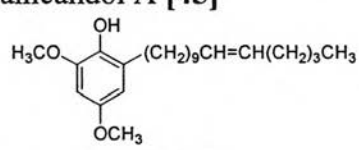
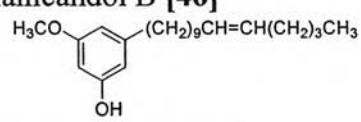
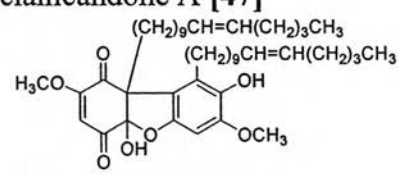
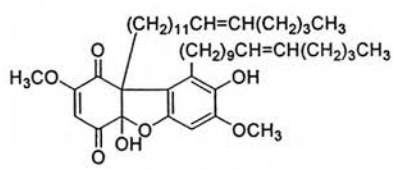
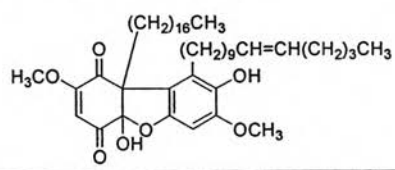
Chemical compound	Category	Plant part	Reference
Apocyanin **[41]** 	Benzenoid	Rhizome	Lee *et al.*, 2004
Ardisianone **[42]** 	Quinoid	Seed	Fukuyama *et al.*, 1991
Belamcandaquinone A **[43]** 	Quinoid	Seed	Fukuyama *et al.*, 1993
Belamcandaquinone B **[44]** 	Quinoid	Seed	Fukuyama *et al.*, 1993
Belamcandol A **[45]** 	Benzenoid	Seed	Fukuyama *et al.*, 1991
Belamcandol B **[46]** 	Benzenoid	Seed	Fukuyama *et al.*, 1991
Belamcandone A **[47]** 	Quinoid	Seed	Seki *et al.*, 1995
BelamcandoneB **[48]** 	Quinoid	Seed	Seki *et al.*, 1995
BelamcandoneC **[49]** 	Quinoid	Seed	Seki *et al.*, 1995

Table 3 (Continued)

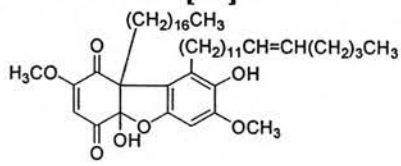
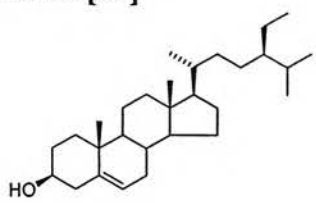
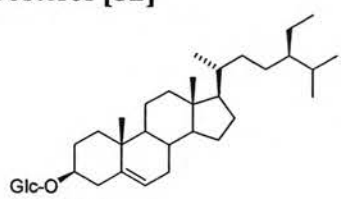
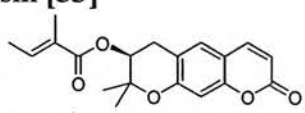
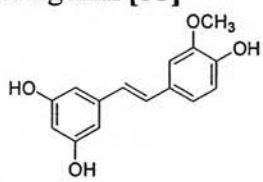
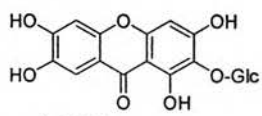
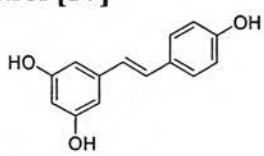
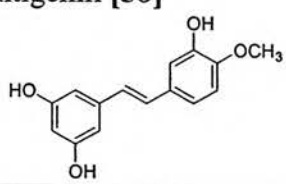
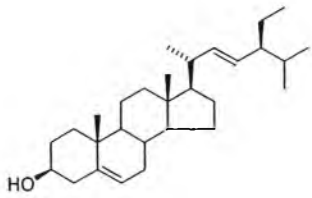
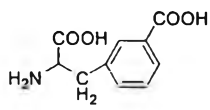
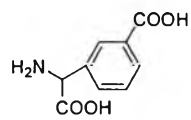
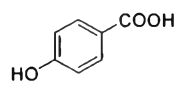
Chemical compound	Category	Plant part	Reference
BelamcandoneD**[50]** 	Quinoid	Seed	Seki *et al.*, 1995
β-Sitosterol **[51]** 	Steroid	Rhizome	Lee *et al.*, 2004
Daucosterol **[52]** 	Steroid	Rhizome	Lin *et al.*, 1998
Decursin **[53]** 	Coumarin	Rhizome	Lee *et al.*, 2004
Fluoride **[54]**	Inorganic	Rhizome	Sakai *et al.*, 1985
Isorhapontigenin **[55]** 	Stilbene	Rhizome	Zhou *et al.*, 2000 Fang *et al.*, 2002
Mangiferin **[56]** 	Xanthone	Rhizome	Lui *et al.*, 2000
Resveratrol **[57]** 	Stilbene	Rhizome	Lin *et al.*, 1998 Zhou *et al.*, 2000
Rhapontigenin **[58]** 	Stilbene	Rhizome	Lin *et al.*, 1998

Table 3 (Continued)

Chemical compound	Category	Plant part	Reference
Sheganone **[59]**	Benzenoid	Rhizome	Yu *et al.*, 1983
Shegansu B **[60]**	Phenylpropanoid	Rhizome	Zhou *et al.*, 2000
Shegansu B **[61]**	Phenylpropanoid	Rhizome	Lin *et al.*, 1998
Stigmasterol **[62]** 	Steroid	Rhizome	Zhou *et al.*, 1996
3-(3′-Carboxy-phenyl)-alanine **[63]** 	Proteid	Entire plant	Larsen *et al.*, 1987
3′-Carboxy-phenyl-glycine **[64]** 	Proteid	Entire plant	Larsen *et al.*, 1987
4-Hydroxy-benzoic acid **[65]** 	Benzeniod	Rhizome	Zhou *et al.*, 2000

3. Chemical Constituents of *Dalbergia* spp.

Chemical investigations of *Dalbergia* species have been shown to be a good source of flavonoids. In addition, other classes of natural compounds such as triterpenes, quinoids, coumarins, alkaloids and miscellaneous substances have been found (Table 4-5).

Table 4 Distribution of flavonoids in *Dalbergia* Spp.

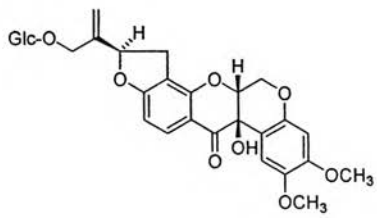
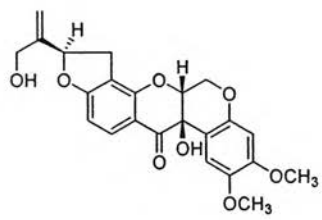
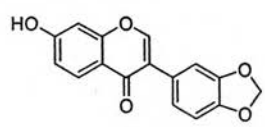
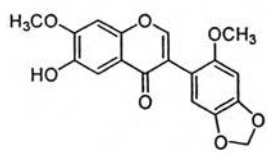
Plant and chemical compound	Plant part	Reference
Dalbergia assamica		
Dalbin **[67]** 	Seed	Chibbber *et al.*, 1978
Dalbinol **[68]** 	Seed	Chibbber *et al.*, 1978
Pseudobaptigenin **[69]** 	Seed	Chibbber *et al.*, 1978
6-Hydroxy-2′,7-dimethoxy-4′,5′-methylenedioxyisoflavone **[70]** 	Seed	Chibbber *et al.*, 1978

Table 4 (Continued)

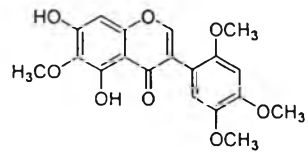
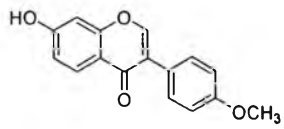
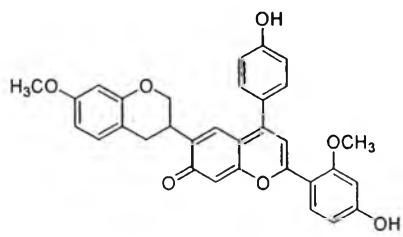
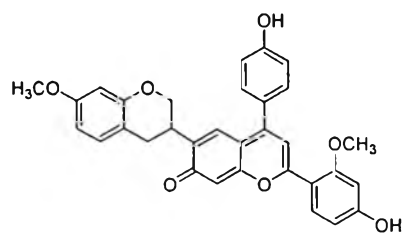
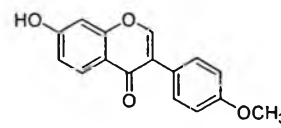
Plant and chemical compound	Plant part	Reference
D. baronii		
Caviunin **[71]** 	Heartwood	Seshadri., 1972
Formononetin **[72]** 	Heartwood	Seshadri *et al.*, 1972
D. balansea		
Retusapurpurin A **[73]** 	Callus tissue	Czako *et al.*, 2001
D. calycina		
Retusapurpurin A **[73]** 	Callus tissue	Czako *et al.*, 2001
D. candenatensis		
Formononetin **[72]** 	Heartwood	Hamberger *et al.*, 1987

Table 4 (Continued)

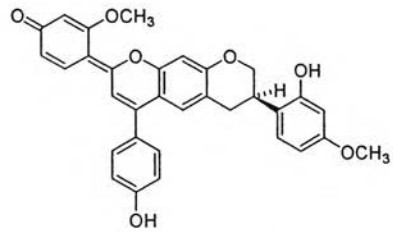
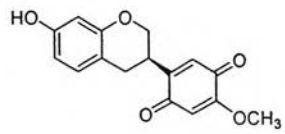
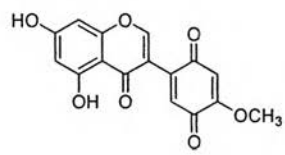
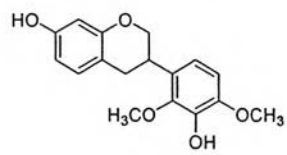
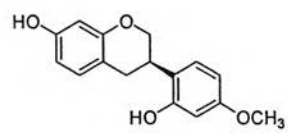
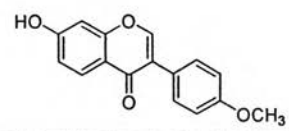
Plant and chemical compound	Plant part	Reference
Candenatone **[74]** 	Heartwood	Hamberger *et al.*, 1988
(–)-(*R*)-Claussequinone **[75]** 	Heartwood	Hamberger *et al.*,1987
5-Hydroxybowdichione **[76]** 	Heartwood	Hamberger *et al.*, 1987
(±)-(*RS*)-Mucronulatol **[77]** 	Heartwood	Hamberger *et al.*, 1987
(–)-(*R*)-Vestitol **[78]** 	Heartwood	Hamberger *et al.*, 1987
D. cearensis		
Formononetin **[72]** 	Wood	De Souza Guimaraes *et al.*,1975

Table 4 (Continued)

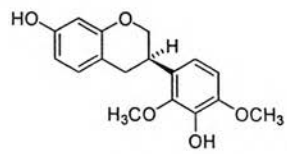
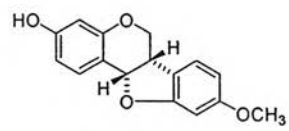
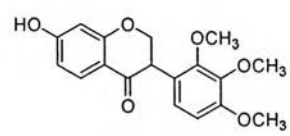
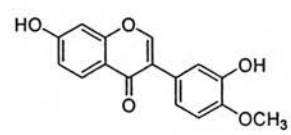
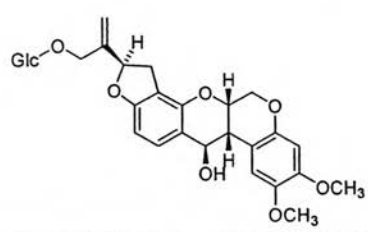
Plant and chemical compound	Plant part	Reference
(*R*)-Mucronulatol **[77]** 	Wood	De Souza Guimaraes *et al.*,1975
(6a*S*,11a*S*)-3-hydroxy-9-methoxypterocarpan (Demethylhomopterocarpin) **[79]** 	Wood	De Souza Guimaraes *et al.*,1975
7-Hydroxy-2′,3′,4′-trimethoxyisoflavanone **[80]** 	Wood	De Souza Guimaraes *et al.*,1975
D. cochinchinensis		
Calycosin **[81]** 	Heartwood	Kuroyanagi *et al.*,1996
Dalcochinin-8′-*O*-*β*-D-glucoside **[82]** 	Stem	Svasti *et al.*, 1999

Table 4 (Continued)

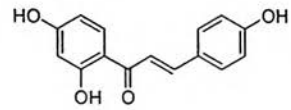
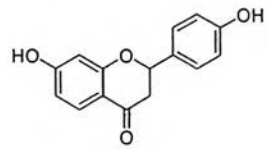
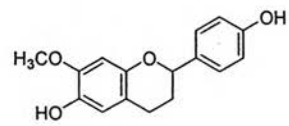
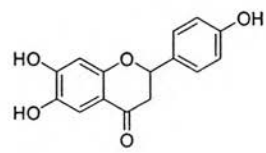
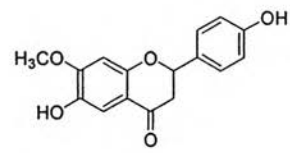
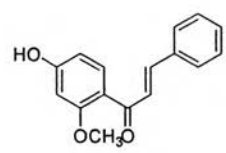
Plant and chemical compound	Plant part	Reference
Isoliquiritigenin **[83]** 	Heartwood	Kuroyanagi *et al.*, 1996
Liquiritigenin **[84]** 	Heartwood	Kuroyanagi *et al.*, 1996
(2*S*)-4′,6-Dihydroxy-7-methoxyflavan **[85]** 	Stem	Pathak *et al.*, 1997
4′,6,7-Trihydroxyflavanone **[86]** 	Heartwood	Kuroyanagi *et al.*, 1996
4′,6-Dihydroxy-7-methoxyflavanone **[87]** 	Heartwood	Kuroyanagi *et al.*, 1996
4′-Hydroxy-2′-methoxychalcone **[88]** 	Stem	Shirota *et al.*, 2003

Table 4 (Continued)

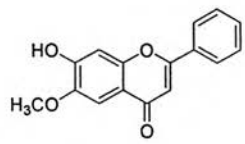
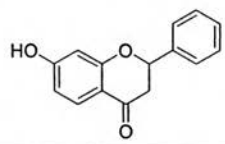
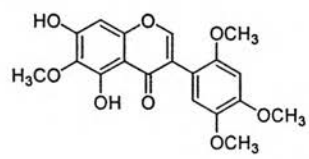
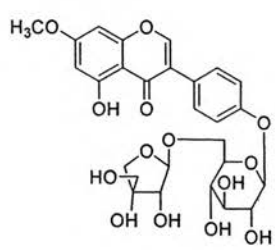
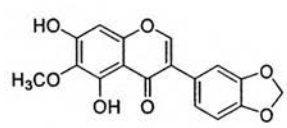
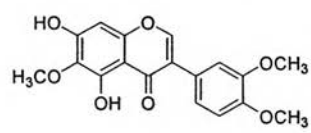
Plant and chemical compound	Plant part	Reference
7′- Hydroxy-6- methoxyflavanone **[89]** 	Stem	Pathak *et al.*, 1997
7- Hydroxyflavanone **[90]** 	Stem	Shirota *et al.*, 2003
D. coromandeliana		
Caviunin **[71]** 	Root	Ramesh *et al.*, 1995
Coromandelin **[91]** 	Leaf	Ramesh *et al.*, 1995
Dalspinin **[92]** 	Root	Ramesh *et al.*, 1995
Dalspinosin (Junipegenin B) **[93]** 	Root	Ramesh *et al.*, 1995

Table 4 (Continued)

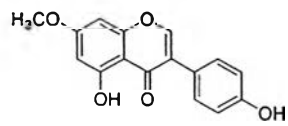
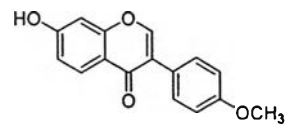
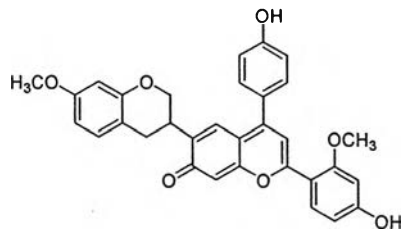
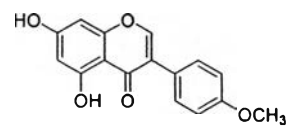
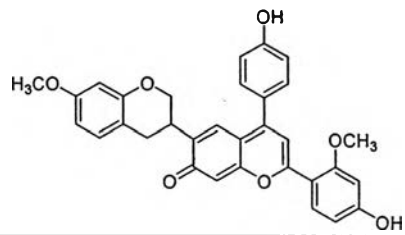
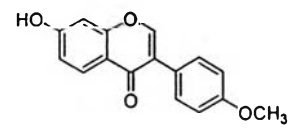
Plant and chemical compound	Plant part	Reference
Prunetin **[94]** 	Leaf	Ramesh *et al.*, 1995
D. cultrata		
Formononetin **[72]** 	Stembark	Ito *et al.*, 2003
Retusapurpurin A **[73]** 	Heartwood Stembark	Czako *et al.*, 2001 Ito *et al.*, 2003
Biochanin A **[95]** 	Stembark	Ito *et al.*, 2003
D. densa* var. *australis		
Retusapurpurin A **[73]** 	Callus tissue	Czako *et al.*, 2001
D. ecastophyllum		
Formononetin **[72]** 	Wood	Matos *et al.*, 1975

Table 4 (Continued)

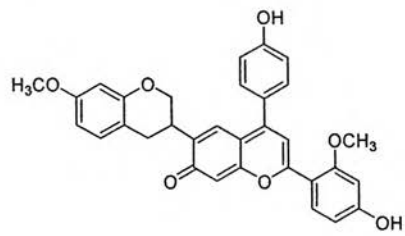
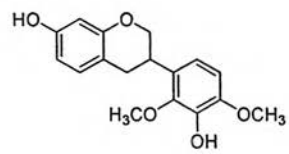
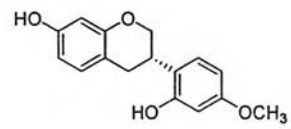
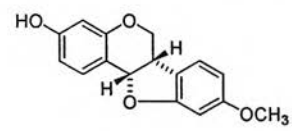
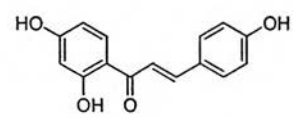
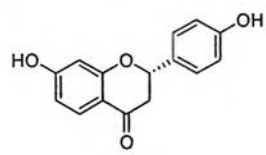
Plant and chemical compound	Plant part	Reference
Retusapurpurin A **[73]** 	Heartwood	Czako *et al.*, 2001
Mucronulatol **[77]** 	Wood	Donelly *et al.*, 1973
(3*S*)-Vestitol **[78]** 	Wood	Donelly *et al.*, 1973
Demethylhomopterocarpan **[79]** 	Wood	Donelly *et al.*, 1973
Isoliquiritigenin **[83]** 	Wood	Donelly *et al.*, 1973
(2*S*)- Liquiritigenin **[84]** 	Wood	Donelly *et al.*, 1973

Table 4 (Continued)

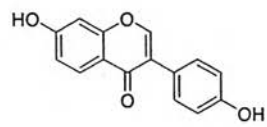
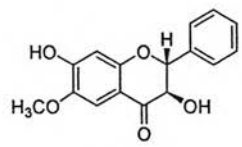
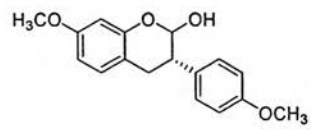
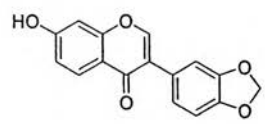
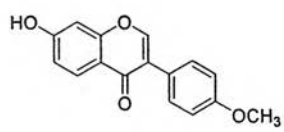
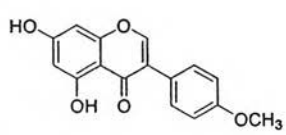
Plant and chemical compound	Plant part	Reference
Daidzein **[96]** 	Wood	Matos *et al.*, 1975
(2*R*)-(3*R*)-3,7-Dihydroxy-6-methoxy flavanone **[97]** 	Wood	Matos *et al.*, 1975
(3*S*)-2-Hydroxy-4′,7-dimethoxyisoflavan ((3*S*)-7-*O*-Methylvestitol) **[98]** 	Wood	Matos *et al.*, 1975
D. frutescens		
Pseudobaptigenin **[69]** 	Stembark	Khan *et al.*, 2000
Formononetin **[72]** 	Stembark	Khan *et al.*, 2000
Biochanin A **[95]** 	Stembark	Khan *et al.*, 2000

Table 4 (Continued)

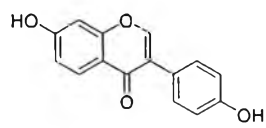
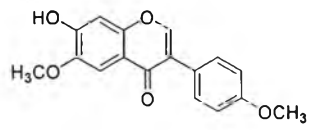
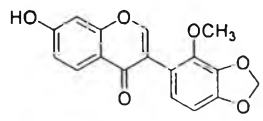
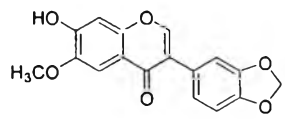
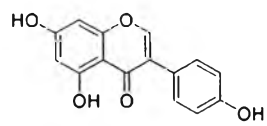
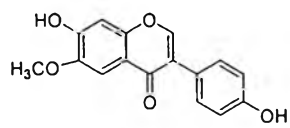
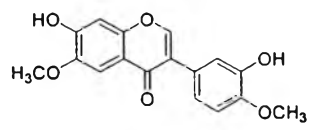
Plant and chemical compound	Plant part	Reference
Daidzein **[96]** 	Stembark	Khan *et al.*, 2000
Castanin **[99]** 	Stembark	Khan *et al.*, 2000
Cuneatin **[100]** 	Stembark	Khan *et al.*, 2000
Fujikinetin **[101]** 	Stembark	Khan *et al.*, 2000
Genistein **[3]** 	Stembark	Khan *et al.*, 2000
Glycitein **[103]** 	Stembark	Khan *et al.*, 2000
Odoratin **[104]** 	Stembark	Khan *et al.*, 2000

Table 4 (Continued)

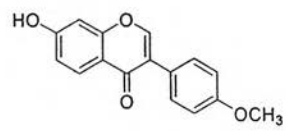
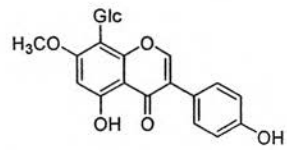
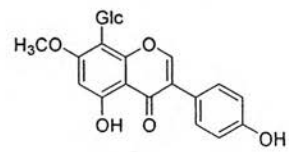
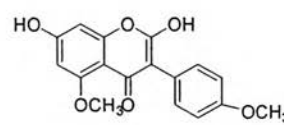
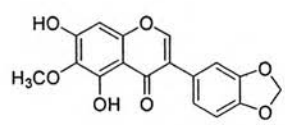
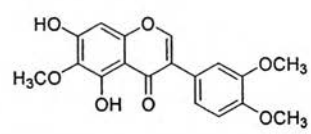
Plant and chemical compound	Plant part	Reference
D. hainanensis		
Formononetin **[72]** 	Leaf	Zhang *et al.*, 2003
Genistein-8-*C*-glucoside **[105]** 	Leaf	Zhang *et al.*, 2003
Prunetin-8-*C*-glucoside **[106]** 	Leaf	Zhang *et al.*, 2003
2-Hydroxy-5-methoxybiochanin A **[107]** 	Leaf	Zhang *et al.*, 2003
D. horrida		
Dalspinin **[92]** 	Root	Manoj *et al.*, 2003
Dalspinosin **[93]** 	Root	Manoj *et al.*, 2003

Table 4 (Continued)

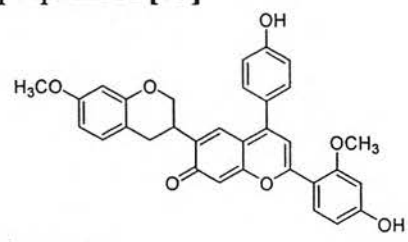
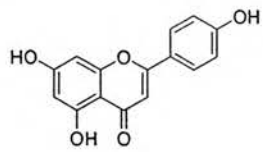
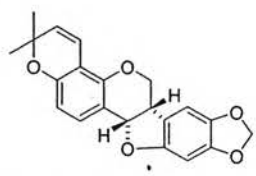
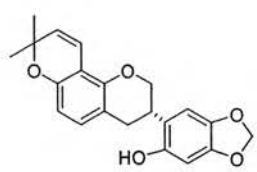
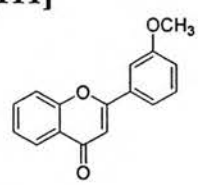
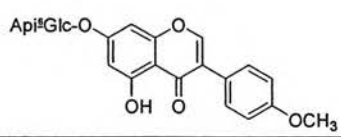
Plant and chemical compound	Plant part	Reference
D. hupeana		
Retusapurpurin A **[73]** 	Heartwood	Czako *et al.*, 2001
Apigenin **[108]**	Bark Bark	Yahara *et al.*, 1989 Yahara *et al.*, 1989
		
(+)-Leiocarpin **[109]**	Bark	Yahara *et al.*, 1989
		
(−)-Leiocin **[110]**	Bark	Yahara *et al.*, 1989
		
Isorhamnetin **[111]** 	Bark	Yahara *et al.*, 1989
D.lanceolata		
Biochanin A-7-apiosyl-(1→6)glucoside (Lanceolarin) **[113]** 	Rootbark	Rao *et al.*, 1989

