CHAPTER 2

Literature Reviews

Polyalthia belong to the Annonaceae family which comprises of about 120 species. This genus is extensively distributed in tropical and subtropical areas [1]. This genus showed many phytochemical compositions and revealed interesting pharmacological activities. The significant biological activities and important phytochemicals of other varieties of *P. evecta*, *P. bullata* and other species of *Polyalthia* genus have been studied and reported as follows.

2.1 *Polyalthia evecta* var. *attopeuensis*

In Thailand, there are three varieties of *P. evecta*, that are *P. evecta* var. *evecta*, *P. evecta* var. *intermedia* and *P. evecta* var. *attopeuensis* [37] (Fig. 2.1). Nowadays, research of *P. evecta* var. *attopeuensis* has not been yet reported.

(A) (B) (C)

Figure 2.1 The *P. evecta* varieties: (A) *P. evecta* var. *evecta* [40]; (B) *P. evecta* var. *intermedia* [41]; (C) *P. evecta* var. *attopeuensis* [39]

2.1.1 Classification of *Polyalthia evecta* var. *attopeuensis*

Kingdom:	Plantae
Phylum:	Magnoliophyta
Class:	Magnoliopsida
Order:	Magnoliale

Family: Annonaceae

Genus: *Polyalthia*

Species: *Polyalthia evecta*

Full Name: *Polyalthia evecta* var. *attopeuensis* (Pierre) Finet & Gagnep. [38]

2.1.2 Botany of *Polyalthia evecta* var. *attopeuensis*

This plant is called “Khamhom” in Thai and was found in the north-eastern part of Thailand. It is a small bush about 50–70 cms tall. The little flower is very fragrant before dusk [39] (Fig. 2.2).

Figure 2.2 Morphological illustration of *P. evecta* var. *attopeuensis* [39, 42]

2.2 *Polyalthia bullata*

P. bullata King is a flowering plant in Annonaceae family. This plant has been used as traditional medicine in Malaysia such as general tonic for men, treatment for skin problems, high blood pressure medication, treatments for diabetes and liver diseases [36].

2.2.1 Classification of *Polyalthia bullata*

Kingdom:	Plantae
Phylum:	Magnoliophyta
Class:	Magnoliopsida
Order:	Magnoliale
Family:	Annonaceae
Genus:	*Polyalthia*
Species:	*Polyalthia bullata*
Full Name:	*Polyalthia bullata* King. [43]

2.2.2 Botany of *Polyalthia bullata*

In Thailand, *P. bullata* is called "Lang Kong". This plant is widely distributed in the Indian subcontinent, Malay peninsula and lowland forest [7]. It is a shrub, up to 3 m tall. Its young twigs are covered with golden hairs. The leaves are lance-shaped or oblong lance-shaped with a size of 28–37 cm multiply 3–12 cm, deeply heart-shaped and auricle at base. The leaves are papery or thinly leathery and bullate, the petiole is 3–5 mm long and portly. The flowers are solitary or 2–3 together opposite the leaves and linear floral leaves, which are about 2.5 cm long. The monocarps are spherical, about 1 cm in diameter while the stem is about 0.5 cm long and 2-seeded [44] (Fig. 2.3).

Figure 2.3 Morphological illustration of *P. bullata* [44, 45]

Figure 2.3 Morphological illustration of *P. bullata* (continued) [44, 45]

