

Supporting Information

Biologically active diterpenes containing a *gem*-dimethylcyclopropane

subunit: An intriguing source of PKC modulators

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Abbreviations: The following structural abbreviations are used in this review:

2-MeBu	2-methylbutanoyl
Ang	Angelate
Anth	Anthranoyl
Bz	Benzoyl
Cinn	Cinnamoyl
Glc	Glucose
<i>i</i>-Val	Isovaleroyl
Nic	Nicotinyl
PKC	Protein kinase C
PMA	Phorbol Myristate Acetate
Tig	Tigliate
TPA	Tetradecanoyl Phorbol Acetate

1 Tiglianes

Table 1.1 The occurrence and biological activity of tiglianes

N°	Compound	Species	Biological activities	References
1	12- <i>O</i> -benzoyl-13- <i>O</i> -isobutyryl-4-deoxyphorbol	<i>Euphorbia semiperfoliata</i>	-	1, 2, 3
2	12- <i>O</i> -tigloyl-13- <i>O</i> -isobutyryl-4-deoxyphorbol	<i>Euphorbia semiperfoliata</i>	-	1, 2, 3
3	12- <i>O</i> -isobutyryl-13- <i>O</i> -acetyl-20- <i>O</i> -angeloylphorbol	<i>Euphorbia coerulescens</i>	- Irritant toxin	4, 5
4	12,13- <i>O</i> -bis(isobutyryl)-4,20-dideoxyphorbol	<i>Euphorbia obtusifolia</i>	- NADH oxidase inhibitor	6, 7
5	12,13- <i>O</i> -bis(isobutyryl)-20- <i>O</i> -acetyl-4-deoxyphorbol	<i>Euphorbia obtusifolia</i>	- NADH oxidase inhibitor	6, 7
6	PMA (13-acetyl-12-miristoylphorbol)	<i>Euphorbia peplus</i>	- PKC activator - Antiviral - Human platelet aggregation inducer	8, 9, 10, 11, 12, 13, 14, 15, 16
7	compound 7	<i>Pimelea elongata</i>	-	17
8	compound 8	<i>Pimelea elongata</i>	-	17
9	compound 9	<i>Pimelea elongata</i>	-	17
10	compound 10	<i>Pimelea elongata</i>	-	17
11	compound 11	<i>Euphorbia fischeriana</i>	-	18
12	12,13- <i>O</i> -bis(isobutyryl)-4- <i>epi</i> -4-deoxyphorbol	<i>Euphorbia obtusifolia</i>	- Inhibitor of the NADH oxidase activity	7
13	12,13- <i>O</i> -bis(isobutyryl)-4-deoxyphorbol	<i>Euphorbia obtusifolia</i>	- Inhibitor of the NADH oxidase activity	7
14	12- <i>O</i> -tigloyl-13- <i>O</i> -decanoylphorbol	<i>Croton tiglium</i>	- Antileukemic	19
15	phorbol	<i>Euphorbia franckiana</i>	- Irritant	20
16	13- <i>O</i> -benzoyl-12-deoxyphorbol	<i>Sapium sebiferum</i>	-PKC activator	21
17	12- <i>O</i> -((2 <i>R</i>)- <i>N,N</i> -dimethyl-3-methylbutanoyl)-13- <i>O</i> -acetyl-4-deoxyphorbol	<i>Croton ciliatoglandulifer</i>	- Inhibitor of prostaglandin production by action of COX-1 and COX-2 - PKC activator	22, 23
18	12- <i>O</i> -((2 <i>S</i>)- <i>N,N</i> -dimethyl-3-methylbutanoyl)-13- <i>O</i> -acetyl-4-deoxyphorbol	<i>Croton ciliatoglandulifer</i>	- PKC activator	22
19	12- <i>O</i> -((<i>N,N</i> -dimethyl-3-methyl-2-butenoyl)-13- <i>O</i> -acetyl-4-deoxyphorbol	<i>Croton ciliatoglandulifer</i>	-	22
20	12- <i>O</i> -((2 <i>R</i>)- <i>N,N</i> -dimethyl-3-methylbutanoyl)-13- <i>O</i> -acetylphorbol	<i>Croton ciliatoglandulifer</i>	- Inhibitor of prostaglandin production by action of COX-1 and COX-2	22
21	compound 21	<i>Euphorbia macroclada</i>	-	24
22	jatropherol-I	<i>Jatropha curcas</i>	- Insecticidal	25, 26