Table 4 (Continued)

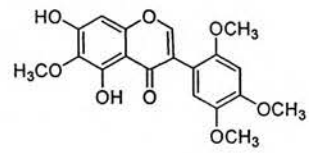
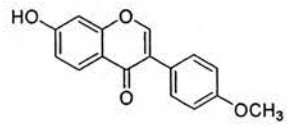
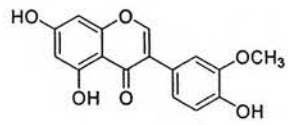
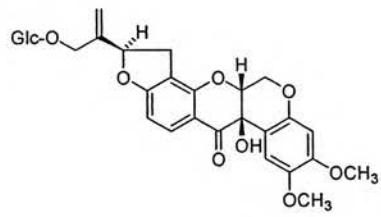
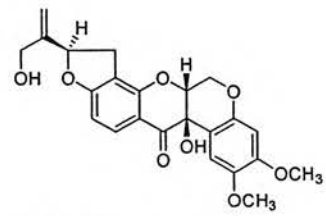
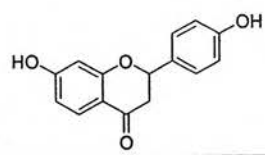
Plant and chemical compound	Plant part	Reference
D. iundata		
Caviunin **[71]** 	Trunkwood	Leite de almeida *et al.*, 1974
Formononetin **[72]** 	Trunkwood	Leite de almeida *et al.*, 1974
3′-*O*-Methylorobol **[112]** 	Trunkwood	Leite de almeida *et al.*, 1974
D. latifolia		
Dalbin **[67]** 	Seed	Chibber *et al.*, 1979
Dalbinol **[68]** 	Seed	Chibber *et al.*, 1979
Liquiritigenin **[84]** 	Not specified	Donnelly *et al.*, 1973

Table 4 (Continued)

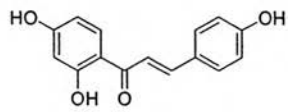
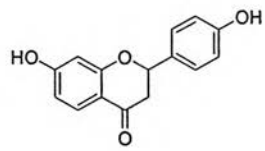
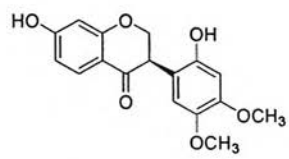
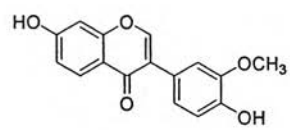
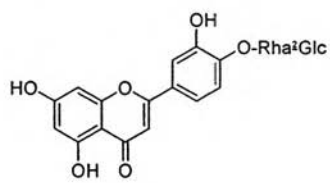
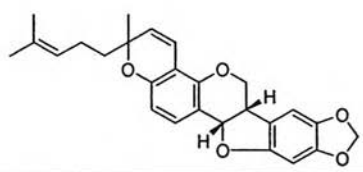
Plant and chemical compound	Plant part	Reference
D. louvelii		
Isoliquiritigenin **[83]** 	Heartwood	Beldjoudi *et al.*, 2003
Liquiritigenin **[84]** 	Heartwood	Beldjoudi *et al.*, 2003
(3*R*)-2′,7-Dihydroxy-4′,5′-dimethoxyisoflavanone **[114]** 	Heartwood	Beldjoudi *et al.*, 2003
4′,7- Dihydroxy-3′- methoxyisoflavanone **[115]** 	Heartwood	Beldjoudi *et al.*, 2003
D. malabarica		
Luteolin-4′-*O*-neohesperidoside **[116]** 	Leaf	Vanangamudi *et al.*, 1998
Nitiducarpin **[117]** 	Flower Fruit Stem	Vanangamudi *et al.*, 1998

Table 4 (Continued)

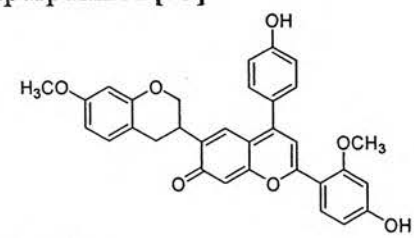
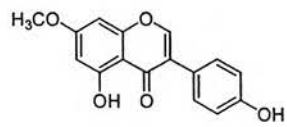
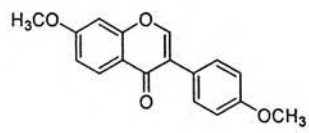
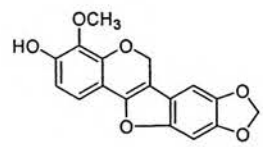
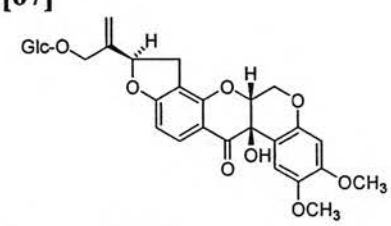
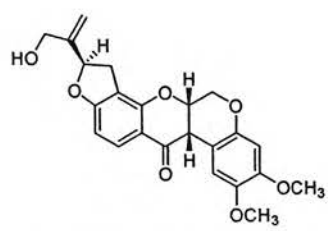
Plant and chemical compound	Plant part	Reference
D. miscolobium		
Retusapurpurin A **[73]** 	Heartwood	Czako *et al.*, 2001
Prunetin **[94]** 	Heartwood	Gregson *et al.*, 1978
Di-*O*-Methyldaizein **[118]** 	Heartwood	Gregson *et al.*, 1978
3-Hydroxy-4-methoxy-8,9-methylendioxy-6a,11a-dehydropterocarpan **[119]** 	Trankwood	Formiga *et al.*,1975
D. monetaria		
Dalbin **[67]** 	Seed	Abe *et al.*, 1985
Amorphigenin **[120]** 	Seed	Abe *et al.*, 1985

Table 4 (Continued)

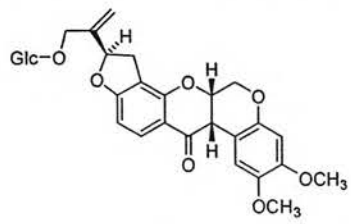
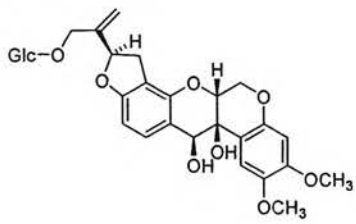
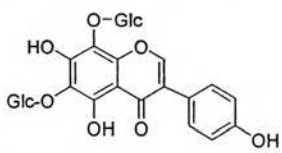
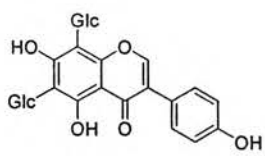
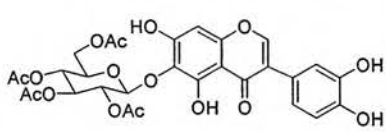
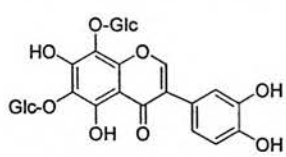
Plant and chemical compound	Plant part	Reference
Amorphigenin-8′-β-D-glucoside **[121]** 	Seed	Abe *et al.*, 1985
12-Dihydrodalbin **[122]** 	Seed	Abe *et al.*, 1985
Genistein-6,8-bis-β-D-glucoside **[123]** 	Stembark	Nunes *et al.*, 1989
Genistein-6,8-di-*C*-glucoside (Paniculatin) **[124]** 	Stembark	Nunes *et al.*, 1989
Orobol-6-(*O*-acetyl-β-D-glucoside) **[125]** 	Stembark	Nunes *et al.*, 1989
Orobol-6,8-bis-β-D-glucopyranoside **[126]** 	Stembark	Nunes *et al.*, 1989

Table 4 (Continued)

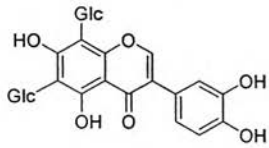
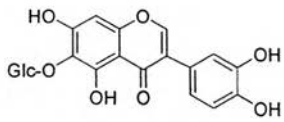
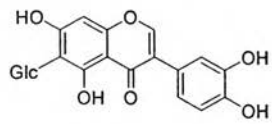
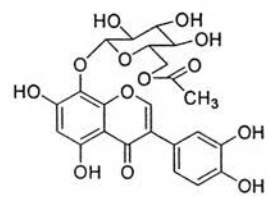
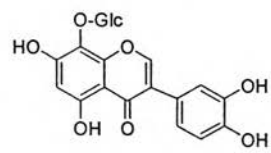
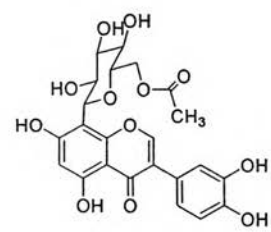
Plant and chemical compound	Plant part	Reference
Orobol-6,8-di-*C*-glucoside **[127]** 	Stembark	Nunes *et al.*, 1989
Orobol-6-*β*-D-glucoside **[128]** 	Stembark	Nunes *et al.*, 1989
Orobol-6-*C*-glucoside **[129]** 	Bark	Kawaguchi *et al.*, 1998
Orobol-8-(6″-*O*-acetyl-*β*-D-glucoside) **[130]** 	Stembark	Nunes *et al.*, 1989
Orobol-8-*β*-D-glucoside **[131]** 	Stembark	Nunes *et al.*, 1989
Orobol-8-*C*-(6″acetylglucoside) **[132]** 	Stembark	Nunes *et al.*, 1989

Table 4 (Continued)

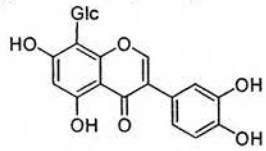
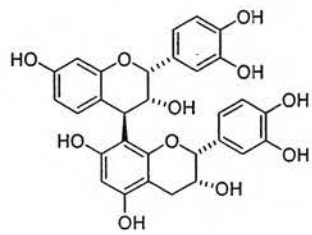
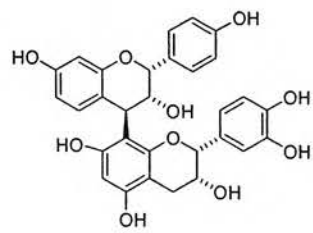
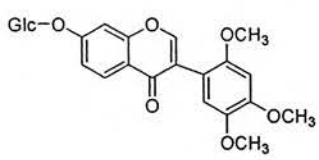
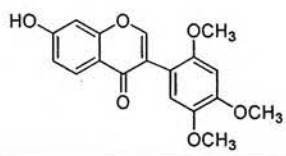
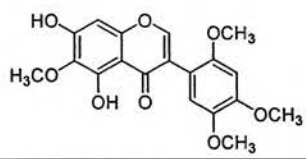
Plant and chemical compound	Plant part	Reference
Orobol-8-*C*-glucoside **[133]** 	Bark	Kawaguchi *et al.*, 1998
(2*R*,3*R*,4*R*)-3,3′,4′,7-Tetrahydroxyflavan-(4β→8)-epicatechin **[134]** 	Bark	Nunes *et al.*, 1989
(2*R*,3*R*,4*R*)-3, 4′,7-Trihydroxyflavan-(4β →8)-epicatechin **[135]** 	Bark	Nunes *et al.*, 1989
2′,4′,5′-Trimethoxy-7-*O*-β-D-glucoside **[136]** 	Seed	Abe *et al.*, 1985
7-Hydroxy-2′,4,5′-trimethoxyisoflavone **[137]** 	Seed	Abe *et al.*, 1985
D. nigra		
Caviunin **[71]** 	Heartwood	Seshadri 1972

Table 4 (Continued)

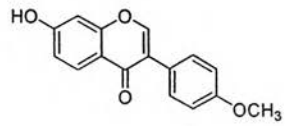
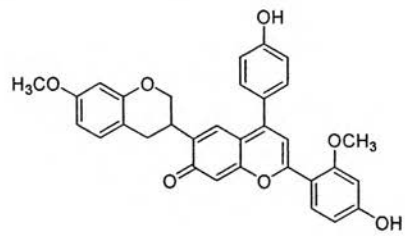
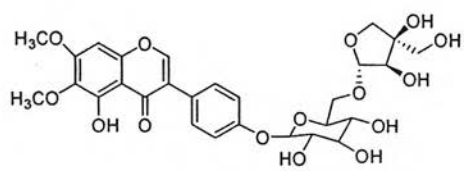
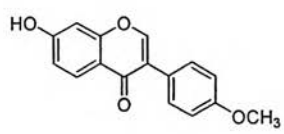
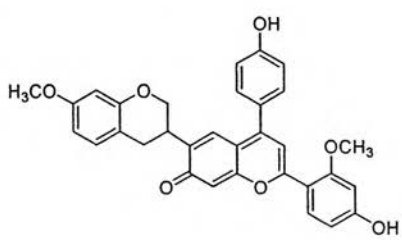
Plant and chemical compound	Plant part	Reference
Formononetin **[72]** 	Heartwood	Seshadri 1972
Retusapurpurin A **[73]** 	Heartwood	Czako *et al.*, 2001
5-Hydroxy-6,7-dimethoxy-4′-*O*-(6″-*O*-D-apio-*β*-D-furanosyl-*β*-D-glucopyranosyl) isoflavone **[138]** 	Leaf	Mathias *et al.*, 1998
D. nigrescens		
Fomononetin **[72]** 	Stembark	Ito *et al.*, 2003
Retusapurpurin A **[73]** 	Heartwood	Czako *et al.*, 2001

Table 4 (Continued)

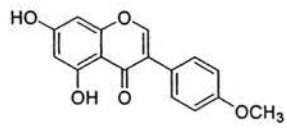
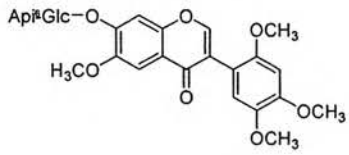
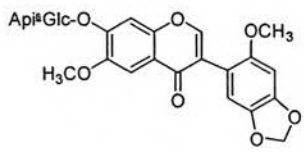
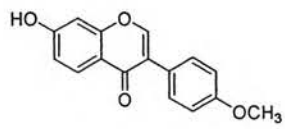
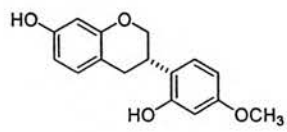
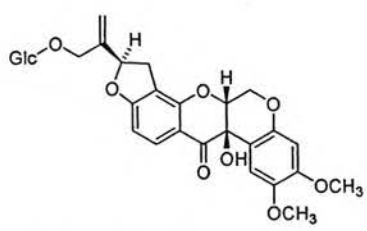
Plant and chemical compound	Plant part	Reference
Biochanin A **[95]** 	Stembark	Ito *et al.*, 2003
Dalnigrein-7-*O*-*β*-D-apiofuranosyl(1→6)-*β*-D-glucopyranoside **[139]** 	Seed	Chuankhayan *et al.*, 2005
Dalpatein-7-*O*-*β*-D-apiofuranosyl(1→6)-*β*-D-glucopyranoside **[140]** 	Seed	Chuankhayan *et al.*, 2005
D. nitidula		
Formononetin **[72]** 	Heartwood	Letcher *et al.*, 1976
(3*S*)-Vestitol **[78]** 	Heartwood	Bekker *et al.*, 2002
(5′*R*,6a*R*,12a*R*)-8′-*O*-*β*-D-glucopyranosyl-12a-hydroxyamorphigenin **[82]** 	Bark	Heerden *et al.*, 1980

Table 4 (Continued)

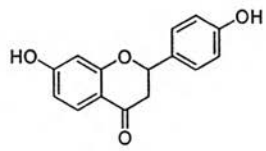
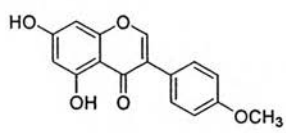
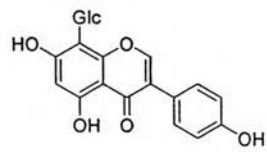
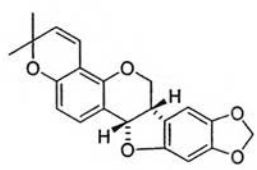
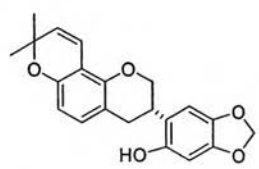
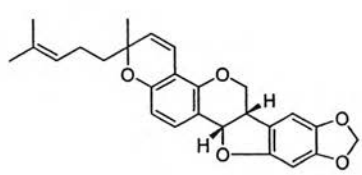
Plant and chemical compound	Plant part	Reference
Liquiritigenin **[84]** 	Heartwood	Bekker *et al.*, 2002 Letcher *et al.*, 1976
Biochanin A **[95]** 	Heartwood	Letcher *et al.*, 1976
Genistein-8-*C*-*β*-D-glucoside **[105]** 	Bark	Heerden *et al.*, 1980
(+)-Leiocarpin **[109]** 	Bark	Van Heerden *et al.*, 1978
(−)-Leiocin **[110]** 	Bark	Van Heerden *et al.*, 1978
Nitiducarpin **[117]** 	Bark	Van Heerden *et al.*, 1978

Table 4 (Continued)

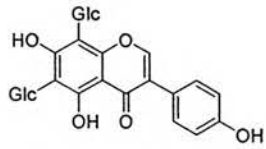
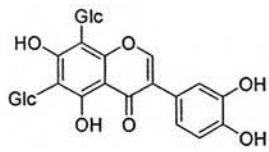
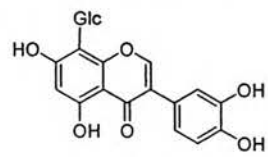
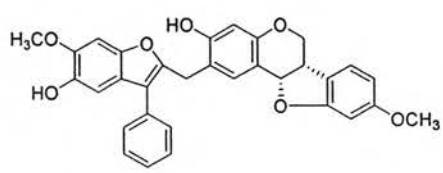
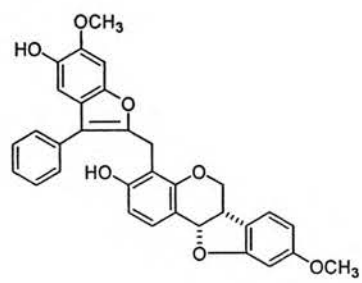
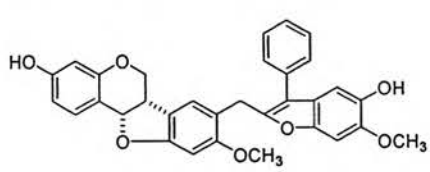
Plant and chemical compound	Plant part	Reference
Paniculatin **[124]** 	Bark	Van Heerden *et al.*, 1980
Orobol-6,8-di-*C*-*β*-D-glucoside **[127]** 	Bark	Van Heerden *et al.*, 1980
Orobol-8- *C*-*β*-D-glucoside **[133]** 	Bark	Van Heerden *et al.*, 1980
Daljanelin A **[141]** 	Heartwood	Ferreira *et al.*, 1995
Daljanelin B **[142]** 	Heartwood	Ferreira *et al.*, 1995
Daljanelin C **[143]** 	Heartwood	Ferreira *et al.*, 1995

Table 4 (Continued)

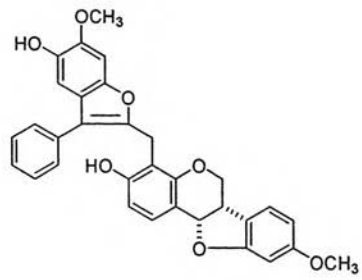
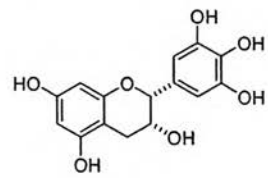
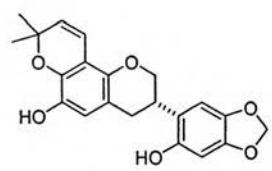
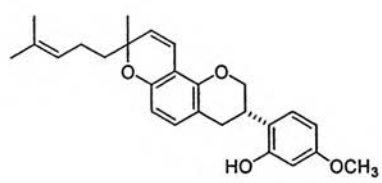
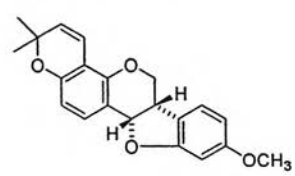
Plant and chemical compound	Plant part	Reference
Daljanelin D **[144]** 	Heartwood	Ferreira *et al.*, 1995
(–)-Epi-gallocatechin **[145]** 	Not Specified	Hussein *et al.*, 1985
(–)-Leiocinol **[146]** 	Bark	Van Heerden *et al.*, 1978
Heminitidulan **[147]** 	Bark	Van Heerden *et al.*, 1978
(+)-Hemileiocarpin **[148]** 	Bark	Van Heerden *et al.*, 1978

Table 4 (Continued)

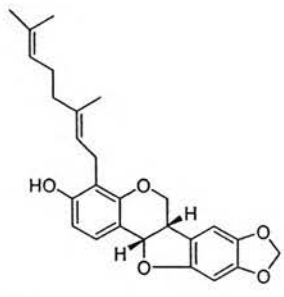
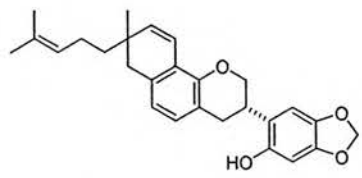
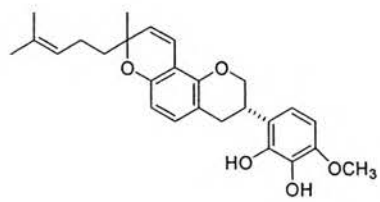
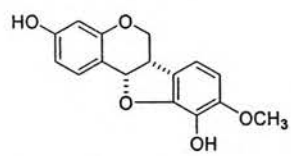
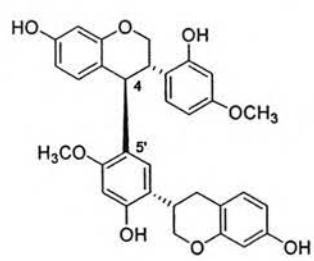
Plant and chemical compound	Plant part	Reference
Nitiducol **[149]** 	Bark	Van Heerden *et al.*, 1978
Nitidulan **[150]** 	Bark	Van Heerden *et al.*, 1978
Nitidulin **[151]** 	Bark	Van Heerden *et al.*, 1978
(+)-(3*S*) Vesticarpan **[152]** 	Heartwood	Bekker *et al.*, 2002
(3*S*,4*S*)-3,4-*Trans*-2′,7-dihydroxy-4′-methoxy-4-[(3*S*)-2′,7-dihydroxy-4′-methoxyisoflavan-5′-yl] isoflavan (Vestitol-(4→5′) vestitol) **[153]** 	Heartwood	Brandt *et al.*, 1982

Table 4 (Continued)

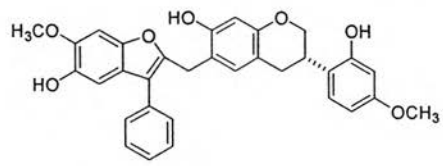
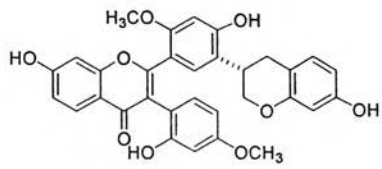
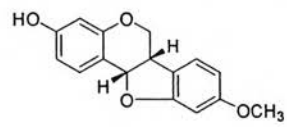
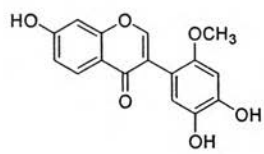
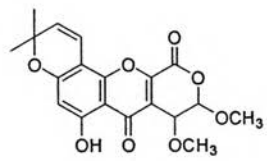
Plant and chemical compound	Plant part	Reference
(3*S*)-6-(3-Phenyl-5-hydroxy-6-methoxy-benzo[b] furan-2-ylmethyl)vestitol **[154]** 	Heartwood	Bekker *et al.*, 2002
2′,7-Dihydroxy-2-((3*S*),6′,7)-dihydroxy-4′-methoxyisoflavan-3′-yl)-4′-methoxyisoflavone (Vestitol-(5′→2)-2′-hydroxyformononetin) **[155]** 	Heartwood	Bezuidenhoudt *et al.*, 1988
(+)-3-Hydroxy-9-methoxypterocarpan **[156]** 	Heartwood	Letcher *et al.*, 1976
4′,5′,7-Trihydroxy-2′-methoxyisoflavone **[157]** 	Heartwood	Bekker *et al.*, 2002
D. oblonga		
6-Oxo-6a,12a-dehydro-α-toxicarol **[158]** 	Root	Boland *et al.*, 1998

Table 4 (Continued)

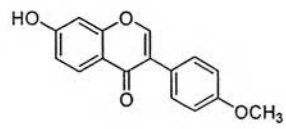
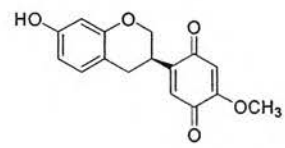
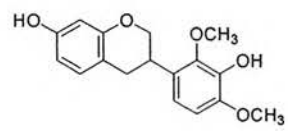
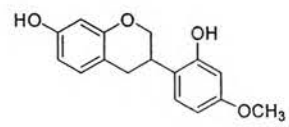
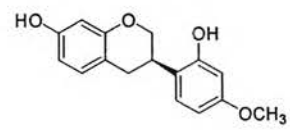
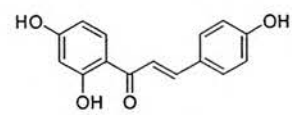
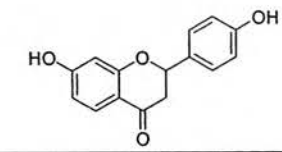
Plant and chemical compound	Plant part	Reference
D. odorifera		
Formononetin **[72]** 	Heartwood	Chan *et al.*, 1998
(3*R*)-Claussequinone **[75]** 	Heartwood	Yahara *et al.*, 1985
(±)-Mucronulatol **[77]** 	Heartwood	Goda *et al.*, 1985
(±)-Vestitol **[78]** 	Heartwood	Goda *et al.*, 1985
(3*R*)-Vestitol **[78]** 	Heartwood	Yahara *et al.*, 1985
Isoliquiritigenin **[83]** 	Heartwood	Chan *et al.*, 1998
(–)-Liquiritigenin **[84]** 	Heartwood	Chan *et al.*, 1998