2.3 Reviews of Chemical Constituents and Biologicals of *Polyalthia* Genus

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus

Compound	Plant	Part	Bioactive	Structure	Ref no.
1. Alkaloids					
Aporphines					
Anolobine	*P. acuminata*	bk&l		**1**	[6]
Anonaine	*P. acuminata*	bk&l		**2**	[6]
	P. emarginate	l			[5]
	P. oliveri	sb&l			[50]
	P. longifolia	l			[51]
	P. purpurea	w			[52]
Asimilobine	*P. acuminata*	l		**3**	[6]
	P. stenopetala	sb			[10]
	P. suberosa	sb			[53]
	P. insignis	bk			[54]
Boldine	*P. cauliflora* var. *beccari*	bk		**4**	[55]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
Cavarine	*P. acuminata*	bk&l	-	**5**	[6]
Dehydroanonaine	*P. debilis*	rt	Antimicrobial	**6**	[88]
Dehydropredicentrine	*P. cauliflora* var. *beccari*	l	-	**7**	[55]
3-Hydroxy-nornuciferine	*P. acuminata*	l	-	**8**	[6]
3-Hydroxy-nuciferine	*P. acuminata*	l	-	**9**	[6]
Isoboldine	*P. acuminata*	l	-	**10**	[6]
Isopiline	*P. acuminata*	l	-	**11**	[6]
N-Methylcorydine	*P. oliveri*	sb&l	-	**12**	[50]
N-Methylnandigerine-*β*-*N*-oxide	*P. longifolia*	l	-	**13**	[51]
Norannuradhapurini	*P. acuminata*	l	-	**14**	[6]
(–)-Norboldine	*P. longifolia* var. *pendula*	l	Cytotoxic	**15**	[29]
(+)-Norboldine	*P. longifolia* var. *pendula*	l	Cytotoxic	**16**	[29]
Norconovine	*P. oligosperma*	tb	-	**17**	[5]
Norliridinine	*P. acuminata*	l	-	**18**	[6]
Norlirioferine	*P. longifolia*	tb	-	**19**	[51]
Nornuciferine	*P. acuminata*	l	-	**20**	[6]
O-Methyl bulbocapnine-*α*-*N*-oxide	*P. longifolia*	l	-	**21**	[51]
O-Methyl bulbocapnine-*β*-*N*-oxide	*P. longifolia*	l	-	**22**	[51]
O-Methyl isopiline	*P. acuminata*	l			
Predicentrine	*P. cauliflora*	bk	-	**23**	[6]
	var. *beccari*		-	**24**	[55]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
Polygospermine	*P. oligosperma*	bk	-	**25**	[5]
Tuduranine	*P. acuminata*	l	-	**26**	[6]
7-Substituted Aporphines					
Guatterine	*P. suaveolens*	tb	-	**27**	[4]
N-Methyl pachypodanthine-*N*-oxide	*P. oliveri*	sb&l	-	**28**	[50]
Noroliveridine	*P. oliveri*	sb&l	-	**29**	[50]
Noroliverine	*P. oliveri*	sb&l	-	**30**	[50]
	P. suaveolens	tb	-		[4]
Noroliveroline	*P. acuminata*	bk&l	-	**31**	[6]
	P. longifolia	st	Cytotoxic		[15]
Norushinsunine	*P. acuminata*	bk&l	-	**32**	[6]
	P. nittidissima	bk	-		[13]
	P. cauliflora	bk	-		[55]
N-Oxyoliverine	*P. macropoda*	-	-	**33**	[46]
Oliveridine	*P. oliveri*	sb&l	-	**34**	[50, 56]
	P. suaveolens	bk	-		[4]
	P. longifolia	bk	-		[50]
Oliveridine-*N*-oxide	*P. suaveolens*	tb	-	**35**	[11]
Oliverine	*P. oliveri*	sb&l	-	**36**	[50, 56]
	P. suaveolens	bk	-		[4]
	P. longifolia	bk	-		[50]
Oliverine-*N*-oxide	*P. suaveolens*	tb	-	**37**	[11]
	P. macropoda	sb	-		[10]
Oliveroline	*P. oliveri*	sb&l	-	**38**	[50]
	P. suaveolens	tb	-		[4]
	P. macropoda	sb	Antimicrobial		[10, 47]
Oliveroline-*N*-oxide	*P. oliveri*	sb&l	-	**39**	[50]
	P. longifolia	st	Cytotoxic		[15]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
	P. macropoda	sb	-		[10]
Pachypodanthine	*P. oliveri*	sb&l	-	**40**	[50]
	P. suaveolens	sb	-		[4]
Polyalthine	*P. oliveri*	sb&l	-	**41**	[50]
	P. suaveolens	sb	-		[4]
Polysuavine	*P. oliveri*	sb&l	-	**42**	[50]
	P. suaveolens	tb	-		[4, 11]
Ushinsunine	*P. nittidissima*	bk	-	**43**	[13]
	P. cauliflora	bk	-		[55]
Oxoaporphines					
Atherospermidine	*P. cauliflora* var. *beccarii*	bk	-	**44**	[55]
	P. purpurea	w	-		[52]
10-Hydroxyliriodenine	*Polyalthia sp.*	-	-	**45**	[60]
Lanuginosine	*P. suberosa*	sb	-	**46**	[53]
	P. longifolia var. *pendula*	bk	-		[57]
	P. emarginata	tb	-		[5]
	P. oliveri	sb&l	-		[50]
Liriodenine	*P. oliveri*	sb&l	-	**47**	[50]
	P. acuminata	bk	-		[6]
	P. cauliflora var. *cauliflora*	sb	Cytotoxic		[1]
	P. cauliflora var. *beccarii*	sb	-		[55]
	P. emarginata	l	-		[5]
	P. nittidissima	bk	-		[13, 58]
	P. insignis	bk	-		[54]
	P. longifolia var. *pendula*	sb	-		[18]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
	P. longifolia	st&sb	Cytotoxic		[15, 51]
	P. macropoda	sb	-		[10]
	P. stenopetala	sb	-		[10]
	P. suberosa	sb	-		[53]
	P. purpurea	w	-		[52]
Lysicamine	*P. cauliflora* var. *beccarii*	sb	-	**48**	[55]
	P. suaveolens	sb	-		[4]
O-Methyl moschatoline	*P. acuminata*	bk&l	-	**49**	[6]
	P. insignis	bk	-		[54]
	P. cauliflora var. *beccarii*	sb	-		[55]
	P. serica	bk	-		[59]
Oxolaureline	*Polyalthia sp.*			**50**	[60]
Oxostephanine	*P. cauliflora* var. *beccarii*	sb	-	**51**	[13, 58]
	P. suaveolens	tb	Antimalarial		[89]
	P. stenopetala	sb	-		[10]
	P. suberosa	sb	-		[53]
	P. insignis	bk	-		[54]
Thailandine	*P. cauliflora* var. *beccarii*	bk	-	**52**	[55]
Bisaporphines					
Beccapoline	*P. cauliflora* var. *beccarii*	bk	-	**53**	[55, 61]
Beccapolinium	*P. cauliflora* var. *beccarii*	bk	-	**54**	[55, 61]
Beccapolydione	*P. cauliflora* var. *beccarii*	bk	-	**55**	[55]
Polybeccarine	*P. cauliflora*	bk	-	**56**	[55]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
	var. *beccarii*				
Bisdehydroaporphines					
Bidebiline A	*P. debilis*	rt	Antimalarial	**57**	[8]
Bidebiline B	*P. debilis*	rt	Antimalarial	**58**	[8]
Bidebiline C	*P. debilis*	rt	Antimalarial	**59**	[8]
Bidebiline D	*P. debilis*	rt	Antimalarial	**60**	[8]
Bidebiline E	*P. cerasoides*	rt	Antimalarial	**61**	[9]
Bis-7,7′-dehydro anonaine	*P. debilis*	rt	Antimalarial	**62**	[8]
Bis-7,7′-dehydro-8,8′-dimethoxyanonaine	*P. debilis*	rt	Antimalarial	**63**	[8]
Bis-7,7′-dehydro-10,10′-dimethoxy anonaine	*P. debilis*	rt	Antimalarial	**64**	[8]
7,7′-Bisdehydro-*O*-methylisopiline	*P. bullata*	sb	-	**65**	[7]
7-Dehydroanonaine-7′-dehydro-8′-methoxy anonaine	*P. debilis*	rt	Antimalarial	**66**	[8]
7-Dehydro nornuciferine-7′-dehydro-*O*-methyl isopiline	*P. bullata*	sb	-	**67**	[7]
Urabaine	*P. bullata*	sb	-	**68**	[7]
Proaporphine					
Stepharine	*P. acuminata*	bk&l	-	**69**	[6]
Benzylisoquinolines					
Coclaurine	*P. macropoda*	Sb	-	**70**	[10]
	P.acuminata	bk&l	-		[6]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
Codamine	*P. cerasoides*	rt	Antimalarial	**71**	[9]
Laudanidine	*P. cerasoides*	rt	Antimalarial	**72**	[9]
Laudanosine	*P. cerasoides*	rt	Antimalarial	**73**	[9]
N–Methylcoclaurine	*P. acuminata*	bk&l	-	**74**	[6]
Protosinomenine	*P. nittidissima*	bk	-	**75**	[13]
Reticuline	*P. acuminata*	bk&l	-	**76**	[6]
	P. nittidissima	bk	-		[13]
	P. cerasoides	rt	Antimalarial		[9]
Bisbenzylisoquinolines					
Dauricine	*P. nittidissima*	bk	-	**77**	[13]
Daurisoline	*P. nittidissima*	bk	-	**78**	[13]
Isodaurisoline	*P. nittidissima*	bk	-	**79**	[13]
Lindoldhamine	*P. nittidissima*	bk	-	**80**	[13]
N-*N*′-Dimethyl lindoldhamine	*P. nittidissima*	bk	-	**81**	[13]
O-Methyl-7-lindoldhamine	*P. nittidissima*	bk	-	**82**	[13]
O-Methyl-7′-lindoldhamine	*P. nittidissima*	bk	-	**83**	[13]
Phenanthrene					
Uvariopsamine	*P. oliveri*	sb	-	**84**	[62]
Tetrahydroprotoberberines					
Discretamine	*P. stenopetala*	sb	-	**85**	[10]
Kikemanine	*P. oligosperma*	bk	-	**86**	[5]
	P. acuminata	bk	-		[6]
Stepholidine	*P. longifolia*	bk	-	**87**	[63]
	P. nittidissima	bk	-		[13]
	P. acuminata	bk&l	-		[6]
Tetrahydropalmatine	*P. suberosa*	sb	-	**88**	[64]
Thaipetaline	*P. stenopetala*	sb	-	**89**	[10]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
	P. macropoda	sb	-		[10]
Xylopinine	*P. oligosperma*	bk	-	**90**	[5]
Sesquiterpenylindoles					
α-Cadinol	*P. cerasoides*	rt	Antimalarial	**91**	[9]
α-Humulene	*P. cerasoides*	rt	Antimalarial	**92**	[9]
Caryophyllene-oxide	*P. cerasoides*	rt	Antimalarial	**93**	[9]
Greenwayodendrine	*P. suaveolens*	st	-	**94**	[11]
Greenwayodendrine-3β-ol	*P. suaveolens*	st	-	**95**	[11]
Greenwayodendrine-3β-yl-acetate	*P. suaveolens*	st	-	**96**	[11]
Greenwayodendrine-3-ol	*P. suaveolens*	st	-	**97**	[11]
Greenwayodendrine-3-one	*P. suaveolens*	st	-	**98**	[11]
Isopolyalthenol	*P. suaveolens*	st	-	**99**	[12]
Neopolyalthenol	*P. suaveolens*	st	-	**100**	[12]
Polyalthenol	*P. suaveolens*	st	-	**101**	[12]
	P. oliveri	bk	-		[50, 65]
Polyavolensine	*P. suaveolens*	st	-	**102**	[67, 68]
Polyavolensinol	*P. suaveolens*	st	-	**103**	[67, 68]
Polyavolensinone	*P. suaveolens*	st	-	**104**	[67, 68]
Polyavolinamide	*P. suaveolens*	st	-	**105**	[68]
Polyveoline	*P. suaveolens*	st	-	**106**	[4, 66]
Azafluorenes					
Darienine	*P. longifolia*	st&sb	Cytotoxic	**107**	[15]
6,8-Dihydroxy-7-methoxy-1-methyl-azafluorenone	*P. cerasoides*	rt	Cytotoxic	**108**	[48, 49]
Isoncodine	*P. longifolia*	st&sb	Cytotoxic	**109**	[15]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
Isoursuline	*P. stenopetala*	sb	-	**110**	[10]
	P. longifolia var. *pendula*	rt	-		[55]
Onychine	*P. longifolia*	sb	Cytotoxic	**111**	[15]
Penduline	*P. longifolia* var. *pendula*	rt	Antimicrobial	**112**	[31]
Polyfothine	*P. longifolia*	st&sb	Cytotoxic	**113**	[15, 63]
Morphinanedienones					
Norpallidine	*P. longifolia* var. *pendula*	l	Cytotoxic	**114**	[29]
Pallidine	*P. longifolia*	-	-	**115**	[90]
Sebiferine	*P. cauliflora* var. *beccarii*	bk	-	**116**	[55]
8-Oxoprotoberberines					
8-Oxopolyalthiaine	*P. longifolia* var. *pendula*	rt	Cytotoxic	**117**	[29]
Pendulamine A	*P. longifolia* var. *pendula*	rt	Antimicrobial	**118**	[31]
Pendulamine B	*P. longifolia* var. *pendula*	rt	Antimicrobial	**119**	[31]
Azaanthracenes					
1-Aza-4-methyl-2-oxo-1,2-dihydro-9,10-anthracenedione	*P. longifolia* var. *pendula*	rt	Cytotoxic	**120**	[29]
Kalasinamide	*P. suberosa*	st	-	**121**	[70]
Imide					
Bisclerodane imide	*P. longifolia* var. *pendula*	rb	Hypotensive, Toxicology	**122**	[91]
4(18)-Olefinic isomer of bisclerodane imide	*P. longifolia* var. *pendula*	rb	Hypotensive, Toxicology	**123**	[91]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
Amide					
N-cis-Feruloyltyramine	*P. longifolia* var. *pendula*	w	-	**124**	[92]
N-trans-Feruloyl tyramine	*P. longifolia* var. *pendula*	w	-	**125**	[92]
N-trans-p-Coumaroyl tyramine	*P. longifolia* var. *pendula*	-	-	**126**	[93]
N-trans-Sinapoyl thramine	*P. longifolia* var. *pendula*	-	-	**127**	[93]
2.Terpenoids					
Clerodane Diterpenoids					
Cleroda-3,13-dien-15,16-olide	*P. longifolia*	sb	-	**128**	[82]
	P. longifolia var. *pendula*	w	-		[92]
Cleroda-3,13*E*-dien-15-oic acid (Kolavenic acid)	*P. viridis*	bk	-	**129**	[17, 77]
	P. longifolia	sb, sd	Antimicrobial, Cytotoxic		[19, 71]
	P. longifolia var. *pendula*	rw	Antimicrobial		[18, 20]
	P. cheliensis	sb	-		
Cleroda-4(18),13-dien-15,16-olide	*P. longifolia*	sb	-	**130**	[82]
Cleroda-4(18),13*E*-dien-15-oic acid	*P. longifolia*	sb	-	**131**	[82]
	P. cheliensis	sb	-		[75]
2-Oxokolavenic acid	*P. viridis*	sb	-	**132**	[77]
	P. longifolia var. *pendula*	sb&l	Antimicrobial		[20, 76]
3,12*E*-Kolavadien-15-oic acid-16-al	*P. viridis*	bk	-	**133**	[48]
	P. longifolia var. *pendula*	l	Cytotoxic		[29] [77]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
3,13*E*-Kolavadien-15-oic acid-16-al	*P. viridis*	bk	-	**134**	[72]
	P. longifolia	l	-		[31]
3*β*,16*α*-Dihydroxy cleroda-4(18),13(14)*Z* -dien-15,16-olide	*P. barnesil*	sb	Antimicrobial	**135**	[75]
	P. chelienesis	sb	-		[20, 31]
	P. longifolia var. *pendula*	l	Antimicrobial		
4(18),12*E*-Kolavadien-15-oic acid-16-al	*P. longifolia* var. *pendula*	rb	Hypotensive, Toxicology	**136**	[91]
4*β*,16*α*-Dihydroxy cleroda-13(14)*Z* -en-15,16-olide	*P. barnesil*	sb	Antimicrobial	**137**	[31]
14,15-Bisnor-3,11*E*-kolavadien-13-one	*P. viridis*	bk	-	**138**	[17]
16(*R*)-3,13*Z*-Kolavadien-15,16-olide	*P. viridis*	bk	-	**139**	[17]
16(*R* and *S*)-3,13(14)*Z* -Kolavadien-15,16-olide-2-one	*P. viridis*	l	-	**140**	[17]
	P. longifolia var. *pendula*	l	Antimicrobial		[20]
16(*R* and *S*)-Hydroxy cleroda-3,13(14)*Z*-dien-15,16-olide	*P. longifolia* var. *pendula*	l	Antimicrobial	**141**	[20]
16-Hydroxycleroda -13-ene-15,16-olide -3-one	*P. longifolia* var. *pendula*	l	Cytotoxic, Antiinflam-matory	**142**	[29, 100]
16-Hydroxycleroda-3, 13-dien-15-oic acid	*P. longifolia* var. *pendula*	l	Cytotoxic	**143**	[29]
16-Hydroxycleroda-3, 13-dien-15,16-olide	*P. longifolia*	sb	-	**144**	[82]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
16-Hydroxycleroda-4(18),13-dien-15,16-olide	*P. longifolia*	sb	-	**145**	[82]
16*α*-Hydroxycleroda-3,13*Z*-dien-15,16-olide	*P. longifolia*	bk, sb&l	Cytotoxic	**146**	[71-73]
	P. viridis	bk	-		[74]
	P. barnesii	sb	Cytotoxic		[28]
	P. cheliensis	sb	-		[75]
16*α*-Hydroxycleroda-4(18),13(14)*Z*-dien-15,16-olide	*P. cheliensis*	sb	-	**147**	[75]
16*α*-Methoxycleroda-3,13*Z*-dien-15,16-olide	*P. longifolia*	bk	-	**148**	[73]
	P. viridis				[74]
16*β*-Hydroxycleroda-3,13(14)*Z*-dien-15,16-olide	*P. longifolia* var. *pendula*	sb	-	**149**	[18]
16-Oxocleroda-3,13(14)*E*-dien-15-oic acid	*P. longifolia*	sb&l, sd	Antimicrobial, Cytotoxic	**150**	[19, 71, 72]
	P. longifolia var. *pendula*	l	Antimicrobial		[20]
16-Oxocleroda-3,13*Z*-dien-15-oic acid (Polyalthaialdoic acid)	*P. longifolia*	sb&l	Antimicrobial	**151**	[18, 20]
16-Oxocleroda-4(18),13*E*-dien-15-oic acid	*P. longifolia*	sb	-	**152**	[82]
Polyalthic acid	*P. fragrans*	sb	-	**153**	[83]
Methyl-16-oxo cleroda-3,13(14)*E*-dien-15-oate	*P. longifolia* var. *pendula*	l	Antimicrobial	**154**	[20]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
Abeo-Clerodane Diterpenoids					
(4→2)-Abeo-16(*R* and *S*)	*P. viridis*	bk	-	**155**	[78, 79]
-2,13(14)*Z*-dien-15,16-	*P. longifolia*	l	Antimicrobial		[20]
olide-3-al	var. *pendula*				
(4→2)-Abeo-16(*R* and *S*)	*P. viridis*	bk	-	**156**	[17]
-2,13(14)*Z*-dien-15,16-					
olide-3-ol					
Solidagonal acid	*P. longifolia*	rw	Antimicrobial	**157**	[20]
	var. *pendula*				
Halimane Diterpenoids					
3*β*,5*β*,16*α*-Trihydroxy	*P. longifolia*	sb	Cytotoxic	**158**	[29]
halima-13(14)-en-	var. *pendula*				
15,16-olide					
Ent-halima-1(10),13*E*-	*P. longifolia*	sb	-	**159**	[82]
dien-15-oic acid					
Ent-halima-1(10),13*E*-	*P. longifolia*	sb	-	**160**	[82]
dien-15,16-olide					
Ent-halima-5(10),13*E*-	*P. longifolia*	sb	-	**161**	[82]
dien-15-oic acid					
Ent-halima-5(10),13*E*-	*P. longifolia*	sb	-	**162**	[82]
dien-15,16-olide					
16-Hydroxy-ent-halima-	*P. longifolia*	sb	-	**163**	[82]
5(10),13-dien-15,16-					
olide					
16-Oxo-ent-halima-	*P. longifolia*	sb	-	**164**	[82]
5(10),13*E*-dien-15-oic					
acid					
Labdane-Clerodane Diterpenids					
Labd-13*E*-en-8-ol-15	*P. longifolia*	l	Cytotoxic	**165**	[29]
-oic acid	var. *pendula*				