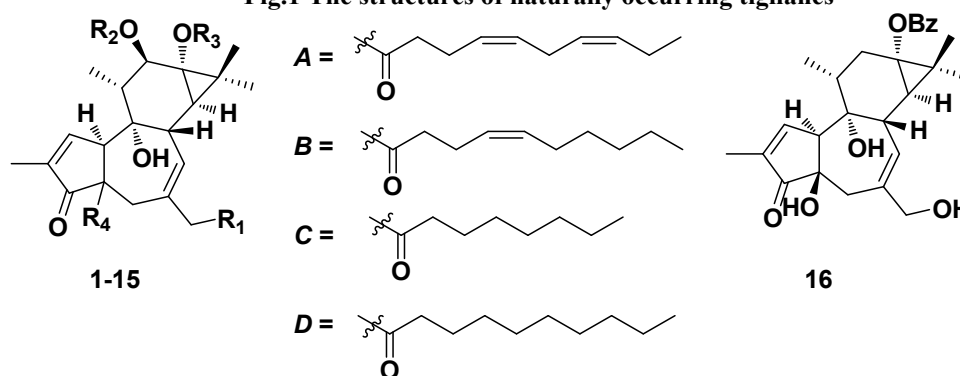
- Rodenticial				
23	13- <i>O</i> -acetyl-7-hydroperoxy-4,9,20-trihydroxy-1,5-tigliadien-3-one	<i>Pimelea</i> species	-	27
24	fischeroside A	<i>Euphorbia fischeriana</i>	- anti-HIV	28
25	fischeroside B	<i>Euphorbia fischeriana</i>	- anti-HIV -anti-oxidative stress	28, 29
26	fischeroside C	<i>Euphorbia fischeriana</i>	- anti-HIV	28
27	compound 27	<i>Euphorbia fischeriana</i>	-	18
28	compound 28	<i>Euphorbia fischeriana</i>	-	18
29	13 α - <i>O</i> -methylbutyroyl-20- <i>O</i> -acetyl-12-deoxyphorbol	<i>Euphorbia coerulescens</i>	- Irritant toxin	4
30	13- <i>O</i> -lauroyl-20- <i>O</i> -acetyl-12-deoxyphorbol	<i>Euphorbia coerulescens</i>	- Irritant toxin	4
31	13 α - <i>O</i> -methylbutyroyl-12-deoxyphorbol	<i>Euphorbia coerulescens</i>	- Irritant toxin	4
32	13- <i>O</i> -heptanoyl-12-deoxyphorbol	<i>Euphorbia coerulescens</i>	- Irritant toxin	4
33	13- <i>O</i> -lauroyl-12-deoxyphorbol	<i>Euphorbia coerulescens</i>	- Irritant toxin	4
34	13- <i>O</i> -hexadecanoyl-4,12-dideoxy(4 α)phorbol	<i>Euphorbia guyoniana</i>	-	30
35	13- <i>O</i> -hexadecanoyl-12-deoxyphorbol	<i>Euphorbia fischeriana</i>	-	31
36	prostratin	<i>Euphorbia fischeriana</i> , <i>Euphorbia cornigera</i>	- Analgesic - Sedative - Inhibitor of HIV-1 infection - Antiviral - PKC activator	16, 28, 31, 32, 34, 35
37	13,20- <i>O</i> -diacetyl-12-deoxyphorbol	<i>Croton californicus</i> , <i>Euphorbia fischeriana</i>	- Anti-HIV	36, 28
38	13- <i>O</i> -acetyl-12-deoxyphorbaldehyde	<i>Euphorbia fischeriana</i>	-	33
39	13- <i>O</i> -hexadecanoyl-12-deoxyphorbaldehyde	<i>Euphorbia fischeriana</i>	-	33
40	13- <i>O</i> -((9 <i>Z</i>)-octadec-9-enoyl)-20- <i>O</i> -acetyl-12-deoxyphorbol	<i>Euphorbia fischeriana</i>	-	33
41	compound 41	<i>Euphorbia macroclada</i>	-	24
42	compound 42	<i>Euphorbia macroclada</i>	-	24
43	compound 43	<i>Euphorbia macroclada</i>	-	24
44	compound 44	<i>Euphorbia macroclada</i>	-	24
45	13- <i>O</i> -acetyl-20- <i>O</i> -angeloyl-12-deoxyphorbol	<i>Euphorbia cauducifolia</i>	- Molluscicides	37
46	13- <i>O</i> -(<i>N</i> -(2-aminobenzoyl))anthraniloyl-20- <i>O</i> -acetyl-12-deoxyphorbol	<i>Euphorbia cauducifolia</i>	- Molluscicides	37
47	13,20- <i>O</i> -dibenzoyl-12-deoxyphorbol	<i>Euphorbia cauducifolia</i>	- Molluscicides	37

48	13,20- <i>O</i> -diangeloyl-12-deoxyphorbol	<i>Euphorbia cauducifolia</i>	- Molluscicides	37
49	13- <i>O</i> -angeloyl-20- <i>O</i> -(<i>N</i> -(2-aminobenzoyl))anthraniloyl-12-deoxyphorbol	<i>Euphorbia cauducifolia</i>	- Molluscicides	37
50	13- <i>O</i> -tigloyl-20- <i>O</i> -(<i>N</i> -(2-aminobenzoyl))anthraniloyl-12-deoxyphorbol	<i>Euphorbia cauducifolia</i>	- Molluscicides	37
51	13- <i>O</i> -benzoyl-20- <i>O</i> -[<i>N</i> -(2-aminobenzoyl)]anthraniloyl-12-deoxyphorbol	<i>Euphorbia cauducifolia</i>	- Molluscicides	37
52	13- <i>O</i> -hexanoyl-20- <i>O</i> -(<i>N</i> -(2-aminobenzoyl))anthraniloyl-12-deoxyphorbol	<i>Euphorbia cauducifolia</i>	- Molluscicides	37
53	13- <i>O</i> -(<i>p</i> -acetoxypheylacetyl)-20- <i>O</i> -acetyl-12-deoxyphorbol	<i>Euphorbia poisonii</i>	-	38
54	20- <i>O</i> -acetyl-13- <i>O</i> -angeloyl-12-deoxyphorbol	<i>Euphorbia poisonii</i>	- Cytotoxic	39
55	20- <i>O</i> -acetyl-13- <i>O</i> -phenylacetyl-12-deoxyphorbol	<i>Euphorbia poisonii</i>	- Cytotoxic	39
56	13- <i>O</i> -(9,10-methylene)undecanoyl-12-deoxyphorbol	<i>Euphorbia poisonii</i>	- Cytotoxic	39
57	20-hydroxy-13- <i>O</i> -angeloyl-12-deoxyphorbol	<i>Euphorbia poisonii</i>	-	39
58	20- <i>O</i> -benzoyl-13- <i>O</i> -isobutyroyl-4,12-dideoxy(4 β)phorbol	<i>Euphorbia pannonica</i>	-	40
59	20- <i>O</i> -benzoyl-13- <i>O</i> -isovaleroyl-4,12-dideoxy(4 β)phorbol	<i>Euphorbia pannonica</i>	-	40
60	compound 60	<i>Euphorbia fischeriana</i>	- Cytotoxic	18
61	13- <i>O</i> -acetyl-20- <i>O</i> -benzoyl-12-deoxyphorbol	<i>Euphorbia cornigera</i>	-	41
62	13- <i>O</i> -acetyl-20- <i>p</i> -methoxybenzoyl-12-deoxyphorbol	<i>Euphorbia cornigera</i>	-	41
63	13- <i>O</i> -decanoyl-20- <i>O</i> -angeloyl-12-deoxyphorbol	<i>Euphorbia cornigera</i>	-	41
64	13- <i>O</i> -decanoyl-20- <i>O</i> -tigloyl-12-deoxyphorbol	<i>Euphorbia cornigera</i>	-	41
65	13- <i>O</i> -acetyl-20- <i>O</i> -decanoyl-12-deoxyphorbol	<i>Euphorbia cornigera</i>	-	41
66	13- <i>O</i> -butanoyl-20- <i>O</i> -decanoyl-12-deoxyphorbol	<i>Euphorbia cornigera</i>	-	41
67	13- <i>O</i> -hexanoyl-20- <i>O</i> -decanoyl-12-deoxyphorbol	<i>Euphorbia cornigera</i>	-	41
68	13- <i>O</i> -octanoyl-20- <i>O</i> -decanoyl-12-deoxyphorbol	<i>Euphorbia cornigera</i>	- Cytotoxic	41
69	13,20- <i>O</i> -didecanoylphorbol	<i>Euphorbia cornigera</i>	- Cytotoxic	41
70	13- <i>O</i> -dodecanoyl-20- <i>O</i> -decanoyl-12-deoxyphorbol	<i>Euphorbia cornigera</i>	- Cytotoxic	41
71	compound 71	<i>Euphorbia lagascae</i>	-	42
72	compound 72	<i>Euphorbia lagascae</i>	-	42
73	13- <i>O</i> -acetyl-12-deoxyphorbolaldehyde	<i>Euphorbia fischeriana</i>	-	43

