CHAPTER II

BOTANICAL AND CHEMICAL PROFILES OF THE PLANTS

2.1 Botanical Characteristic of *Gymnema griffithii* Craib

Kingdom: *Plantae*

Subkingdom: *Viridaeplantae*

Phylum: *Tracheophyta*

Class: *Magnoliopsida*

Subclass: *Asteridae*

Order: *Gentianales*

Family: *Apocynaceae*

Subfamily: *Asclepiadoideae*

Genus: *Gymnema*

G. griffithii (Tang pae) is a climber or creeper that grows in the dry deciduous dipterocarp forests, which can be found in southwestern to northern region of Thailand. The plant is grown as an ornamental climber on account of its magnificence. The stems are terete, smooth, minutely tomentose throughout and exude a milky white latex after incision. The leaves are simple, opposite, and exstipulate. The petiole is 1.5–2 cm. The blade is ovate-elliptic, ovate-lanceolate or cordate, apiculate at the apex, 4–6 cm x 5–7 cm, and shows 4– 8 pairs of secondary nerves as wells as a few tertiary nerves below. The inflorescences are raceme-like cymes. The flowers are white recurved with purple tips on the petals, 3 mm long and tubular with 5 longitudinal ridges. The corona has five lobes. The fruits are pairs of follicles which are 10–12 cm x 6 cm [40, 41].