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

Compound	Plant	Part	Bioactive	Structure	Ref no.
(4*S*,9*R*,10*R*)-Methyl-18 -carboxy-labda-8,13*E*-dien-15-oate	*P. macropoda*	sb	-	**166**	[80, 81]
Triterpenoids					
α-Amyrin	*P. longifolia*	-	-	**167**	[94]
	P. suberosa	l	-		[95]
β-Amyrin	*P. longifolia*	-	-	**168**	[94]
	P. suberosa	l	-		[95]
Lupeol	*P. suberosa*	l	-	**169**	[95]
Polycarpol	*P. oliverii*	bk	-	**170**	[50, 86]
	P. suaveolens	bk	-		[12]
Suberosol	*P. suberosa*	st&l	Anti-AIDS	**171**	[16]
Steroids					
α-Spinasterol	*P. cerasoides*	-	-	**172**	[96]
β-Sitosterol	*P. longifolia*	-	-	**173**	[94, 97]
	P. cerasoides	-	-		[96]
β-Sitosterol-*β*-D-glucoside	*P. suberosa*	-	-	**174**	[96]
β-Sitosterol-D-glucoside	*P. suberosa*	-	-	**175**	[96]
Campesterol	*P. longifolia*	-	-	**176**	[94]
	P. suberosa	l	-		[95]
Stigmast-5-en-3-*O*-*β*-D-glucoside-tetraacetate	*P. longifolia*	-	-	**177**	[98]
Stigmasterol	*P. longifolia*	-	-	**178**	[94]
	P. suberosa	l	-		[95]
Stigmasterol-D-glucoside	*P. suberosa*	-	-	**179**	[96]
Taraxasterol	*P. longifolia*	-	-	**180**	[94]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

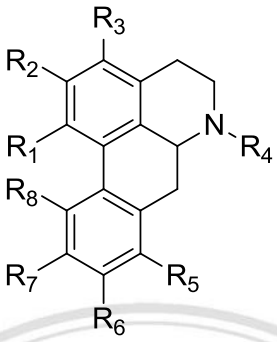
Compound	Plant	Part	Bioactive	Structure	Ref no.
3. Prenyltetrahydrofurano-5-pyrone					
Altholactone	*P. longifolia*	sb	-	**181**	[84]
	P. crassa	l	Cytotoxic		[25]
Crassalactone A	*P. crassa*	l	Cytotoxic	**182**	[25]
Crassalactone B	*P. crassa*	l	Cytotoxic	**183**	[25]
Crassalactone C	*P. crassa*	l	Cytotoxic	**184**	[25]
Crassalactone D	*P. crassa*	l	Cytotoxic	**185**	[25]
1(2-Furyl)-pentacosa-7,9-diyne	*P. evecta*	rt	-	**186**	[21]
1(2-Furyl)-pentacosa-16,18-diyne	*P. suberosa*	st	Antimicrobial	**187**	[33]
3-Acetylaltholactone	*P. crassa*	l	Cytotoxic	**188**	[25]
19(2-Furyl)-nonadeca-5-ynoic acid	*P. evecta*	rt	-	**189**	[21]
19(2-Furyl)-nonadeca-5,7-diynoate	*P. evecta*	rt	-	**190**	[21]
19(2-Furyl)-nonadeca-5,7-diynoic acid	*P. evecta*	rt	-	**191**	[21]
23(2-Furyl)-tricosa-5,7-diynoic acid	*P. suberosa*	st	Antimicrobial	**192**	[33]
4. Prenylated Benzopyran					
6*E*,10*E*-Isopoly cerasoidol	*P. sclerophylla*	sb	-	**193**	[24]
	P. cerasoides	sb	-		[24]
Polycerasoidol	*P. sclerophylla*	sb	-	**194**	[23]
	P. cerasoides	sb	-		[24]
Polyalthidin	*P. cerasoides*	sb	Inhibitors mammalian mitochondrial respiratory chain	**195**	[87]
Polycerasoidin	*P. sclerophylla*	sb	-	**196**	[24]

Table 2.1 Chemical constituents and biologicals of *Polyalthia* genus (continued)

