CHAPTER 1.1

INTRODUCTION

1.1.1 Introduction

Clerodendrum serratum, is a plant belonging to Verbenaceae family. The genus *Clerodendrum* contains about 560 species. In Thailand, only 35 species and 1 variety are found (Leeratiwong, 2001). *Clerodendrum serratum* has various local names: อัคคีทวาร; “Khaeng ma” (แข้งม้า) (Chiang rai); “Khwi-do” (ควิโด), “Tue-sue-sa-chong” (ตือซือ-ซาฉ้อง), “Toe-si-pha-du” (เตอสีพ่ะดู่), “Ya-kae” (ยาแก้) (Karen-Mae Hong Son); “Khui-do-cho” (คุ้ยโดโจ) (Karen-Kamphaeng Phet); “Khwaeng kha” (แคว้งค่า) (Northern); “Charak pa” (ชะรักป่า), “Mok nang ta” (หมอกนางต๊ะ), “Lua sam kian” (หลัวสามเกียน) (Chiang Mai); “Pha hai ho kham” (ผ้าห้ายห่อคำ), “Mak kan to” (หมักก้านต่อ), “Hu waeng” (หูเวง), “Hang to” (ฮังตอ) (เลย); “Mak khaeng kha” (มักแค้งข่า)(Prachin buri) (เต็ม, 2544). *C. serratum* is a tree, 2-8 ft. high. Leaves usually some of them ternate, commonly 6 by 2 in., narrowly obvate-oblong or subelliptic, base cuneate, mature glabrate puberulous pubescent or closely villous on the lamina beneate; petiol 0-0.25 in. Panicle 6 by 1 in., sublinear , or 10 by 5 in. subpyramidal, pubescent often villous, branches and pedicels patently shortly hairly; bracts 0.5-1.5 in., from obovate to lanceolate, pubescent supersistant, often coloured; pedicels 0-0.25 in. Calyx 0.20 in., cup-shaped, pubescent or puberulous, limp very shortly 5-lobed; slightly enlarged in fruit. Corolla nearly glabrous without, hairy at the base of the stamens, from purplish-blue and white to nearly white; tube 0.33-0.50 in., narrow-cylindric; mouth oblique, 2-lipped; lobes 0.33-0.50 in., oblong or elliptic. Drupe 0.25 by 0.16-0.33 in., succulent, purple-black, 4-1 pyrened. (Hooker, 1885)

Figure 1. *Clerodendrum serratum* (Verbenaceae)

1.1.2 Review of Literatures

Species belonging to the genus *Clerodendrum* (Verbenaceae) are rich source of variety compounds, e.g., diterpenes (Tian, 1993; Achari, 1992; Lin, 1989), steroids (Akihisa, 1990, 1988), iridoid monoterpenes (Calis, 1994), triterpenes (Dong, 1999; Ganapaty, 1985) and flavones (Tian, 1999; Gunasegaran, 1993; Barua, 1989)

Information from NAPRALERT database developed by University of Illinois at Chicago reveals several types of compounds present in plants of the genus *Clerodendrum* and they can be classified into twenty groups. These compounds are present in **Table 1**.

Table 1 Compounds from the plants of *Clerodendrum* genus

1 = Alicyclics **2** = Alkaloids **3** = Alkanes

4 = Benzenoids **5** = Carbohydrates **6** = Chromones

7 = Diterpenes **8** = Flavanones **9** = Flavones

10 = Flavonoids **11** = Flavonols **12** = Indole alkaloids

13 = Iridoid monoterpenes **14** = Isoflavones **15** = Lignans

16 = Lipids **17** = Phenyl propanoids **18** = Proteids

19 = Steroids **20** = Triterpenes

Scientific name	**Investigated Part**	**Compound**	**Reference**
C. aculeatum	Leaves+Stems	Verbascoside, **17a**	Garnier, *et al.,* 1989
C. brachyanthum	Leaves	Clerodin, **7a** Clerodinin A, **7c** Clerodinin B, **7d** Clerodinin C, **7e** Clerodiol, **7m** Eudesmin, **15a** 3-*epi*-Glutinol, **20a** Stigmasta-5,22,25-trien-3β-ol, **19a** Syringaresinol dimethyl ether, **15b** Verbascoside, **17a**	Lin, *et al.,* 1989 Lin and Kuo, 1992 Lin, *et al.,* 1989 Lin and Kuo, 1992
C. buchananii	Leaves	Verbascoside, **17a** *iso*-Verbascoside, **17b**	Taoubi, *et al.,*1992

Table 1 (continued)

Scientific name	Investigated Part	Compound	Reference
C. buchneri	Leaves	Buchnerine, **2a**	Lumbu and Hootele 1993
C. bungei	Entire plant	α-Amyrin, **20b** Bungesterol, **19b** Clerosterol, **19c** Friedelin, **20e** Taraxerol, **20g**	Dong, *et al.,* 1999 He, *et al.,* 1997
	Leaves+Stems	Anisic acid, **4b** Maltol, **6** Succinic acid, **3a** Vanilic acid, **4c**	Zhou, *et al.,* 1982
	Stems	Bungone A, **7t** Bungone B, **7u** Sugiol, **7v** Teuvincenone F, **7w** Uncinatone, **7x**	Fan, *et al.,* 1999 Fan, 1978
C. calamitosum	Leaves	3-*epi*-Caryoptin, **7b**	Vigneron, *et al.,* 1978
C. capitatum var. Capitatum	Leaves	Verbascoside, **17a**	Taoubi, *et al.,* 1992
C. colebrookianum	Aerial parts	Colebrin A, **19d** Colebrin B, **19e**	Yang, *et al.,* 2000c

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. colebrookianum	Aerial parts	Colebrin C, **19f** Colebrin D, **19g** Colebrin E, **19h** Daucosterol, **19i** β-Sitosterol, **19j**	Yang, *et al.,* 2000c
	Fruits	Harpagide, **13a** Melittoside, **13b**	Jacke and Rimpler 1983
	Leaves	Clerosterol, **19c** Palmitic acid, **16a** *n*-Pentatriacontane, **3b** β-Sitosterol, **19j** Stearic acid, **16b**	Goswami, *et al.,* 1996 Goswami, *et al.,* 1995 Singh, *et al.,* 1995 Goswami, *et.al.,* 1996 Goswami, *et al.,* 1995
	Roots	β-Amyrin, **20j**	Joshi, *et al.,* 1979
C. cyrtophyllum	Entire plant	Clerodendrin A, **7f** Stigmasterol, **19k**	Vigneron, *et al.,* 1978 Chen and Shin, 1976b
	Stems	Clerodolone, **20h**	Tian, *et al.,* 1993