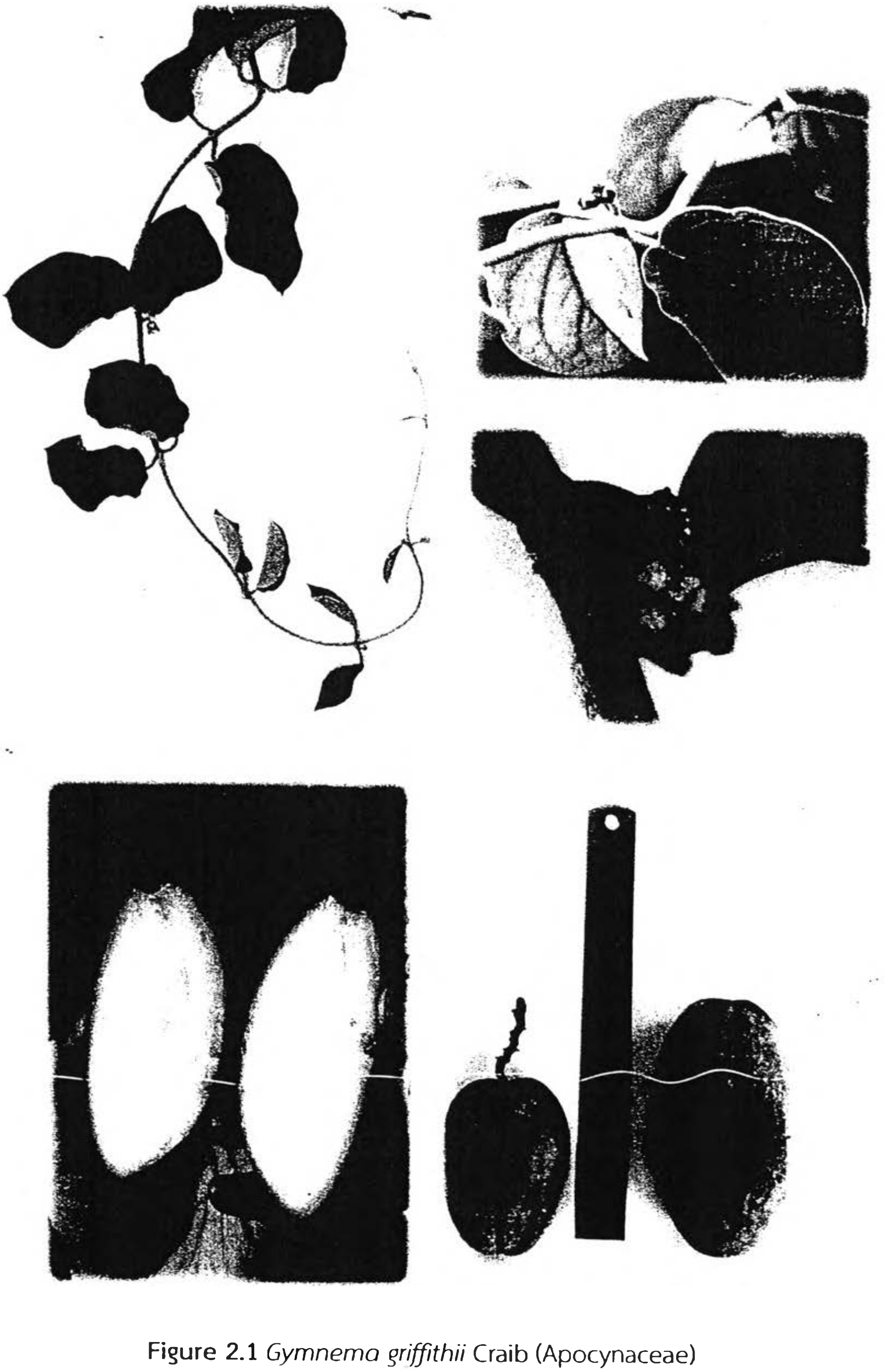


Figure 2.1 *Gymnema griffithii* Craib (Apocynaceae)

2.2 Botanical Characteristic of *Holarrhena curtisii* King & Gamble

Kingdom: *Plantae*

Subkingdom: *Viridaeplantae*

Phylum: *Tracheophyta*

Class: *Magnoliopsida*

Subclass: *Asteridae*

Order: *Gentianales*

Family: *Apocynaceae*

Subfamily: *Apocynoideae*

Genus: *Holarrhena*

H. curtisii (Pud-tung) is native to the dry deciduous dipterocarp forests, which can be found all over Thailand. It's an undershrub or a shrub about 0.30 – 2.50 m high. Branches pale grey to dark grey, often lenticellate or white-dotted or spotted, while branchlets pale grey to brown and pubescent. The leaves are simple, decussate, and exstipulate. The petiole is 5 mm long and grooved above. The blade is spathulate, thick, and velvety below, 3.5 cm × 2.5 cm – 6.5 cm × 3.4 cm – 9 cm × 3.4 cm, and shows 8 – 16 pairs of secondary nerves as wells as a few tertiary nerves below. The inflorescences are long-stalked terminal cymes. The flowers are white and tubular with five contorted lobes. The fruits are pairs of follicles which are 18.5 – 25 cm × 5 mm [14, 32, 41].