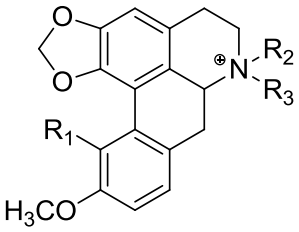
Compound	Plant	Part	Bioactive	Structure	Ref no.
	P. cerasoides	sb	-		[23]
Polycerasoidin-methylester	*P. cerasoides*	sb	-	**197**	[24]
trans-Asarone	*P. sclerophylla*	sb	-	**198**	[24]
	P. cerasoides	sb	-		[24]
5. Lignans					
Eudesmin	*P. longifolia*	f	-	**199**	[99]
Syringaresinol	*P. longifolia* var. *pendula*	w	-	**200**	[92]
6. Flavonoids					
Hyperoside	*P. longifolia*	l	-	**201**	[14]
Rutin	*P. longifolia*	l	-	**202**	[14]
trans-Methylferulate	*P. longifolia* var. *pendula*	l	Antiinflamma-tory,cytotoxic	**203**	[100]
Quercetin	*P. longifolia*	l	-	**204**	[14]
7. Acetogenins					
Howiicin A	*P. plagioneura*	s	-	**205**	[22]
	P. crassa	l	Cytotoxic		[25]
Plagionicin A	*P. plagioneura*	s	-	**206**	[22]
8. Non-Alkaloids Nitrogen Heterocycles					
2-Mercapto-pyridine-*N*-oxide-zinc salt	*P. longifolia*	sb	-	**207**	[84]
	P. nemoralis	sb	-		[85]
Zinc polyanemine	*P. nemoralis*	sb	-	**208**	[85]
9. Chalcone					
2′,4′-Dihydroxy-3′-methoxy chalcone	*P. cauliflora* var. *cauliflora*	sb	Cytotoxic	**209**	[1]
2′,4′-Dihydroxy chalcone	*P. cauliflora* var. *cauliflora*	sb	Cytotoxic	**210**	[1]

sb: stem bark; sd: seed; l: leaves; st: stem; rt: root; bk: bark; tb: trunk bark; w: wood; f: flower; rw: root wood

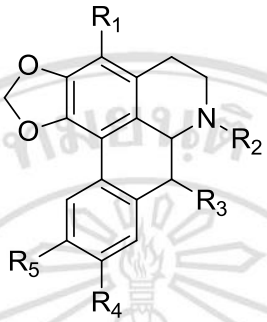
2.4 The Structure of Chemical Constituents from *Polyalthia* Genus



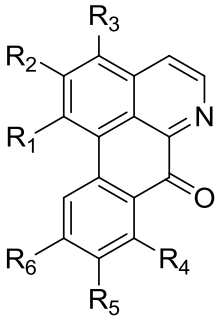
	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8
1	OCH_2O		H	H	H	OH	OCH_3	H
2	OCH_2O		H	H	H	H	H	H
3	OCH_3	OH	H	H	H	H	H	H
4	OCH_3	OH	H	CH_3	H	OH	OCH_3	H
5	OH	OCH_3	H	H	H	H	H	H
6	OCH_2O		H	H	H	H	H	H
7	OCH_3	OH	H	CH_3	H	OCH_3	OCH_3	H
8	OCH_3	OCH_3	OH	H	H	H	H	H
9	OCH_3	OCH_3	OCH_3	CH_3	H	H	H	H
10	OH	OCH_3	H	CH_3	H	OH	OCH_3	H
11	OH	OCH_3	OCH_3	H	H	H	H	H
12	OH	OCH_3	H	$(CH_3)_2$	H	H	OCH_3	OCH_3
14	OCH_2O		H	H	OH	OCH_3	H	H
15	OCH_3	OH	H	H	H	OH	OCH_3	H
16	OCH_3	OH	H	H	H	OH	OCH_3	H
17	OCH_3	OCH_3	OCH_3	H	H	H	OCH_3	OH
18	OCH_3	OH	OCH_3	H	H	H	H	H
19	OCH_3	OCH_3	H	H	H	OCH_3	OH	H
20	OCH_3	OCH_3	H	H	H	H	H	H
23	OCH_3	OCH_3	OCH_3	H	H	H	H	H
24	OCH_3	OH	H	CH_3	H	OCH_3	OCH_3	H
25	OCH_3	OCH_3	OCH_3	H	H	H	OCH_2O	
26	OCH_3	OCH_3	H	H	H	H	OH	H

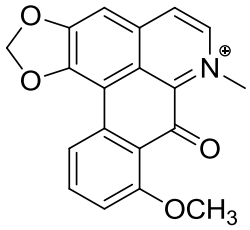


	R_1	R_2	R_3
13	OH	β-O	α-CH_3
21	OCH_3	α-O	β-CH_3
22	OCH_3	β-O	α-CH_3



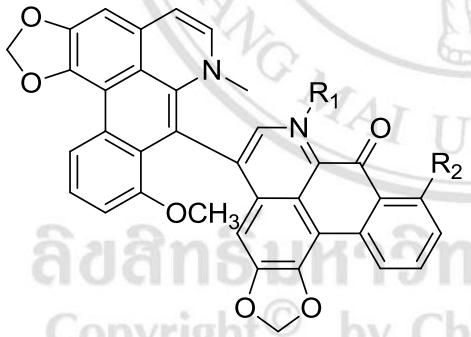
	R_1	R_2	R_3	R_4	R_5
27	OCH_3	CH_3	OH	H	H
28	H	OCH_3	β-OCH_3	H	H
29	H	H	β-OH	OCH_3	H
30	H	H	β-OCH_3	OCH_3	H
31	H	H	β-OH	H	H
32	H	H	α-OH	H	H
33	H	CH_3	β-OCH_3	OCH_3	H
34	H	CH_3	β-OH	OCH_3	H
35	H	OCH_3	β-OH	OCH_3	H
36	H	CH_3	β-OCH_3	OCH_3	H
37	H	OCH_3	β-OCH_3	OCH_3	H
38	H	CH_3	β-OH	H	H
39	H	OCH_3	β-OH	H	H
40	H	H	β-OCH_3	H	H
41	OCH_3	CH_3	β-OH	OCH_3	H
42	H	CH_3	β-OCH_3	OH	H
43	H	CH_3	α-OH	H	H



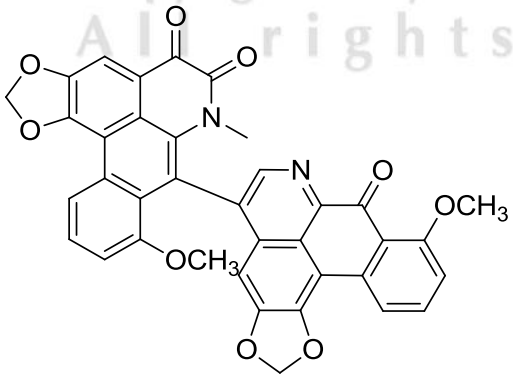


	R_1	R_2	R_3	R_4	R_5	R_6
44	OCH_2O		OCH_3	H	H	H
45	OCH_2O		H	H	H	OH
46	OCH_2O		H	H	OCH_3	H
47	OCH_2O		H	H	H	H
48	OCH_3	OCH_3	H	H	H	H
49	OCH_3	OCH_3	OCH_3	H	H	H
50	OCH_2O		H	H	H	OCH_3
51	OCH_2O		H	OCH_3	H	H

52



	R_1	R_2
53	-	OCH_3
54	CH_3	OCH_3
56	-	H



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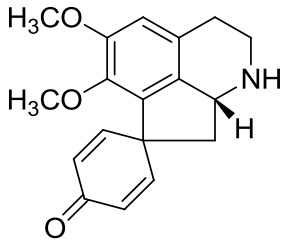

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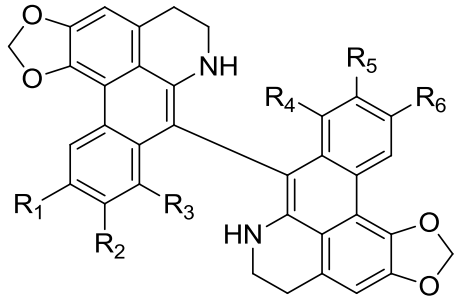
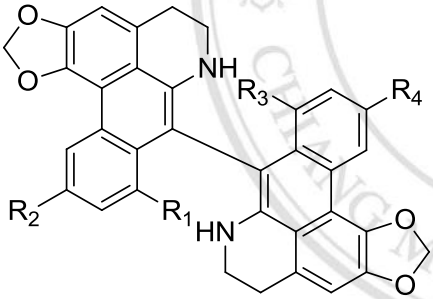
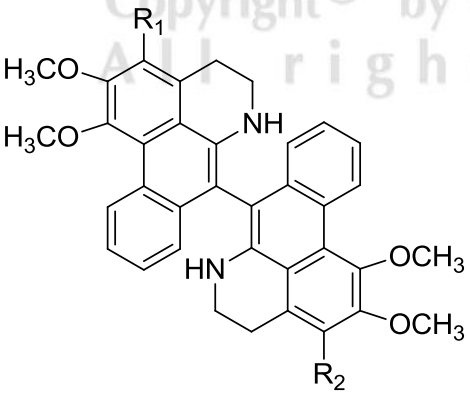


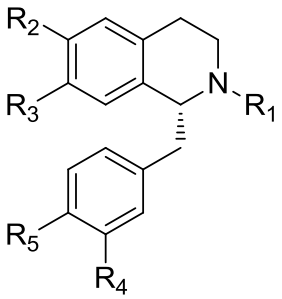
	R_1	R_2	R_3	R_4	R_5	R_6
57	H	H	H	H	H	H
58	H	H	H	OCH_3	H	H
59	H	H	OCH_3	OCH_3	H	H
61	OCH_3	H	H	H	H	OCH_3
62	H	OCH_3	H	H	OCH_3	H



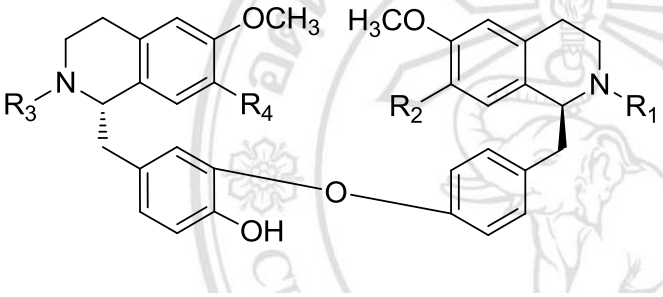
	R_1	R_2	R_3	R_4
62	H	H	H	H
63	OCH_3	H	OCH_3	H
64	H	OCH_3	H	OCH_3
66	H	H	OCH_3	H