74	13- <i>O</i> -hexadecacetyl-12-deoxyphorbaldehyde	<i>Euphorbia fischeriana</i>	-	43
75	13- <i>O</i> -hexadecanoyl-12-deoxyphorbol	<i>Euphorbia fischeriana</i>	- Cytotoxic	43
76	13- <i>O</i> -(9 <i>Z</i>)-octadecanoyl-20- <i>O</i> -acetyl-12-deoxyphorbol	<i>Euphorbia fischeriana</i>	-	43
77	mellerin A	<i>Neoboutonia melleri</i>	-	44
78	13- <i>O</i> - <i>p</i> -hydroxyphenylacetyl-20- <i>O</i> -acetyl-12-deoxy-4 β -hydroxyphorbol	<i>Euphorbia poissonii</i>	-	45
79	4,12,20-trideoxyphorbol-13- <i>O</i> -(2,3-dimethyl)butyrate	<i>Euphorbia pithyusa</i>	-	46
80	4,12-dideoxyphorbol-13- <i>O</i> -(2,3-dimethyl)butyrate	<i>Euphorbia pithyusa</i>	-	46
81	4,12-dideoxyphorbol-13- <i>O</i> -(2,3-dimethyl)butyrate-20- <i>O</i> -acetate	<i>Euphorbia pithyusa</i>	-	46
82	12-deoxy-5 β -hydroxy-13- <i>O</i> -tetradecanoylphorbol-6 α ,7 α -oxide	<i>Pimelea species</i>	- Highly irritant	27
83	13- <i>O</i> -phenylacetyl-12-deoxyphorbol (DPP)	<i>Euphorbia poissonii</i> , <i>Euphorbia resinifera</i> Berg.	- Activate HIV-1 gene expression	47, 48 , 49
84	compound 84	<i>Pimelea elongata</i>	-	17
85	compound 85	<i>Pimelea elongata</i>	-	17
86	12,13- <i>O</i> -diisobutyryl-20- <i>O</i> -acetyl-4-deoxy(4 α)phorbol	<i>Euphorbia nubica</i>	- Irritant - tumor promoter	50
87	12- <i>O</i> -benzoyl-13- <i>O</i> -isobutyryl-20- <i>O</i> -acetyl-4-deoxy(4 β)phorbol	<i>Euphorbia nubica</i>	- Irritant - tumor promoter	50
88	12- <i>O</i> -benzoyl-13- <i>O</i> -isobutyryl-20- <i>O</i> -acetyl-4-deoxy(4 α)phorbol	<i>Euphorbia nubica</i>	- Irritant - tumor promoter	50
89	12- <i>O</i> -isobutyryl-13- <i>O</i> -acetyl-20- <i>O</i> -benzoyl-4-deoxyphorbol	<i>Euphorbia nubica</i>	- Irritant - tumor promoter	50
90	5,13- <i>O</i> -(acetylisobutyryl)-12- <i>O</i> -benzoyl-4,20-dideoxy-5 ξ -hydroxyphorbol	<i>Euphorbia nubica</i>	- Irritant - tumor promoter	50
91	compound 91	<i>Sapium lateriflorum</i>	-	51
92	stillingia Factor S ₈	<i>Stillingia sylvatica</i> L.	- Irritant	52
93	12- <i>O</i> -isobutyryl-13- <i>O</i> -acetyl-20- <i>O</i> -angeloylphorbol	<i>Euphorbia frankia</i> , <i>euphorbia coeruleascens</i>	- Cryptic irritant	53, 54
94	euphodendriane A	<i>Euphorbia dendroides</i>	- Cancer cell growth inhibitor	55
95	mancinellin	<i>Hippomane mancinella</i>	-	56
96	pedilstatin	<i>Pedilanthus sp.</i>	- Cancer cell growth inhibitor - PKC inhibitor	57
97	12- <i>O</i> -hexanoyl-13- <i>O</i> -acetyl-4 α -deoxyphorbol	<i>Sapium insigne</i>	-	58
98	sapatoxin A	<i>Sapium indicum</i>	- Toxin	59
99	sapatoxin B	<i>Sapium indicum</i>	- Toxin	59