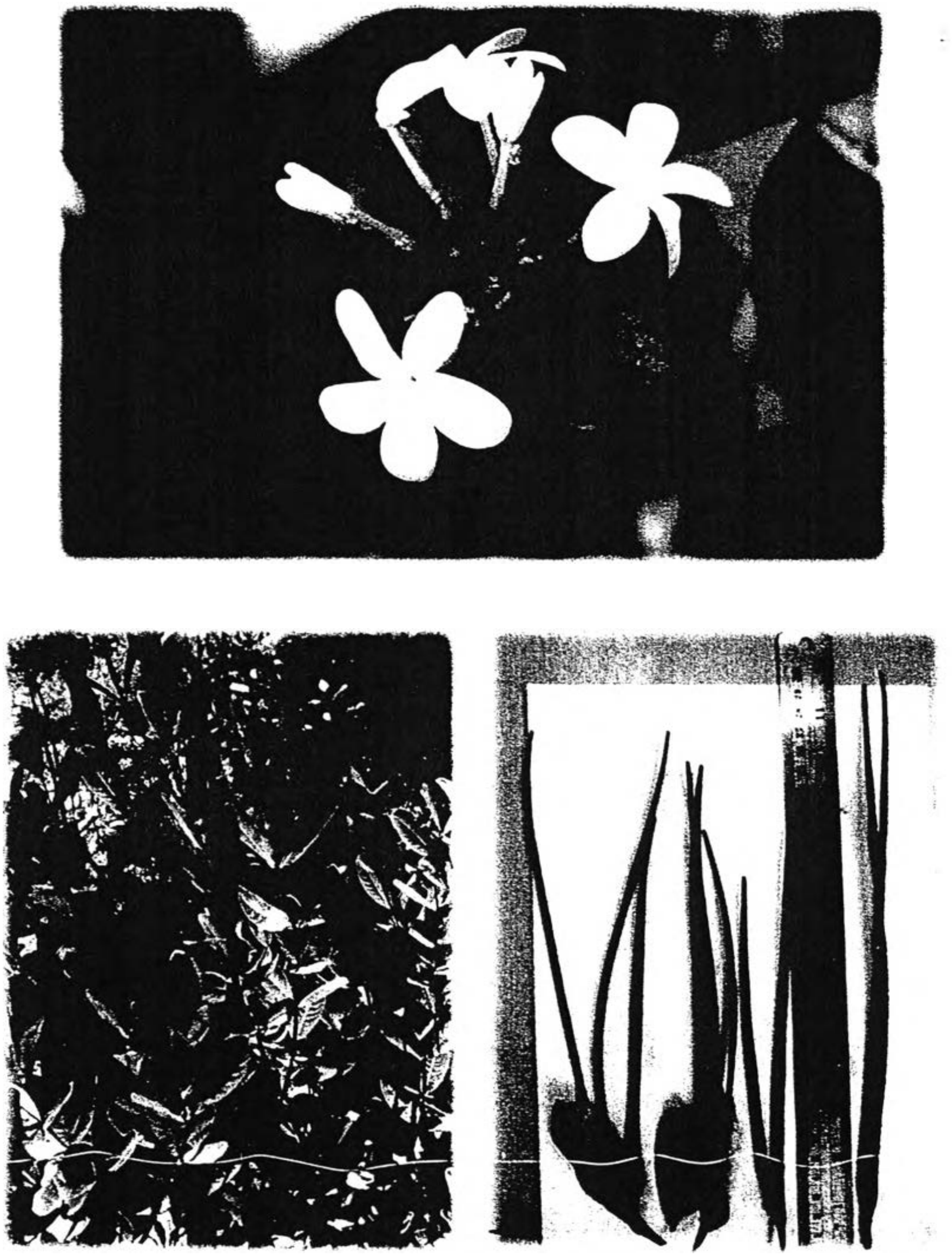


Figure 2.2 *Holarrhena curtisii* King & Gamble (Apocynaceae)

2.3 Chemical constituents of *Gymnema* spp.

In 1989, Yoshikawa and co-workers have reported the isolation of an antisweet principle, gymnemic acid I – IV (**1-4**), from the hot water extract of leaves of *G. sylvestre* for the first time. Mild acid hydrolysis of **1-4** furnished gymnemagenin (**5**), olean-12-ene-3β,16β,21β,22α,23,28-hexol, and alkaline hydrolysis of **1-4** furnished prosapagenin (**6**) [42] (Figure 2.3).

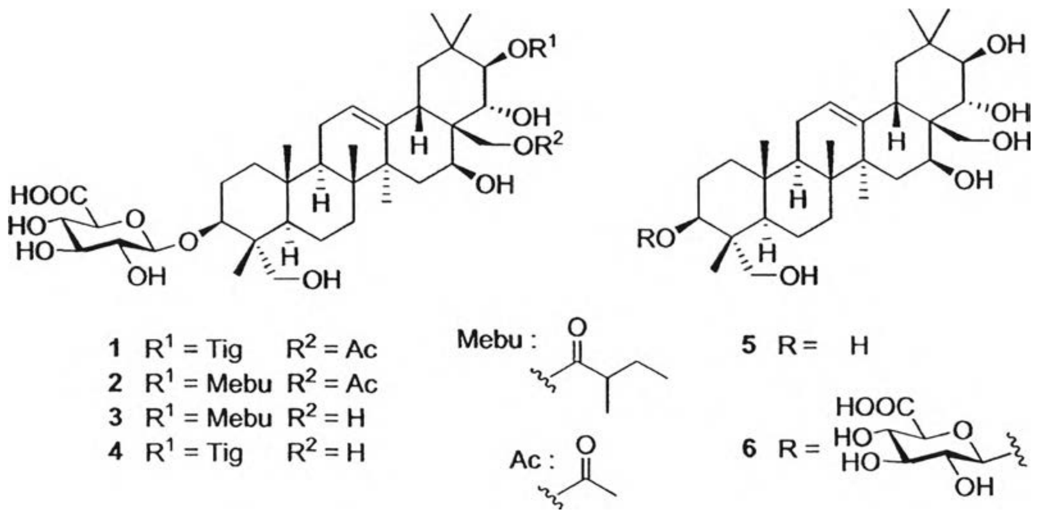


Figure 2.3 Isolated compounds from *G. sylvestre*.

In 1996, Murakami and co-workers investigated the hypoglycemic activity of gymnemaic acid I – V (**1-4** and **7**) and VII (**8**), gymnemosides A (**9**) and B (**10**), and gymnemasaponin II (**11**), IV (**12**) and V (**13**) (Figure 2.4) from leaves of *G. sylvestre*. Compounds **7** and **10** inhibited glucose absorption in small intestine of rats in sucrose tolerance test [43].