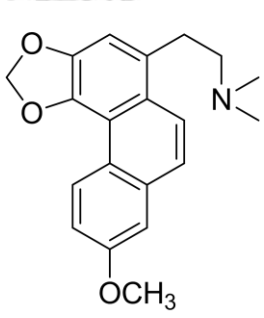
	R_1	R_2
65	OCH_3	OCH_3
67	H	OCH_3
68	H	H



	R_1	R_2	R_3	R_4	R_5
70	H	OCH_3	OH	H	OH
71	CH_3	OCH_3	OH	OCH_3	OCH_3
72	CH_3	OCH_3	OCH_3	OCH_3	OH
73	CH_3	OCH_3	OCH_3	OCH_3	OCH_3
74	CH_3	OCH_3	OH	H	OH
77	CH_3	OH	OCH_3	OH	OCH_3
76	CH_3	OCH_3	OH	OH	OCH_3



	R_1	R_2	R_3	R_4
77	CH_3	OCH_3	CH_3	OCH_3
78	CH_3	OCH_3	CH_3	OH
79	CH_3	OH	CH_3	OCH_3
80	H	OH	H	OH
81	CH_3	OH	CH_3	OH
82	H	OH	H	OCH_3
83	H	OCH_3	H	OH



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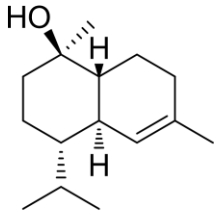

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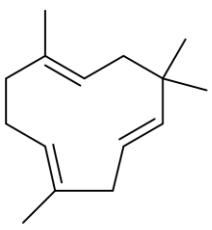

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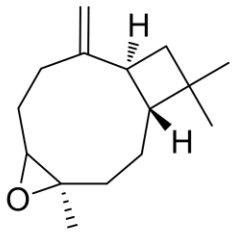

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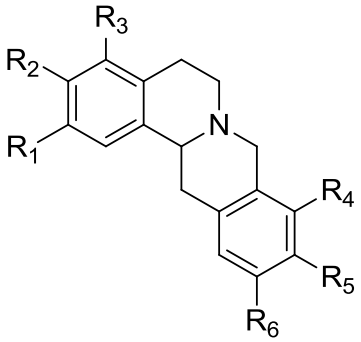
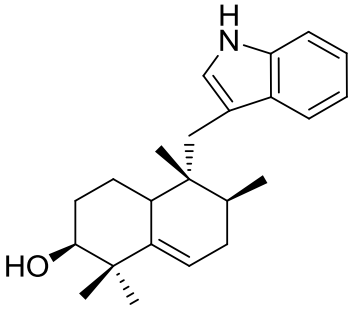


	R_1	R_2	R_3	R_4	R_5	R_6
85	OCH_3	OH	H	OCH_3	OH	H
86	OCH_3	OCH_3	H	OCH_3	OH	H
87	OH	OCH_3	H	OCH_3	OH	H
88	OCH_3	OCH_3	H	OCH_3	OCH_3	H
89	OCH_3	OCH_3	OH	OCH_3	OH	H
90	OCH_3	OCH_3	H	H	OCH_3	OCH_3



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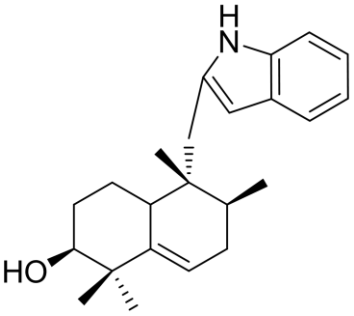

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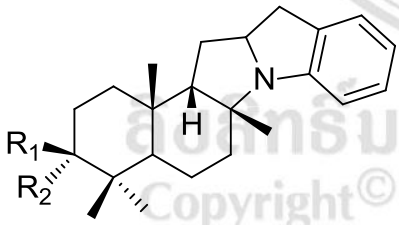
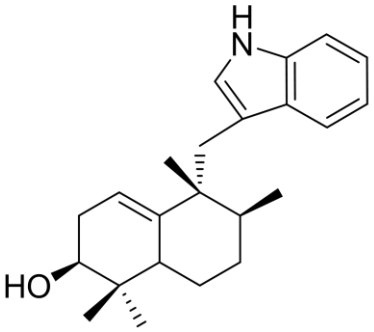


	R_1	R_2
94	H	H
95	OH	H
96	OAc	H
97	H	OH
98	O	



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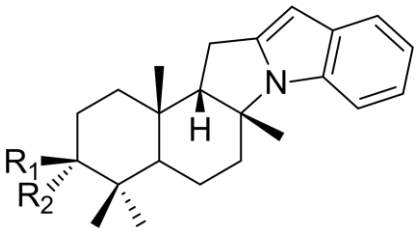
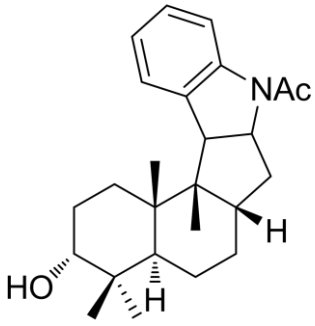


	R_1	R_2
102	OAc	H
103	OH	H
104	O	



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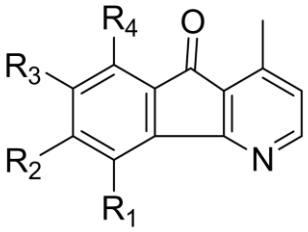
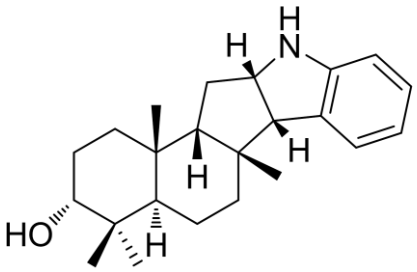


	R_1	R_2	R_3	R_4
107	OCH_3	OCH_3	OH	H
108	H	OH	OCH_3	OH
109	H	OCH_3	OH	H
110	OH	OCH_3	H	H
111	H	H	H	H
112	H	OH	OH	OCH_3
113	H	OCH_3	OCH_3	H



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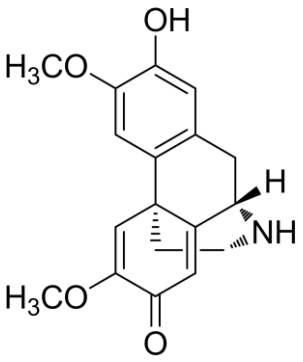
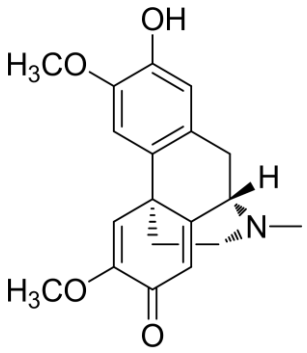


114



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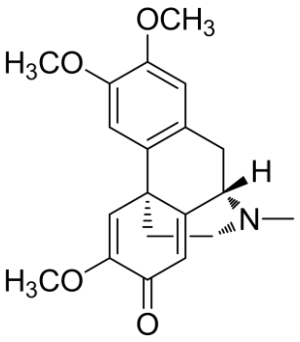

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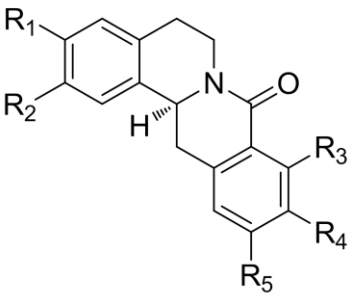
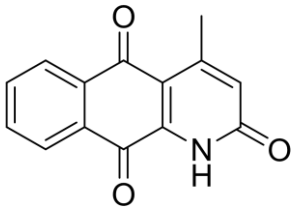


	R_1	R_2	R_3	R_4	R_5
117	OCH_3	OH	OH	OCH_3	OH
118	OH	H	OCH_3	OH	OCH_3
119	OH	H	OCH_3	OH	OCH_3



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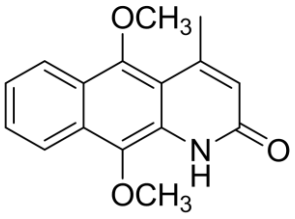

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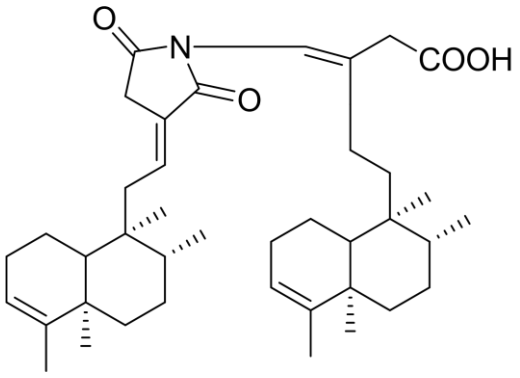

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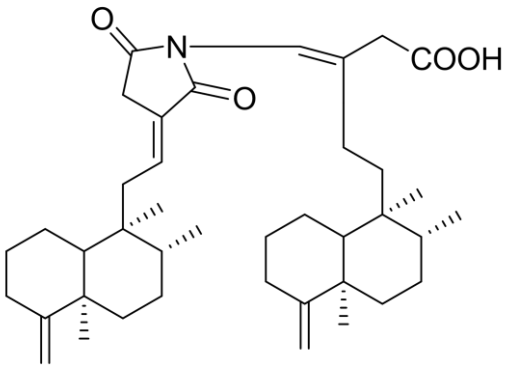