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. cyrtophyllum	Stems	Clerosterol, **19c** Cyrtophyllone A, **7y** Cyrtophyllone B, **7z** Friedelin, **20e** Stigmasta-5,22,25-trien-3β-ol, **19a** Sugiol, **7v** Teuvincenone F, **7w** Uncinatone, **7x**	Tian, *et al.,* 1993
C. fragrans	Aerial parts	Poriferasterol, **19l** Stigmasterol, **19k**	Akihisa, *et al.,* 1988
	Leaves+Stems	24α-Ethyl-5α-cholest-22*E*-en-3β-ol, **19m** 24β-Methylcholesta-5,22*E*,25-trien-3β-ol, **19n** Cholesterol, **19o** Cirsimaritin, **9a** Clerosterol, **19c** 22-Dehydroclerosterol, **19q** Sorbifolin, **9b**	Akihisa, *et al.,* 1988 Barua, *et al.,* 1989 Akihisa, *et al.,* 1988 Barua, *et al.,* 1989

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. fragrans	Roots+Stems	α-Amyrin, **20b** Clerodolone, **20h** Clerosterol, **19c** Daucosterol, **19i** β-Sitosterol, **19j** *n*-Triacontane, **3c**	Singh and Singh, 1981
C. incisum	Leaves+Stems	Euphroside, **13c** 2′-*O*-8-*O*-difoliamen-thoyleuphroside, **13d** 8-*O*-difoliamenthoyl euphroside, **13e**	Stenzel, *et al.,* 1986
	Roots	Plantarenaloside, **13f**	Stenzel, *et al.,* 1986
C. indicum	Aerial parts	Cleroindicin A, **1a** Cleroindicin B, **1b** Cleroindicin C, **1c** Cleroindicin D, **1d** Cleroindicin E, **1e** Cleroindicin F, **1f**	Tian, *et al.,* 1997

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. indicum	Aerial parts	Eupafolin, **9j** Hispidulin, **9c** Hispidulin-7-*O*-glucuronide, **9m** Scutellarein, **9d**	Tian, *et al.,* 1999
	Entire plant	Apigenin, **9e** Hispidulin, **9c** Scutellarein, **9d** Scutellarein-7-*O*-β-D-glucoronide, **9n**	Gunasegaran, *et al.,* 1993
	Leaves	Harpagide, **13a** Verbascoside, **17a**	Jake and Rimpler, 1983
	Stems	β-Sitosterol, **19j**	Prakash and Garg, 1981
C. inerme	Aerial parts	Acacetin, **9f** Apigenin, **9e** Cleroinermin, **7ac** Clerosterol, **19c**	Raha, *et al.,* 1991 El-shamy, *et al.,* 1996 Raha, *et al.,* 1991 Rehman, *et al.,* 1997

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. inerme	Aerial parts	Glutinol, **20i**	Rehman, *et al.,* 1997
	Entire plant	Acacetin, **9f**	Raha and Das, 1989
		Salvigenin, **9g**	
	Leaves	Acacetin, **9f**	Achari, *et al.,* 1990
		Apigenin, **9e**	
		Clerosterol, **19c**	Abdul-Alim, 1971
		Clerodendrin B, **7g**	Rao, *et al.,* 1993
		Clerodendrin C, **7i**	
		Friedelin, **20e**	Achari, *et al.,* 1990
		Inerminoside A-1, **13g**	Calis, *et al.,* 1994
		Inerminoside B, **13i**	Calis, *et al.,* 1992
		Inerminoside C, **13j**	Calis, *et al.,* 1994
		Inerminoside D, **13h**	
		Melittoside, **13b**	Jacke and Rimpler, 1983
		Salvigenin, **9g**	Achari, *et al.,* 1990
		Verbascoside, **17a**	Taoubi, *et al.,* 1992

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. inerme	Leaves+Stems	β-Amyrin, **20j** Apigenin, **9o** Campesterol, **19r** Clerosterol, **19c** Cosmosiin, **9r** Cynaroside, **9s** Oleanolic acid, **20k** Verbascoside, **17a** α-Amyrin, **20b** β-Amyrin, **20j** Betulin, **20n** Royleanone, **7aa** Dehydroroyleanone, **7ab** β-Sitosterol, **19j**	El-shamy, *et al.,* 1996 Akihisa, *et al.,* 1989 El-shamy, *et al.,* 1996 Fauvel, *et al.,* 1989 Singh and Prakash, 1983
C. infortunatum	Aerial parts	Cholesterol, **19o** Clerosterol, **19c** Poriferasterol, **19l** Stigmasterol, **19k**	Thakur, *et al.,* 1988 Akihisa, *et al.,* 1988
	Flowers	Acacetin, **9f** Apigenin, **9e** Clerodin, **7a** Daucosterol, **19i**	Sinha, *et al.,* 1981 Joshi, *et al.,* 1978

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. infortunatum	Leaves	β-Sitosterol, **19j**	Joshi, *et al.,* 1978
		Verbascoside, **17a**	
		Verbascoside, **17a**	Taoubi, *et al.,* 1992
C. japonicum	Entire plant	Clerodenoside A, **17c**	Tian, *et al.,* 1995
		Martynoside, **17d**	
		Tricin, **9l**	
		Ursolic acid, **20d**	
		Verbascoside, **17a**	
C. linearis	Leaves	Apigenin-7-*O*-β-D-glucuronide, **9o**	Nia and Gunasekar, 1991
		Chrysoeriol-7-*O*-β-D-glucuronide, **9p**	
		Lutiolin-7-*O*-β-D-glucuronide, **9q**	
C. mandarinorum	Root barks	Betulinic acid, **20o**	Zhu, *et al.,* 1996
		Cirsimaritin, **9a**	
		Clerosterol, **19c**	
		Lupeol, **20l**	
		Sucrose, **5a**	
	Stems	Mandarone A, **7n**	Fan, *et al.,* 1999
		Mandarone B, **7o**	

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. mandarinorum	Stems	Mandarone C, **7p**	Fan, *et al.,* 1999
C. myricoides	Entire plant	Cleromyrine I, **18** Myricoidine, **2b**	Bashwira, *et al*., 1989 Bashwira and Hootele, 1988
C. neriifolium	Barks	Nerifolinol, **7q**	Purushothaman, *et al*., 1986
	Leaves	Acacetin, **9f** Apigenin, **9e** Campesterol, **19r** Cirsimaritin, **9a** 5-Hydroxy-4′,7-dimethoxyflavone, **9i** Pectolinarigenin, **9h** Salvigenin, **9g** Scutellarein, **9d** β-Sitosterol, **19j** Stigmasterol, **19k**	Ganapaty and Rao, 1989
	Stem barks	α-Amyrin acetate, **20c**	Ganapaty and Rao, 1985