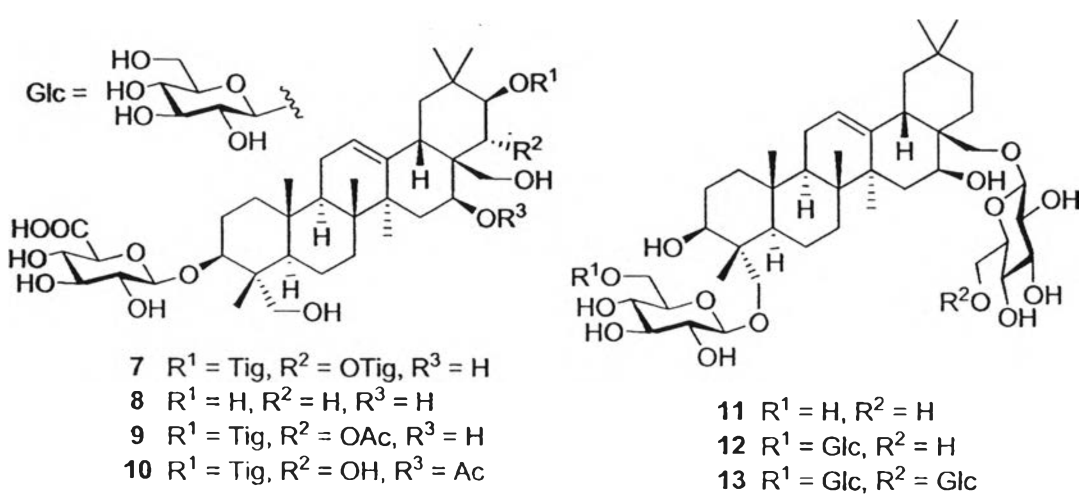


Figure 2.4 Isolated compounds from *G. sylvestre*.

In 1998, Yoshikawa and co-workers studied the chemical constituents of the roots of *G. alternifolium*. Six new polyoxypregnane glycosides, gymnepregosides A – F (**14-19**), and two known compounds (**20** and **21**) (Figure 2.5) were isolated. The mild acid hydrolysis of compound **14** afforded the aglycone prosapogenin (**22**), 12-*O*-cinnamoyl-20-*O*-(*E*)-2-methyl-2-butenoyl-(20*S*)-pregn-6-ene-3β,5α,8β,12β,14β,17β,20-heptol [24].