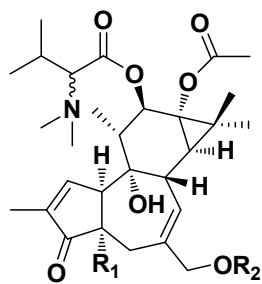
100	sapatoxin C	<i>Sapium indicum</i>	- Toxin	59
101	compound 101	<i>Euphorbia biglandulosa</i>	- Fish toxin - Skin irritant - Inhibitor of oxidative phosphorylation	60
102	compound 102	<i>Euphorbia biglandulosa</i>	- Fish toxin - Skin irritant - Inhibitor of oxidative phosphorylation	60
103	compound 103	<i>Euphorbia biglandulosa</i>	- Fish toxin - Skin irritant - Inhibitor of oxidative phosphorylation	60
104	sapintoxin A	<i>Sapium sebiferum</i> , <i>Sapium indicum</i>	- Irritant	21, 61, 62
105	sapintoxin B	<i>Sapium indicum</i>	- Irritant	62, 63
106	sapintoxin C	<i>Sapium sebiferum</i> , <i>Sapium indicum</i>	- Irritant	21, 62, 63
107	sapintoxin D	<i>Sapium indicum</i>	- Irritant	62
108	milliamine H	<i>Euphorbia milii</i>	- Irritant	64
109	milliamine I	<i>Euphorbia milii</i>	-	64
110	trigowiin A	<i>Trigonostemon howii</i>	- Antiviral	16

Fig.1 The structures of naturally occurring tiglianes



Comp.	R ₁	R ₂	R ₃	R ₄	Comp.	R ₁	R ₂	R ₃	R ₄
1	OH	Bz	<i>i</i> Bu	β -H	9	OH	<i>C</i>	Ac	β -OH
2	OH	Tig	<i>i</i> Bu	β -H	10	OH	<i>D</i>	Ac	β -OH
3	<i>O</i> -Ang	<i>i</i> Bu	Ac	β -OH	11	OH	H	Ac	β -OH
4	H	<i>i</i> Bu	<i>i</i> Bu	β -H	12	OH	<i>i</i> Bu	<i>i</i> Bu	α -H
5	OAc	<i>i</i> Bu	<i>i</i> Bu	β -H	13	OH	<i>i</i> Bu	<i>i</i> Bu	β -H
PMA (6)	OH	CO(CH ₂) ₁₂ Me	Ac	β -OH	14	OH	Tig	OC(CH ₂) ₈ Me	β -OH
7	OH	<i>A</i>	Ac	β -OH	phorbol (15)	OH	H	H	β -OH
8	OH	<i>B</i>	Ac	β -OH					

Table 1.2 Substituents of naturally occurring tiglianes 1-15

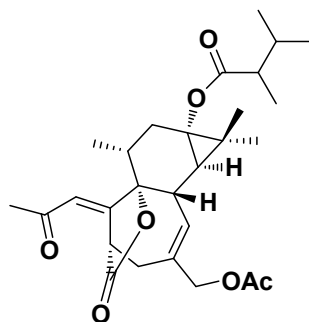


17: C-2' R, R₁=R₂=H

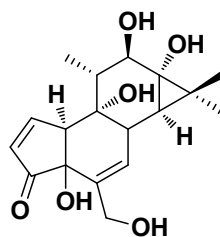
18: C-2' S, R₁=R₂=H

19: Δ^{2,3}, R₁=R₂=H

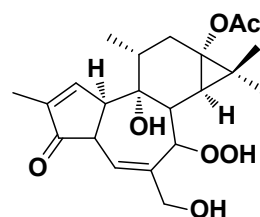
20: C-2' R, R₁=OH, R₂=H



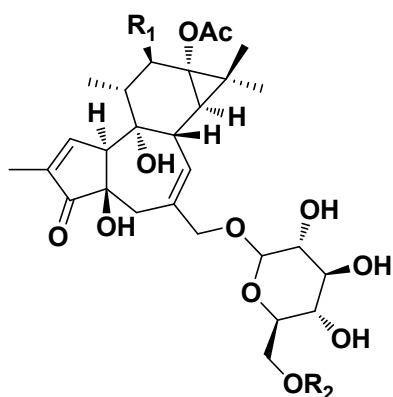
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jatropherol-I (22)



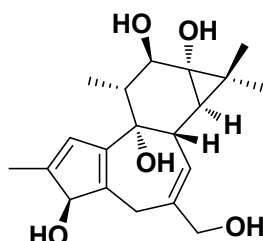
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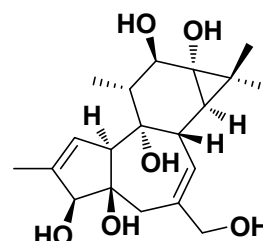
fischeroside A (24): R₁=H, R₂=H