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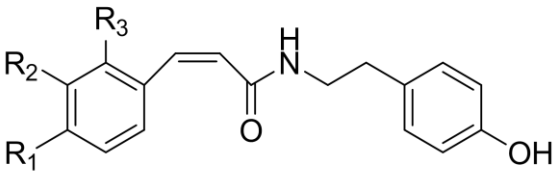
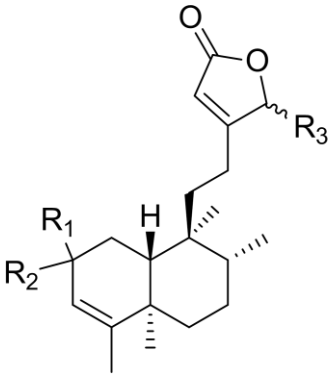
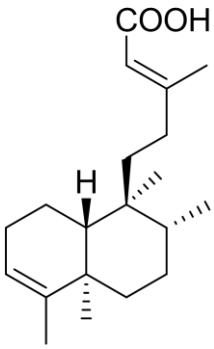


	R_1	R_2	R_3
124	OH	OCH_3	H
125	OCH_3	OH	H
126	H	OH	H
127	OCH_3	OH	OCH_3



	R_1	R_2	R_3
128	H	H	H_2
139	H	H	α-OH
140	O		OH
141	H	H	OH
148	H	H	α-OCH_3
149	H	H	β-OH



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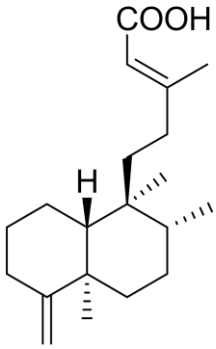

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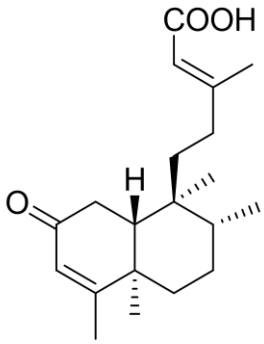

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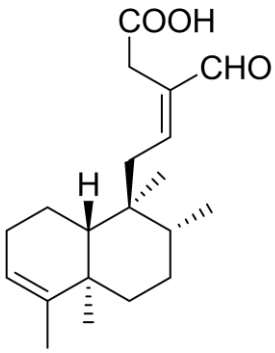

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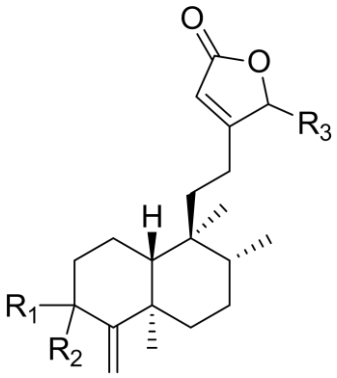
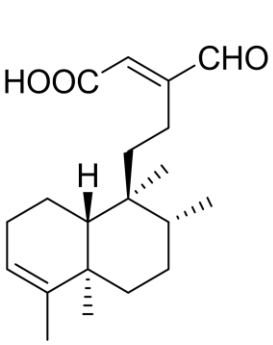


	R_1	R_2	R_3
130	H	H	H_2
135	β-OH	H	α-OH
147	H	H	α-OH



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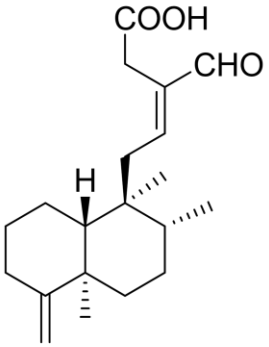

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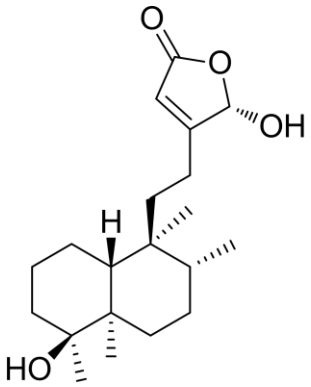

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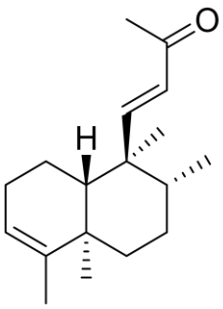

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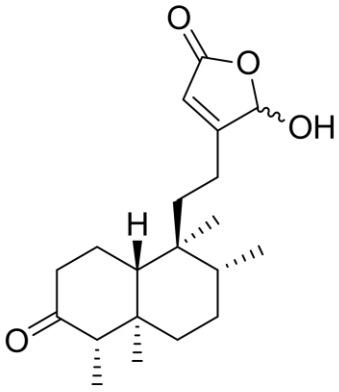

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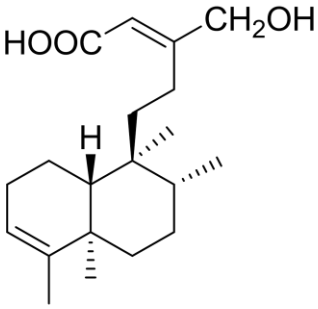

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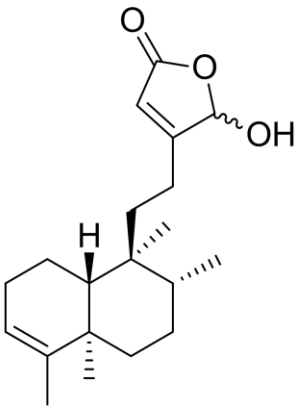

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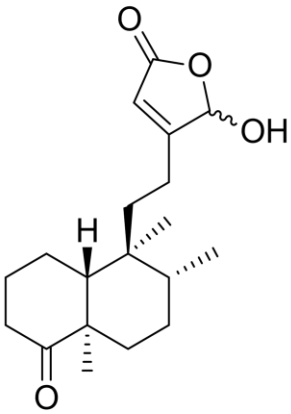

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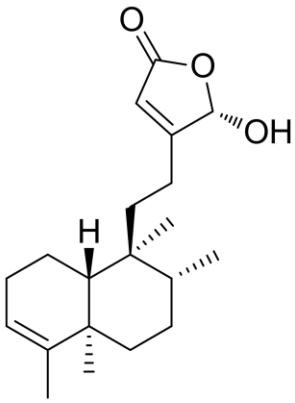

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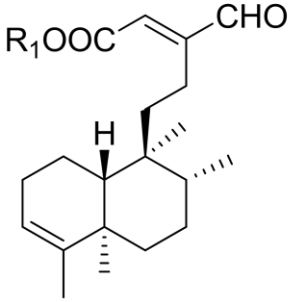

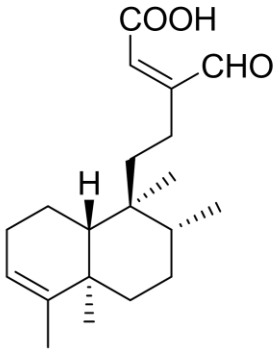

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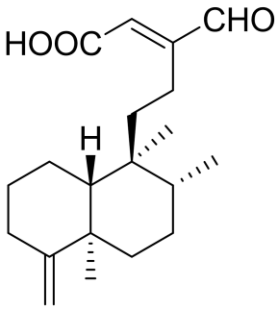
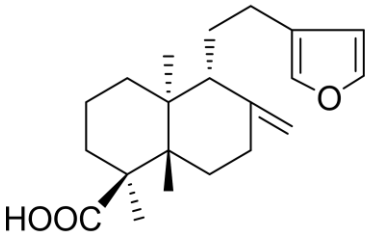


152

	R_1
150	H
154	CH_3



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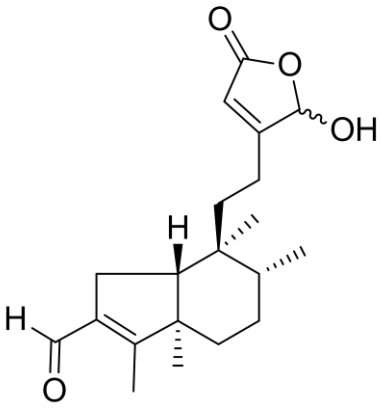

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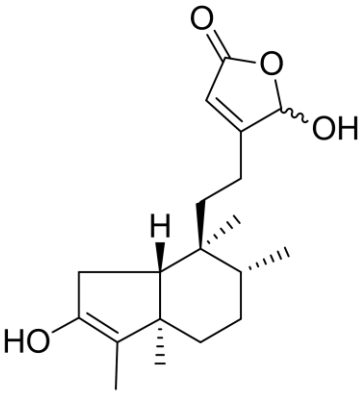

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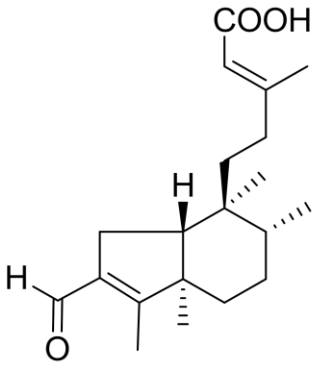

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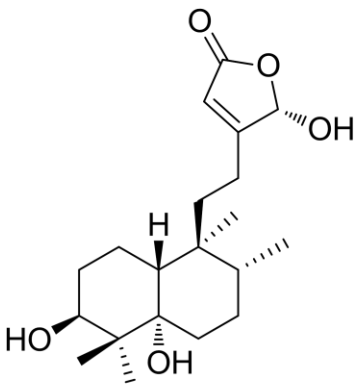

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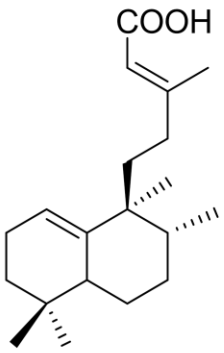