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. neriifolium	Stem barks	Betulinic acid, **20o** Lupeol, **20l** Lupeol aceate, **20m** β-Sitosterol, **19j** Ursolic acid, **20d**	Ganapaty and Rao, 1985
C. nutans	Aerial parts	Clerosterol, **19c** β-Sitosterol, **19j** Stigmasterol, **19k**	Joshi, *et al*., 1985
C. paniculatum	Entire plant	β-Sitosterol, **19j**	Chen and Shin, 1976a
	Roots	β-Amyrin, **20j** β-Sitosterol, **19j**	Joshi, *et al.,* 1979
	Entire plant	Glutinol, **20i**	Hsu, *et al*., 1983
	Leaves	Verbascoside, **17a** Isoverbascoside, **17b**	Taoubi, *et al*.,1992
C. phlomoides	Entire plant	4,2′,4′-Trihydroxy-6′-methoxychacone-4,-4′-D-glucoside, **10** 7-Hydroxyflavone**, 8** Pectolinarigenin, **9h**	Roy and Pandy, 1994 Roy, *et al.*, 1995
	Flowers	Apigenin, **9e**	Seth, *et al*., 1982

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. phlomoides	Flowers	4,2′,4′-Trihydroxy-6′-methoxychacone-4,-4′-D-glucoside, **10** 7-Hydroxyflavone, **8** Hispidulin, **9c** Luteolin, **9k** Pectolinarigenin, **9h**	Roy and Pandy, 1994
	Leaves	7-Hydroxyflavone, **8**	Roy and Pandy, 1994
	Roots	Clerodendrin A, **7f** Clerodin, **7a** Clerosterol, **19c**	Joshi, *et al*., 1979
C. scandens	Leaves+Stems	Campesterol, **19r** Cholesterol, **19o**	Akihisa, *et al*., 1990
C. serratum	Leaves	Luteolin, **9k** Martynoside, **17d** α-Spinasterol, **19s**	Nair, *et al*., 1976 Wei, *et al*., 2000
	Roots	Apigenin, **9e** 5-Hydroxy-4′,7-dimethoxyflavone, **9i** Luteolin, **9k**	Jaya, *et al*., 1997

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. serratum	Roots	Scutellarein, **9d** β-Sitosterol, **19j** Ursolic acid, **20d**	Jaya, *et al*., 1997
C. serratum **var. Amplexifolium**	Aerial parts	*cis*-Cinnamic acid, **17e** *trans*-Cinnamic acid, **17f** Cleroserroside A, **7r** Cleroserroside B, **7s** Serratoside A, **13k** Serratoside B, **13l**	Yang, *et al*., 2000a Yang, *et al*., 1999 Yang, *et al*., 2000b
C. serratum **var. Dentatum**	Leaves	Euphroside, **13c** Plantarenaroside, **13f**	Jacke and Rimpler, 1983
C. siphonanthus	Entire plant	Cirsimaritin, **9a** Pectolinarigenin, **9h** Uncinatone, **7x**	Barua, *et al*., 1989 Pal, *et al*., 1988
	Leaves+Stems	Pectolinalrigenin, **9h** Uncinatone, **7x**	Pal, *et al*., 1989
C. splendens	Aerial parts	β-Amyrin, **20j** Clerodolone, **20h** Friedelan-3β-ol, **20f** *n*-Triacontane, **3c**	Joshi, *et al*., 1985
	Leaves	α-Amyrin, **20b**	Ohiri, 1987

Table 1 (Continued)

Scientific name	Investigated Part	Compound	Reference
C. splendens	Leaves+Stems	Clerosterol, **19c** Cycloartenol, **20p**	Pinto and Nes, 1985
C. thomsonae	Aerial parts	Ajugoside, **13m** Aucubin, **13n** Melittoside, **13b** Reptoside, **13o**	Lammel and Rimpler, 1981 Franke and Rimpler, 1986
	Leaves	Ajugoside, **13m** Aucubin, **13n** Melittoside, **13b** Reptoside, **13o** Verbascoside, **17a**	Jacke and Rimpler, 1983 Lammel and Rimpler, 1981 Taobi, *et al*., 1992
C. tomentosum	Leaves	Harpagide, **13a**	Jacke and Rimpler, 1983
C. trichotomum	Barks	Friedelin, **20e**	Nonomura, 1955
	Callus tissue	Trichotomine, **12a** Trichotomine G-1, **12b** Verbascoside, **17a**	Koda, *et al*., 1992 Sakurai and Kato, 1983

Table 1 (Continued)

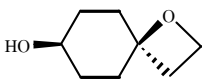
Scientific name	Investigated Part	Compound	Reference
C. trichotomum	Fruits	Harpagide, **13a**	Jacke and Rimpler, 1983
		Melittoside, **13b**	
		Trichotomine, **12a**	
		Trichotomine G-1, **12b**	Koda, *et al*., 1992
	Leaves	Clerodendrin B, **7g**	Kawai, *et al*., 1998
		Clerodendrin D, **7h**	
		Clerodendrin E, **7j**	
		Clerodendrin H, **7l**	
		Clerodendrin F, **7k**	
		Harpargide, **13a**	Jacke and Rimpler, 1983
		meso-Inositol, **5b**	Tseng, *et al*., 1963
		Verbascoside, **17a**	Sakurai and Kato, 1983
C. ugandense	Leaves	Euphroside, **13c**	Jacke and Rimpler, 1983
C. uncinatum	Roots	Uncinatone, **7x**	Chapuis, *et al*., 1988
	Root barks	Uncinatone, **7x**	Dorsaz, *et al*., 1985
C. viscosum	Seed oil	Linoleic acid, **16c**	Kapoor, *et al*., 1990
		Oleic acid, **16d**	

Table 1 (Continued)

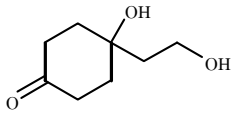
Scientific name	Investigated Part	Compound	Reference
C. viscosum	Seed oil	Palmitic acid, **16a**	Kapoor, *et al*., 1990
C. wildii	Roots	*mi*-Saponin A, **20q**	Toyota, *et al*., 1990

Structures

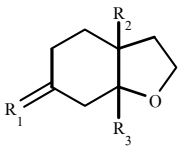
1. Alicyclics



1a: Cleroindicin A



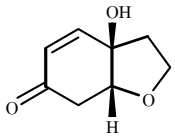
1b: Cleroindicin B



1c: R_1 = O, R_2 = β-OH, R_3 = β-H : Cleroindicin C

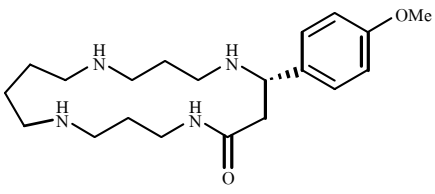
1d: R_1 = O, R_2 = α-OH, R_3 = α-H : Cleroindicin D

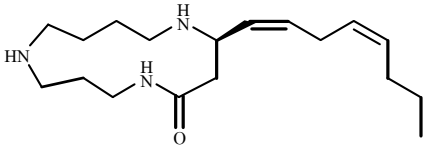
1e: R_1 = α-OH, β-H, R_2 = α-OH, R_3 = α-H : Cleroindicin E