fischeroside B (25): R₁=H, R₂=galloyl

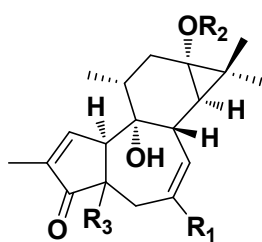
fischeroside C (26): R₁=OH, R₂=H



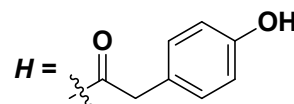
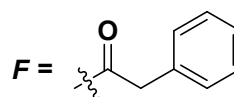
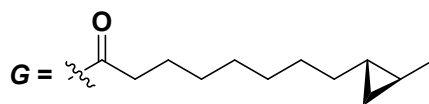
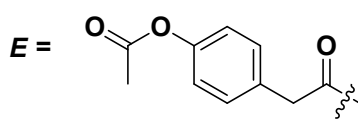
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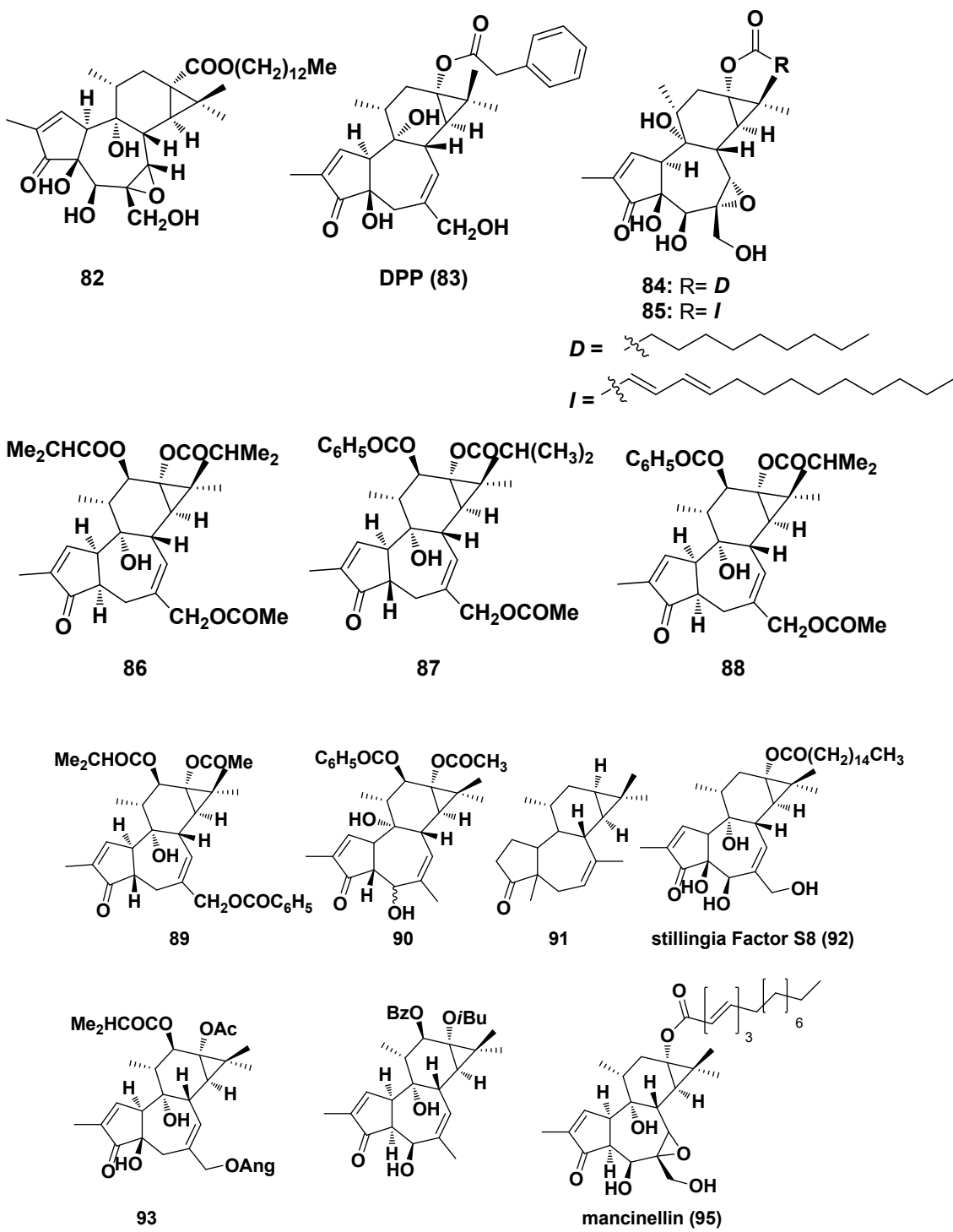