Table 4 (Continued)

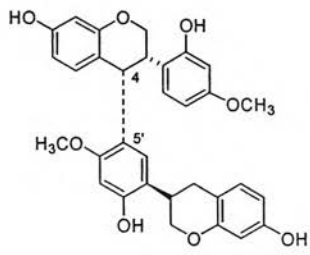
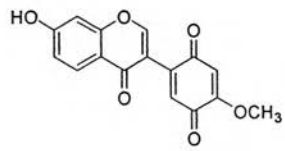
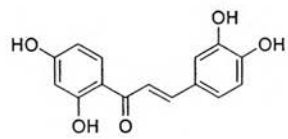
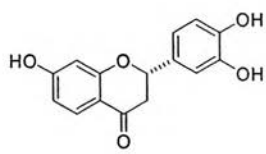
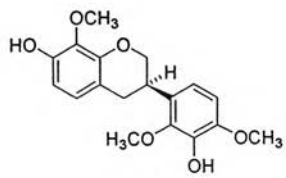
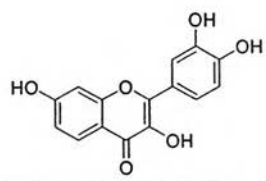
Plant and chemical compound	Plant part	Reference
(3*R*)-Vestitol-(4→5′)-vestitol **[153]** 	Heartwood	Yahara *et al.*, 1985
Bowdichione **[159]** 	Heartwood	Chan *et al.*, 1998
Butein **[160]** 	Heartwood	Chang *et al.*, 1992
(–)-Butin **[161]** 	Heartwood	Liu *et al.*, 2005
(–)-Duartin **[162]** 	Root Heartwood	Goda *et al.*, 1992
Fisetin **[163]** 	Heartwood	Chan *et al.*, 1998

Table 4 (Continued)

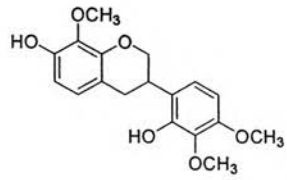
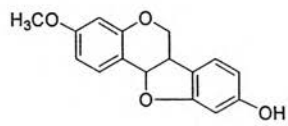
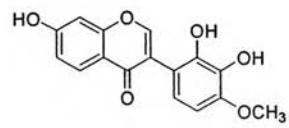
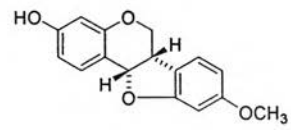
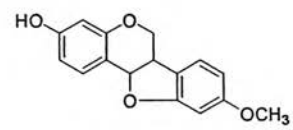
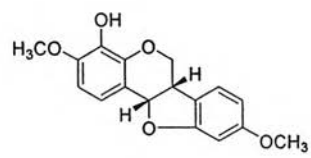
Plant and chemical compound	Plant part	Reference
(±)-Isoduartin **[164]** 	Root heartwood	Goda *et al.*, 1992
Iso-medicarpin **[165]** 	Not Specific	Miller *et al.*, 1987
Koparin **[166]** 	Heartwood	Chan *et al.*, 1998
(+)-Medicarpin **[167]** 	Heartwood	Chan *et al.*, 1998
(±) Medicarpin **[167]** 	Heartwood	Goda *et al.*, 1985,1987
(+)-Melilotocarpan A **[168]** 	Heartwood	Chan *et al.*, 1998

Table 4 (Continued)

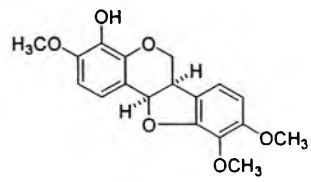
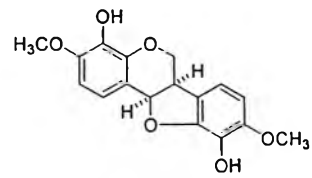
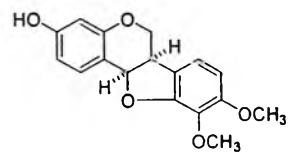
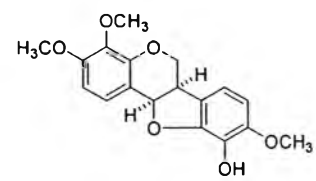
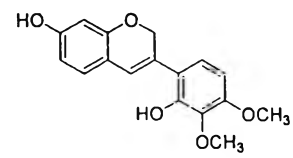
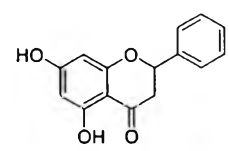
Plant and chemical compound	Plant part	Reference
(–)-Melilotocarpan C **[169]** 	Heartwood	Goda *et al.*, 1985
(–)-Melilotacarpan D **[170]** 	Heartwood	Goda *et al.*, 1985
(–)-Methylnissolin **[171]** 	Heartwood	Goda *et al.*, 1985
(–)-Odoricarpan **[172]** 	Heartwood	Goda *et al.*, 1985
Odoriflavene **[173]** 	Heartwood	Goda *et al.*, 1985
Pinocembrin **[174]** 	Heartwood	Liu *et al.*, 2005

Table 4 (Continued)

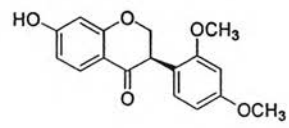
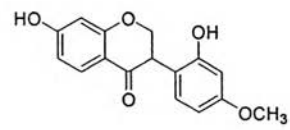
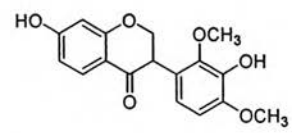
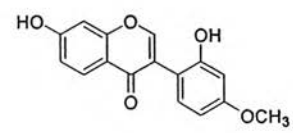
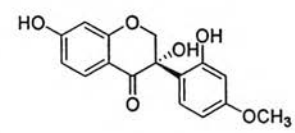
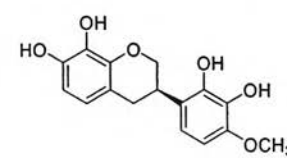
Plant and chemical compound	Plant part	Reference
(+)-(3*R*)-Sativanone **[175]** 	Heartwood	Chan *et al.*, 1998
Vestitone **[176]** 	Heartwood	Lui *et al.*, 2005
Violanone **[177]** 	Heartwood	Lui *et al.*, 2005
Xenognosin B **[178]** 	Heartwood	Chan *et al.*, 1998
(3*R*)-2′,3,7-Trihydroxy-4′-methoxy isoflavanone **[179]** 	Heartwood	Chan *et al.*, 1998
(3*R*)-3′,8-Dihydroxyvestitol **[180]** 	Heartwood	Yahara *et al.*, 1989

Table 4 (Continued)

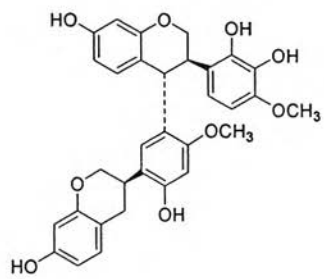
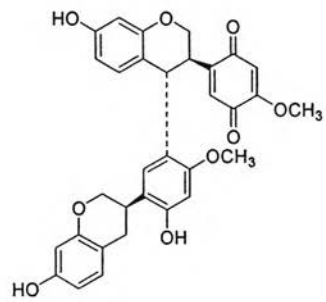
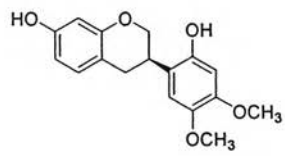
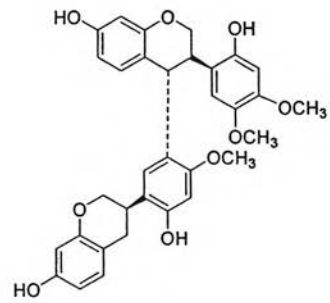
Plant and chemical compound	Plant part	Reference
(3*R*)-3′-Hydroxyvestitol-(4→5′)-vestitol **[181]** 	Heartwood	Yahara *et al.*, 1985
(3*R*)-4-*Trans*-vestitol-5′-yl-claussequinone **[182]** 	Heartwood	Saijo *et al.*, 1986 Yahara *et al.*, 1989
(3*R*)-5′-Methoxyvestitol **[183]** 	Heartwood	Yahara *et al.*, 1985
(3*R*)-5′-Methoxyvestitol-(4→ 5′)-vestitol **[184]** 	Heartwood	Yahara *et al.*, 1985

Table 4 (Continued)

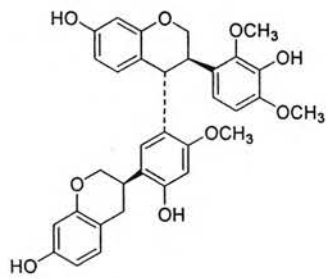
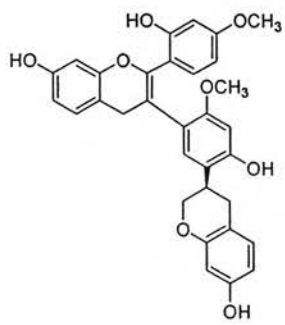
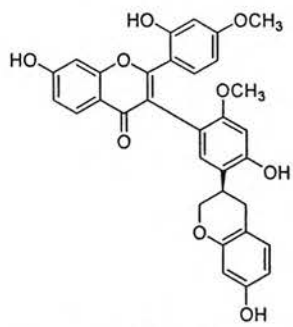
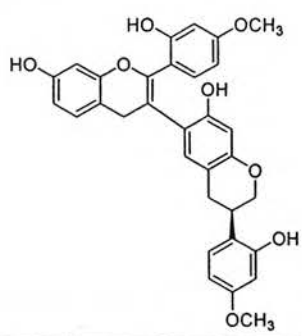
Plant and chemical compound	Plant part	Reference
(3*R*)-Mucronulatol (4→ 5′)-vestitol **[185]** 	Heartwood	Yahara *et al.*, 1985
(3*R*)-Vestitol-(5′ → 3)-7,2′-dihydroxy-4′-methoxyflavan-2-ene **[186]** 	Heartwood	Ogata *et al.*, 1990
(3*R*)-Vestitol-(5′→ 3)-7,2′-dihydroxy-4′-methoxyflavone **[187]** 	Heartwood	Ogata *et al.*, 1990
(3*R*)-Vestitol-(6→3)-7,2′-dihydroxy-4′-methoxyflavan-2-ene **[188]** 	Heartwood	Ogata *et al.*, 1990

Table 4 (Continued)

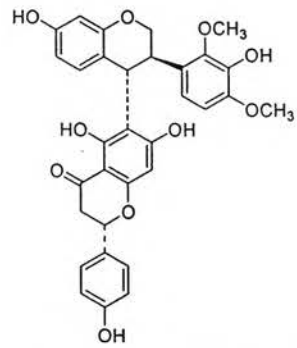
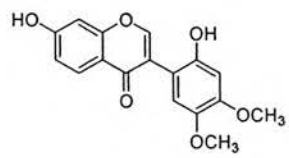
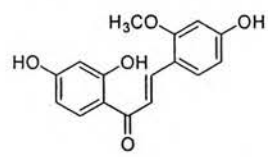
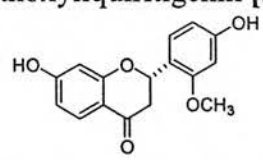
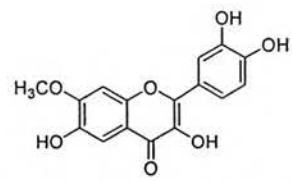
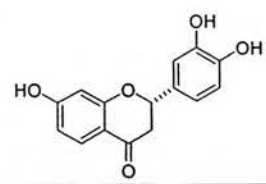
Plant and chemical compound	Plant part	Reference
(3*R*,4*R*)-3,4-*Trans*-3′,7-dihydroxy-2′,4′-dimethoxy-4-[(2*S*)-4′,5,7-trihydroxyflavanone -6-yl] isoflavan ((3*R*,4*R*)-Mucronulatol-(4→6)-naringenin) **[189]** 	Heartwood	Ogata *et al.*, 1990
2′,7-Dihydroxy-4′,5′-dimethoxyisoflavanone **[190]** 	Heartwood	Chan *et al.*, 1998
2′-*O*-Methoxyisoliquiritigenin **[191]** 	Heartwood	Park *et al.*, 1995
(–)-2′-*O*-Methoxyliquiritigenin **[192]** 	Heartwood	Park *et al.*, 1995
3,3′,4′,6-Tetrahydroxy-7-methoxyflavone **[193]** 	Heartwood	Chan *et al.*, 1998
3′,4′,7-Trihydroxyflavanone **[194]** 	Heartwood	Chan *et al.*, 1998

Table 4 (Continued)

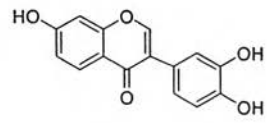
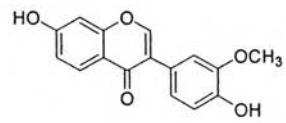
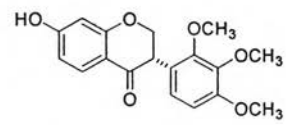
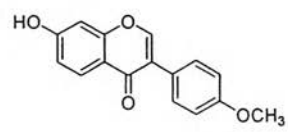
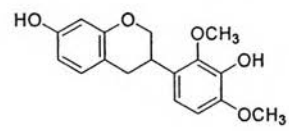
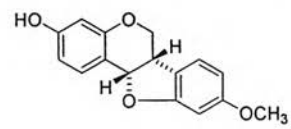
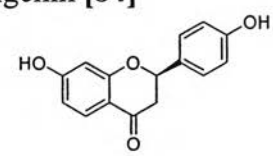
Plant and chemical compound	Plant part	Reference
3′-Hydroxydaidzein **[195]** 	Heartwood	Liu *et al.*, 2005
3′-Methoxydaidzein **[196]** 	Heartwood	Yahara *et al.*, 1985
(3*S*)-3′-*O*-Methylviolanone **[197]** 	Heartwood	Chan *et al.*, 1998
D. oliveri		
Formononetin **[72]** 	Heartwood	Donnelly *et al.*, 1974
(±)-Mucronulatol **[77]** 	Heartwood	Donnelly *et al.*, 1974
(+)-Demethylhomopterocarpin **[79]** 	Heartwood	Donnelly *et al.*, 1974
(+)-Liquiritigenin **[84]** 	Heartwood	Donnelly *et al.*, 1974

Table 4 (Continued)

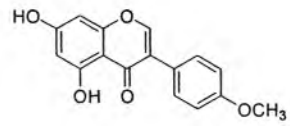
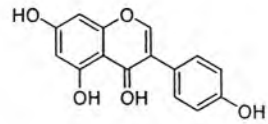
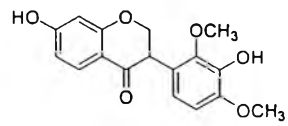
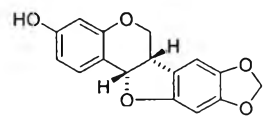
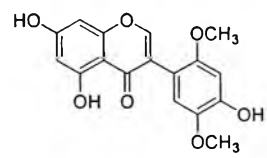
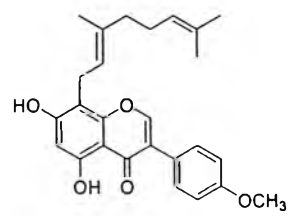
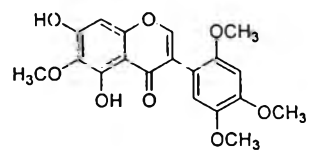
Plant and chemical compound	Plant part	Reference
Biochanin A **[95]** 	Stembark	Ito *et al.*, 2003
Genistein **[3]** 	Stembark	Ito *et al.*, 2003
(±)-Violanone **[177]** 	Heartwood	Donnelly *et al.*, 1974
(+)-Maackiain **[198]** 	Heartwood	Donnelly *et al.*, 1974
Olibergin A **[199]** 	Stembark	Ito *et al.*, 2003
Olibergin B **[200]** 	Stembark	Ito *et al.*, 2003
D. paniculata		
Caviunin **[71]** 	Bark Seed Root	Parthasarathy *et al.*, 1980 Adinarayana *et al.*, 1975 Radhakrishnniah 1979

Table 4 (Continued)

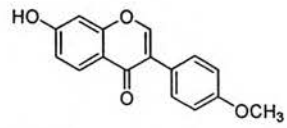
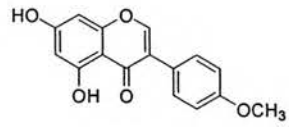
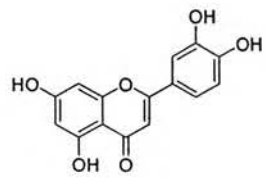
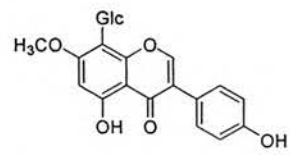
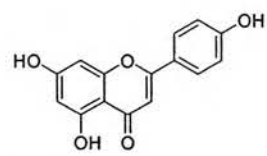
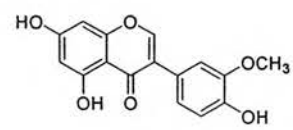
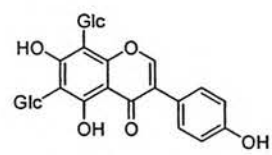
Plant and chemical compound	Plant part	Reference
Formononetin **[72]** 	Bark	Narayanan *et al.*, 1971
Biochanin A **[95]** 	Bark	Parthasarathy *et al.*, 1976
Luteolin **[102]** 	Fruit Leaf	Ramachandraiah *et al.*, 1991 Rao *et al.*, 1992
Prunetin-8-*C*-glucoside **[106]** 	Bark	Parthasarathy *et al.*, 1976
Apigenin **[108]** 	Leaf Fruit	Rajasekhara 1992 Rajasekhara 1991
3′-*O*-Methylorobol **[112]** 	Seed	Rao *et al.*, 1991
Paniculatin **[124]** 	Bark Heartwood	Parthasarathy *et al.*, 1976 Narayanan *et al.*, 1971 Aiyar *et al.*, 1973

Table 4 (Continued)

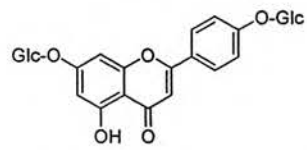
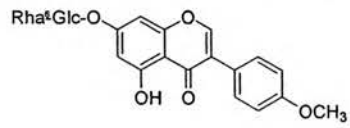
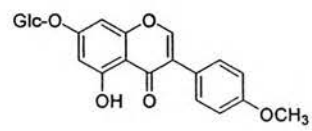
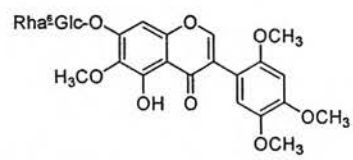
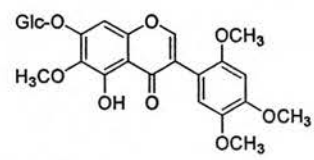
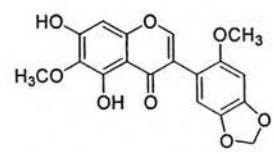
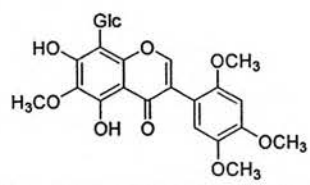
Plant and chemical compound	Plant part	Reference
Apeginin-4′,7-di-*O*-glucoside **[201]** 	Leaf	Rajasekhara 1992
Biochanin A-7-*O*-*β*-D-rutinoside **[202]** 	Bark	Parthasarathy *et al.*, 1976
Biochanin A-7-*O*-*β*-D-glucoside (Sissotrin) **[203]** 	Bark	Parthasarathy *et al.*, 1976
Caviunin-7-*O*-*α*-L-rhamnoglucoside**[204]** 	Root	Rajuu *et al.*, 1980
Caviunin-7-*O*-*β*-D-glucoside **[205]** 	Root	Radhakrishnniah 1979
Dalpalatin **[206]** 	Seed	Rao *et al.*, 1996
Dalpaniculin **[207]** 	Seed	Rao *et al.*, 1996

Table 4 (Continued)

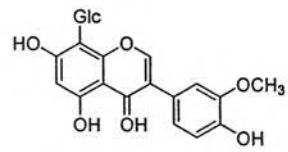
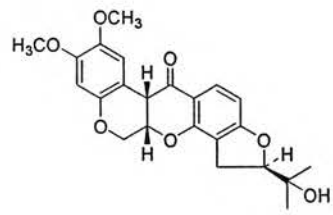
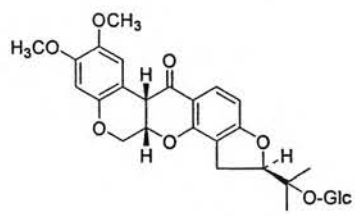
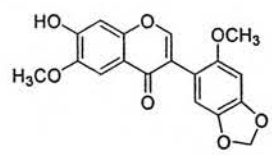
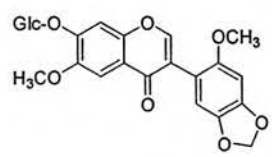
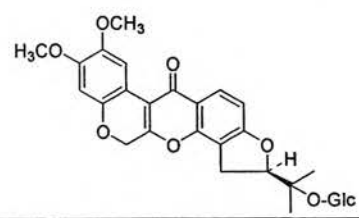
Plant and chemical compound	Plant part	Reference
Dalpanitin **[209]** 	Seed	Adinarayana 1971 Radhakrishnniah 1973
Dalpanol **[210]** 	Seed	Adinarayana 1971 Radhakrishnniah 1973
Dalpanol-*O*-*β*-D-glucoside **[211]** 	Seed	Rajasekhara *et al.*, 1991
Dalpatein **[212]** 	Seed	Adinarayana *et al.*, 1975
Dalpatin **[213]** 	Seed	Adinarayana *et al.*, 1975
Dehydrodalpanol-*O*- glucoside **[214]** 	Seed	Rajasekhara *et al.*, 1991

Table 4 (Continued)

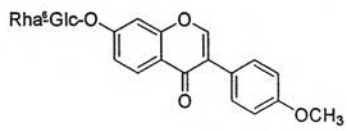
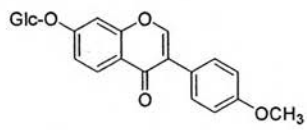
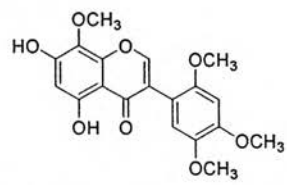
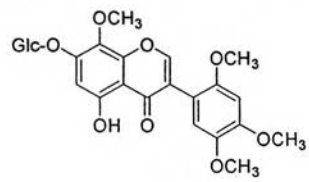
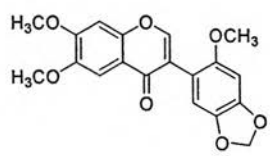
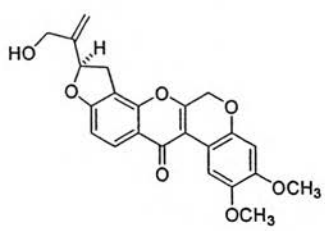
Plant and chemical compound	Plant part	Reference
Formononetin-7-*O*-*β*-D-rutinoside **[215]** 	Bark	Parthasarathy *et al.*, 1976
Formononetin-7-*O*-*β*-D-glucoside (Ononin) **[216]** 	Bark	Parthasarathy *et al.*, 1976
Isocaviunin **[217]** 	Seed	Parthasarathy 1980
Isocaviunin-7-*O*-*β*-D-glucoside **[218]** 	Bark Seed	Parthasarathy *et al.*, 1980 Rajasekhara *et al.*, 1991
Milldurone **[219]** 	Seed	Adinarayana *et al.*, 1975
(6a,12a)-Dehydroamorphigenin **[220]** 	Seed	Ramachandraiah *et al.*, 1992

Table 4 (Continued)

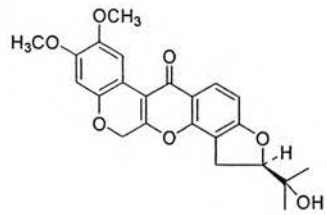
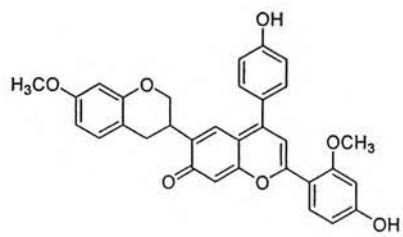
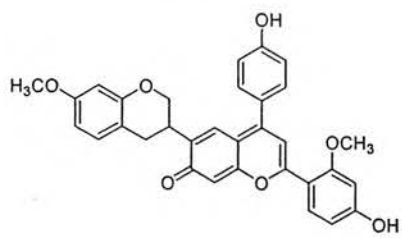
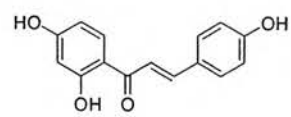
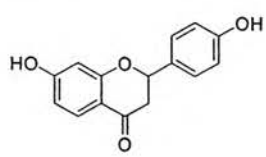
Plant and chemical compound	Plant part	Reference
(6a,12a)-Dehydrodalpanol **[221]** 	Seed	Ramachandraiah 1992
D. parviflora		
Retusapurpurin A **[73]** 	Heartwood	Czako *et al.*, 2001
D. retusa		
Retusapurpurin A **[73]** 	Callus tissue	Czako *et al.*, 2001
Isoliquiritigenin **[83]** 	Heartwood	Manners *et al.*, 1974
Liquiritigenin **[84]** 	Heartwood	Manners *et al.*, 1974