1f: Cleroindicin F

2. Alkaloids





2a: Buchnerine **2b**: Myricoidine

3. Alkanes

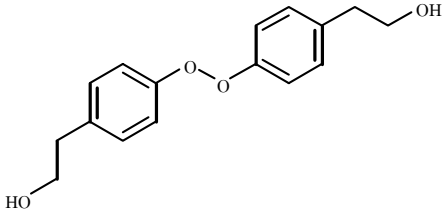
$HO_2C\text{-}CH_2\text{-}CH_2\text{-}CO_2H$ $Me\text{-}(CH_2)_{33}\text{-}Me$

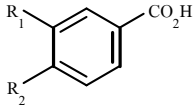
3a: Succinic acid **3b**: *n*-Pentatriacontane

$Me\text{-}(CH_2)_{28}\text{-}Me$

3c: *n*-Triacontane

4. Benzenoids

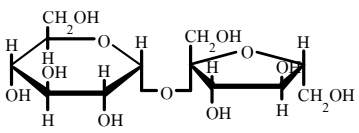


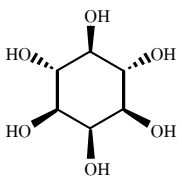


4a: Bungein A **4b**: R_1 = H, R_2 = OMe : Anisic acid

4c: R_1 = OMe, R_2 = OH : Vanilic acid

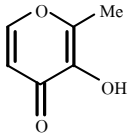
5. Carbohydrates





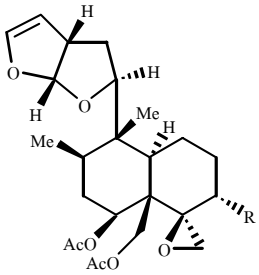
5a: Sucrose **5b**: *meso*-Inositol

6. Chromones



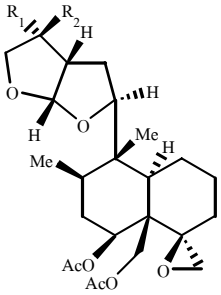
6: Maltol

7. Diterpenes



7a: R = H : Clerodin

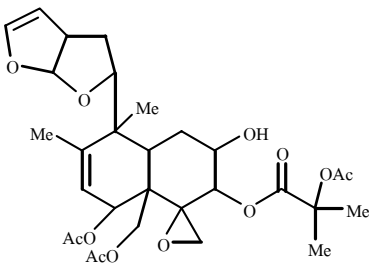
7b: R = OAc : 3-*epi*-Caryoptin



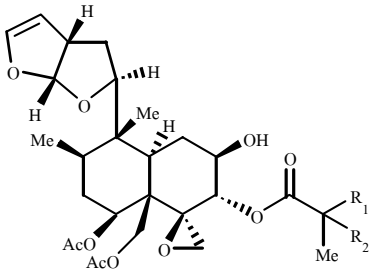
7c: R_1 = H, R_2 = OMe : Clerodinin A

7d: R_1 = OMe, R_2 = H : Clerodinin B

7e: R_1 = H, R_2 = OEt : Clerodinin C

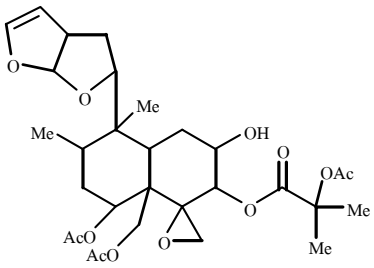


7f: Clerodendrin A

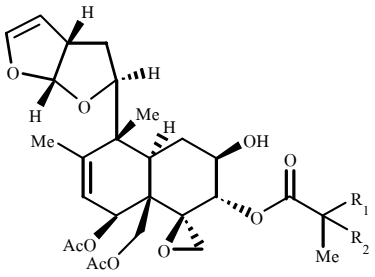


7g: R_1 = Et, R_2 = OAc : Clerodendrin B

7h: R_1 = Et, R_2 = H : Clerodendrin D



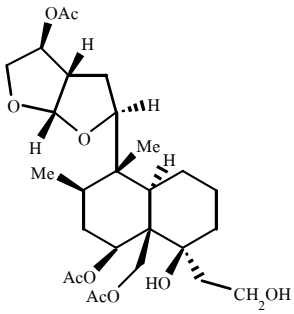
7i: Clerodendrin C



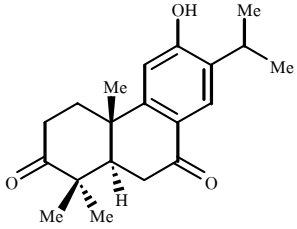
7j: R_1 = Me, R_2 = OAc : Clerodendrin E

7k: R_1 = Et, R_2 = H : Clerodendrin F

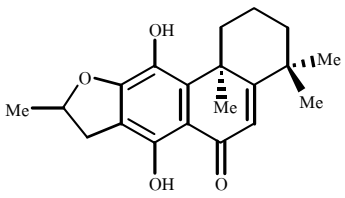
7l: R_1 = OAc, R_2 = CH(Me)OAc : Clerodendrin H