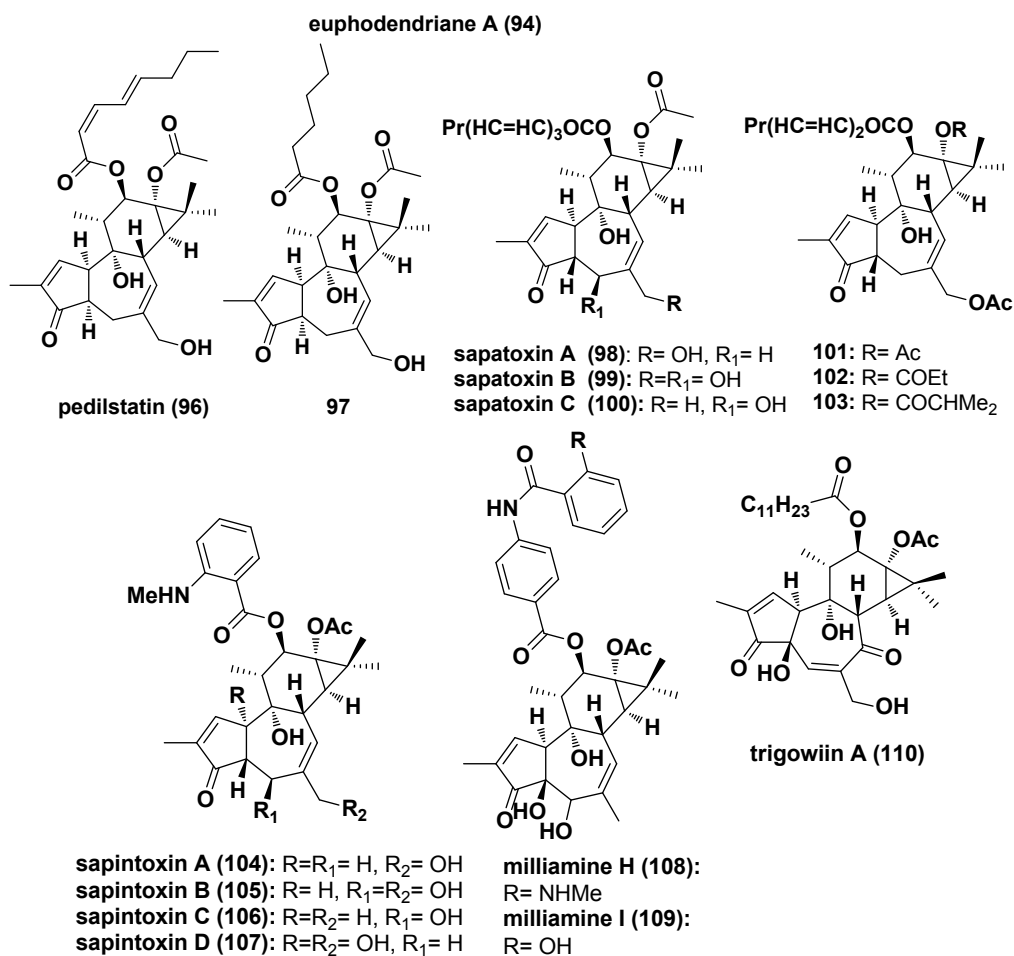
29-81



Compound	R ₁	R ₂	R ₃
29	CH ₂ OAc	α -methyl butyroyl	β -OH
30	CH ₂ OAc	lauroyl	β -OH
31	CH ₂ OH	α -methyl butyroyl	β -OH
32	CH ₂ OH	heptanoyl	β -OH
33	CH ₂ OH	lauroyl	β -OH
34	CH ₂ OH	OC(CH ₂) ₁₄ Me	α -H
35	CH ₂ OH	CO(CH ₂) ₁₄ Me	β -OH
prostratin (36)	CH ₂ OH	Ac	β -OH
37	CH ₂ OAc	Ac	β -OH
38	CHO	Ac	β -OH
39	CHO	Me(CH ₂) ₁₄ CO	β -OH
40	CH ₂ OAc	Me(CH ₂) ₇ CH=CH(CH ₂) ₇ CO	β -OH
41	CH ₂ OAc	OCCH(Me)CHMe ₂	β -H
42	CH ₂ OAc	OCCH(Me)CHMe ₂	α -H
43	CH ₂ OAc	OCCH(Me)CH ₂ Me	α -H
44	CHO	OCCH(Me)CHMe ₂	α -H
45	CH ₂ OAng	Ac	β -OH
46	CH ₂ OAc	Anth	β -OH
47	CH ₂ OBz	Bz	β -OH
48	CH ₂ OAng	Ang	β -OH
49	CH ₂ OAnth	Ang	β -OH
50	CH ₂ OAnth	Tig	β -OH
51	CH ₂ OAnth	Bz	β -OH
52	CH ₂ OAnth	hexanoyl	β -OH
53	CH ₂ OAc	<i>E</i>	β -OH
54	CH ₂ OAc	Ang	β -OH
55	CH ₂ OAc	<i>F</i>	β -OH
56	CH ₂ OH	<i>G</i>	β -OH
57	CH ₂ OH	Ang	β -OH
58	CH ₂ OBz	<i>i</i> -Pr(CO)	β -H
59	CH ₂ OBz	<i>i</i> Val	β -H
60	CH ₂ OH	OC(CH ₂) ₁₄ Me	β -OH
61	CH ₂ OBz	Ac	β -OH
62	CH ₂ O- <i>p</i> -methoxybenzoyl	Ac	β -OH
63	CH ₂ O-angeloyl	decanoyl	β -OH
64	CH ₂ O-tigloyl	decanoyl	β -OH
65	CH ₂ O-decanoyl	Ac	β -OH
66	CH ₂ O-decanoyl	butanoyl	β -OH
67	CH ₂ O-decanoyl	hexanoyl	β -OH
68	CH ₂ O-decanoyl	octanoyl	β -OH
69	CH ₂ O-decanoyl	decanoyl	β -OH
70	CH ₂ O-decanoyl	dodecanoyl	β -OH
71	CH ₂ OH	CO(CH ₂) ₁₀ Me	β -OH
72	CH ₂ OH	CO(CH ₂) ₉ Me	β -OH
73	CHO	Ac	β -OH
74	CHO	OC(CH ₂) ₁₄ Me	β -OH
75	CH ₂ OH	hexadecanoyl	β -OH
76	CH ₂ OAc	OC(CH ₂) ₇ CH=CH(CH ₂) ₇ Me (<i>Z</i>)	β -OH
mellerin A (77)	CH ₂ OH	OC(CH ₂) ₆ Me	β -OH
78	CH ₂ OAc	<i>H</i>	β -OH
79	CH ₃	OCCH(Me)CHMe ₂	β -H
80	CH ₂ OH	OCCH(Me)CHMe ₂	β -H
81	CH ₂ OAc	OCCH(Me)CHMe ₂	β -H