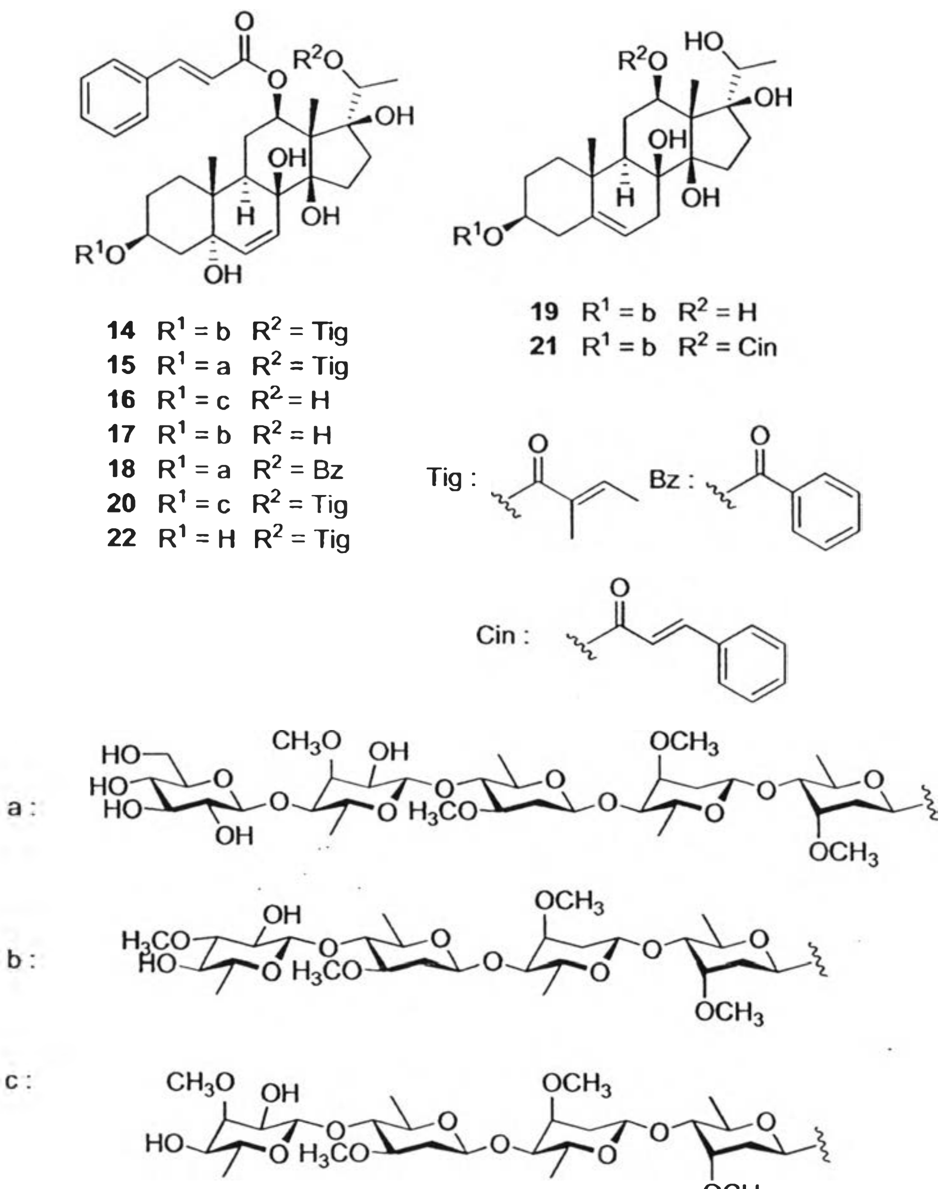


Figure 2.5 Isolated compounds from *G. alternifolium*.

In 2000, Ye and co-workers have reported the isolation of six oleanane-type saponins (**23-28**) (Figure 2.6) from the leaves of *G. sylvestre*. The major saponin constituents, compounds **25-28** which processed on aglycone skeleton of oleanolic acid, of G. sylvestre leaves obtained from China are different from previously reported of the Indian species [28].

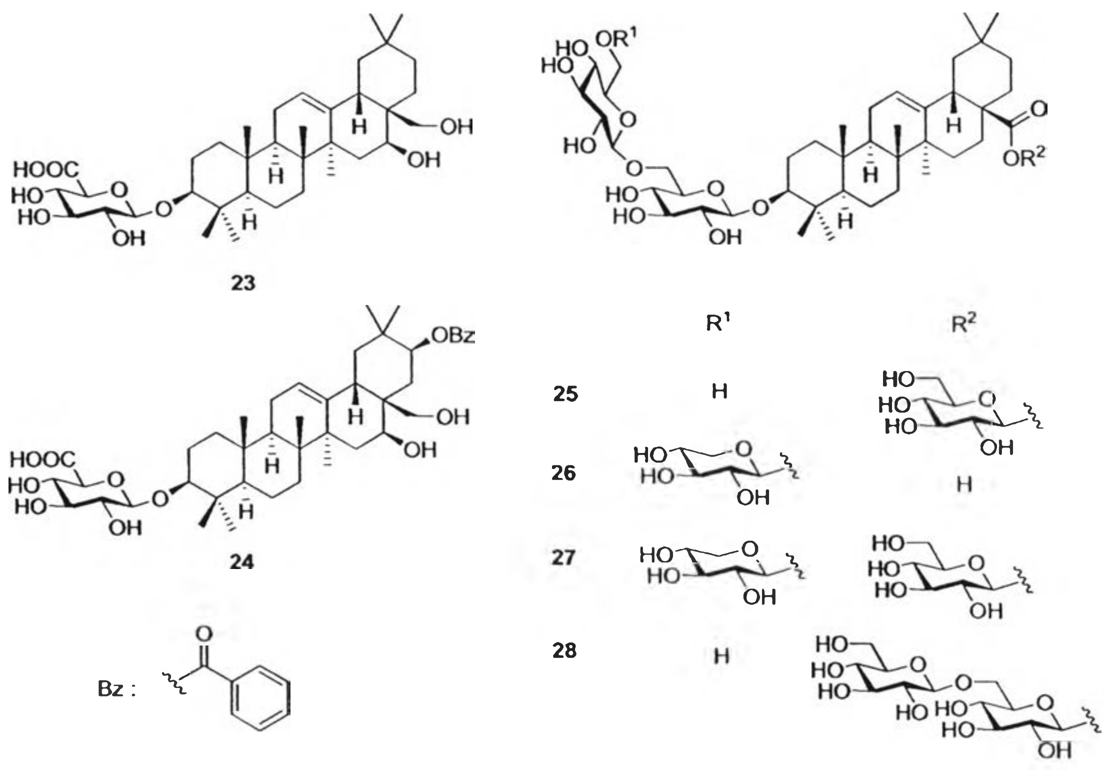
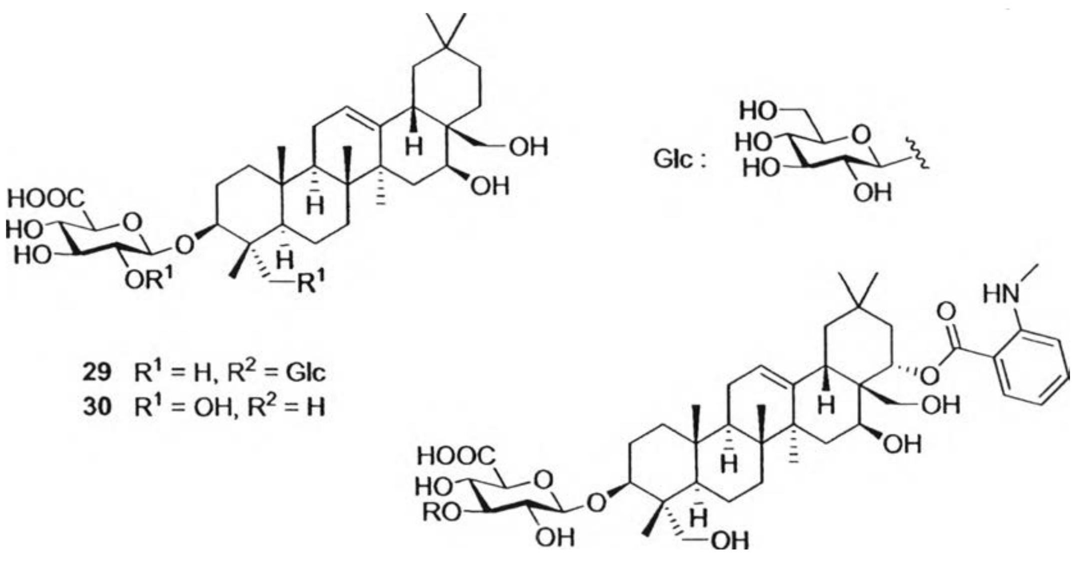