Table 4 (Continued)

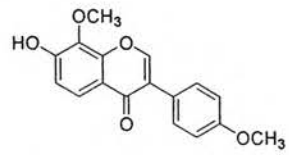
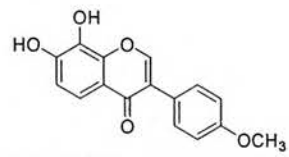
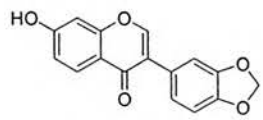
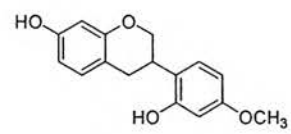
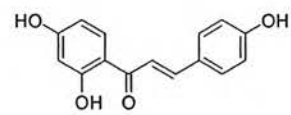
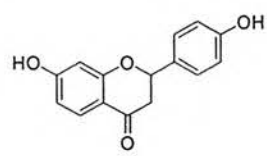
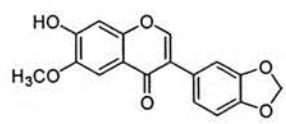
Plant and chemical compound	Plant part	Reference
7-Hydroxy-4′,8-dimethoxyisoflavone (8-*O*-Methylretusin) **[222]** 	Heartwood	Jurd *et al.*, 1972
Retusin **[223]** 	Heartwood	Jurd *et al.*, 1972
D. sericea		
Pseudobaptigenin **[69]** 	Leaf Bark	Dayal *et al.*, 1977 Parthasarathy *et al.*, 1976
Vestitol **[78]** 	Leaf	Ingham 1979
Isoliquiritigenin **[83]** 	Bark	Parthasarathy *et al.*, 1976
Liquiritigenin **[84]** 	Bark	Parthasarathy *et al.*, 1976
Fujikinetin **[101]** 	Bark	Parthasarathy *et al.*, 1976

Table 4 (Continued)

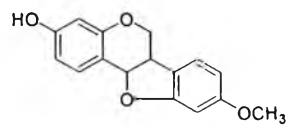
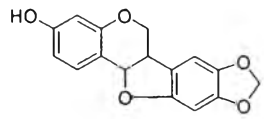
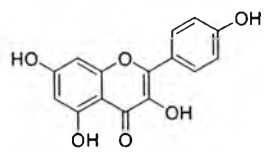
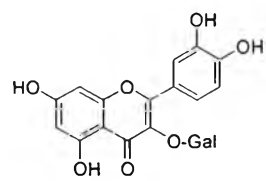
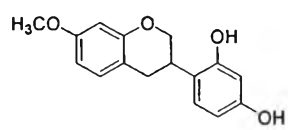
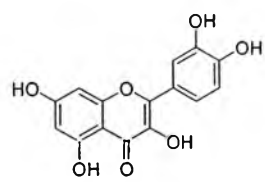
Plant and chemical compound	Plant part	Reference
Medicarpin **[167]** 	Leaf	Ingham, 1979
Maackiain **[198]** 	Leaf	Ingham, 1979
Dihydrokaempferol-3-*O*-glucoside (Aromadendrin-3-*O*-glucoside) **[224]** 	Leaf	Dayal *et al.*, 1977
Hyperoside **[225]** 	Leaf	Dayal *et al.*, 1977
Neovestitol **[226]** 	Leaf	Ingham 1979
Quercetin **[227]** 	Leaf	Dayal *et al.*, 1977

Table 4 (Continued)

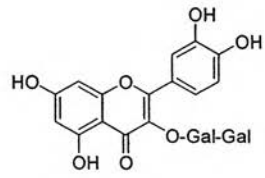
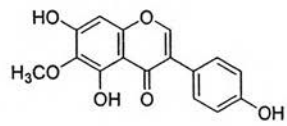
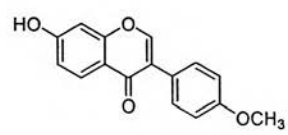
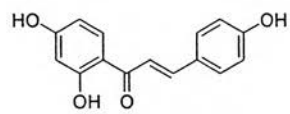
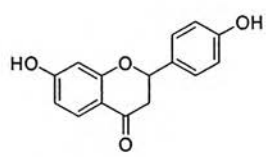
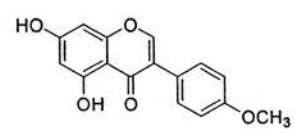
Plant and chemical compound	Plant part	Reference
Quercetin-3-*O*-digalactoside **[228]** 	Leaf	Dayal *et al.*, 1977
D. sissoides		
Tectorigenin **[14]** 	Pod	Nagarajan *et al.*, 1990
	Root	Nagarajan *et al.*, 1988
Formononetin **[72]** 	Flowers	Revi *et al.*, 1990
Isoliquiritigenin **[83]** 	Heartwood	Revi *et al.*, 1990
Liquiritigenin **[84]** 	Heartwood	Revi *et al.*, 1990
Biochanin A **[95]** 	Root	Nagarajan *et al.*, 1988
	Pod	Nagarajan *et al.*, 1990
	Flower	Kavimani *et al.*, 1997

Table 4 (Continued)

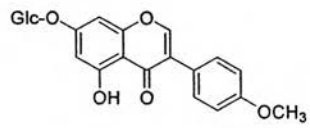
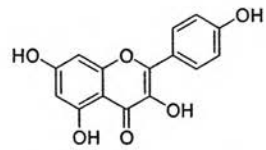
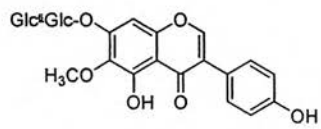
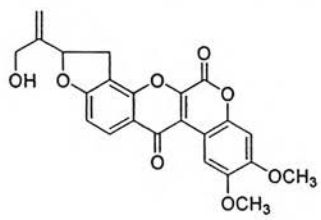
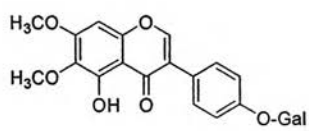
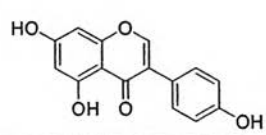
Plant and chemical compound	Plant part	Reference
Sissotrin **[203]** 	Leaf	Nagarajan *et al.*, 1988
Kaempferol **[229]** 	Flowers	Revi *et al.*, 1990
Tectorigenin-7-gentiobioside **[230]** 	Root	Nagarajan *et al.*, 1988
6-Ketodehydro-amorphigenin **[231]** 	Stembark	Sripathi *et al.*, 1994
7-*O*-Methyltectorigenin-4′-*O*-galactoside **[232]** 	Root	Nagarajan *et al.*, 1988
D. sissoo		
Genistein **[3]** 	Seed	Sarg *et al.*, 1999

Table 4 (Continued)

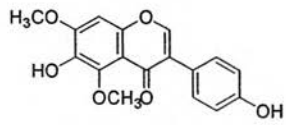
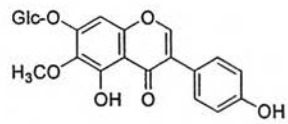
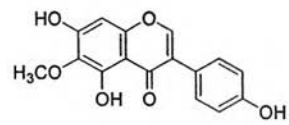
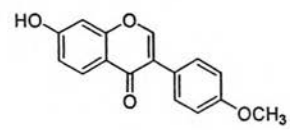
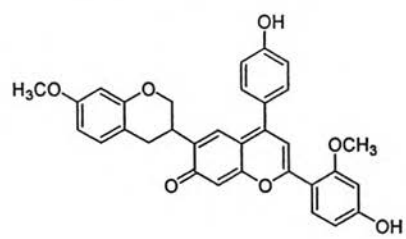
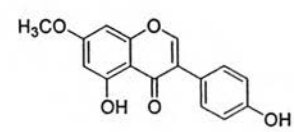
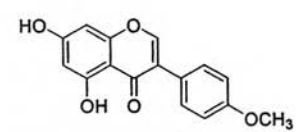
Plant and chemical compound	Plant part	Reference
Muningin **[10]** 	Leaf	Sarg *et al.*, 1999
Tectoridin **[13]** 	Pod	Sharma *et al.*, 1980
Tectorigenin **[14]** 	Pod Bark Leaf	Sharma *et al.*, 1979 Dhingra *et al.*, 1974 Sarg *et al.*, 1999
Formononetin **[72]** 	Flower	Harborne 1993
Retusapurpurin A **[73]** 	Heartwood	Czako *et al.*, 2001
Prunetin **[94]** 	Leaf	Sarg *et al.*, 1999
Biochanin A **[95]** 	Leaf Pod	Sarg *et al.*, 1999 Sharma *et al.*, 1979

Table 4 (Continued)

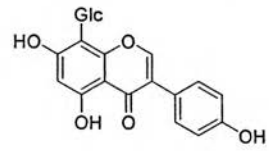
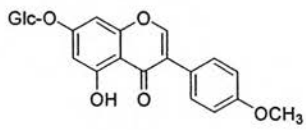
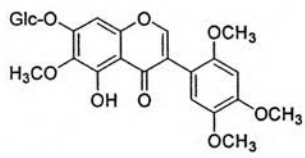
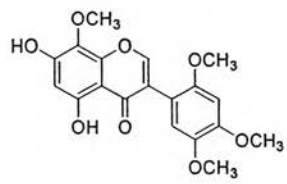
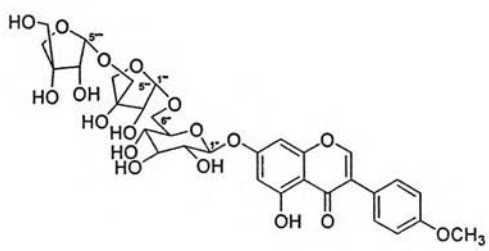
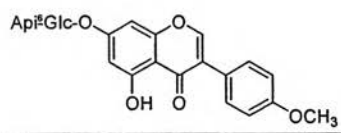
Plant and chemical compound	Plant part	Reference
Genistein-8-*C*-*β*-D-glucopyranoside **[105]** 	Stembark	Farag *et al.*, 2001
Sissotrin **[203]** 	Leaf	Sarg *et al.*, 1999
Caviunin-7-*O*-*β*-glucoside **[205]** 	Pod	Sharma *et al.*, 1979
Isocaviunin **[217]** 	Pod	Sharma *et al.*, 1980
Biochanin A-7-*O*-[*β*-D-apiofuranosyl (1→5)-*β*-D-apiofuranosyl(1→6)-*β*-D-glucopyranoside] **[233]** 	Leaf	Farag *et al.*, 2001
Biochanin A-7-*O*-[*β*-D-apiofuranosyl (1→6)-*β*-D-glucopyranoside] **[234]** 	Leaf	Farag *et al.*, 2001

Table 4 (Continued)

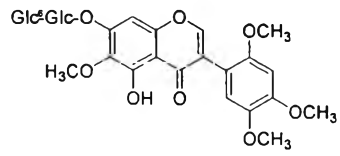
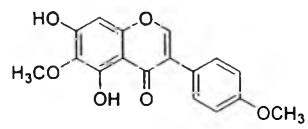
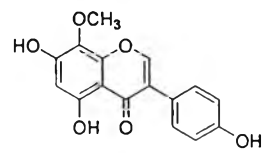
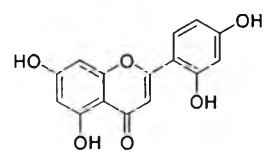
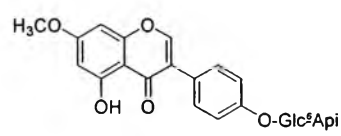
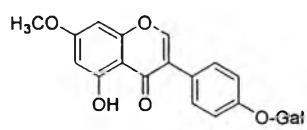
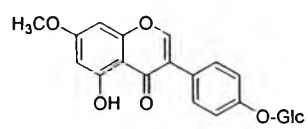
Plant and chemical compound	Plant part	Reference
Caviunin-7-*O*-gentiobioside **[235]** 	Pod	Sharma *et al.*, 1979
Irisolidone **[236]** 	Leaf	Sarg *et al.*, 1999
Isotectorigenin (Pseudotectorigenin) **[237]** 	Bark	Dhingra *et al.*, 1974
Nor-artocarpetin **[238]** 	Leaf	Sarg *et al.*, 1999
Prunetin-4′-*O*-[*β*-D-apiofuranosyl(1→6)-*β*-D-glucopyranoside] **[239]** 	Stembark	Farag *et al.*, 2001
Prunetin-4′-*O*-galactoside **[240]** 	Leaf	Sarg *et al.*, 1999
Prunetin-4′-*O*-*β*-D-glucoside **[241]** 	Stembark	Farag *et al.*, 2001

Table 4 (Continued)

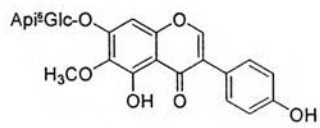
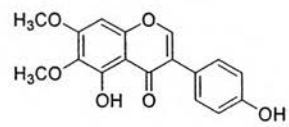
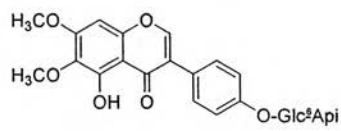
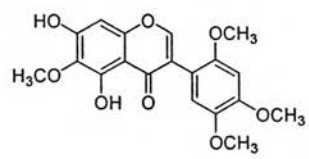
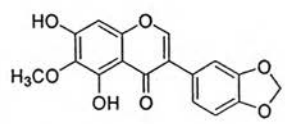
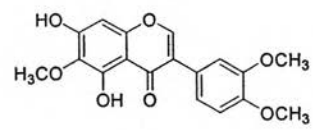
Plant and chemical compound	Plant part	Reference
Tectorigenin-7-*O*-[*β*-D-apiofuranosyl(1→6)-*β*-D-glucopyranoside] **[242]** 	Stembark	Farag *et al.*, 2001
7-*O*-Methyltectorigenin **[243]** 	Pod	Ollis 1966
7-Methyltectorigenin-4′-*O*-[*β*-D-apio furanosyl (1→6)-*β*-D-glucopyranoside] **[244]** 	Stembark	Farag *et al.*, 2001
D. spinosa		
Caviunin **[71]** 	Root Stembark	Dasan *et al.*, 1982 Narayanan *et al.*, 1988
Dalspinin **[92]** 	Root Stembark	Dasan *et al.*, 1982 Narayanan *et al.*, 1988
Dalspinosin **[93]** 	Root	Dasan *et al.*, 1982

Table 4 (Continued)

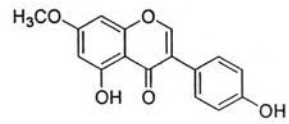
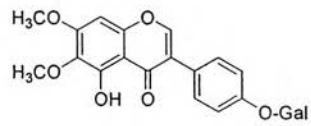
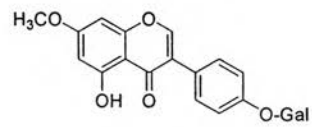
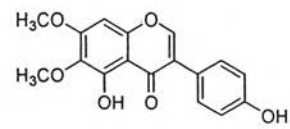
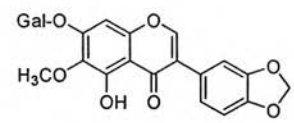
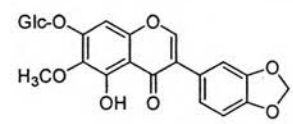
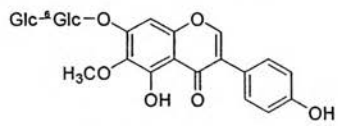
Plant and chemical compound	Plant part	Reference
Prunetin **[94]** 	Leaf	Narayanan *et al.*, 1988
7-Methyltectorigenin-4′-*O*-*β*-D-galactoside **[232]** 	Leaf	Narayanan *et al.*, 1988
Prunetin-4′-*O*-*β*-D-galactoside **[240]** 	Leaf	Narayanan *et al.*, 1988
7-Methyltectorigenin **[243]** 	Leaf	Narayanan *et al.*, 1988
Dalspinin-7-*O*-*β*-D-galactopyranoside **[245]** 	Root	Dasan *et al.*, 1985
Dalspinosin-7-*O*-*β*-D-glucoside **[246]** 	Root	Dasan *et al.*, 1988
Tectorigenin-7-*O*-gentiobioside **[247]** 	Leaf	Narayanan *et al.*, 1988

Table 4 (Continued)

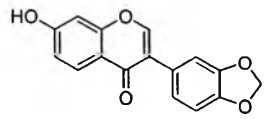
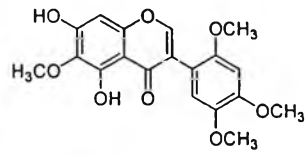
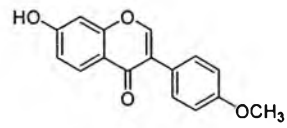
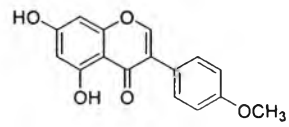
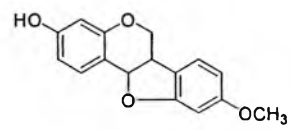
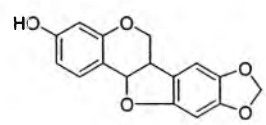
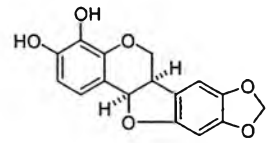
Plant and chemical compound	Plant part	Reference
D. spruceana		
Pseudobaptigenin **[69]** 	Heartwood	Cook *et al.*, 1978
Caviunin **[71]** 	Sapwood	Cook *et al.*, 1978
Formononetin **[72]** 	Sapwood	Cook *et al.*, 1978
Biochanin A **[95]** 	Sapwood	Cook *et al.*, 1978
(±)–Medicarpin **[167]** 	Sapwood	Cook *et al.*, 1978
(±)–Maackiain **[198]** 	Sapwood Heartwood	Cook *et al.*, 1978
(–)-3,4-Dihydroxy-8,9-methylenedioxy pterocarpan **[248]** 	Sapwood	Cook *et al.*, 1978

Table 4 (Continued)

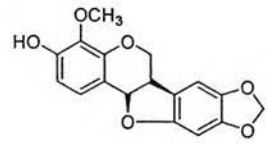
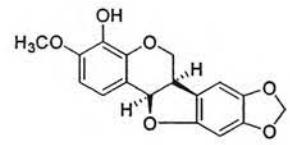
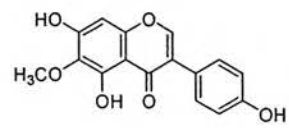
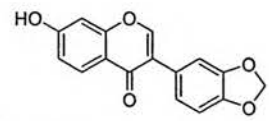
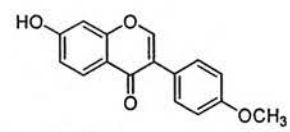
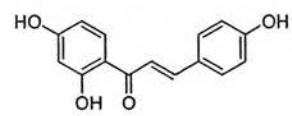
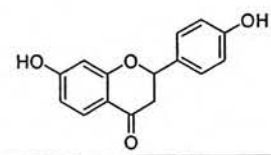
Plant and chemical compound	Plant part	Reference
(–)-3-Hydroxy-4-methoxy-8,9-methylenedi oxypterocarpan **[249]** 	Sapwood	Cook *et al.*, 1978
(–)-4-Hydroxy-3-methoxy-8,9-methylenedi oxypterocarpan **[250]** 	Sapwood Heartwood	Cook *et al.*, 1978
D. stevensonii		
Tectorigenin **[14]** 	Heartwood	Donnelly *et al.*, 1973
Pseudobaptigenin **[69]** 	Heartwood	Donnelly *et al.*, 1973
Formononetin **[72]** 	Heartwood	Donnelly *et al.*, 1973
Isoliquiritigenin **[83]** 	Heartwood	Donnelly *et al.*, 1973
(±)-Liquiritigenin **[84]** 	Heartwood	Donnelly *et al.*, 1973

Table 4 (Continued)

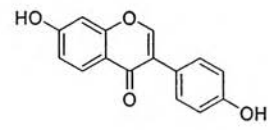
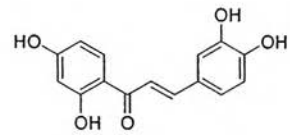
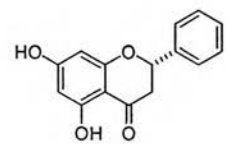
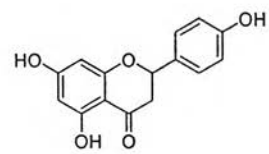
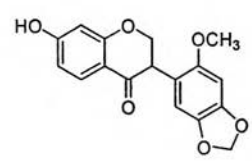
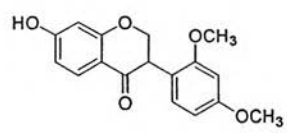
Plant and chemical compound	Plant part	Reference
Daidzein **[96]** 	Heartwood	Donnelly *et al.*, 1973
Butein **[160]** 	Heartwood	Donnelly *et al.*, 1973 Donnelly *et al.*, 1973
(−)-Pinocembrin **[174]** 	Heartwood	Donnelly *et al.*, 1973
(±)-Naringenin **[251]** 	Heartwood	Donnelly *et al.*, 1973
(±)-Onogenin **[252]** 	Heartwood	Donnelly *et al.*, 1973
(±)-7-Hydroxy-2′,4′-dimethoxyisoflavanone **[253]** 	Heartwood	Donnelly *et al.*, 1973

Table 4 (Continued)

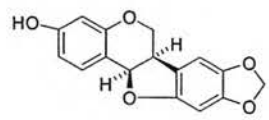
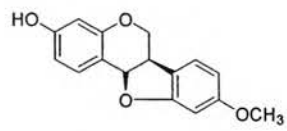
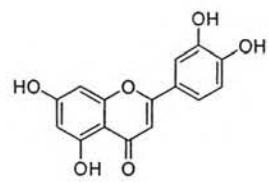
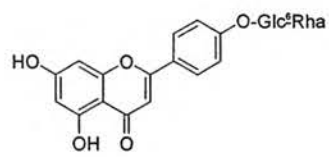
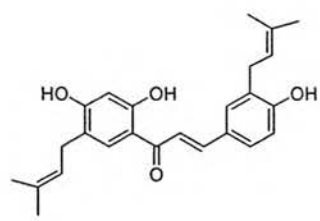
Plant and chemical compound	Plant part	Reference
(6a*R*,11a*R*)-3-Hydroxy-8,9-methylenedioxy pterocarpan **[254]** 	Heartwood	Donnelly *et al.*, 1973
(6a*R*,11a*R*)-3-Hydroxy-9-methoxyptero carpan **[255]** 	Heartwood	Donnelly *et al.*, 1973
D. stipulacea		
Luteolin **[102]** 	Leaf	Boral *et al.*, 1993
Luteolin-4′-rutinoside **[256]** 	Leaf	Boral *et al.*, 1993
Stipulin **[257]** 	Root	Bhatt *et al.*, 1992

Table 4 (Continued)

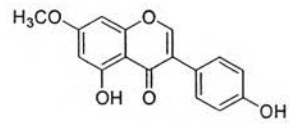
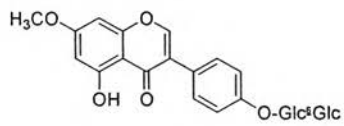
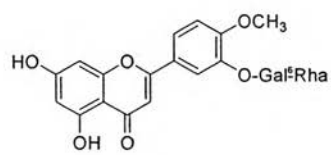
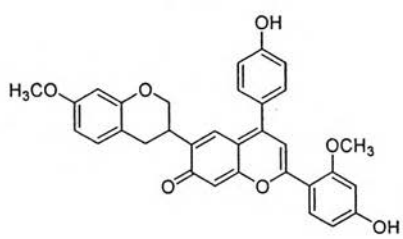
Plant and chemical compound	Plant part	Reference
D. sympathetica		
Prunetin **[94]** 	Not Specified	Nagarajan *et al.*, 2006
Prunetin-4′-*O*-*β*-D-gentiobioside (Dalsympathetin) **[258]** 	Not Specified	Nagarajan *et al.*, 2006
5,7-Dihydoxy-4′-methoxyflavone-5′-*O*-*α*-L-rhamnopyranosyl(1→6)-*O*-*β*-D-galactopyranoside **[259]** 	Stem	Yadava *et al.*, 2000
D. trichocarpa		
Retusapurpurin A **[73]** 	Callus tissue	Czako *et al.*, 2001

Table 4 (Continued)