Table 1.3 Substituents of naturally occurring tiglanes 29-81





2 Lathyranes

Table 2.1 The occurrence and biological activity of lathyranes

N°	Compound	Species	Biological activities	References
111	7,8,12- <i>O</i> -triacetyl-3- <i>O</i> -(2-methylbutanoyl)ingol	<i>Euphorbia cornigera</i>	- Cytotoxic	65
112	3,8,12- <i>O</i> -triacetyl-7- <i>O</i> -(2-methylbutanoyl)ingol	<i>Euphorbia cornigera</i>	- Cytotoxic	65
113	3,7,12- <i>O</i> -triacetyl-8- <i>O</i> -(2-methylbutanoyl)ingol	<i>Euphorbia cornigera</i>	- Cytotoxic	65
114	3,7,8- <i>O</i> -triacetyl-12- <i>O</i> -(2-methylbutanoyl)ingol	<i>Euphorbia cornigera</i>	- Cytotoxic	65
115	7,12- <i>O</i> -diacetyl-3- <i>O</i> -(2-methylbutanoyl)-8-methylingol	<i>Euphorbia cornigera</i>	- Cytotoxic	65
116	2,7- <i>O</i> -diacetyl-12- <i>O</i> -(3-methylbutanoyl)-8-methylingol	<i>Euphorbia cornigera</i>	- Cytotoxic	65
117	3,12- <i>O</i> -diacetyl-7- <i>O</i> -(2-methylbutanoyl)-8-methylingol	<i>Euphorbia cornigera</i>	- Cytotoxic	65
118	3,7,8,12- <i>O</i> -tetraacetyl-2- <i>epi</i> -ingol	<i>Euphorbia portulacoides</i>	-	66
119	3,8,12- <i>O</i> -triacetyl-7- <i>O</i> -isobutyryl-2- <i>epi</i> -ingol	<i>Euphorbia portulacoides</i>	-	66
120	3,8,12- <i>O</i> -triacetyl-7- <i>O</i> -methylbutyryl-2- <i>epi</i> -ingol	<i>Euphorbia portulacoides</i>	-	66
121	3,8,12- <i>O</i> -triacetyl-7- <i>O</i> -benzoyl-2- <i>epi</i> -ingol	<i>Euphorbia portulacoides</i>	-	66
122	3,7,12- <i>O</i> -triacetyl-8- <i>O</i> -benzoyl-2- <i>epi</i> -ingol	<i>Euphorbia canariensis</i>	-	67
123	7,12- <i>O</i> -diacetyl-8- <i>O</i> -benzoyl-	<i>Euphorbia</i>	-	67

	2,3-di- <i>epi</i> -ingol	<i>canariensis</i>		
124	7,12- <i>O</i> -diacetyl-8- <i>O</i> -isobutyryl-2,3-di- <i>epi</i> -ingol	<i>Euphorbia canariensis</i>	- Vascular activity	67, 68
125	3,8,12- <i>O</i> -triacyl-8- <i>O</i> -isovaleroylingol	<i>Euphorbia acurensis</i>	-	69
126	compound 126	<i>Euphorbia acurensis</i>	-	69
127	3,12- <i>O</i> -diacetyl-7,8- <i>O</i> -ditigloylingol	<i>Euphorbia acurensis</i>	-	69
128	compound 128	<i>Euphorbia acurensis</i>	-	69
129	compound 129	<i>Euphorbia acurensis</i>	-	69
130	compound 130	<i>Euphorbia acurensis</i>	-	69
131	3,12- <i>O</i> -diacetyl-7- <i>O</i> -angeloyl-8-methoxyingol	<i>Euphorbia nivulia</i>	- Cytotoxic	70, 71
132	7- <i>O</i> -angeloyl-12- <i>O</i> -acetyl-8-methoxyingol	<i>Euphorbia nivulia</i>	- Cytotoxic - Prostaglandina E2 inhibitor	70, 71
133	3,7,12- <i>O</i> -triacyl-8- <i>O</i> -benzoylingol	<i>Euphorbia nivulia</i>	-	70, 71
134	3,12- <i>O</i> -diacetyl-8- <i>O</i> -benzoylingol	<i>Euphorbia nivulia</i>	-	70, 71
135	3,12- <i>O</i> -diacetyl-7- <i>O</i> -benzoyl-8- <i>O</i> -nicotinylingol	<i>Euphorbia nivulia</i>	-	70, 71
136	3- <i>O</i> -acetyl-8-methoxy-7- <i>O</i> -angeloyl-12-hydroxylingol	<i>Euphorbia nivulia</i>	-	70
137	3,12- <i>O</i> -diacetyl-7-hydroxy-8-methoxyingol	<i>Euphorbia nivulia</i>	- Cytotoxic	70
138	3,12- <i>O</i> -diacetyl-7- <i>O</i> -angeloyl-8-hydroxyingol	<i>Euphorbia nivulia</i>	-	70
139	tirucalicine	<i>Euphorbia tirucalli</i>	-	72
140	3,7,12- <i>O</i> -triacyl-8- <i>O</i> -isovalerylingol	<i>Euphorbia tirucalli</i>	-	73
141	3,12- <i>O</i> -diacetyl-8- <i>O</i> -tigloylingol	<i>Euphorbia lactea</i>	- Activity over HIV-1 reactivation - Cell proliferation activity	74, 75, 76, 77
142	7,8,12- <i>O</i> -triacyl-3- <i>O</i> -phenylacetylingol	<i>Euphorbia officinarum</i>	-	78
143	7,8,12- <i>O</i> -triacyl-3- <i>O</i> -(4-methoxyphenyl)acetylingol	<i>Euphorbia officinarum</i>	-	78
144	7,12- <i>O</i> -diacetyl-3- <i>O</i> -phenylacetyl-8-methoxyingol	<i>Euphorbia officinarum</i>	- Cell-cycle arrest inductor - Activity over HIV-1 reactivation	78
145	12- <i>O</i> -acetyl-3,8- <i>O</i> -ditigloylingol	<i>Euphorbia royleana</i>	-	79
146	8,12- <i>O</i> -diacetyl-3,7- <i>O</i> -ditigloylingol	<i>Euphorbia royleana</i>	-	79
147	12- <i>O</i> -acetyl-7- <i>O</i> -benzoyl-3,8- <i>O</i> -ditigloylingol	<i>Euphorbia royleana</i>	-	79
148	8,12- <i>O</i> -diacetyl-3,7- <i>O</i> -dibenzoylingol	<i>Euphorbia royleana</i>	-	79
149	3,8,12- <i>O</i> -triacyl-7- <i>O</i> -benzoylingol	<i>Euphorbia royleana</i>	-	79
150	12- <i>O</i> -acetyl-8- <i>O</i> -benzoyl-3- <i>O</i> -tigloylingol	<i>Euphorbia royleana</i>	-	79