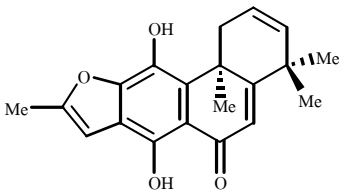
7m: Clerodiol



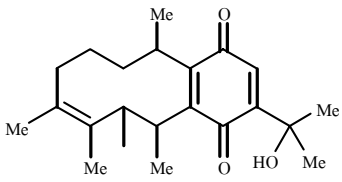
7n: Mandarone A



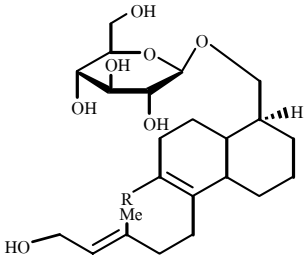
7o: Mandarone B



7p: Mandarone C

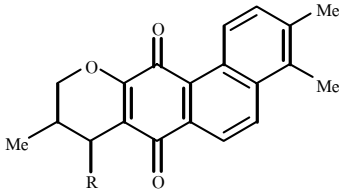


7q: Nerifolinol



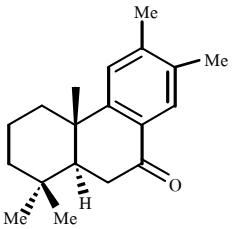
7r: R = CHO : Cleroserroside A

7s: R = CH_2OH : Cleroserroside B

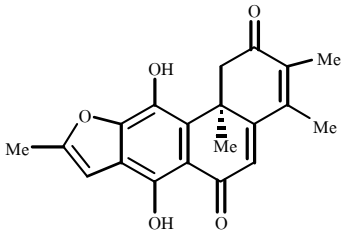


7t: R = H : Bungone A

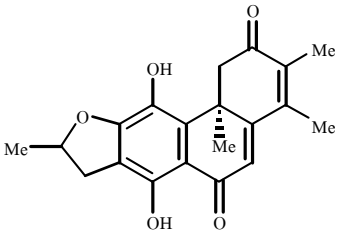
7u: R = CH_2OH : Bungone B



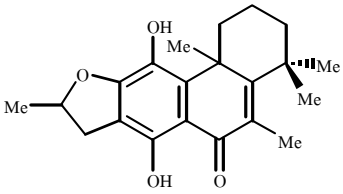
7v: Sugiol



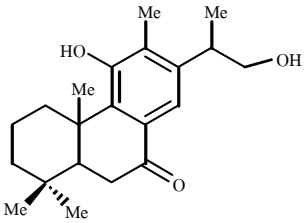
7w: Teuvincenone F



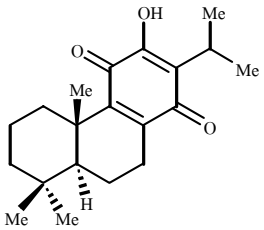
7x: Uncinatone



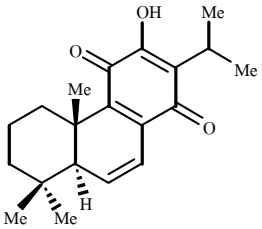
7y: Cyrtophyllone A



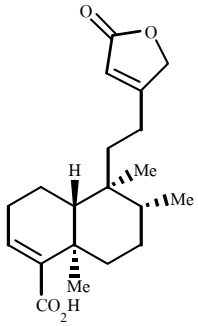
7z: Cyrtophyllone B



7aa: Royleanone

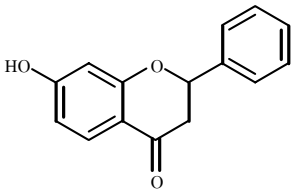


7ab: Dehydroroyleanone



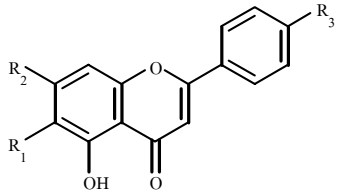
7ac: Cleroinermin

8. Flavanones



8: 7-Hydroxyflavanone

9. Flavones



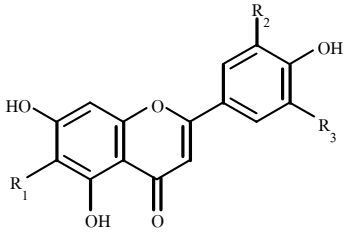
9a: $R_1 = R_2 = OMe$, $R_3 = H$: Cirsimaritin **9b**: $R_1 = OH$, $R_2 = OMe$, $R_3 = H$: Sorbifolin

9c: $R_1 = OMe$, $R_2 = OH$, $R_3 = H$: Hispidulin **9d**: $R_1 = R_2 = OH$, $R_3 = H$: Scutellarein

9e: $R_1 = R_3 = H$, $R_2 = OH$: Apigenin **9f**: $R_1 = H$, $R_2 = OH$, $R_3 = OMe$: Acacetin

9g: $R_1 = R_2 = R_3 = OMe$: Salvigenin **9h**: $R_1 = R_3 = OMe$, $R_2 = OH$: Pectolinarigenin

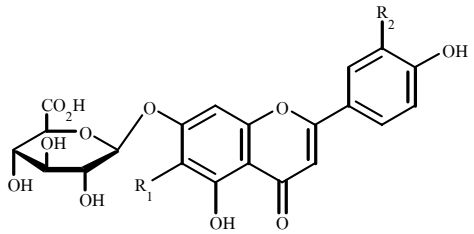
9i: $R_1 = R_2 = H$, $R_3 = OH$: 5-Hydroxy-4′,-
7-dimethoxyflavone



9j: $R_1 = OMe$, $R_2 = H$, $R_3 = OH$: Eupafolin

9k: $R_1 = R_2 = H$, $R_3 = OH$: Lutiolin

9l: $R_1 = H$, $R_2 = R_3 = OMe$: Tricin



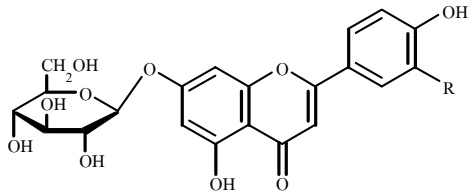
9m: R_1 = OMe, R_2 = H : Hipidulin 7-*O*-glucuronide

9n: R_1 = H, R_2 = OH : Scutellarein 7-*O*-β-D-glucuronide

9o: R_1 = R_2 = H : Apigenin 7-*O*-β-D-glucuronide

9p: R_1 = H, R_2 = OMe : Chrysoeriol 7-*O*-β-D-glucuronide

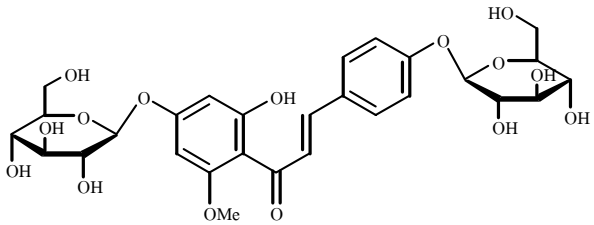
9q: R_1 = H, R_2 = OH : Lutiolin 7-*O*-β-D-glucuronide



9r: R = H: Cosmosiine

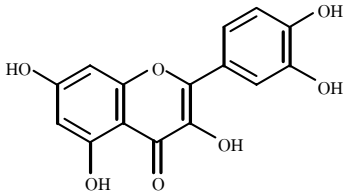
9s: R = OH: Cynaroside

10. Flavonoids



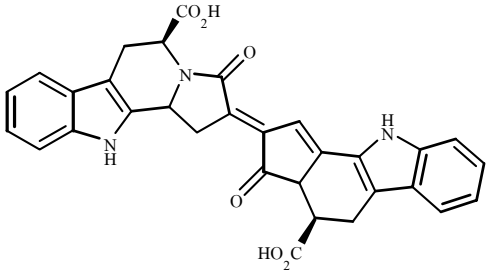
10: 4,2′,4′-Trihydroxy-6-methoxychacone 4,4′-D-glucoside