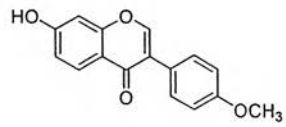
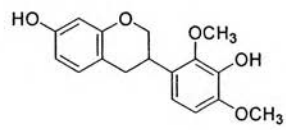
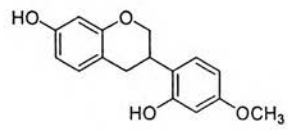
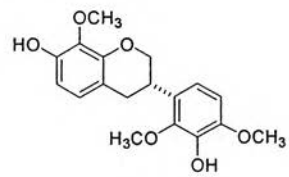
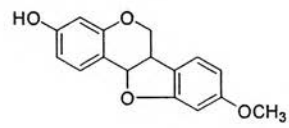
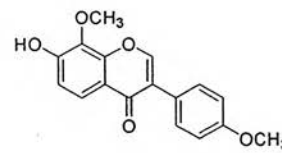
Plant and chemical compound	Plant part	Reference
D. variabilis		
Formononetin **[72]** 	Trunkwood	Kurosawa *et al.*, 1978
(±)-Mucronulatol **[77]** 	Trunkwood	Kurosawa *et al.*, 1978
(±)-Vestitol **[78]** 	Trunkwood	Kurosawa *et al.*, 1978
(−)-Duartin **[162]** 	Trunkwood	Kurosawa *et al.*, 1978
(±)-Medicarpin **[167]** 	Trunkwood	Kurosawa *et al.*, 1978
8-*O*-Methylretusin **[222]** 	Trunkwood	Kurosawa *et al.*, 1978

Table 4 (Continued)

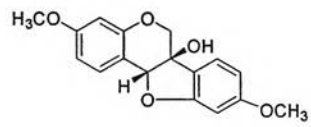
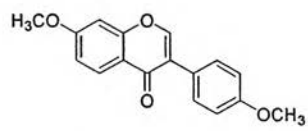
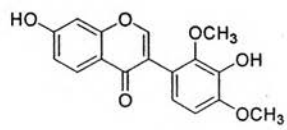
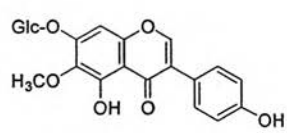
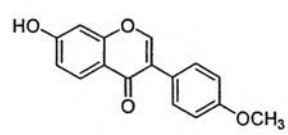
Plant and chemical compound	Plant part	Reference
(+)-Variabilin **[260]** 	Trunkwood	Kurosawa *et al.*, 1978
D. violacea		
Di-*O*-Methyldaidzein **[118]** 	Not specified	Ollis 1966
Violanone **[177]** 	Not specified	Ollis 1966
D. volubilis		
Tectoridin **[13]** 	Stembark	Khera *et al.*, 1978
Formononetin **[72]** 	Leaf	Chawla *et al.*, 1977

Table 4 (Continued)

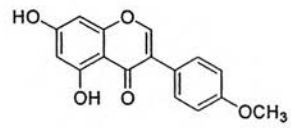
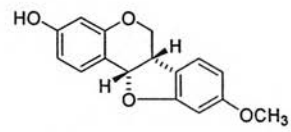
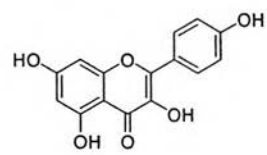
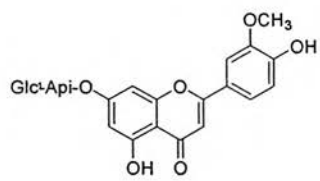
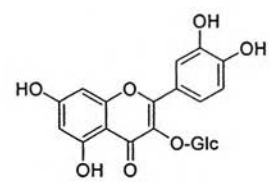
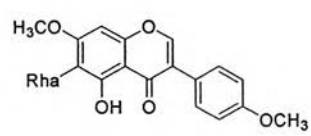
Plant and chemical compound	Plant part	Reference
Biochanin A **[95]** 	Flower Leaf Twig Branch	Chawla *et al.*, 1975 Chawla *et al.*, 1977 Chawla *et al.*, 1987 Chawla *et al.*, 1989
(+)-Medicarpin **[167]** 	Stembark	Khera *et al.*, 1978
Kaempferol **[229]** 	Branch	Chawla *et al.*, 1989
Chrysoeriol-7-*O*-*β*-D-glucopyranosyl (2→1)-D-apiofuranoside (Graveobioside B) **[261]** 	Leaf	Biswas *et al.*, 1977
Isoquercitrin **[262]** 	Branch	Chawla *et al.*, 1989
Isovolubilin **[263]** 	Flower	Chawla *et al.*, 1975

Table 4 (Continued)

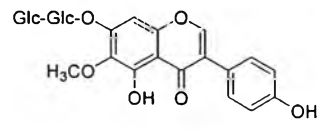
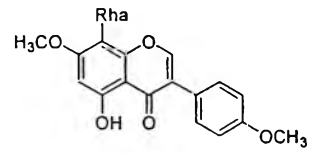
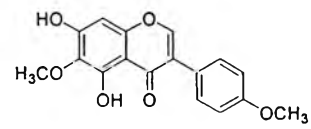
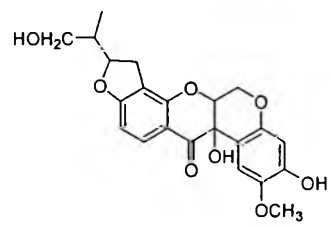
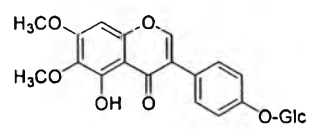
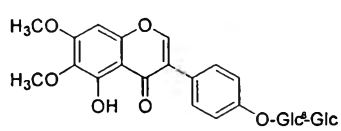
Plant and chemical compound	Plant part	Reference
Tectorigenin-7-*O*-*β*-D-gentiobioside **[264]** 	Stembark	Khera *et al.*, 1978
Volubilin **[265]** 	Flower	Chawla *et al.*, 1976
Volubilinin **[266]** 	Flower	Chawla *et al.*, 1976
Volubinol **[267]** 	Bark	Chawla *et al.*, 1984
7-*O*-Methyltectorigenin-4′-*O*-*β*-D-glucoside **[268]** 	Stembark	Khera *et al.*, 1978
7-*O*-Methyltectorigenin-4′-*O*-*β*-D-glucosyl-(1→6)-*β*- D-glucoside (7-*O*-Methyltectorigenin-4′-*O*-gentiobioside) **[269]** 	Stembark	Khera *et al.*, 1978

Table 5 Distribution of miscellaneous compounds in *Dalbergia* spp.

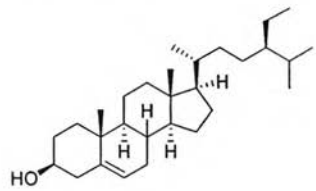
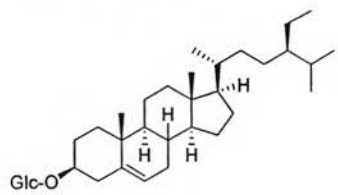
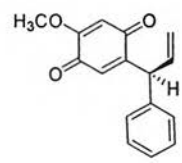
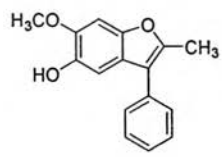
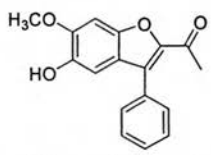
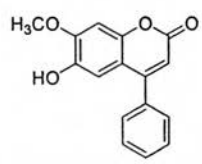
Plant and chemical compound	Category	Plant part	Reference
D. assamica			
β-Sitosterol **[51]** 	Steroid	Seed	Chibber *et al.*, 1978
Daucosterol **[52]** 	Steroid	Seed	Chibber *et al.*, 1978
D. baroni			
(*S*)-Dalbergione **[270]** 	Quinoid	Wood	Donelly *et al.*, 1965 Seshadri, 1972
Isoparvifuran **[271]** 	Benzofuran	Not specified	Donelly *et al.* 1981
2-Formylisoparvifuran **[272]** 	Benzofuran	Not specified	Donelly *et al.* 1981
6-Hydroxy-7-methoxy-4-phenyl coumarin (Dalbergin) **[273]** 	Coumarin	Wood	Seshadri, 1972

Table 5 (Continued)

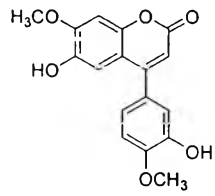
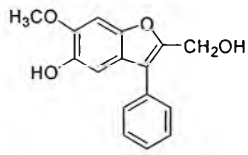
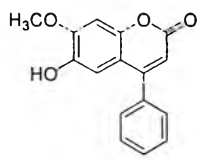
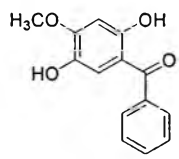
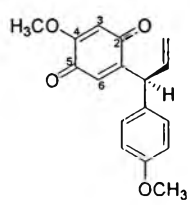
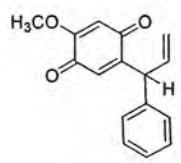
Plant and chemical compound	Category	Plant part	Reference
Melannein **[274]** 	Coumarin	Wood	Seshadri, 1972
2- Hydroxy-methylisoparvifuran **[275]** 	Benzofuran	Not specified	Donelly *et al.* 1981
D. cearensis			
Dalbergin **[273]** 	Coumarin	Softwood	De Souza Guimaraes, *et al.*, 1975
2,5-Dihydroxy-4-methoxybenzo phenone (Cearoin) **[276]** 	Benzenoid	Softwood	De Souza Guimaraes, *et al.*, 1975
(*S*)-4′-Methoxydalbergione **[277]** 	Quinoid	Softwood	De Souza Guimaraes, *et al.*, 1975
D. cochinchinnensis Dalbergione **[270]** 	Quinoid	Heartwood	Donelly *et al.*, 1968

Table 5 (Continued)

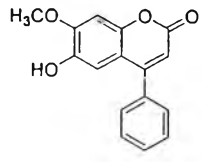
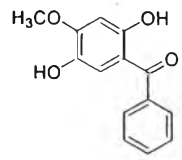
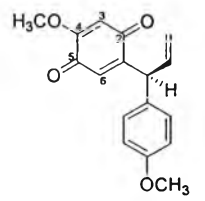
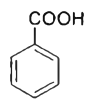
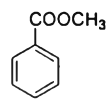
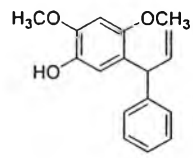
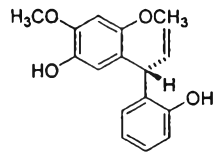
Plant and chemical compound	Category	Plant part	Reference
Dalbergin **[273]** 	Coumarin	Stem	Shirota *et al.*, 2003
Cearoin **[276]** 	Benzenoid	Heartwood	Kuroyanagi *et al.*, 1996
Methoxydalbergione **[277]** 	Quinoid	Stem	Shirota *et al.*, 2003
Benzoic acid **[278]** 	Benzenoid	Heartwood	Donelly *et al.*, 1968
Benzoic acid methyl ester **[279]** 	Benzenoid	Heartwood	Donelly *et al.*, 1968
Dalbergiphenol **[280]** 	Lignan	Stem	Shirota *et al.*, 2003
(*R*)-Latifolin **[281]** 	Lignan	Stem	Donelly *et al.*, 1968

Table 5 (Continued)

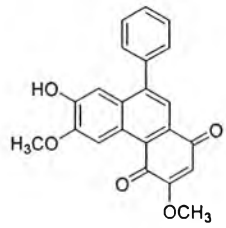
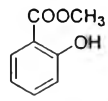
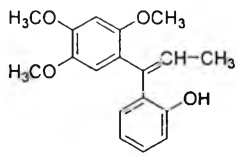
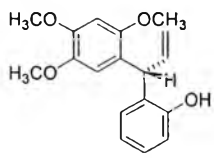
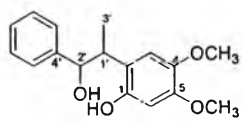
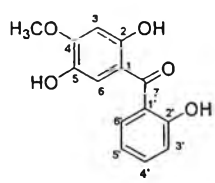
Plant and chemical compound	Category	Plant part	Reference
Latinone **[282]** 	Quinoid	Stem	Shirota *et al.*, 2003
Salicylic acid methyl ester **[283]** 	Benzenoid	Heartwood	Donelly *et al.*, 1968
(*R*)-5-*O*-Methylisolatifolin **[284]** 	Lignan	Stem	Kuroyanagi *et al.*, 1996
(*R*)-5-*O*-Methyllatifolin **[285]** 	Lignan	Stem	Kuroyanagi *et al.*, 1996
2-(2-Hydroxy-1-methyl-2-phenyl-ethyl)-4,5-dimetoxyphenol **[286]** 	Quinoid	Stem	Shirota *et al.*, 2003
2,2′,5-Trihydroxy-4-methoxy-benzophenone **[287]** 	Benzenoid	Heartwood	Pathak *et al.*, 1997

Table 5 (Continued)

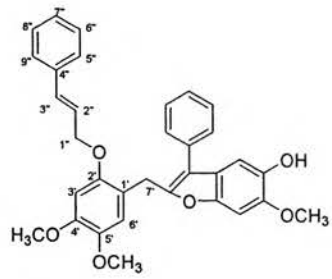
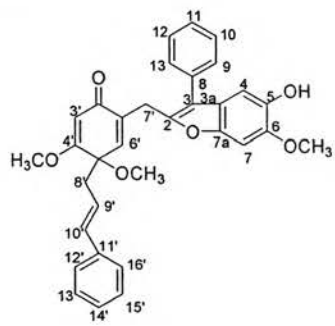
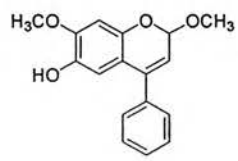
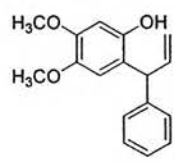
Plant and chemical compound	Category	Plant part	Reference
2-[4,5-Dimethoxy-2-(3-phenyl-*trans*-allyloxy) benzyl]-5-hydroxy-6-methoxy-3-phenylbenzofuran **[289]** 	Benzenoid	Stem	Shirota *et al.*, 2003
2-[4,5-Dimethoxy-5-(3-phenyl-*trans*-allyl)cyclohexa-3,6-dien-2-one-1-yl-methyl]-5-hydroxy-6-methoxy-3-phenyl benzofuran **[290]** 	Benzenoid	Stem	Shirota *et al.*, 2003
6-Hydroxy-2,7-dimethoxyphenyl chromene **[291]** 	Lignan	Stem	Pathak *et al.*, 1997
9- Hydroxy-2,7-dimethoxydalber giquinol **[292]** 	Lignan	Stem	Pathak *et al.*, 1997

Table 5 (Continued)

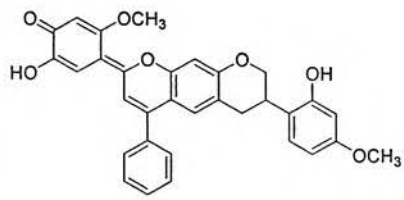
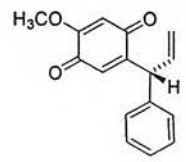
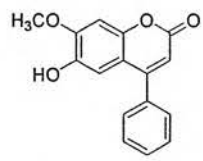
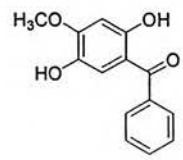
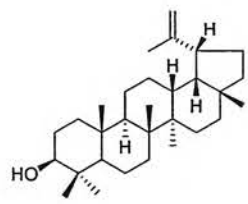
Plant and chemical compound	Category	Plant part	Reference
D. congestiflora			
Vestitol[6→9″ ; 7-*O*→7″] obtusaquinone (Neocandeatone) **[293]** 	Quinoid	Heartwood	Barrangan-Huerta *et al.*, 2004
D. coromandeliana			
(+)-(*R*)-Dalbergione **[270]** 	Quinoid	Root	Ramesh *et al.*, 1995
Dalbergin **[273]** 	Coumarin	Root	Ramesh *et al.*, 1995
Cearoin **[276]** 	Benzenoid	Root	Ramesh *et al.*, 1995
Lupeol **[294]** 	Triterpene	Root	Ramesh *et al.*, 1995

Table 5 (Continued)

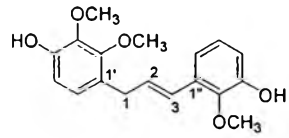
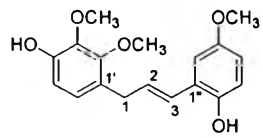
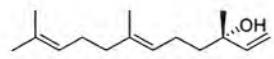
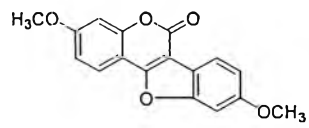
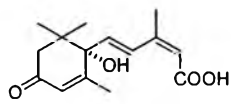
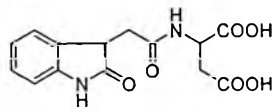
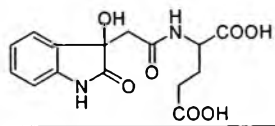
Plant and chemical compound	Category	Plant part	Reference
D. cultrata			
Dalberatin A **[295]** 	Benzenoid	Stembark	Ito *et al.*, 2003
Dalberatin B **[296]** 	Benzenoid	Stembark	Ito *et al.*, 2003
D. decipularis			
Trans-nerolidol **[297]** 	Sesquiterpene	Not specified	De Alencar *et al.*, 1974
3,9-Dimethoxycoumestrol **[298]** 	Pterocarpene	Not specified	Farnsworth *et al.*, 1975
D. dolichopetala			
Abscisic acid **[299]** 	Sesquiterpene	Seed	Monteiro *et al.*, 1987
Dioxindole-3-acetyl-aspartic acid **[300]** 	Indole alkaloid	Cotyledons	Ostin *et al.*, 1992
Dioxindole-3-acetyl-glutamic acid **[301]** 	Indole alkaloid	Cotyledons	Ostin *et al.*, 1992

Table 5 (Continued)

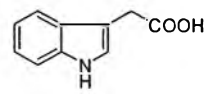
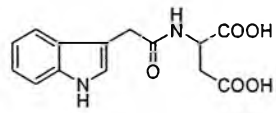
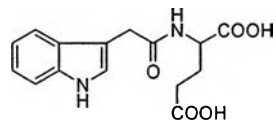
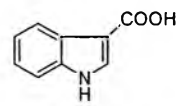
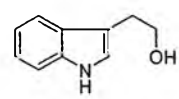
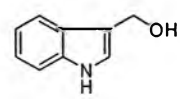
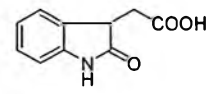
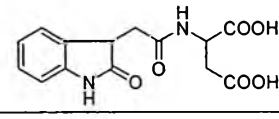
Plant and chemical compound	Category	Plant part	Reference
Indol-3-acetic acid **[302]** 	Indole alkaloid	Seed	Monteiro *et al.*, 1987
Indol-3-acetyl-aspartate **[303]** 	Indole alkaloid	cotyledons	Ostin *et al.*, 1992
Indol-3-acetyl-glutamate **[304]** 	Indole alkaloid	cotyledons	Ostin *et al.*, 1992
Indol-3-carboxylic acid **[305]** 	Indole alkaloid	Seed	Monteiro *et al.*, 1987
Indol-3-ethanol **[306]** 	Indole alkaloid	Seed	Monteiro *et al.*, 1987
Indol-3-methanol **[307]** 	Indole alkaloid	Seed	Monteiro *et al.*, 1987
Oxindole-3-acetic acid **[308]** 	Indole alkaloid	Seed	Monteiro *et al.*, 1987
Oxindole-3-acetyl-aspartic acid **[309]** 	Indole alkaloid	cotyledons	Ostin *et al.*, 1992

Table 5 (Continued)

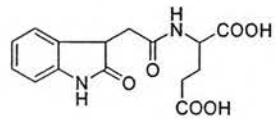
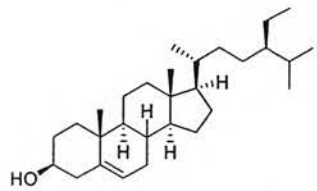
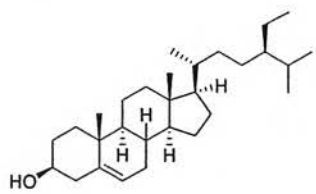
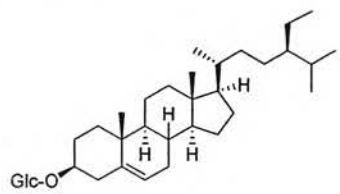
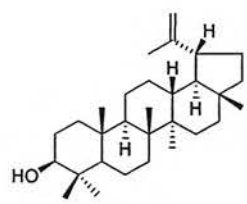
Plant and chemical compound	Category	Plant part	Reference
Oxindole-3-acetyl-glutamic acid **[310]** 	Indole alkaloid	cotyledons	Ostin *et al.*, 1992
D. ecastophyllum			
β-Sitosterol **[51]** 	Steroid	Leaf	Matos *et al.*, 1975
D. hainanensis			
β-Sitosterol **[51]** 	Steroid	Leaf	Zhang *et al.*, 2003
Daucosterol **[52]** 	Steroid	Leaf	Zhang *et al.*, 2003
Lupeol **[294]** 	Triterpene	Leaf	Zhang *et al.*, 2003

Table 5 (Continued)

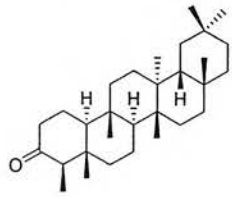
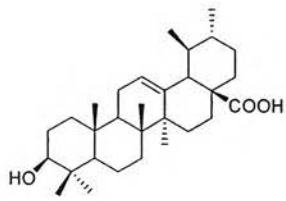
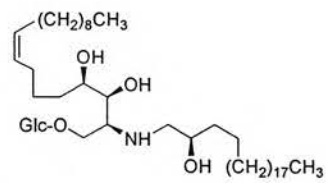
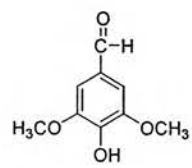
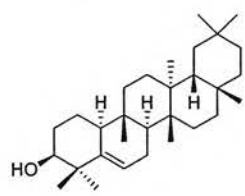
Plant and chemical compound	Category	Plant part	Reference
Friedelin **[311]** 	Steroid	Leaf	Zhang *et al.*, 2003
Taxaxerol **[312]**	Triterpene	Leaf	Zhang *et al.*, 2003
Ursolic acid **[313]** 	Steroid	Leaf	Zhang *et al.*, 2003
1-*O*-*β*-D-Glucopyranosyl-(2*S*, 3*S*,4*R*,8*Z*)-2-[(2*R*)-2-hydroxyl-docosylamino]-8-octadecene-1,3,4-triol **[314]** 	Alkaloid	Leaf	Zhang *et al.*, 2003
3,5-Dimethoxy-4-hydroxybenzal dehyde **[315]** 	Benzenoid	Leaf	Zhang *et al.*, 2003
3-Hydroxy-glutin-5-ene **[316]** 	Triterpene	Leaf	Zhang *et al.*, 2003

Table 5 (Continued)

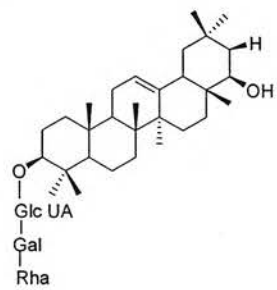
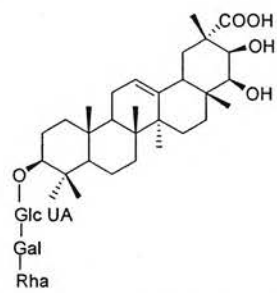
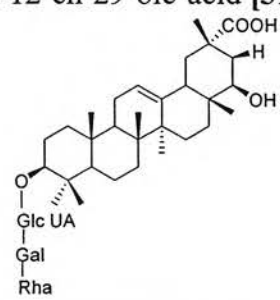
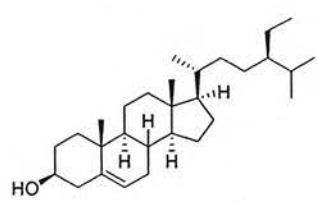
Plant and chemical compound	Category	Plant part	Reference
D. hupeana			
Kaikasaponin III **[317]** 	Triterpene	Bark	Yahara *et al.*, 1989
3-*O*-α-L-rhamnosyl-(1→2)-β-D-galactosyl-(1→2)-β-D-glucurono syluronic acid, 3-β-21-β-22-β-trihydroxy-olean-12-en-29-oic-acid **[318]** 	Triterpene	Bark	Yahara *et al.*, 1989
3-*O*-α-L-Rhamnosy(1→2)-β-D-galactosyl-(1→2)-β-D- glucurono syluronic acid-3-β-22-β-dihydroxy -olean-12-en-29-oic-acid **[319]** 	Triterpene	Bark	Yahara *et al.*, 1989
D. inundata			
β-Sitosterol **[51]** 	Steroid	Trunkwood	Leite De Almeida, *et al.*, 1974

Table 5 (Continued)

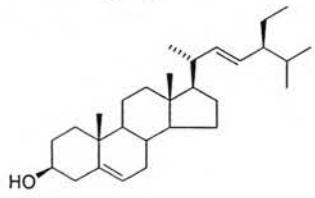
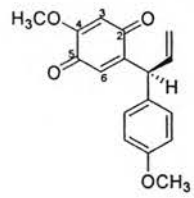
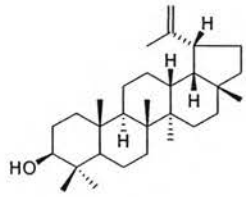
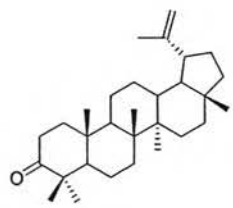
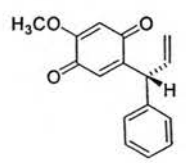
Plant and chemical compound	Category	Plant part	Reference
Stigmasterol **[62]** 	Steroid	Trunkwood	Leite De Almeida, *et al.*, 1974
(*S*)-4′-Methoxydalbergione **[277]** 	Quinoid	Trunkwood	Leite De Almeida, *et al.*, 1974
Lupeol **[294]** 	Triterpene	Trunkwood	Leite De Almeida, *et al.*, 1974
Lupenone **[320]** 	Triterpene	Trunkwood	Leite De Almeida, *et al.*, 1974
Stearic acid **[321]** $CH_3(CH_2)_{16}COOH$	Lipid	Trunkwood	Leite De Almeida, *et al.*, 1974
D. lafifolia			
(*R*)-Dalbergione **[270]** 	Quinoid	Wood	Donelly *et al.* 1965