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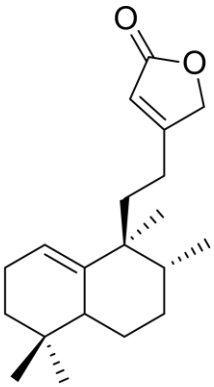

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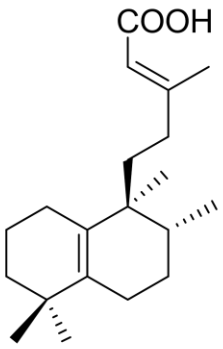

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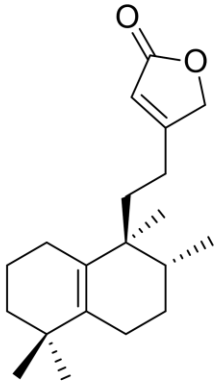

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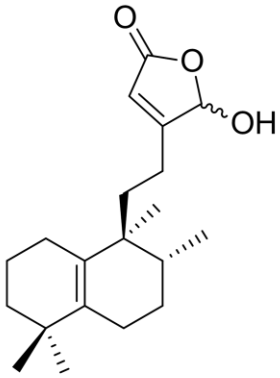

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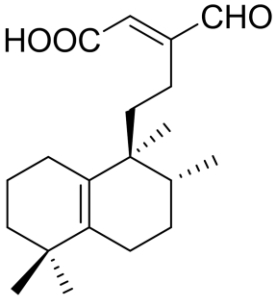

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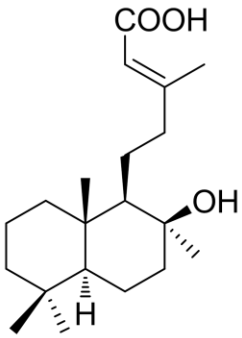

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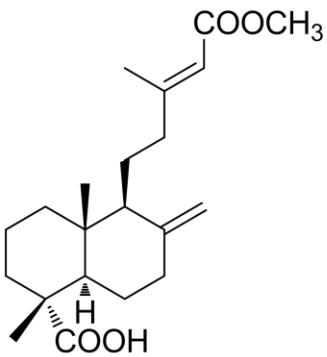

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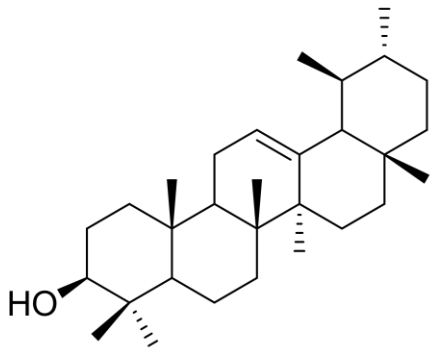

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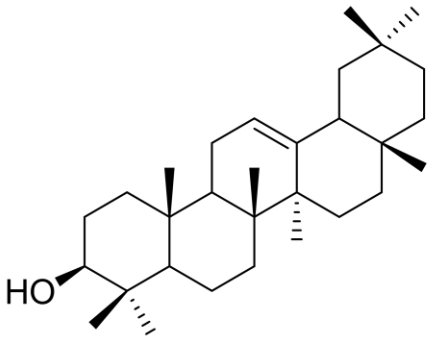

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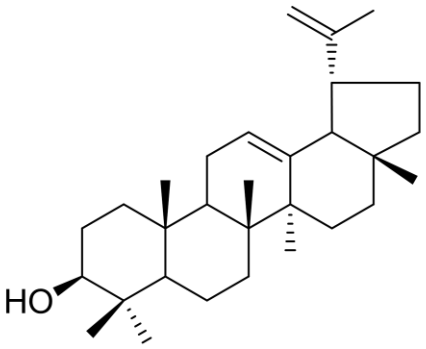

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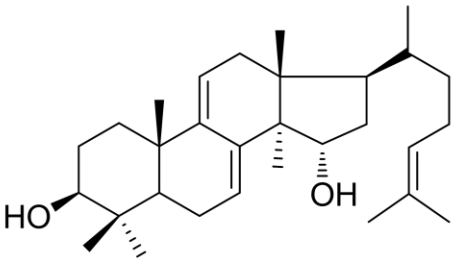

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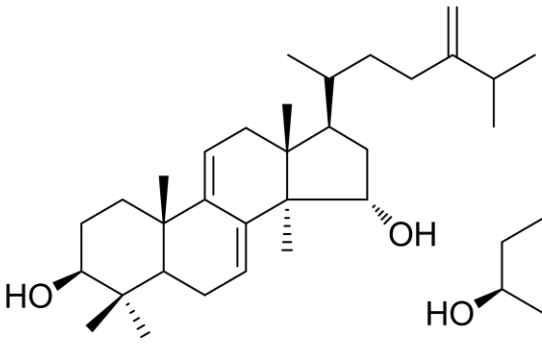

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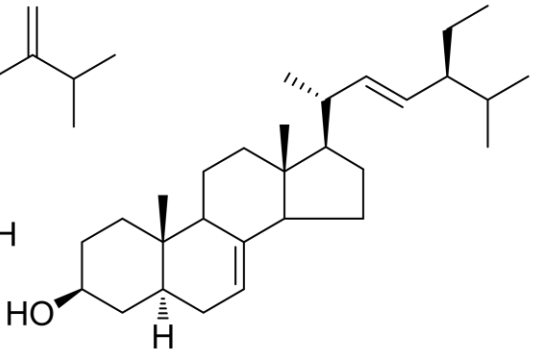

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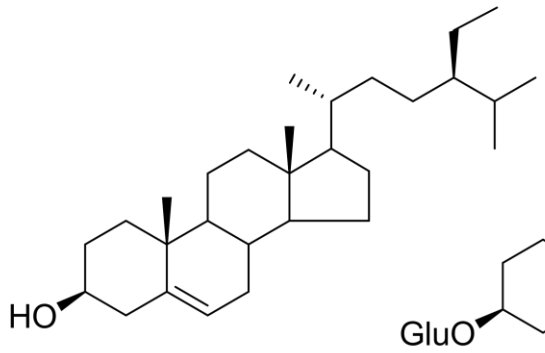

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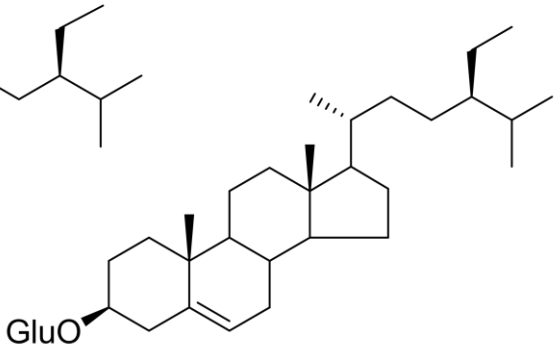

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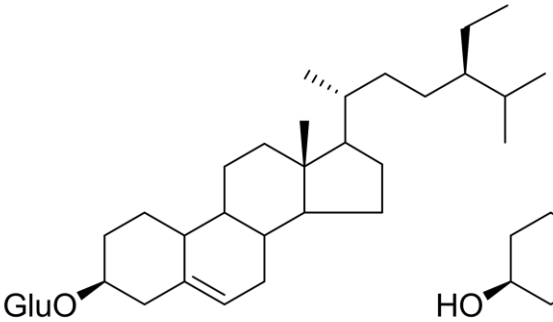

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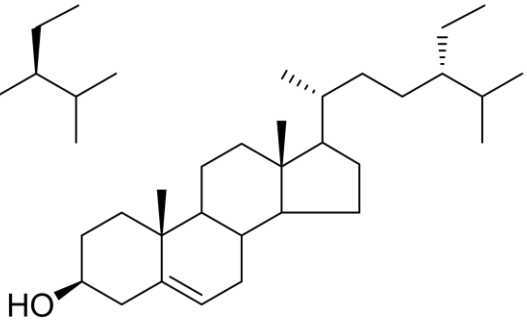

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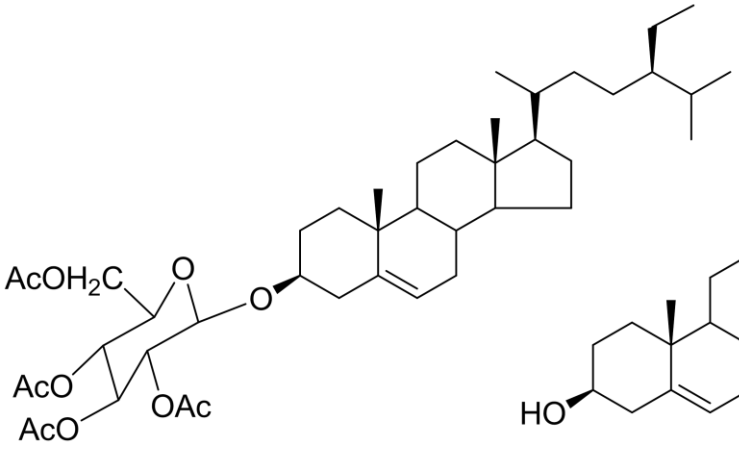

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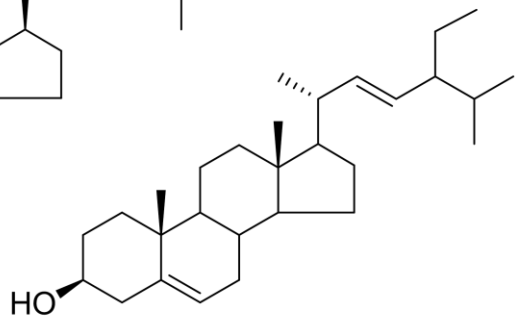