Figure 2.6 Isolated compounds from *G. sylvestre*.

In 2001, Shimizu and co-workers investigated phytochemical from leaves extract of G *inodorum*. Four triterpenoid saponins, (3*β*,16*β*,22*α*)-16,28-dihydroxyolean-12-en-3-yl-*O*-*β*-D-glucopyranosyl-*β*-D-glucopyranosiduronic acid **(29)**, (3*β*,4*α*,16*β*)-16,23,28-trihydroxyolean-12-en-3-yl-*β*-D-glucopyranosiduronic acid **(30)**, (3*β*,4*α*,16*β*,22*α*)-22-(N-methylanthraniloxy)-16,23,28-trihidoroxyolean-12-en-3-yl-3-*O*-*β*-D-glucopy ranosyl-*β*-D-glucopyranosiduronic acid **(31)** and (3*β*,4*α*,16*β*,22*α*)-22-(*N*-methylanthrax niloxy)-16,23,28-trihydroxyolean-12-en-3-yl-*β*-D-glucopyranosiduronic acid **(32)** (Figure 2.7) were isolated and evaluated for their glucose absorption inhibitory activities [44].



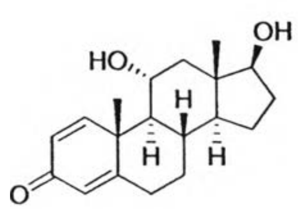
29 R^1 = H, R^2 = Glc
30 R^1 = OH, R^2 = H

31 R = Glc
32 R = H

Figure 2.7 Isolated compounds from *G. inodorum*.

2.4 Chemical constituents of *Holarrhena* spp.

In 1994, Siddiqui and co-workers studied bark extract of *H. pubescens*. Two new compounds, kurchinicin (**33**) and kurchinine (**34**), and one known compound, holadyson (**35**) (Figure 2.8) were isolated [45].