Table 5 (Continued)

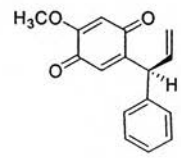
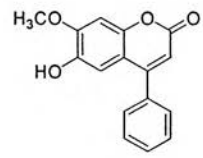
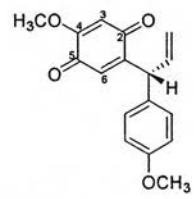
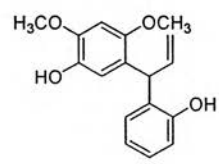
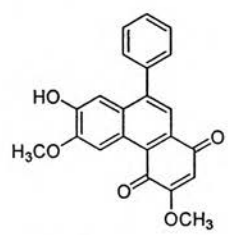
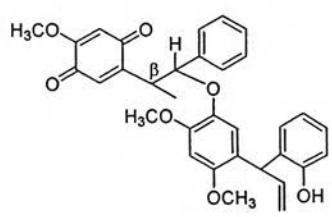
Plant and chemical compound	Category	Plant part	Reference
(*S*)-Dalbergione **[270]** 	Quinoid	Wood	Seshadri, 1972
Dalbergin **[273]** 	Coumarin	Wood	Seshadri, 1972
(*R*)-4-Methoxydalbergione **[277]** 	Quinoid	Wood	Seshadri, 1972
Latifolin **[281]** 	Lignan	Entire plant	Hakamata *et al.*, 1993
Latinone **[282]** 	Quinoid	Heartwood	Criodain *et al.*, 1981
Dalcriodain **[322]** 	Quinoid	Not specified	Donelly *et al.* 1981

Table 5 (Continued)

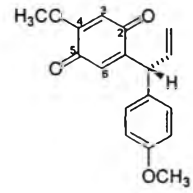
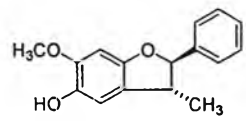
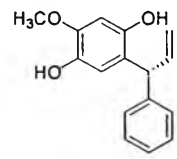
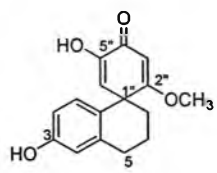
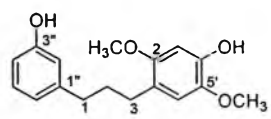
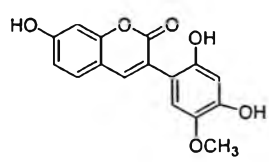
Plant and chemical compound	Category	Plant part	Reference
D. louvelii			
(*R*)-4′-Methoxydalbergione **[277]** 	Quinoid	Heartwood	Beldjoudi *et al.*, 2003
(2*R*,3*R*)-2-Phenyl-3-methyl-2,3-dihydro-5-hydroxy-6-methoxy benzofuran (Obtusafuran) **[323]** 	Benzofuran	Heartwood	Beldjoudi *et al.*, 2003
(*R*)-3-(2,5-Hydroxy-4-methoxy phenyl)-3-phenylpropene (Obtusaquinol) **[324]** 	Lignan	Heartwood	Beldjoudi *et al.*, 2003
Spirolouveline **[325]** 	Spiranoid	Heartwood	Beldjoudi *et al.*, 2003
1-(3-Hydroxyphenyl)-3-(4-hydroxy-2,5-dimethoxyphenyl) propane **[326]** 	Benzenoid	Heartwood	Beldjoudi *et al.*, 2003
3-(2,4-Dihydroxy-5-methoxy)-phenyl-7-hydroxy coumarin **[327]** 	Coumarin	Heartwood	Beldjoudi *et al.*, 2003

Table 5 (Continued)

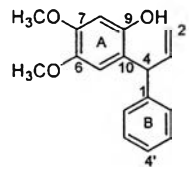
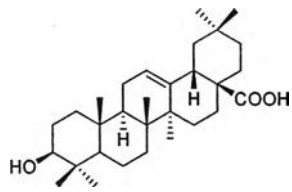
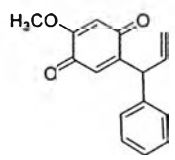
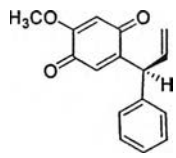
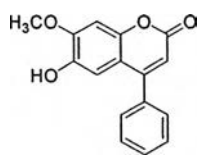
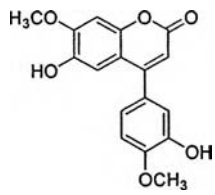
Plant and chemical compound	Category	Plant part	Reference
9-Hydroxy-6,7-dimethoxydalbergi quinol **[328]** 	Lignan	Heartwood	Beldjoudi *et al.*, 2003
D.malabarica			
Oleanolic acid **[329]** 	Triterpene	Flower Fruit Stem Twindia	Vanangamudi *et al.*, 1998
D. melanoxylon			
4-Methoxyldalbergione **[270]** 	Quinoid	Wood	Schultz *et al.*, 1979
(*S*)-4- Methoxyldalbergione **[270]** 	Quinoid	Heartwood	Donelly *et al.*, 1975
Dalbergin **[273]** 	Coumarin	Heartwood	Donelly *et al.*, 1975
Melannein **[274]** 	Coumarin	Heartwood	Donelly *et al.*, 1975

Table 5 (Continued)

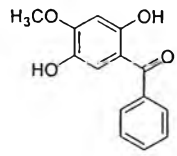
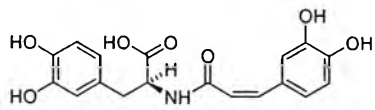
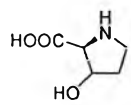
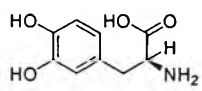
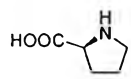
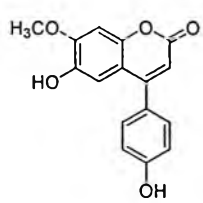
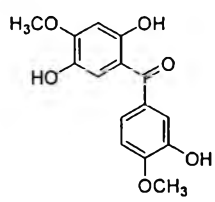
Plant and chemical compound	Category	Plant part	Reference
Cearoin **[276]** 	Benzenoid	Heartwood	Donelly *et al.*, 1975
Cis-(−)-Clovamide **[330]** 	Alkaloid	Bark	Van Heerden *et al.*, 1980
L-4-Hydroxymethyleneproline **[331]** 	Proteid	Bark	Van Heerden *et al.*, 1980
L-Dopa **[332]** 	Proteid	Bark	Van Heerden *et al.*, 1980
L-Proline **[333]** 	Proteid	Bark	Van Heerden *et al.*, 1980
Melanettin **[334]** 	Coumarin	Heartwood	Donelly *et al.*, 1975
2,3′,5-Trihydroxy-4,4′-dimethoxy-benzophenone (Matanoxoin) **[335]** 	Benzenoid	Heartwood	Donelly *et al.*, 1975

Table 5 (Continued)

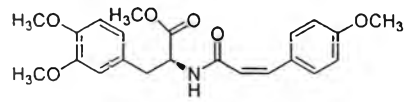
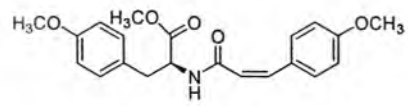
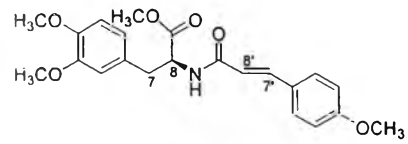
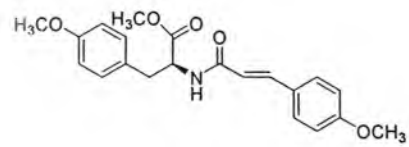
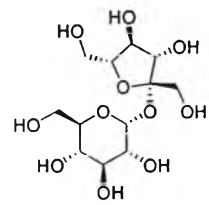
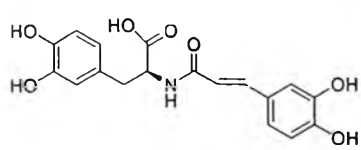
Plant and chemical compound	Category	Plant part	Reference
N-(4′-Methoxy-*cis*-cinamoyl)-3-(3,4-dimethoxyphenyl)-L-alanine **[336]** 	Alkaloid	Bark	Van Heerden *et al.*, 1980
N-(4′-Methoxy-*cis*-cinnamoyl)-3-(4-methoxy-phenyl)-L-alanine **[337]** 	Alkaloid	Bark	Van Heerden *et al.*, 1980
N-(4′-Methoxy-*trans*-cinnamoyl)-3-(3,4-dimethoxyphenyl)-L-alanine **[338]** 	Alkaloid	Bark	Van Heerden *et al.*, 1980
N-(4′-Methoxy-*trans*-cinnamoyl)-3-(4-methoxyphenyl)-L-alanine **[339]** 	Alkaloid	Bark	Van Heerden *et al.*, 1980
Sucrose **[340]** 	Carbohydrate	Heartwood	Donelly *et al.*, 1975
Trans-(−)-clovamide **[341]** 	Alkaloid	Bark	Van Heerden *et al.*, 1980

Table 5 (Continued)

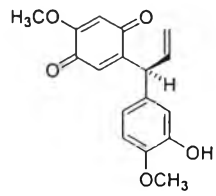
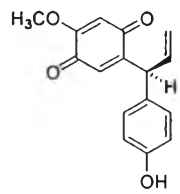
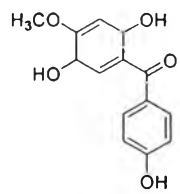
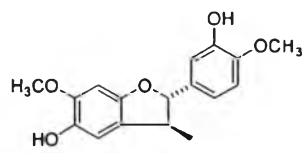
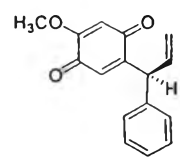
Plant and chemical compound	Category	Plant part	Reference
(*S*)-3′-Hydroxy-4,4′-dimethoxy dalbergione **[342]** 	Quinoid	Heartwood	Donelly *et al.*, 1975
(*S*)-4′-Hydroxy-4-methoxy dalbergione **[343]** 	Quinoid	Heartwood	Donelly *et al.*, 1975
2,4′,5-Trihydroxy-4-methoxybenzo phenone (Melannoin) **[344]** 	Benzenoid	Heartwood	Donelly *et al.*, 1975
Melanoxin **[359]** 	Benzofuran	Heartwood	Donelly *et al.*, 1975
D.miscolobium			
(*S*)-Dalbergione **[270]** 	Quinoid	Heartwood	Gregson *et al.*, 1978

Table 5 (Continued)

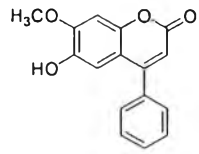
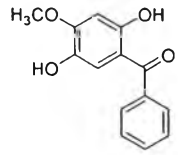
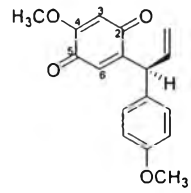
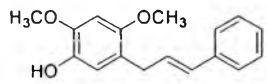
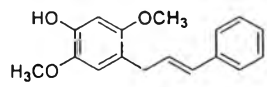
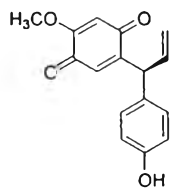
Plant and chemical compound	Category	Plant part	Reference
Dalbergin **[273]** 	Coumarin	Heartwood	Gregson *et al.*, 1978
Cearoin **[276]** 	Benzenoid	Heartwood	Gregson *et al.*, 1978
(*S*)-4′-Methoxydalbergione **[277]** 	Quinoid	Heartwood	Seshadri 1972
Isoviolastyrene **[345]** 	Benzenoid	Heartwood	Seshadri 1972
Violastyrene **[346]** 	Benzenoid	Heartwood	Seshadri 1972
(*S*)-4′-Hydroxydalbergione **[347]** 	Quinoid	Heartwood	Gregson *et al.*, 1978

Table 5 (Continued)

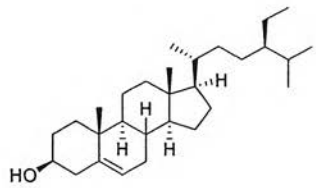
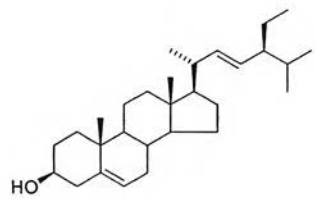
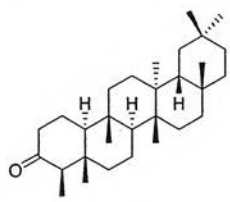
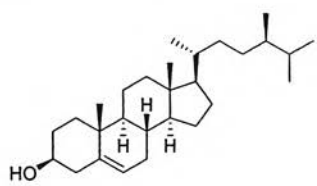
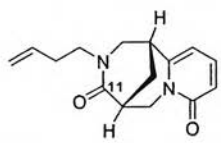
Plant and chemical compound	Category	Plant part	Reference
D. monetaria			
β-Sitosterol **[51]** 	Steroid	Stembark	Nunes *et al.*, 1989
Stigmasterol **[62]** 	Steroid	Stembark	Nunes *et al.*, 1989
Friedelin **[311]** 	Triterpene	Stembark	Nunes *et al.*, 1989
Campesterol **[348]** 	Steroid	Stembark	Nunes *et al.*, 1989
11-Oxotetrahydro-rhombifoline **[349]** 	Quinolizidine Alkaloid	Root	Kinghorn *et al.*, 1982

Table 5 (Continued)

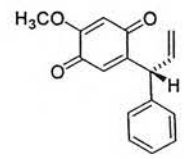
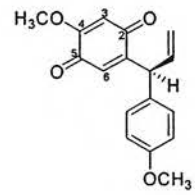
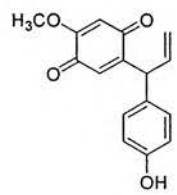
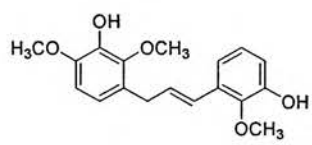
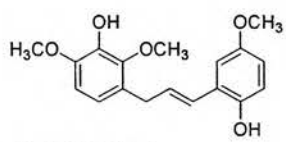
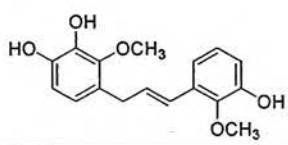
Plant and chemical compound	Category	Plant part	Reference
D. nigra			
(*R*)-Dalbergione **[270]** 	Quinoid	Not specified	Seshardri 1972
(±)-4,4′-Dimethoxydalbergione **[277]** 	Quinoid	Wood	Schultz *et al.*, 1979
(±)-4′-Hydroxydalbergione **[347]** 	Quinoid	Wood	Schultz *et al.*, 1979
D. nigrescens			
Dalberatin C **[350]** 	Benzenoid	Stembark	Ito *et al.*, 2003
Dalberatin D **[351]** 	Benzenoid	Stembark	Ito *et al.*, 2003
Dalberatin E **[352]** 	Benzenoid	Stembark	Ito *et al.*, 2003

Table 5 (Continued)

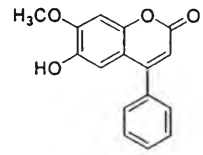
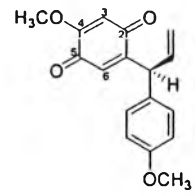
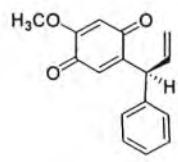
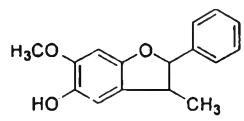
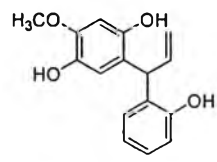
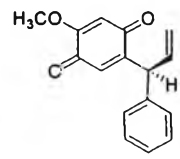
Plant and chemical compound	Category	Plant part	Reference
D. nitidula			
Dalbergin **[273]** 	Coumarin	Heartwood	Letcher *et al.*, 1976
(*S*)-4′-Methoydalbergione **[277]** 	Quinoid	Heartwood	Letcher *et al.*, 1976
D. obtusa			
Dalbergione **[270]** 	Quinoid	Wood	Seshardri 1972
(±) Obtusafuran **[323]** 	Benzofuran	Heartwood	Gregson *et al.*, 1968 Jurd *et al.*, 1972
Obtusaquinol **[324]** 	Lignan	Not specified	Seshardri 1972
D. odorifera			
(*S*)-4-Methoxydalbergione **[270]** 	Quinoid	Heartwood	Chan *et al.*, 1998

Table 5 (Continued)

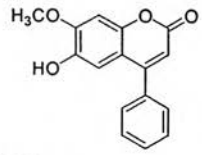
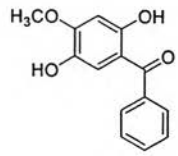
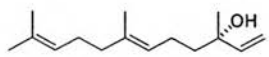
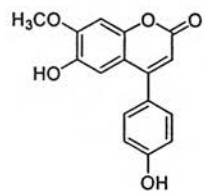
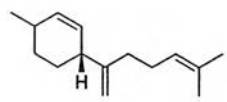
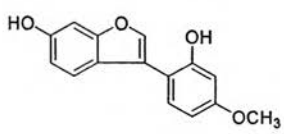
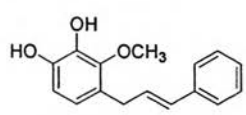
Plant and chemical compound	Category	Plant part	Reference
Dalbergin **[273]** 	Coumarin	Heartwood	Chan *et al.*, 1997
Cearoin **[276]** 	Benzenoid	Heartwood	Chan *et al.*, 1998
Trans-nerolidol **[297]** 	Sesquiter pene	Wood	Guo *et al.*, 1983
Melanettin **[334]** 	Coumarin	Heartwood	Chan *et al.*, 1997
β-Bisabolene **[353]** 	Sesquiter pene	Wood	Guo *et al.*, 1983
Centrolobufuran **[354]** 	Benzofuran	Heartwood	Harborne 1993
Hydroxyyobustyrene **[355]** 	Benzenoid	Heartwood	Goda *et al.*, 1985

Table 5 (Continued)

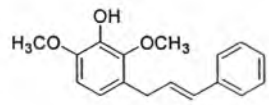
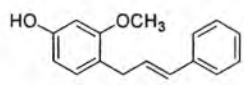
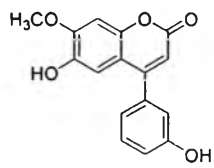
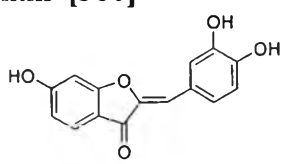
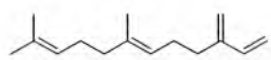
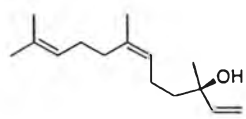
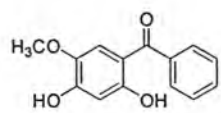
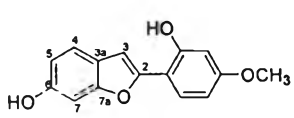
Plant and chemical compound	Category	Plant part	Reference
Iso-mucronustyrene **[356]** 	Benzenoid	Heartwood	Goda *et al.*, 1985
Obtustyrene **[357]** 	Benzenoid	Heartwood Rootwood	Goda *et al.*, 1985 Goda *et al.*, 1992
Stevenin **[358]** 	Coumarin	Heartwood	Chan *et al.*, 1998
Sulfurentin **[360]** 	Benzofuran	Heartwood	Chan *et al.*, 1998
Trans-*β*-farnesene **[361]** 	Sesquiterpene	Wood	Guo *et al.*, 1983
Cis-nerolidol **[362]** 	Sesquiterpene	Wood	Cheng *et al.*, 1996
2,4-Dihydroxy-5-methoxybenzophenone **[363]** 	Benzenoid	Heartwood	Wang *et al.*, 2000
2′,6-Dihydroxy-4′-methoxy-2-arylbenzofuran **[364]** 	Benzofuran	Wood Heartwood	Miller *et al.*, 1989 Ogata *et al.*, 1990

Table 5 (Continued)

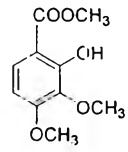
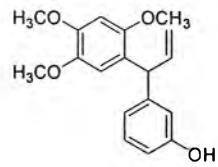
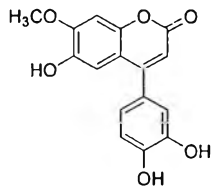
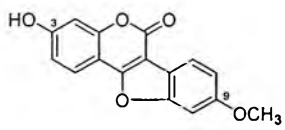
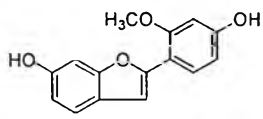
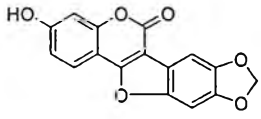
Plant and chemical compound	Category	Plant part	Reference
2- Hydroxy-3,4-dimethoxy-benzoic acid methyl ester **[365]** 	Benzenoid	Heartwood	Goda *et al.*, 1985
3'- Hydroxy-2,4,5-trimethoxydalbergiquinol **[366]** 	Lignan	Heartwood	Chan *et al.*, 1997
3'-Hydroxymelanettin **[367]** 	Coumarin	Heartwood	Chan *et al.*, 1997
3-Hydroxy-9-methoxy-coumestan **[368]** 	Pterocarpene	Heartwood	Chan *et al.*, 1998
6-Demethyl-vignafuran **[369]** 	Benzofuran	Wood	Miller *et al.*, 1989
D.olivera			
Medicagol **[370]** 	Pterocarpene	Heartwood	Donelly *et al.*, 1974

Table 5 (Continued)

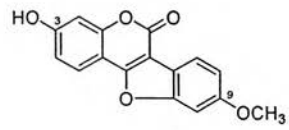
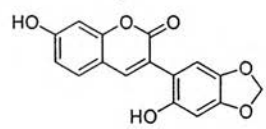
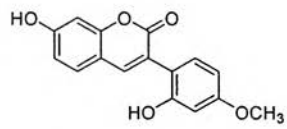
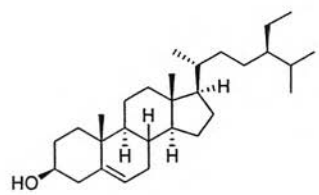
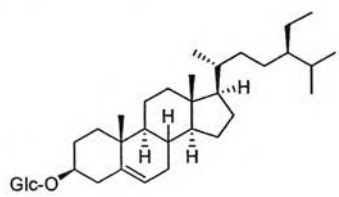
Plant and chemical compound	Category	Plant part	Reference
12-*O*-Methylcoumestrol **[371]** 	Pterocarpene	Heartwood	Donelly *et al.*, 1974
2′,7-Dihydroxy-4′,5′-methylenedioxy -3-phenylcoumarin **[372]** 	Coumarin	Heartwood	Donelly *et al.*, 1974
2′,7-Dihydroxy-4′-methoxy-3-phenyl coumarin **[373]** 	Coumarin	Heartwood	Donelly *et al.*, 1974
D. paniculata			
β-Sitosterol **[51]** 	Steroid	Leaf Root Bark	Pathasarathy *et al.*, 1976 Rao *et al.*, 1992 Narayanan *et al.*, 1971
Daucosterol **[52]** 	Steroid	Bark	Pathasarathy *et al.*, 1980
Stearic acid **[321]** $CH_3(CH_2)_{16}COOH$	Lipid	Seed	Ramachandraiah 1991

Table 5 (Continued)

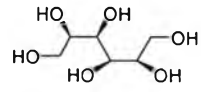
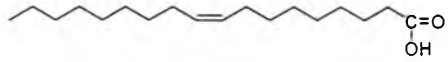
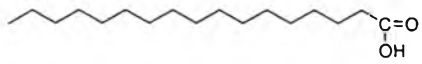
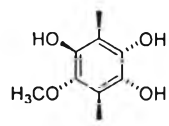
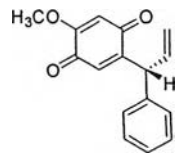
Plant and chemical compound	Category	Plant part	Reference
Linoleic acid **[374]** 	Lipid	Seed	Ramachandraiah 1991
Mannitol **[375]** 	Carbohydrate	Bark	Pathasarathy *et al.*, 1980
Oleic acid **[376]** 	Lipid	Seed	Ramachandraiah 1991
Palmitic acid **[377]** 	Lipid	Seed	Ramachandraiah 1991
(+)-Pinitol **[378]** 	Carbohydrate	Root Leaf Seed	Radhakrishniah *et al.*, 1979 Pathasarathy *et al.*, 1976 Rao *et al.*, 1996
Triacontan-1-ol **[379]** $C_{30}H_{61}OH$	Alkanol	Leaf	Radjasekhara *et al.*, 1992
N-Triacontane **[380]** $C_{30}H_{62}$	Alkane	Root	Radhakrishniah 1979
D. parviflora			
(+)-(*R*)-4-Methoxydalbergione **[270]** 	Quinoid	Heartwood	Muangnoicha-roen *et al.*, 1982

Table 5 (Continued)