11. Flavonols

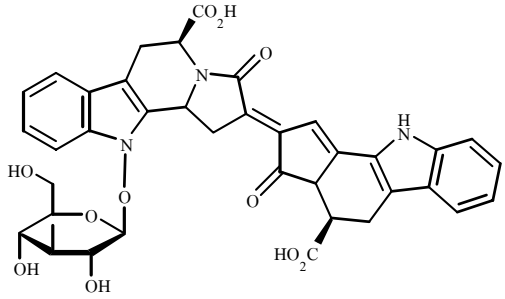


11: Quercetin

12. Indole alkaloids

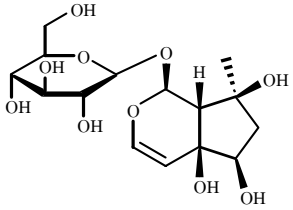


12a: Trichotomine

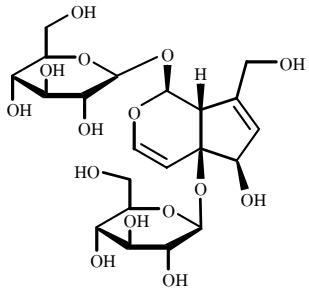


12b: Trichotomine G-1

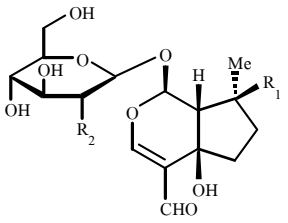
13. Iridoid monoterpenes



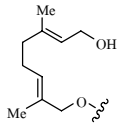
13a: Harpagide

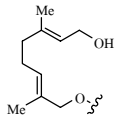


13b: Melittoside

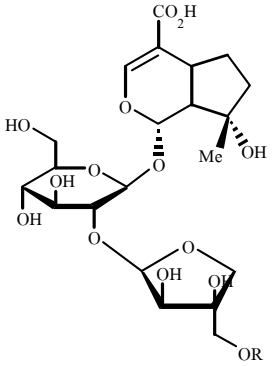


13c: R_1 = OH, R_2 = OH: Euphroside

13d: $R_1 = R_2 =$  : 2′-*O*,8-*O*-Difoliamenthoyleuphroside

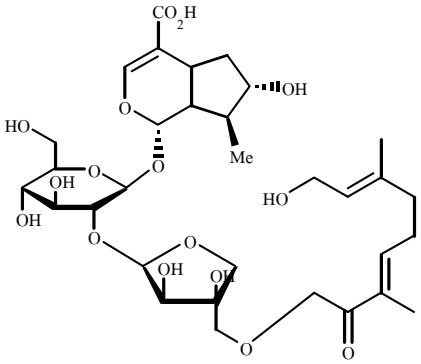
13e: $R_1 =$  , R_2=H : 8-*O*-Difoliamenthoyleuphroside

13f: R_1 = H, R_2= OH : Plantarenaloside

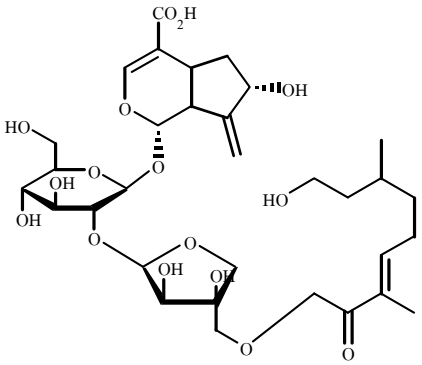


13g: R = H : Inerminoside A-1

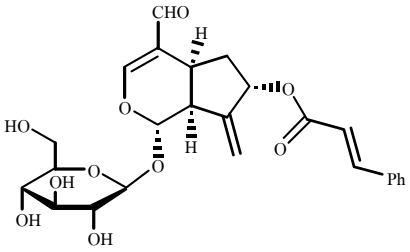
13h: R = *p*-hydroxybenzoyl : Inerminoside D