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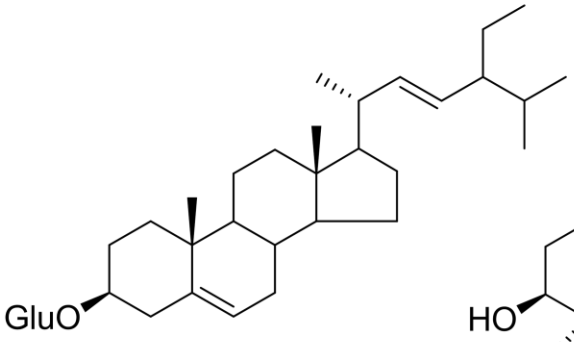

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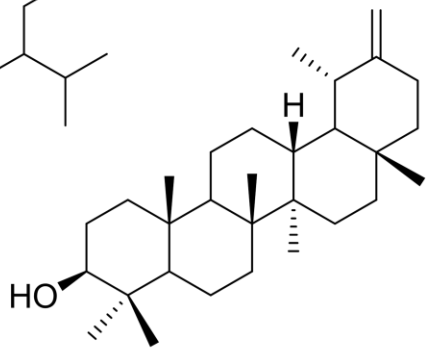

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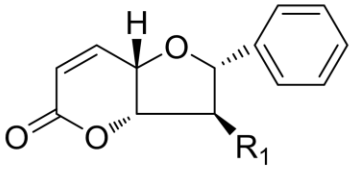
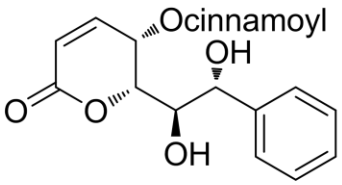
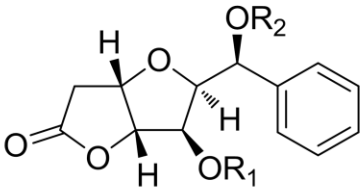


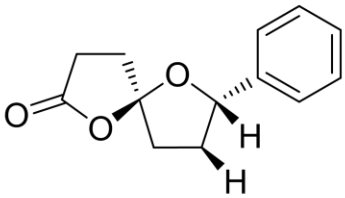
	R_1
181	OH
188	OAc



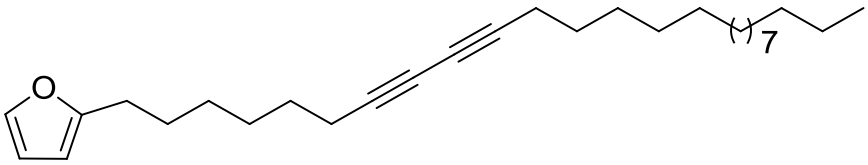
182



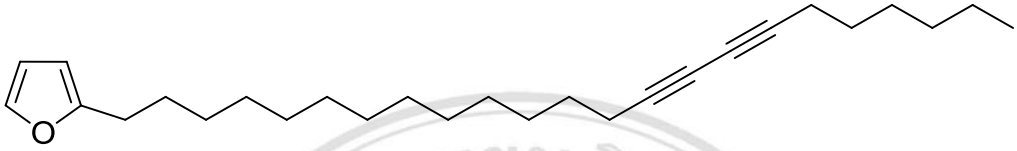
	R_1	R_2
183	cinnamoyl	OH
184	OH	cinnamoyl



185

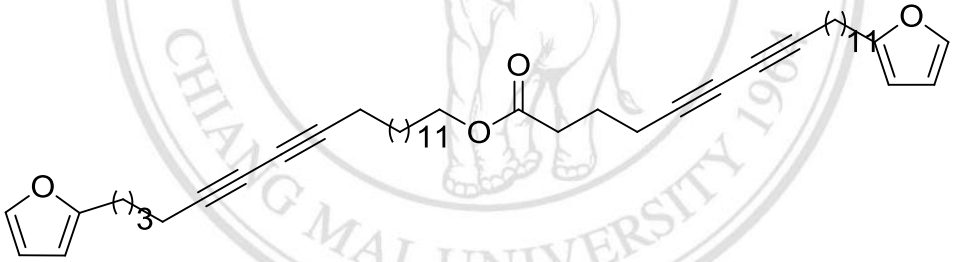


186

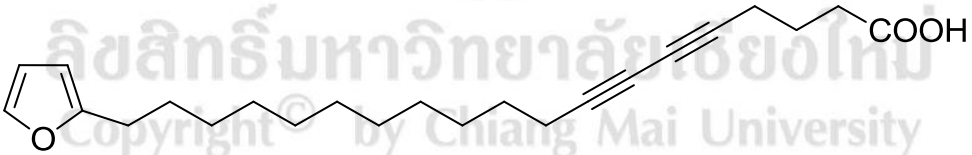


187

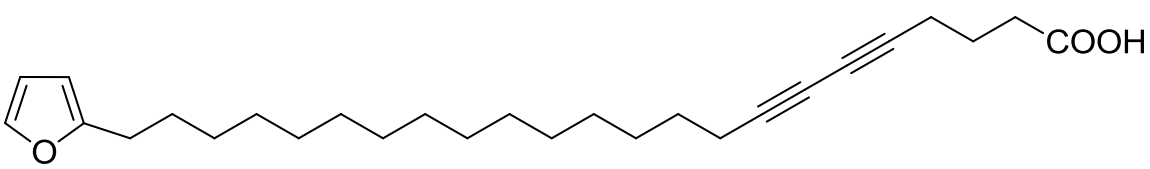
189



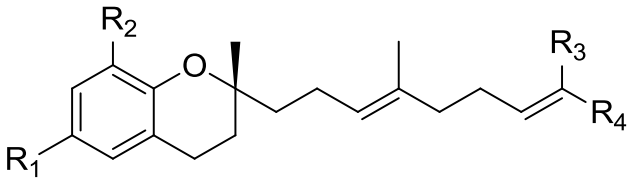
190



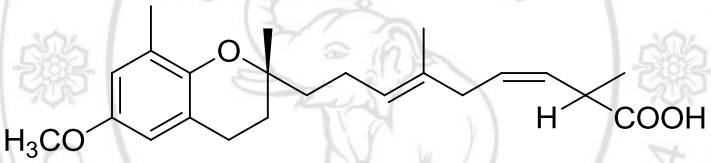
191



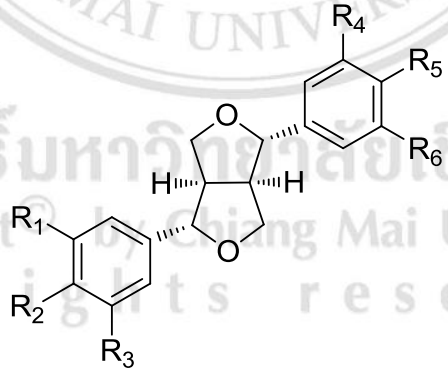
192



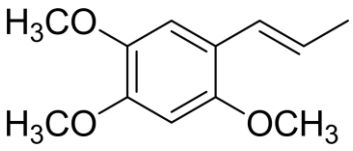
	R_1	R_2	R_3	R_4
193	OH	CH_3	CH_3	COOH
194	OH	CH_3	COOH	CH_3
196	OCH_3	CH_3	COOH	CH_3
197	OCH_3	CH_3	$COOCH_3$	CH_3



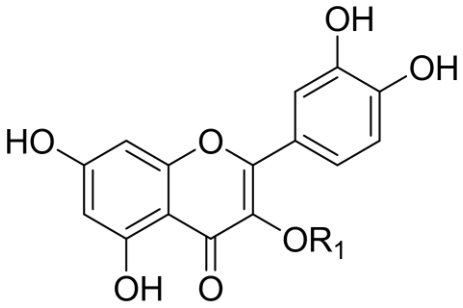
195



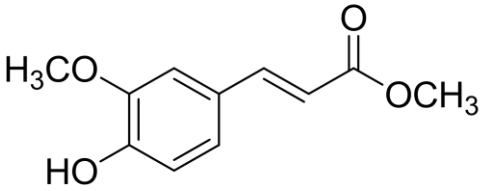
	R_1	R_2	R_3	R_4	R_5	R_6
199	H	OCH_3	OCH_3	H	OCH_3	OCH_3
200	OCH_3	OH	OCH_3	OCH_3	OH	OCH_3



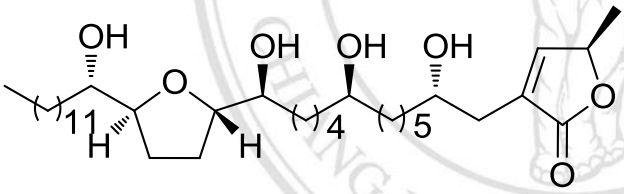
198



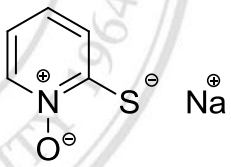
	R_1
201	Gala
202	Rh-Glu
204	H



203



205



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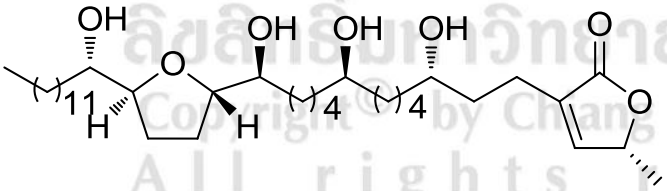

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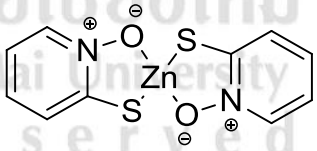

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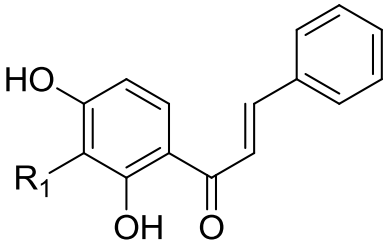

	R_1
209	OCH_3
210	H