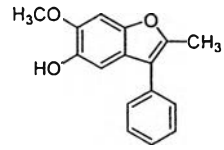
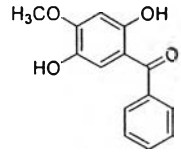
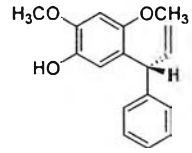
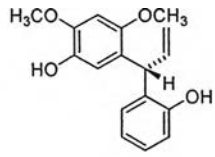
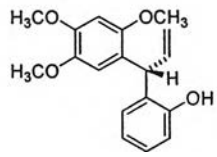
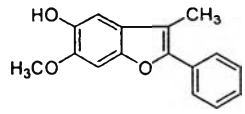
Plant and chemical compound	Category	Plant part	Reference
Isopavifuran **[271]** 	Benzofuran	Heartwood	Muangnoicha-roen *et al.*, 1981
Cearoin **[276]** 	Benzenoid	Heartwood	Muangnoicha-roen *et al.*, 1982
(+)-(*R*)-Dalbergiphenol **[280]** 	Lignan	Heartwood	Muangnoicha-roen *et al.*, 1980
(−)-(*R*)-Latifolin **[281]** 	Lignan	Heartwood	Muangnoicha-roen *et al.*, 1982
(−)-(*R*)-5-*O*-Methyllatifolin **[285]** 	Lignan	Heartwood	Muangnoicha-roen *et al.*, 1982
Parvifuran **[381]** 	Benzofuran	Heartwood	Muangnoicha-roen *et al.*, 1980

Table 5 (Continued)

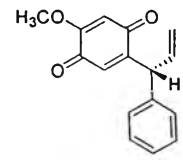
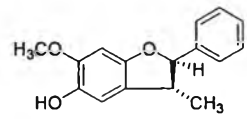
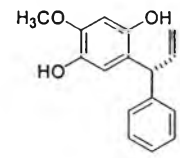
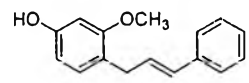
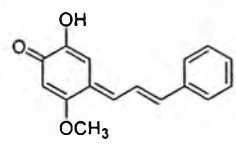
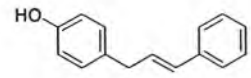
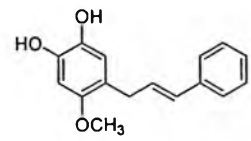
Plant and chemical compound	Category	Plant part	Reference
D. retusa			
(+)-(*R*)-4-Methoxydalbergione **[270]** 	Quinoid	Heartwood	Gregson *et al.*, 1978
(+)-(2*R*,3*R*)-Obtusafuran **[323]** 	Benzofuran	Heartwood	Gregson *et al.*, 1978
		Wood	Jurd *et al.*, 1972
(*R*)-Obtusaquinol **[324]** 	Lignan	Heartwood	Gregson *et al.*, 1978
Obtustyrene **[357]** 	Benzenoid	Heartwood	Gregson *et al.*, 1978
Obtusaquinone **[383]** 	Quinoid	Heartwood	Turner 1976 Gregson *et al.*, 1978
Obtusastyrene **[384]** 	Benzenoid	Heartwood	Gregson *et al.*, 1978
4-Cinnamyl-3-methoxycatechol **[385]** 	Benzenoid	Heartwood	Manners *et al.*, 1974

Table 5 (Continued)

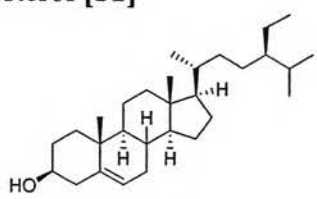
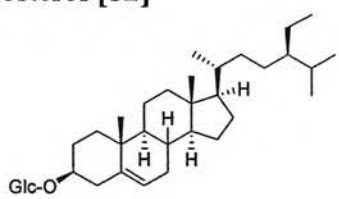
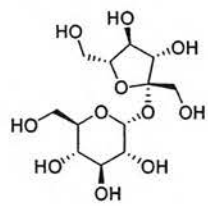
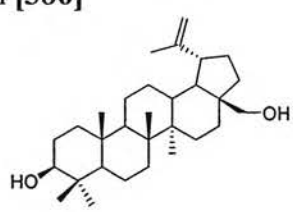
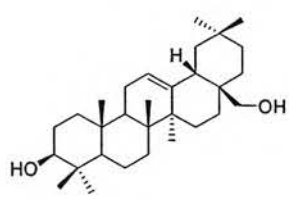
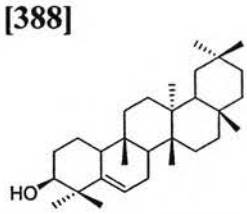
Plant and chemical compound	Category	Plant part	Reference
D. sericea			
β-Sitosterol **[51]** 	Steroid	Bark	Pathasarathy *et al.*, 1976
Daucosterol **[52]** 	Steroid	Leaf	Dayal *et al.*, 1977
Sucrose **[340]** 	Carbohydrate	Bark	Pathasarathy *et al.*, 1976
Betulin **[386]** 	Triterpene	Bark	Pathasarathy *et al.*, 1976
Erythrodiol **[387]** 	Triterpene	Bark	Pathasarathy *et al.*, 1976
Glutinol **[388]** 	Triterpene	Bark	Pathasarathy *et al.*, 1976

Table 5 (Continued)

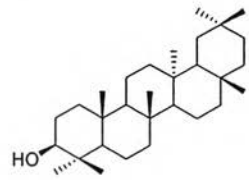
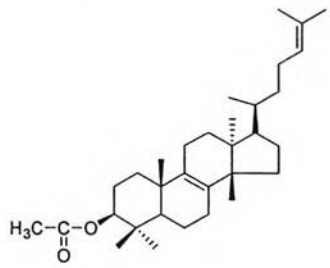
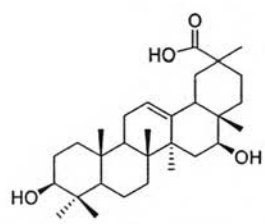
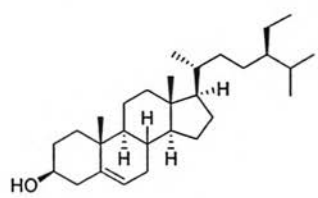
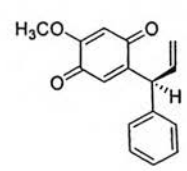
Plant and chemical compound	Category	Plant part	Reference
Teraxerol **[389]** 	Triterpene	Bark	Pathasarathy *et al.*, 1976
Tirucallol acetate **[390]** 	Triterpene	Bark	Pathasarathy *et al.*, 1976
3-β-16-β-Dihydroxy-olean-12-en-29(or 30)-oic acid **[391]** 	Triterpene	Bark	Pathasarathy *et al.*, 1976
D. sisoides			
β-Sitosterol **[51]** 	Steroid	Sapwood	Ravi et al., 1990
(*S*)-4-Methoxydalbergione **[270]** 	Quinoid	Root	Gandhidasan *et al.*, 1990

Table 5 (Continued)

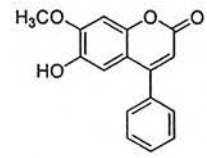
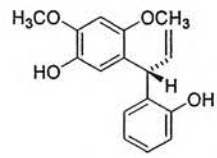
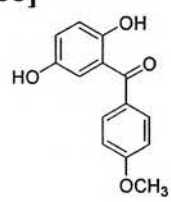
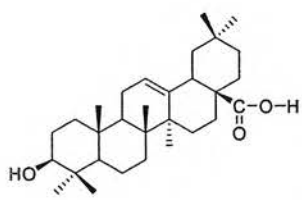
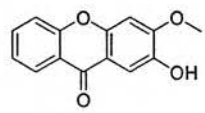
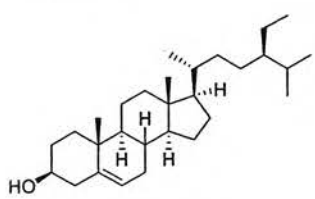
Plant and chemical compound	Category	Plant part	Reference
Dalbergin **[273]** 	Coumarin	Root	Gandhidasan *et al.*, 1990
(*R*)-Latifolin **[281]** 	Lignan	Sapwood Root	Ravi *et al.*, 1990 Gandhidasan *et al.*, 1990
2,5-Dihydroxy-4-methoxybenzophenone **[288]** 	Benzenoid	Root	Sripathai *et al.*, 1994
Oleanolic acid **[329]** 	Triterpene	Heartwood	Ravi *et al.*, 1990
2-Hydroxy-3-methoxyxanthone **[392]** 	Xanthone	Wood	Sripathai *et al.*, 1994
D.sissoo			
β-Sitosterol **[51]** 	Steroid	Leaf	Serg *et al.*, 1999

Table 5 (Continued)

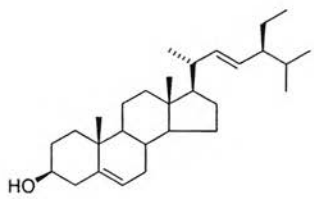
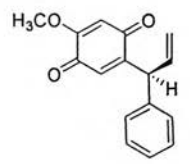
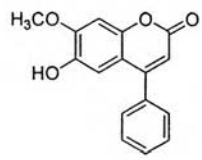
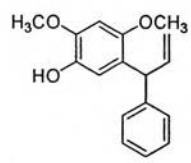
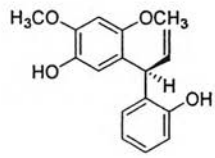
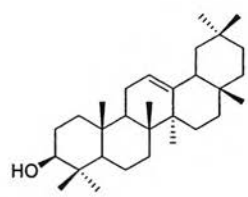
Plant and chemical compound	Category	Plant part	Reference
Stigmasterol **[62]** 	Steroid	Leaf	Serg *et al.*, 1999
(*S*)-Dalbergione **[270]** 	Quinone	Leaf	Ramakrishana *et al.*, 2001
Dalbergin **[273]** 	Coumarin	Seedpod Bark	Sharma *et al.*, 1979 Dhingra *et al.*, 1974
Dalbergiphenol **[280]** 	Lignan	Leaf	Serg *et al.*, 1999
Latifolin **[281]** 	Lignan	Heartwood	Ramakrishana *et al.*, 2001
β-Amyrin **[393]** 	Triterpene	Leaf	Serg *et al.*, 1999

Table 5 (Continued)

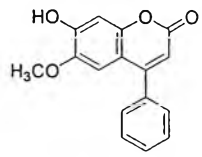
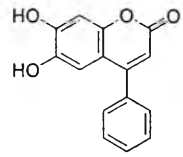
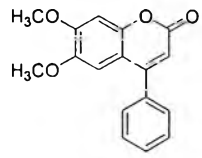
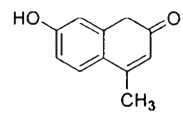
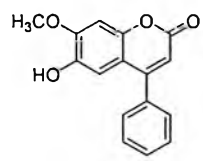
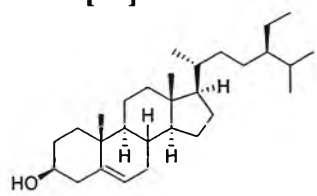
Plant and chemical compound	Category	Plant part	Reference
Isodalbergin **[394]** 	Coumarin	Wood	Seshadri *et al.*, 1972
Nordalbergin **[395]** 	Coumarin	Wood	Seshadri *et al.*, 1972
O-Methyldalbergin **[396]** 	Coumarin	Wood	Seshadri *et al.*, 1972
7-Hydroxy-4-methylcoumarin **[397]** 	Coumarin	Seedpod	Sharma *et al.*, 1979
D. spinosa			
Dalbergin **[273]** 	Coumarin	Root	Gandhidasan *et al.*, 1982
D. spruceana			
β-Sitosterol **[51]** 	Steroid	Sapwood	Cook *et al.*, 1978

Table 5 (Continued)

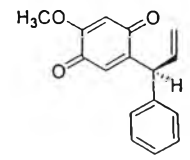
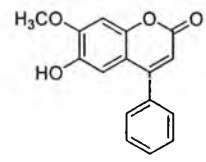
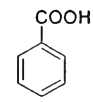
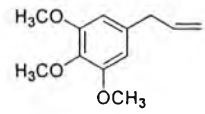
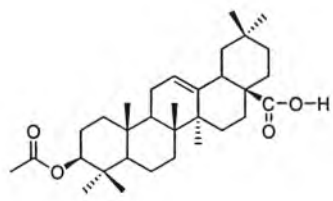
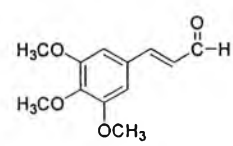
Plant and chemical compound	Category	Plant part	Reference
(*S*)-Dalbergione **[270]** 	Quinoid	Sapwood	Cook *et al.*, 1978
Dalbergin **[273]** 	Coumarin	Sapwood	Cook *et al.*, 1978
Benzoic acid **[278]** 	Benzenoid	Sapwood	Cook *et al.*, 1978
Elemicin **[398]** 	Phenylpropanoid	Sapwood	Cook *et al.*, 1978
3-*β*-Acetoxyolean-12-en-28-oic acid (Oleanolic acid acetate) **[399]** 	Triterpene	Sapwood	Cook *et al.*, 1978
3,4,5-Trimethoxycinnamaldehyde **[400]** 	Phenylpropanoid	Sapwood	Cook *et al.*, 1978

Table 5 (Continued)

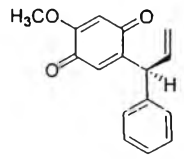
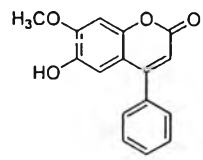
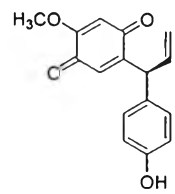
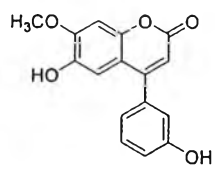
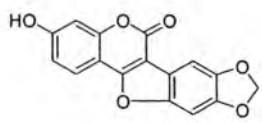
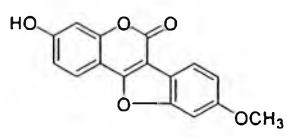
Plant and chemical compound	Category	Plant part	Reference
D.stevensonii			
(*S*)-Dalbergione **[270]** 	Quinoid	Heartwood	Donnelly *et al.*, 1973
Dalbergin **[273]** 	Coumarin	Heartwood	Donnelly *et al.*, 1973
(*S*)-4′-Hydroxydalbergione **[347]** 	Quinoid	Heartwood	Donnelly *et al.*, 1973
Stevenin **[358]** 	Coumarin	Heartwood	Donnelly *et al.*, 1973
Medicagol **[370]** 	Pterocarpene	Heartwood	Donnelly *et al.*, 1973
12-O-Methylcoumestrol **[371]** 	Pterocarpene	Heartwood	Donnelly *et al.*, 1973

Table 5 (Continued)

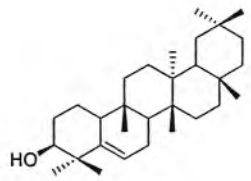
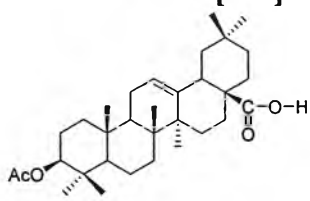
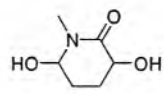
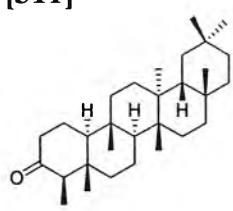
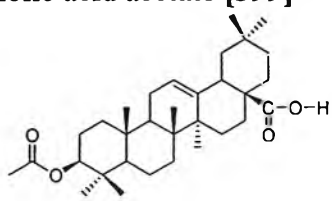
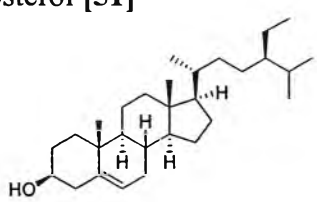
Plant and chemical compound	Category	Plant part	Reference
Glut-5-en-3-beta-ol-(Glutinol) **[388]** 	Triterpene	Heartwood	Donnelly *et al.*, 1973
Oleanolic acid acetate **[399]** 	Triterpene	Heartwood	Donnelly *et al.*, 1973
D. sympathetica			
3,6-Dihydroxy-*N*-methyl-2-piperidone **[401]** 	Alkaloid	Not specified	Nagarajan *et al.*, 2005
D. variabilis			
Friedelin **[311]** 	Triterpene	Stem	Kurosawa *et al.*, 1978
Oleanolic acid acetate **[399]** 	Triterpene	Stem	Kurosawa *et al.*, 1978
D. volubilis			
β-Sitosterol **[51]** 	Steroid	Stembarg Leaf Twig	Khera *et al.*, 1978 Chawla *et al.*, 1977 Chawla *et al.*, 1987

Table 5 (Continued)

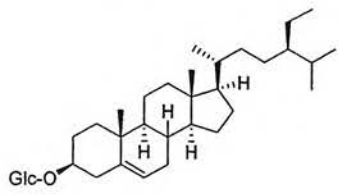
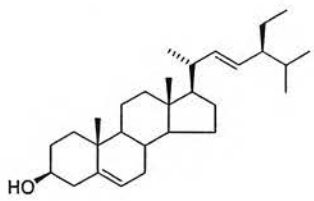
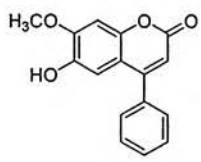
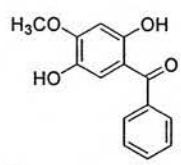
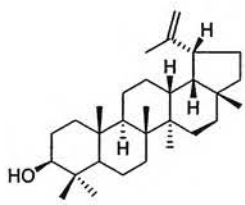
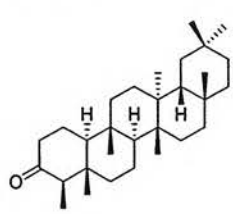
Plant and chemical compound	Category	Plant part	Reference
Daucosterol **[52]** 	Steroid	Stembark	Khera *et al.*, 1978
Stigmasterol **[62]** 	Steroid	Flower	Chawla *et al.*, 1974
Dalbergin **[273]** 	Coumarin	Twig Branches	Chawla *et al.*, 1987 Chawla *et al.*, 1983
Cearoin **[276]** 	Benzenoid	Stembark	Khera *et al.*, 1978
Lupeol **[294]** 	Triterpene	Stembark	Khera *et al.*, 1978
Friedelin **[311]** 	Triterpene	Wood Trunkwood	Biswas *et al.*, 1977 Chandler *et al.*, 1979

Table 5 (Continued)

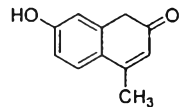
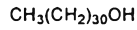
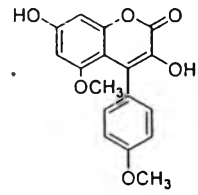
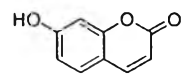
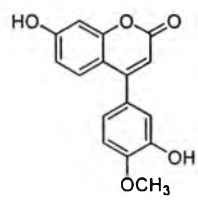
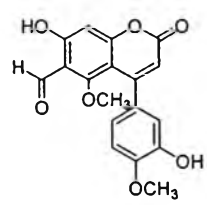
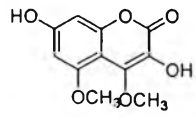
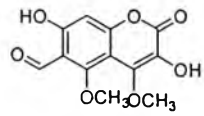
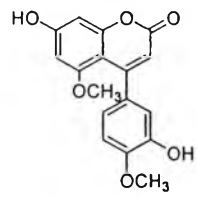
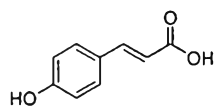
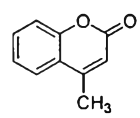
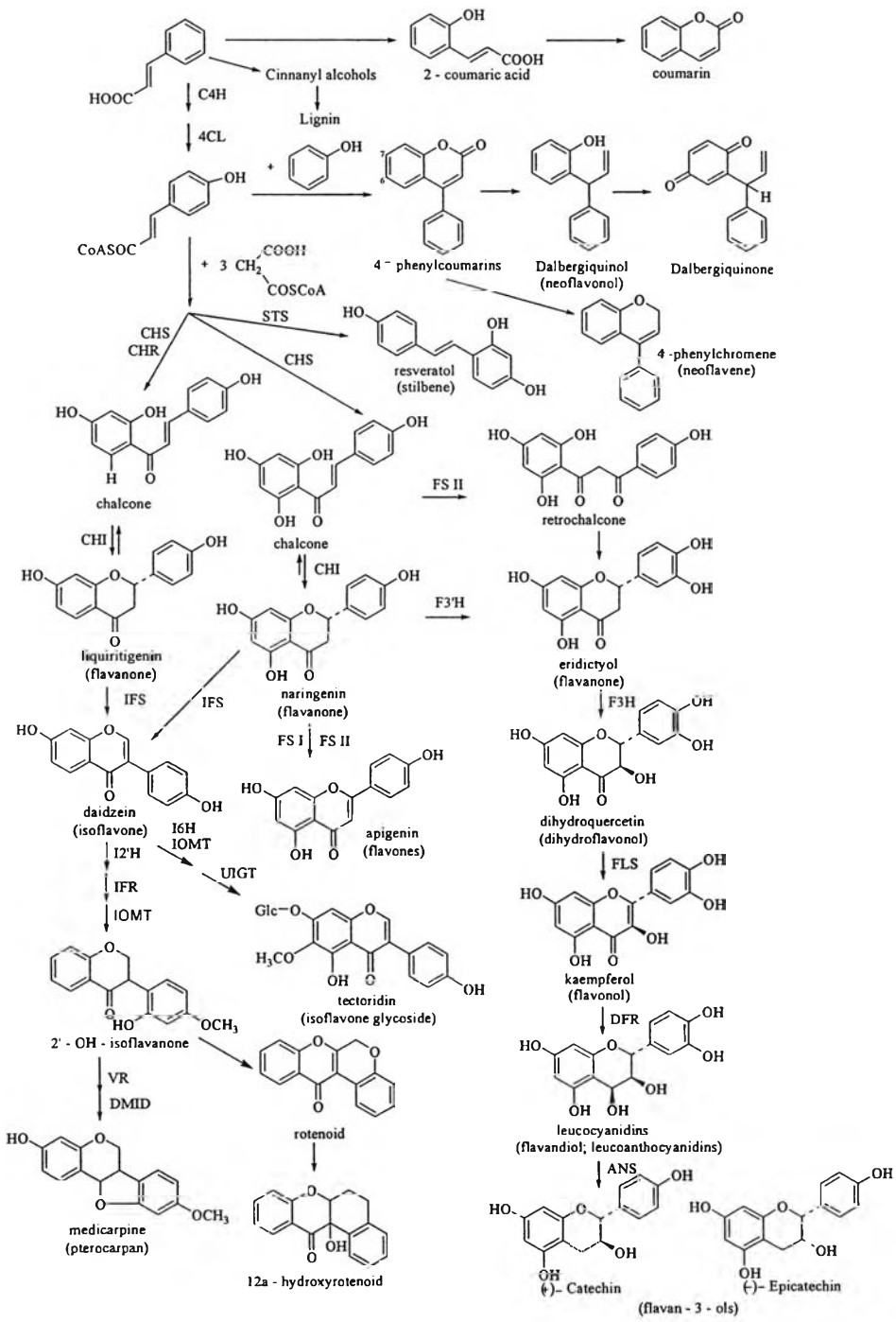
Plant and chemical compound	Category	Plant part	Reference
N-Triacontane **[380]** 	Alkane	Leaf	Chawla *et al.*, 1977
7-Hydroxy-4-methylcoumarin **[397]** 	Coumarin	Branches	Chawla *et al.*, 1983
Myricyl alcohol **[402]** 	Alkanol	Leaf	Chawla *et al.*, 1977
Seshadrin **[403]** 	Coumarin	Branches	Chawla *et al.*, 1984
Umbelliferone **[404]** 	Coumarin	Branches	Chawla *et al.*, 1989
Volubolin **[405]** 	Coumarin	Branches Twig	Chawla *et al.*, 1983 Chawla *et al.*, 1987
6-Formyl-3′,7-dihydroxy-4′,5-dimethoxy-4-phenyl-2H-1-benzo pyran-2-one (Voludal) **[406]** 	Coumarin	Branches	Chawla *et al.*, 1984

Table 5 (Continued)

Plant and chemical compound	Category	Plant part	Reference
3,7-Dihydroxy-4,5-dimethoxy-2H-1-benzopyran-2-one **[407]** 	Coumarin	Branches	Chawla *et al.*, 1989
3,7-Dihydroxy-4,5-dimethoxy-6-formyl-2H-1- benzopyran-2-one **[408]** 	Coumarin	Branches	Chawla *et al.*, 1989
3',7-Dihydroxy-4',5-dimethoxy-4-phenylcoumarin **[409]** 	Coumarin	Branches	Chawla *et al.*, 1984
4-Hydroxycinnamic acid **[410]** 	Phenylpropanoid	Twig Branches	Chawla *et al.*, 1987 Chawla *et al.*, 1983
4-Methyl-2H-1-benzopyran-2-one **[411]** 	Coumarin	Branches	Chawla *et al.*, 1989

4. Biosynthetic Relationship of Flavonoids in *B. chinensis* and *Dalbergia* spp.

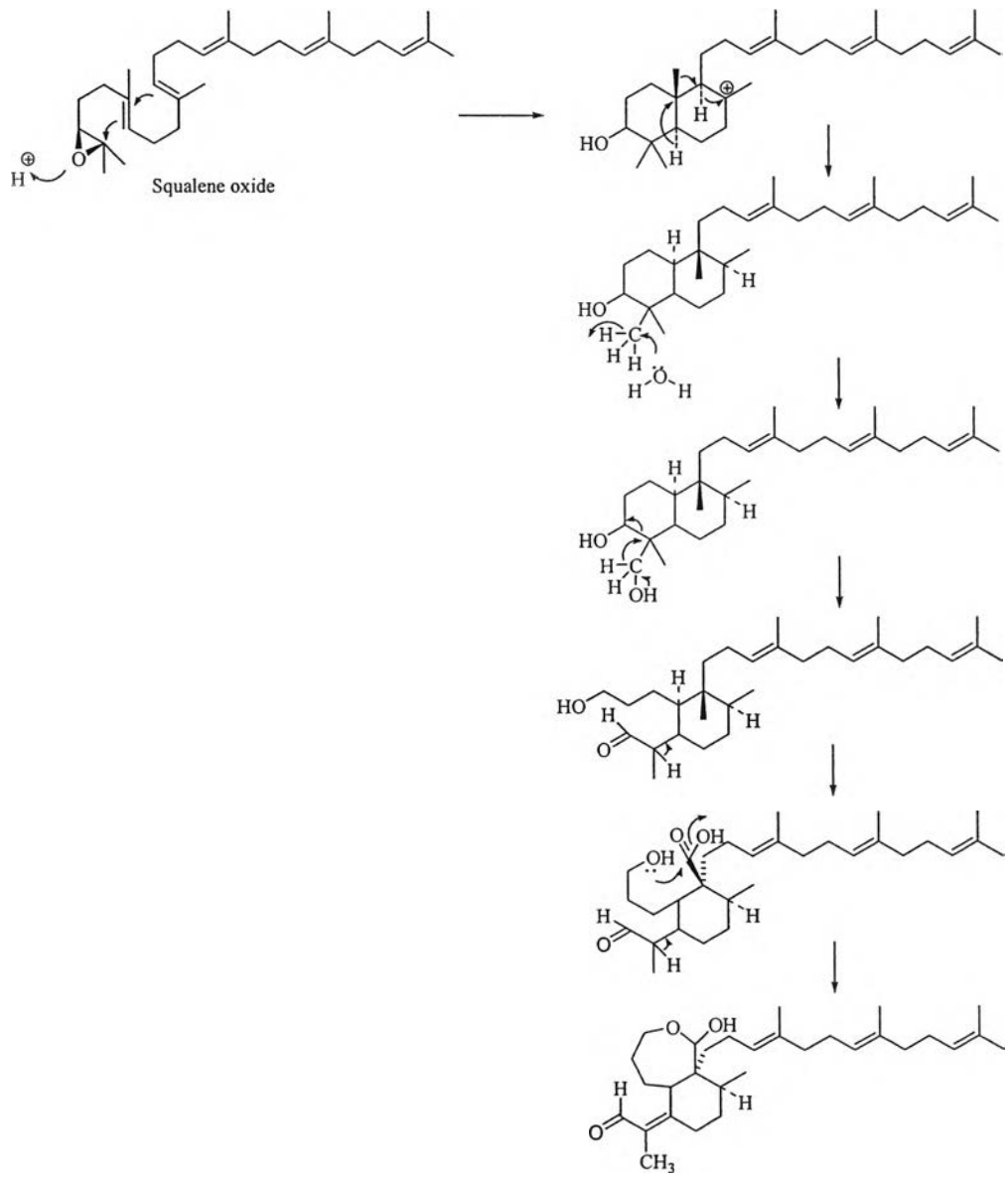
Flavonoids possess fifteen carbons atom in their basic skeletons, which are derived from shikimate and acetate-malonate pathway. The typical flavonoids in *Belamcanda chinensis* is isoflavones and typical flavonoids in *Dalbergia* spp. are chalcones, flavanones, flavones, dihydroflavonols, flavonols, isoflavones, pterocarpans, rotenoids, stilbenes and neoflavonoids. The relationship of flavonoids is displayed in Scheme 1 (Markham, 1982; Seshadri, 1972; Winkel-Shirley, 2001).