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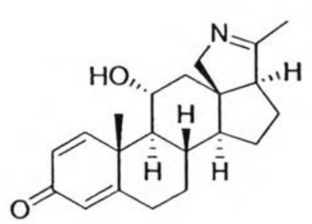

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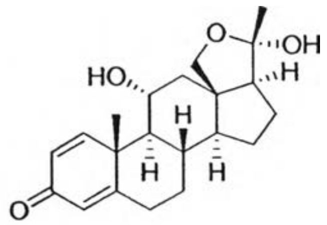

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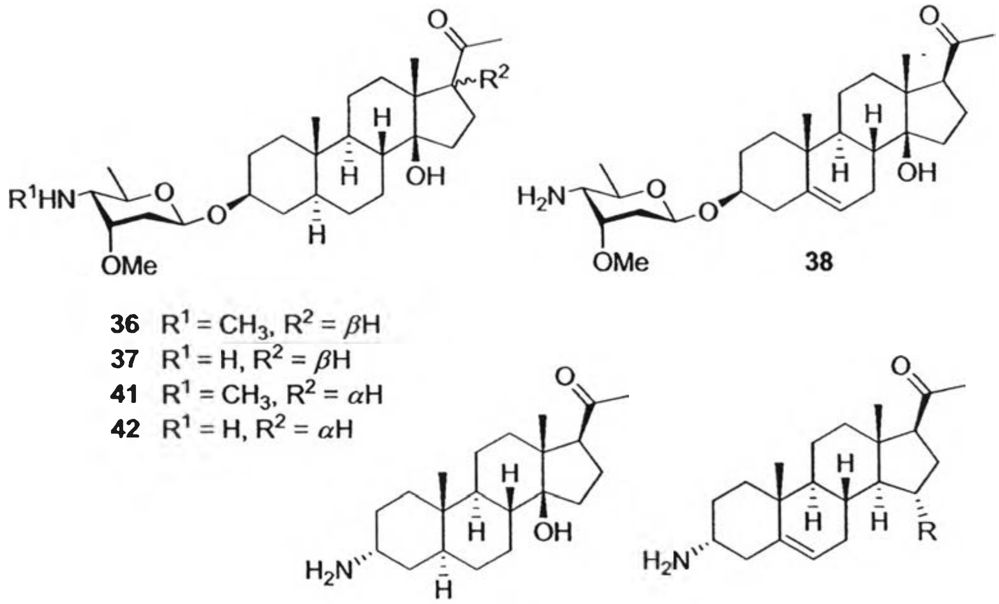
Figure 2.8 Isolated compounds from *H. pubescens*.

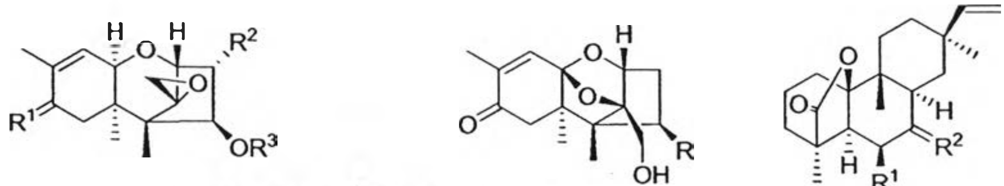
In 1998, Kam and co-workers have reported the isolation of five new steroidal alkaloids, 17-epi-holacurtine (**36**), 17-epi-N-demethylholacurtine (**37**), holacurtinol (**38**), 3α-amino-14β-hydroxypregnan-20-one (**39**) and 15α-hydroxyholamine (**40**) together with three known compounds holacurtine (**41**), N-demethylholacurtine (**42**) and holamine (**43**) (Figure 2.9). All eight compounds showed significant cytotoxic activity against HL-60 and P-388 cell line in rage of 0.2 – 17 μg/mL [35].



36 $R^1 = CH_3$, $R^2 = \beta H$
37 $R^1 = H$, $R^2 = \beta H$
41 $R^1 = CH_3$, $R^2 = \alpha H$
42 $R^1 = H$, $R^2 = \alpha H$
38
39
40 R = OH
43 R = H

Figure 2.9 Isolated compounds from *H. curtisii*.

In 2000, Lockaci and co-workers investigated the ethanol extract of stem of H. *floribunda*. Three new trichothecenes, 8-dihydrotrichothecinol A (**44**), loukacinol A (**45**), and loukacinol B (**46**), and the known compounds, trichothecolone (**47**), trichothecin (**48**), trichothecinol A (**49**), rosenonolactone (**50**), 6β-hydroxy rosenonolactone (**51**), and rosololactone (**52**) (Figure 2.10) were isolated. All compounds show significant cytotoxicity against KB, SK-MEL 30, A-459, and MCF-7 cancer cell lines, especially compound **49** with IC_{50} value in the range of 0.0013 – 0.0021 μg/mL. The antileishmanial activity of isolated compounds was also tested. Only compound **51** showed moderate and weak antileishmanial activity toward extracellular and intracellular *Leishmania donovani*, respectively [46].