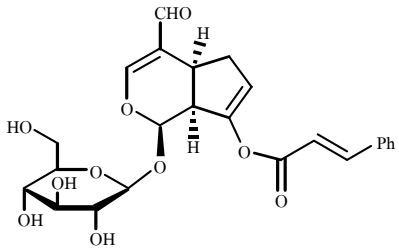
13i: Inerminoside B



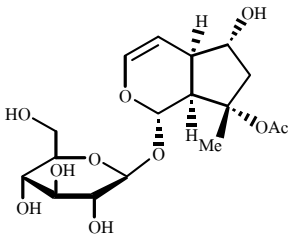
13j: Inerminoside C



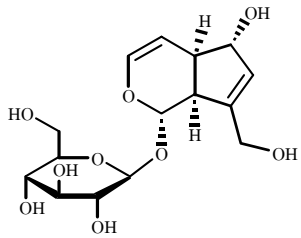
13k: Serratoside A



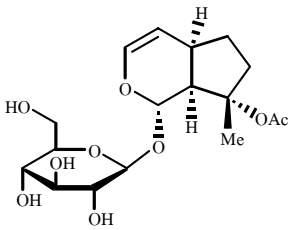
13l: Serratoside B



13m: Ajugoside

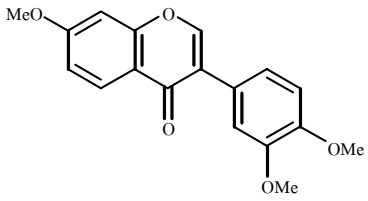


13n: Aucubin



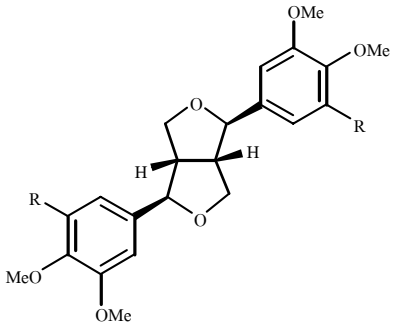
13o: Reptoside

14. Isoflavones



14: Cabreuvin

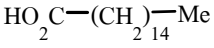
15. Lignans



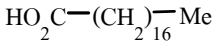
15a: R = H : Eudesmin

15b: R = OMe : Syringaresinol dimethyl ether

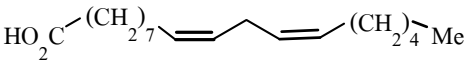
16. Lipids



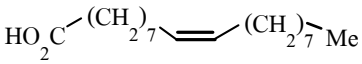
16a: Palmitic acid



16b: Stearic acid

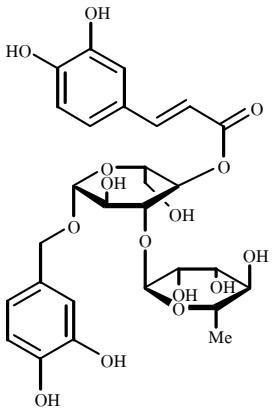


16c: Linoleic acid

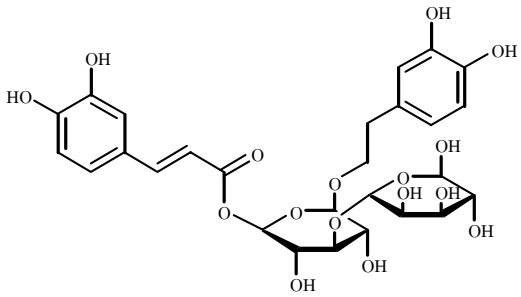


16d: Oleic acid

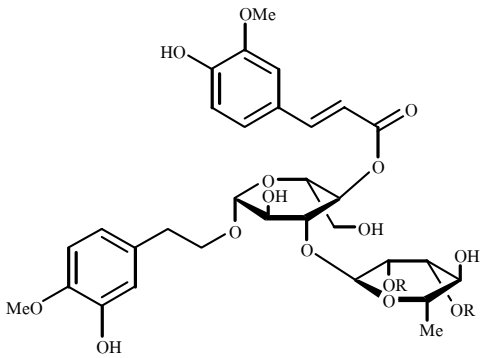
17. Phenyl propanoids



17a: Verbascoside

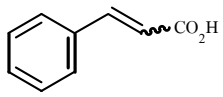


17b: *iso*-Verbascoside



17c: R = OAc : Clerodenoside A

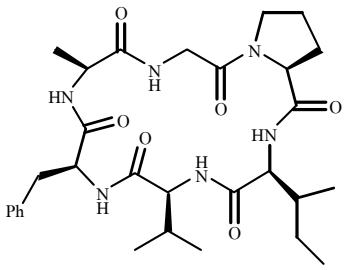
17d: R = H : Martynoside



17e: *cis*-Cinnamic acid

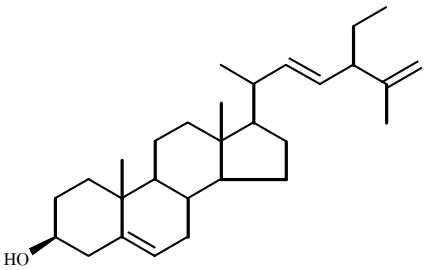
17f: *trans*-Cinnamic acid

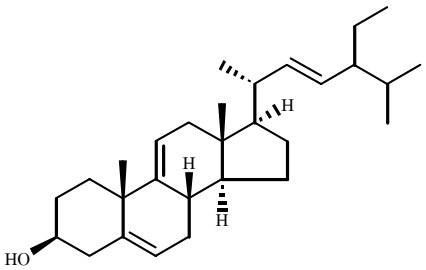
18. Proteids



18: Cleromyrine I

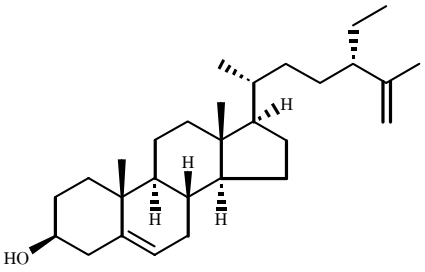
19. Steroids



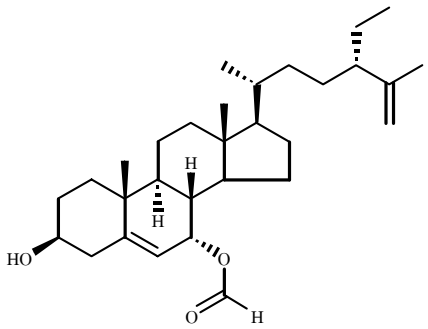


19a: Stigmasta-5,22,25-trien-3β-ol

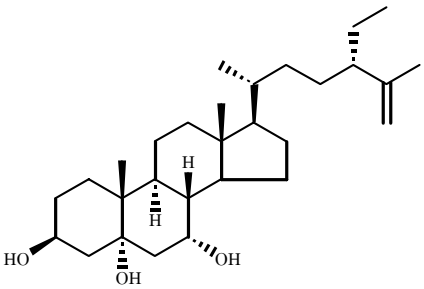
19b: Bungesterol



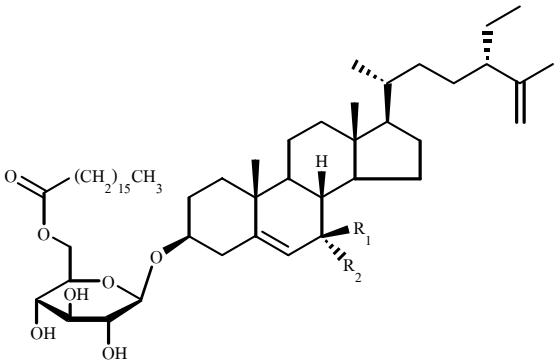
19c: Clerosterol



19d: Colebrin A



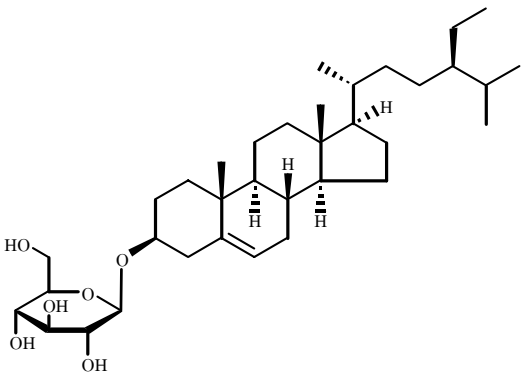
19e: Colebrin B



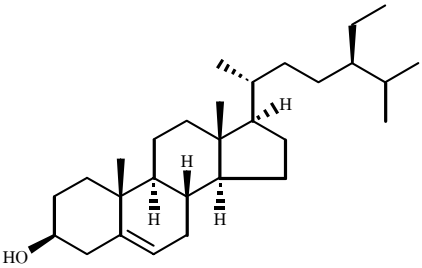
19f: $R_1 = R_2 = H$: Colebrin C

19g: $R_1 = H$, $R_2 = OH$: Colebrin D

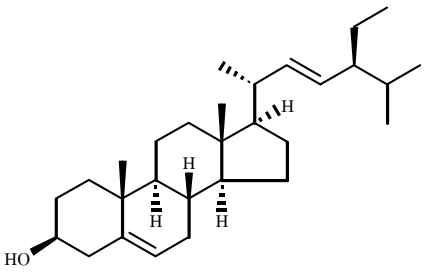
19h: $R_1 = OH$, $R_2 = H$: Colebrin E



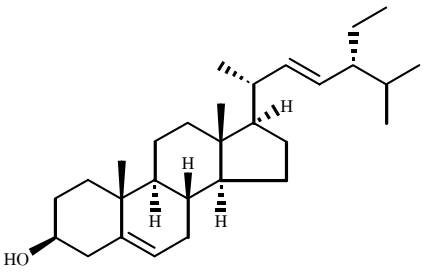
19i: Daucosterol



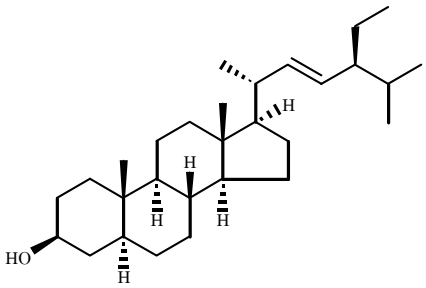
19j: β-Sitosterol



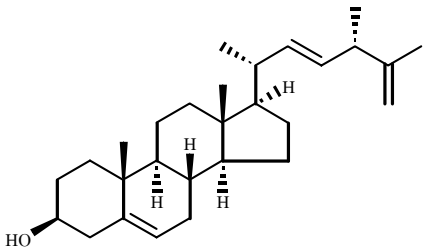
19k: Stigmasterol



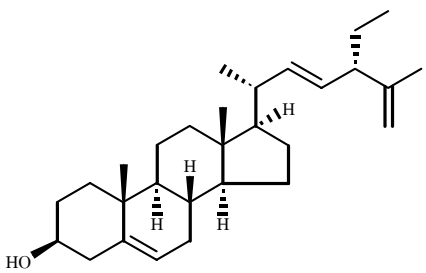
19l: Poriferasterol



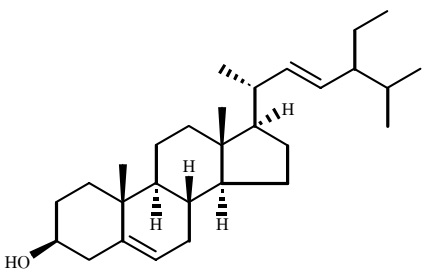
19m: 24α-Ethyl-5α-cholest-22*E*-en-3β-ol