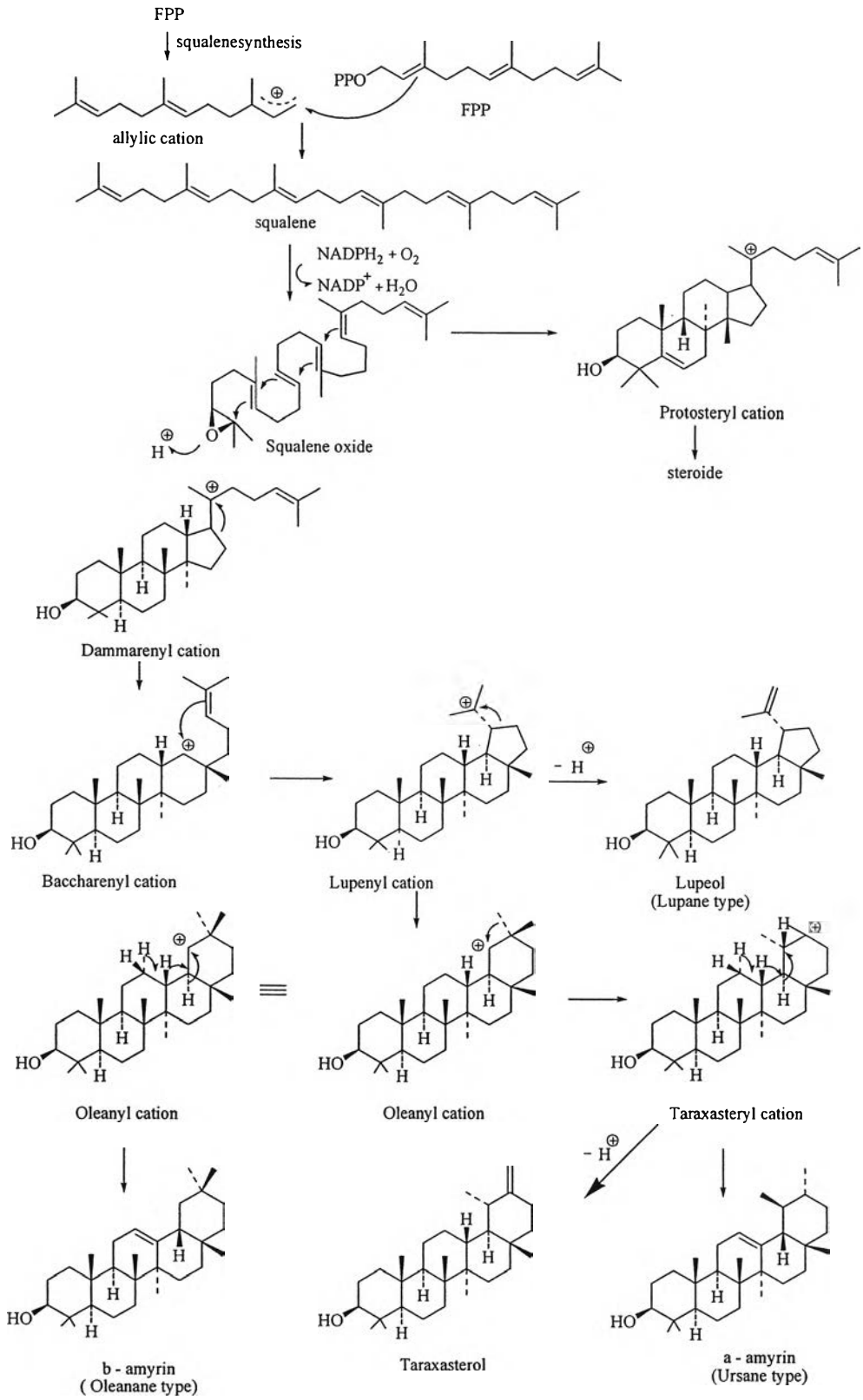
Scheme 1 Currently proposed interrelationships between flavonoid monomer.

5. Biosynthetic of Triterpenoids in *Belamcanda chinensis* and *Dalbergia* spp.

The triterpenes possess thirty carbons atoms in their molecules. They are biogenetically derived from two units of farnesyl pyrophosphate (FPP) to form squalene. The triterpene skeleton is fascinating variation encountered in their core structure. The typical triterpenes in *Belamcanda chinensis* is iridal type and triterpenes in *Dalbergia* spp. are lupine type, oleanane type and ursane type. The biosynthetic of triterpenes of *Belamcanda chinensis* is proposed in scheme 2 and *Dalbegia* spp. is proposed in scheme 3 (Dewick, 1993).



Scheme 2 Proposed biogenetic of iridal type triterpenes in *Belamcanda chinensis*



Scheme 3 Biosynthesis of triterpenes in *Dalbergia* spp.

6. Traditional Uses and Biological Activities of *Belamcanda chinensis*.

Belamcanda chinensis has been used in traditional medicine in oriental countries with many purposes. In china, the decoction of *B. chinensis* dried rhizomes have been used for the treatment of disorders of the throat, *e.g.* expectorant, coughing, pharyngitis, tonsillitis, asthma, laryngeal tumors (Chang, 1977; Duke *et al.*, 1985). Major combinations of *B. chinensis* 1.5-9 gram with *Scutellariae baicalensis* radix were used for sore throat and cough. The *Platycodi grandiflori* radix was added for pain and swelling of the throat with hoarseness, with *Pruni armeniacae* semen and *Platycodi grandiflori* radix for cough, pain and swelling of the throat with difficulty in expectorating (Bensky *et al.*, 1993). The decoction of rhizomes also have been used for dysmenorrhea, breast cancer, gonorrhea, malaria, stomachache, spleen and liver discomfort, antipyretic, boils, rheumatism, goiter (Chang, 1997; Duke, *et al.*, 1985). The decoction of rhizomes 3-6 gram have been used as a menstrual inducer (Kong *et al.*, 1976; Charles *et al.*, 1976).

In south Korea, the hot water extraction of dried rhizomes used as an emmenagogue and dried entire plant for acute gastritis, spleen-swelling, laryngitis and tonsillitis, hemostatic, furuncles also erysipelas (Han *et al.*, 1984 and Woo, *et al.*, 1981). In Vietnam, 3-6 gram of dried rhizomes have been used as antibacterial, anti-inflammatory, antipyretic and expectorant properties. It is prescribed in the treatment of cough, sore throat, tonsillitis, laryngitis, pertussis, dysmenorrhea, dysuria, mastitis, galactophoritis, otogalgia and snake-bite or 10-20 gram of fresh rhizome pounded with a little salt, for perlingual administration. In Malaysia, a decoction of 10 g. of rhizome has been used to promote menstruation, treat mumps and to sooth sore throat. A decoction of roots and leaves has been used for post-natal baths (Wong 2002). In Indonesia, a decoction with piper betel leaves has been used for post-partum care (Hirschhorn, 1983). In India, pulp of dried rhizomes kept in a betel leaf has been used as bandage to sprained muscles (Kahn *et al.*, 1982; 1993). In Nepal, root juice has been used as appetizer and hot water extract of dried rhizomes and roots have been used as purgative (Singh, 1979 and Manandhar, 1994). In Thailand, a decoction of 3 fresh leaves have been used for amenorrhea and laxative (Phaetthanesuan, 1977)

A number of biological investigations of *B. chinensis* have been reported. The 50% ethanol extract of leaves and rhizomes exhibited the bronchorelaxant against histamine induced bronchospasm in guinea pigs (Singh *et al.*,1990) The methanol extract of rhizomes stimulated the throat membrane activated by belamcandal **[23]** (Abe, 1991).

The anti-inflammatory activities have been studies by testing for inhibitory action on 5 lipoxygenase. Ardisianone A **[42]** and belamcandol A **[45]** and belamcandol B **[46]** isolated from seeds showed potent inhibition (Fukuyama *et al.*, 1991; 1993). While Belamcondaquinone A **[43]** isolated from seeds (Fukuyama *et al.*, 1993) inhibited cyclooxygenase activity. Moreover, tectoridin **[13]** and tectorigenin **[14]**, the major isoflavones isolated from the rhizomes acted as selective cyclooxygenase (COX)-2 inhibitor by testing on the suppression of prostaglandin E_2 production induced by rat peritoneal macrophages stimulated by the protein kinase C activator, 12-*O*-tetradecanoylphorbol 13-acetate (TPA) or the endomembrane Ca^{2+}-ATPase inhibitor, thapsigargin (Kim *et al.*, 1999 and Shin *et al.*, 1999).

Isorhapontigenin **[55]** isolated from the roots showed potent anti-oxidative activity (10^{-6}-10^{-5} mol/l.) and was much more potent than vitamin E (10^{-4} mol/l.) on several models such as inhibited malodialdehyde (MDA) formation, decrease of reduced glutathione (GSH) in rat liver microsomes, brain mitochondria and synaptosomes including the increase of ultra-weak chemiluminescence as well as oxidative DNA damages during the lipid peroxidation process (Wang *et al.*, 2001). Also, isorhapontigenin (100 mmol/l) inhibited respiratory burst of phorbol myristate acetate (PMA)-activated rat neutrophils, playing an importance role in inflammatory response, by scavenging oxygen free radicals (Fang and Liu, 2002). In addition, Li and co-workers in 2005 found that this compound inhibited angiotensin-II induced cardiac hypertrophy through an antioxidant mechanism involving inhibition of PKC, Erk1/2, JNK and p38 phosphorylation in cardiomyocytes. They lead to inhibit $NF\text{-}_kB$ and AP-1 activation of signaling transduction pathways.

The ethyl acetate fraction of the rhizomes part was found antifungal activity. Tectorigenin **[14]** was isolated and showed marked antifungal activity against dermatophytes of the genera *Trichophyton*, the minimum inhibitory concentration (MIC) being in the range of 3.12-6.25 μg/ml (On *et al.* 2001). The hot water

extraction was also found as antiviral activity on virus-herpes simplex 1 with concentration 0.5 mg/ml (Kurokawa *et al.*, 1993).

The estrogenic effect was determined by using a recombinant yeast system with both a human estrogen receptor expression plasmid and a reporter plasmid. The 70% ethanol extract of rhizomes showed high estrogenic activity (EC_{50} =142.8 μg/ml), while the EC_{50} values of 17-β-estradiol was 0.205 ng/ml (*Zhang et al.*, 2005). Tectorigenin **[14]** was effects on rat ovariectomize caused to increase uterus weight, inhibit releasing of gonadotropin releasing hormone and inhibit luteinizing hormone (LH) secretion (Wuttke *et al.*, 1999). Therefore, it may be beneficial in women suffering from hot flushes. Moreover, tectorigenin **[14]** has selective estrogen receptor modulator activities by effect on bone mineral density of the metaphysis of tibia. Hence, tectorigenin **[14]** may have antiosteoporotic effects also in postmenopausal woman (Seidlova-Wuttke *et al.*, 2004).

Toxicity of 50% ethanol extract was evaluated by peritoneal injection on mice with LD_{50} 681 mg/kg (Aswal *et al.*, 1984). Tectorigenin **[14]** showed cytotoxic effects, it induced differentiation of human promyelocytic leukemia HL-60 cells to granulocytes and monocytes macrophages, and caused apoptotic changes of DNA in the cell (Lee *et al.*, 2001).

7. Traditional Uses and Biological Activities of *Dalbergia* spp.

A great number of species in the genus *Dalbergia* have been used in folk medicine in many countries with several purposes. In South Africa, young fruits of *D. armata* are taken orally as a laxative, while a leaf decoction is taken half a cup 3 times a day for fever and body pains (Bhat *et al.*, 1995). In the same country, hot water extract of *D. nitidula* trunk bark is used to heal wounds (Van heerden *et al.*, 1978). In Zimbabwe, infusion of bark is used to wash ulcers (Nyazema, 1984) and root is used to cure internal bilharzia (Msonthi *et al.*, 1983). In Brazil, the decoction of bark of *D. monetaria* is popularity used to treat gastric ulcers, liver disorders and anemia (Cota et *al.*, 1999), while it is used as a tonic, lung ailments and used to treat diarrhea (Duck, 1994). In Nicaragua, decoction of *D. brownie* is used for diarrhea, astringent, skin rashes and sores (Coe and Anderson, 1996) also *D. retusa* leaves is used to treat sickness of the blood (Barrett, 1994). In Nigeria, the decoction of *D. saxatilis* root is

used to accelerate birth and expel the placenta (Uchendu and Leek, 1999). In Rwanda, the decoction of leaves and root part of *D. lactea* are used to treat respiratory ailments (Puyvelde *et al.*, 1994), malaria (Hakizamungu *et al.*, 1992) and microbial infection (Boily and Puyvelde, 1986). Many parts of *D. melanoxylon* are used, in Venda, powdered bark is applied to wound for prevent excessive bleeding from wounds (Arnold and Gulumain, 1984). In east Africa hot water extract of bark is used to treat diarrhea, used for cleaning wound. The decoction of the root is drunk against imminent abortion and gonorrhea, to alleviate abdominal pain, as an anthelmantic. The bark from root and stem is an antidiarrhea and the smoke of the burning root is inhaled against headache, rhinitis and bronchitis. The leaves juice is used to cure throat inflammations, cardiac trouble, amoebic dysentery, syphilis and gonorrhea. The decoction is used to relieve pain in joints (Hedberg *et al.*, 1983).

Folkloric used of the other *Dalbergia* species in Indo-china have been recorded. In China, the decoction of *D. hupeana* leaves is taken for treatment of abscesses (Duke and Ayensu, 1985). In the same countries, the hot water extract of heart wood is used to treat stagnation of disordered blood, ischemia and inflammation (Chan *et al.*, 1997). In India, bark of *D. lanceolaria* is used for intermittent fever dyspepsia and arthritis. The decoction of *D. hatifolia* stembark is used to protect hoof diseases (Khan *et al.*, 1994). *D. sissoo* many parts are used in India and Nepal in many proposes. Fruit juice is applied for acne, eczema (Mukherjee and Namhata, 1990). Paste of the leaves is applied on the forehead or drunk the water extract to remedy sun stroke (Singh and Maheshwari, 1994), diarrhea (Bhattarai, 1992) and used as vermifuge (Singh *et al.*, 1996). The boiled leaves or root and stem are use for menstrual excess (Das, 1955). Its bark, stem and wood are used as an abortificient and an aphrodisiac (Karnic and Hocking, 1975; Saha *et al.*, 1961). Its seed oil is used in the treatment of rheumatic pain and skin diseases (Singh and Maheshwari, 1994).

The boiled root, seed hulls, stem wood are employed to promote menstruation while large dose used to induce expulsion of fetus in West Indies, Philippines and Malaysia (Quisumbing, 1951; De Laszlo and Henshaw, 1954; Lewis *et al.*, 1977). In India, the decoction of *D. volubilis* is appled to skin tumors (Tiwari and Padhye, 1993) and a paste of the roots and leaves mixed with sugar is given internally in impotence (Joshi *et al.*, 1980).

Thai folk medicines from *Dalbergia* species have been recorded. The heartwood of *D. candenatensis*, *D. oliveri* and *D. parviflora* were used for blood tonic, normalize menstruation, expectorant, stomachic, moreover *D. parviflora* is used as cardiotonic. The bark of *D. oliveri* and oil of *D. parviflora* wood is used to heal chronic wounds. The wood of *D. parviflora* is used as antipyretic and its leaves have mild aphrodisiac effect (Boonyaprapassorn *et al.*, 2000; Smitinand, 1983; Picheansunthorn *et al.*, 2000).

Extractions of several species of *Dalbergia* are known to produce many biological effects. Detailed information on the biological activities of some *Dalbergia* species is determined below.

The acetone extract and ethanol extract from twig of *D. cearensis* and *D. nigra* showed broad antibacterial activity against *Brucella suis*, *B. abortus*, *B. militensis*, *Escherichia coli*, *Proteus morganii*, *Staphylococcus aureus*, *Bacillus mycoides*, *B. subtilis*, *B. anthracis*, Sarcina lulea, *Streptococcus hemolyticus*, *Neisseria catarrhalis*. They also showed antifungal activity against *Aspergillus carneus*, *Polystictus sanguineus*, *Sterium spp.*, *Fovolus spp.*, *Hypotyssus spp.*, *Polystictus spp.*, *Candida stellatoidea*, *C. Krusei*, *C. albican*, *C. parkrusei*, *C. pseudotropicalis*, *Cryptococcus neoformans* and inhibited against *Microbacterium phlei* and *M. smegmatis* (Goncalves De Lima *et al.*, 1959). The citric acid extract from bark *D. melanoxylon* revealed the antibacterial activity against *Klebsiella pneumoniae*, *Bacillus subtitis*, *Staphyloccus aureus*, *Salmonella typhimurium*, *Escherichia coli*, *and Pseudomonas aeruginosa.* Its ethanol extract inhibited against *Bacillus subtilis* and *Staphylococcus aureus*, while the dichloromethane extract showed antifungal activity against *Candida albicans* and *Aspergillus nigra* (Gundidza and Gaza, 1993). Claussequinone **[75]** isolated from *D. candenatensis* heartwood showed antibacterial activity against *Staphylococcus aureus*, *S. subtilis* and *Escherichia coli* with MIC values ranging from 3-6 μg/ml, it also showed cytotoxic activity against P-388 lymphocytic leukemia with ED_{50} 0.5 μg/ml (Hamburger *et al.*, 1987). The ethanol extract from entire plant of *D. lacteal* displayed cytotoxic activity to CA-9KB cells, colon 38, Leuk-P388 and melanoma-B16 (Suffness *et al.*, 1988). The bioassay guided fractionation of the ethanol crude extracts from stem bark of *D. cultrata* and *D. nigrescens* led to the isolation of four cinnamylphenols, dalberatins A **[295]**, dalberatin B **[296]**, dalberatin C **[350]**,

dalberatin D **[351]** which showed inhibitory activities against Epstein-Barr virus early antigen activation induced by 12-*O*-tetradecanoylporbol-13-acetate (TPA) in Raji cells with an IC_{50} of 203-303 mol ratio/TPA (Ito *et al.*, 2003). Major constituents isolated from the bark of *D. monetaria*, Orobol-6-*C*-glucoside **[129]** and Orobol-8-*C*-glucoside **[133]**, acted as immunomodulating substances by exhibitited mitogenic and colony- stimulating factor-inducing activities (Kawaguchi *et al.*, 1998).

Several isoflavones isolated from the stem bark of *D. frutescens*, formononetin **[72]** showed higher *in vitro* inhibitory activity against *Giardia intestinalis* than metronidazole with an IC_{50} 30 ng/ml and 100 ng/ml, respectively and this compound showed significantly increased cure rates as well as decreased parasite numbers in mice intestines after 4 days of treatment at 10 mg/day (Khan *et al.*, 2000). (*R*)-4-methoxydalbergione **[270]**, obtusafuran **[323]**, 7,4′-dihydroxy-3′-methoxyisoflavone **[115]** and isoliquiritigenin **[83]** isolated from heartwood of *D. lourelii* inhibited *in vitro* the growth of *Plasmodium falciparum* with IC_{50} values ranging from 5.8 to 8.7 μM (Beldjoudi *et al.*, 2003).

As the heartwood of *D. odorifera* has been used to treat the stagnation of disordered blood. The benzene-soluble fraction has been studied for its inhibitory effect on platelet aggregation, which regulated the blood flow by the balance between thromboxane A_2 (TXA_2) and PGI_2. From this activities guided fractionation the isolation of odoriflavene **[173]**, hydroxyobustyrene **[355]**, isomucronustyrene **[356]** and methyl-2-hydroxy-3, 4-dimethoxybenzoate **[365]** were potent inhibitors of PG synthetase as strong as indomethacin with an IC_{50} value of 4.8, 9.2, 2.8, 23 and 4.9 μM, respectively and strongly inhibited platelet aggregation induced by arachidonic acid and collagen (Goda *et al.*, 1985; 1992). Since activated neutrophils will release lysosomal enzymes and generate highly reactive oxygen species. This process is probably involved in the pathogenesis of many diseases including emphysema, glomerulonephritis, rheumatoid arthritis and tissue damage in ischemia-reperfusion states. Several compounds isolated from *D. odoriifera* heartwood such as (*S*)-4-methoxydalbergione **[270]**, cearoin **[276]**, butein **[160]**, koparin **[166]**, bowdichione **[159]**, 3′-*O*-methylviolanone **[197]** and xenognosin B **[178]** showed significant anti-inflammatory activity while (*S*)-4-methoxydalbergione **[270]** and cearoin **[276]** exhibited antiallergic activity on suppression of histamine release from rat mast cell

(Chan *et al.*, 1998). About anti-ulcerogenic activity, the lyophilized aqueous extract of *D. monetaria* has significant anti-ulcerogenic activity and inhibits gastric ulcer lesions induced by pylorus-ligature, ethanol and hypothermic restrainst stress. The protective effect cause by synergistic effect between increased prostaglandin E_2 (PGE_2) synthesis, antagonism of H_2 histamine and β-adrenergic receptors reduce gastric acid secretion (Cota *et al.*, 1999).

The antiandrogenic activities of *D. cochinchinensis* were investigated. Methoxydalbergione **[270]**, isoliquiritigenin **[83]** and calycosin **[81]** showed potent inhibitory activity against testosterone 5α-reductase, while latinone **[282]** and dalbergiphenol **[280]** were found to show moderatr and weak inhibitory activity, respectively. As for the inhibitory activity, against the formation of 5α-dihydrotestosterone (DHT)-receptor binding complex, methoxydalbergione **[270]**, latifolin **[281]**, 9-hydroxy-6,7-dimethoxy dalbergiquinol **[292]** and 6-hydroxy-2,7-dimethoxyneoflavene **[291]** have been reported as showing potent inhibitory activity (Shirota *et al.*, 2003).