44	$R^1 = H_2$	R^2 = OH	R^3 = C(O)CH=CHCH$_3$ (Z)
47	R^1 = O	R^2 = H	R^3 = H
48	R^1 = O	R^2 = H	R^3 = C(O)CH=CHCH$_3$
49	R^1 = O	R^2 = OH	R^3 = C(O)CH=CHCH$_3$

45 R = OH
46 R = H

50 R^1 = H R^2 = O
51 R^1 = OH R^2 = O
52 R^1 = OH $R^2 = H_2$

Figure 2.10 Isolated compounds from *H. floribunda*.

In 2007, Kumar and co-workers determined the chemical constituents of stem bark of *H. antidysenterica*. A new steroidal alkaloid holadysenterine (**53**) and three known steroidal alkaloids, conessine (**54**), isoconessimine (**55**) and kurchessine (**56**) (Figure 2.11) were isolated [47].

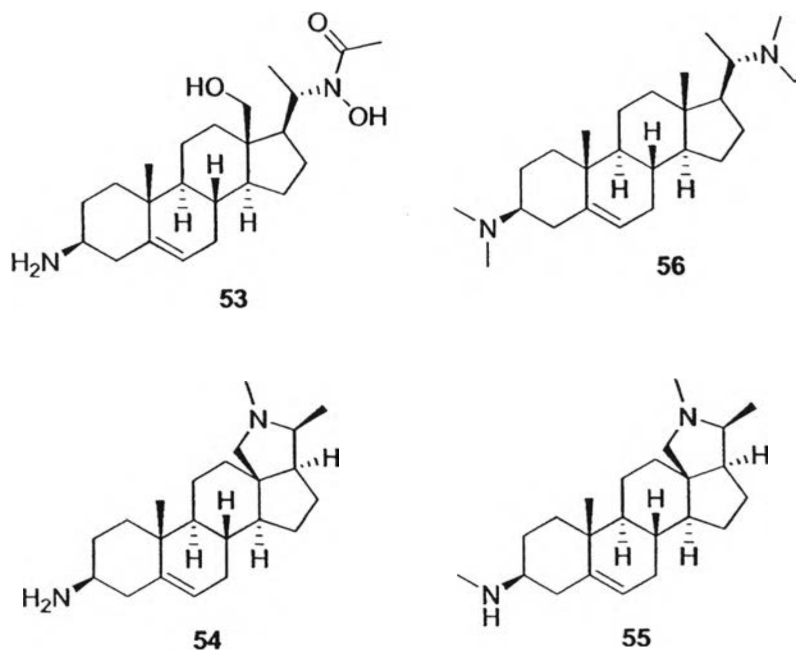
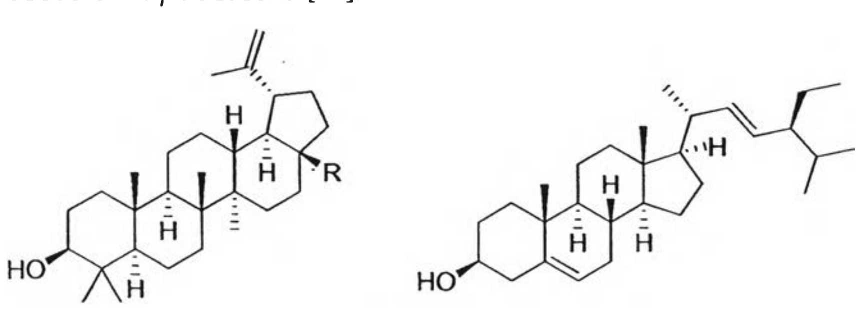


Figure 2.11 Isolated compounds from *H. antidysenterica*.

In 2009, Bhattachartya and co-workers have reported the isolation of three known pentacyclic triterpenoids, lupeol (**57**), betulinaldehyde (**58**), and betulinic acid (**59**) and a steroidal compound, stigmasterol (**60**) (Figure 2.12) from the methanolic extract of seeds of *H. pubescens* [37].



57 R = CH_3
58 R = COOH
59 R = CHO

60

Figure 2.12 Isolated compounds from *H. pubescens*.