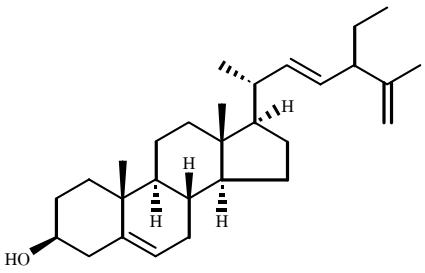
19n: 24β-Methylcholesta-5,22*E*,25-trien-3β-ol



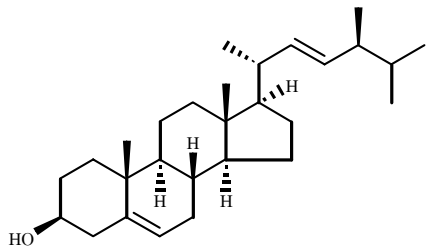
19o: Cholesterol



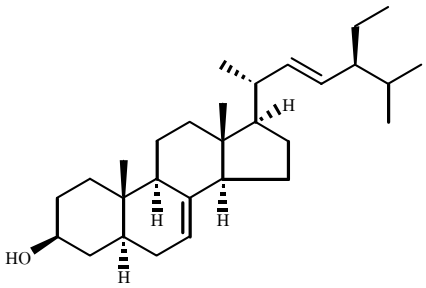
19p: 24-Ethylcholesterol



19q: 22-Dehydroclerosterol

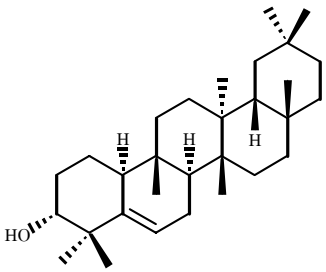


19r: Campesterol

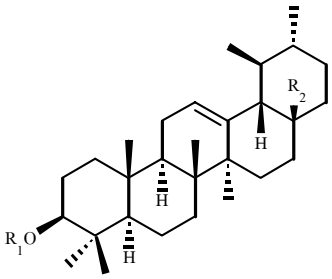


19s: α-Spinasterol

20. Triterpenes



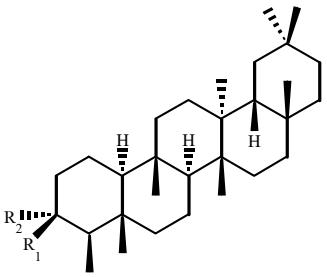
20a: 3-*epi*-Glutinol



20b: $R_1 = R_2 = H$: α-Amyrin

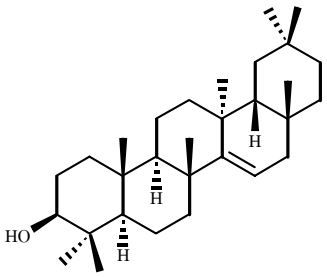
20c: $R_1 = OAc$, $R_2 = H$: α-Amyrin acetate

20d: $R_1 = H$, $R_2 = CO_2H$: Ursolic acid

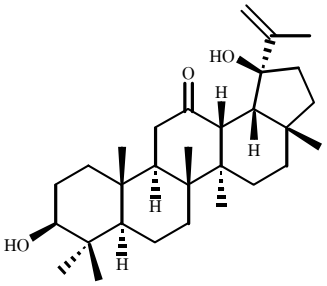


20e: $R_1 = R_2 = O$: Friedelin

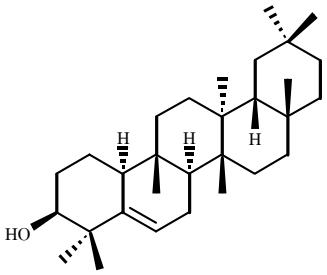
20f: $R_1 = OH$, $R_2 = H$: Friedelan-3β-ol



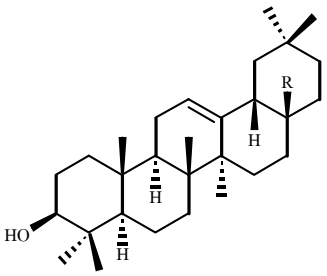
20g: Taraxerol



20h: Clerodolone

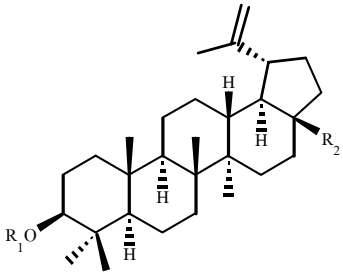


20i: Glutinol



20j: R = H; β-Amyrin

20k: R = CO_2H; Oleanolic acid

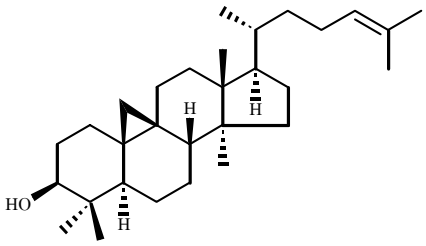


20l: $R_1 = H$, $R_2 = Me$: Lupeol

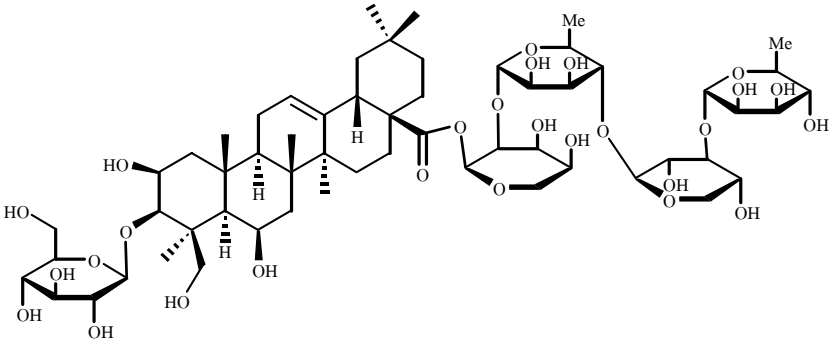
20m: $R_1 = OAc$, $R_2 = Me$: Lupeol acetate

20n: $R_1 = H$, $R_2 = CH_2OH$: Betulin

20o: $R_1 = H$, $R_2 = CO_2H$: Betulinic acid



20p: cycloartenol



20q: *mi*-Saponin A