151	12- <i>O</i> -acetyl-3,8- <i>O</i> -dibenzoylingol	<i>Euphorbia royleana</i>	-	79
152	12- <i>O</i> -acetyl-3- <i>O</i> -benzoyl-8- <i>O</i> -tigloylingol	<i>Euphorbia royleana</i>	-	79
153	12- <i>O</i> -acetyl-3,8- <i>O</i> -dibenzoyl-2- <i>epi</i> -ingol	<i>Euphorbia royleana</i>	-	79
154	12- <i>O</i> -acetyl-3- <i>O</i> -benzoyl-8- <i>O</i> -tigloyl-2- <i>epi</i> -ingol	<i>Euphorbia royleana</i>	-	79
155	7,12- <i>O</i> -diacetyl-8- <i>O</i> -isovaleroyl-2,3-di- <i>epi</i> -ingol	<i>Euphorbia bungei</i> Boiss	-	80
156	3,12- <i>O</i> -diacetyl-7- <i>O</i> -((<i>E</i>)-2-methyl-2-butenoyl)-8,12-di- <i>epi</i> -ingol	<i>Euphorbia trigona</i>	-	81
157	3,12- <i>O</i> -diacetyl-7- <i>O</i> -tigloylingol	<i>Euphorbia kamerunica</i>	-	82
158	3,12- <i>O</i> -diacetyl-7- <i>O</i> -angeloyl-8-methoxyingol	<i>Euphorbia nivulia</i>	-	83
159	3,7,12- <i>O</i> -triacetyl-8- <i>O</i> -benzoylingol	<i>Euphorbia nivulia</i>	-	83
160	7- <i>O</i> -angeloyl-8-methoxy-12- <i>O</i> -acetylingol	<i>Euphorbia nivulia</i>	-	83
161	compound 161	<i>Euphorbia royleana</i>	-	84
162	compound 162	<i>Euphorbia royleana</i>	-	84
163	compound 163	<i>Euphorbia royleana</i>	-	84
164	compound 164	<i>Euphorbia royleana</i>	-	84
165	compound 165	<i>Euphorbia royleana</i>	-	84
166	compound 166	<i>Euphorbia royleana</i>	-	84
167	compound 167	<i>Euphorbia royleana</i>	-	84
168	compound 168	<i>Euphorbia royleana</i>	-	84
169	3,12- <i>O</i> -diacetyl-7- <i>O</i> -benzoyl-8-methoxyingol	<i>Euphorbia hermentiana</i>	-	85
170	3,12- <i>O</i> -diacetyl-7- <i>O</i> -tigloyl-8-methoxyingol	<i>Euphorbia hermentiana</i>	-	85
171	3,12- <i>O</i> -diacetyl-7- <i>O</i> -angeloyl-8-methoxyingol	<i>Euphorbia hermentiana</i>	-	85
172	3-dehydro-7,12- <i>O</i> -diacetyl-8-angeloyl-2- <i>epi</i> -ingol	<i>Euphorbia segetalis</i>	-	86
173	euphorbia factor L ₁	<i>Euphorbia pithyusa</i> , <i>Euphorbia lathyris</i>	- Anticancer	46, 87, 88
174	euphorbia factor L ₁₀	<i>Euphorbia lathyris</i>	- P-glycoprotein inhibitors	89
175	lathylol-3-phenylacetate-5,15-diacetate (= deoxy euphorbia factor L ₁)	<i>Euphorbia pithyusa</i>	-	87
176	euphorbia factor L ₂	<i>Euphorbia lathyris</i>	-	46
177	euphorbia factor L ₃	<i>Euphorbia lathyris</i>	- Anticancer	46, 90

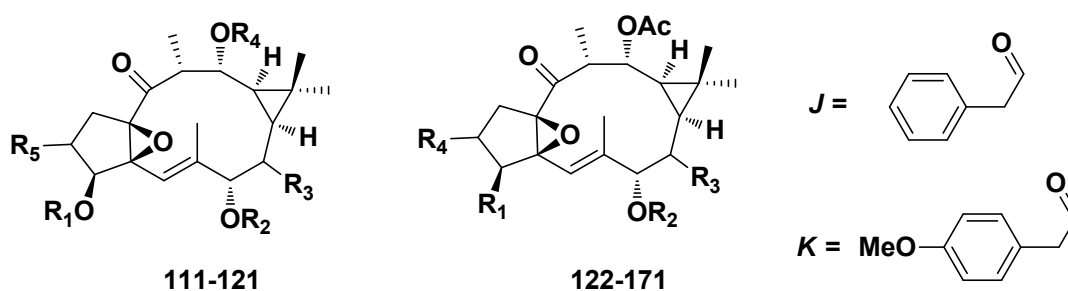
178	euphorbia factor L ₈	<i>Euphorbia lathyris</i>	-	46
179	compound 179	<i>Euphorbia villosa</i>	-	91
180	euphorbia factor L ₁₁	<i>Euphorbia lathyris</i>	-	92, 93
181	compound 181	<i>Euphorbia lathyris</i>	-	46
182	euphorbia factor L ₉	<i>Euphorbia lathyris</i>	-	46, 94
183	latilagascene A	<i>Euphorbia lagascae</i>	-anti-CMV - Antitumoral - P-glycoproteins inhibitor	95
184	latilagascene B	<i>Euphorbia lagascae</i>	-anti-CMV - Antitumoral - P-glycoproteins inhibitor	95, 96, 97, 98
185	latilagascene C	<i>Euphorbia lagascae</i>	-anti-CMV - Antitumoral - P-glycoproteins inhibitor	95, 99
186	latilagascene D	<i>Euphorbia lagascae</i>	-Antineoplastic activity - Antitumoral	98, 99
187	latilagascene E	<i>Euphorbia lagascae</i>	-anti-CMV -Antitumoral - Apoptosis inducitor	95, 98
188	jolkinol B	<i>Euphorbia lagascae</i>	-anti-CMV - Antitumoral	95, 98, 99
189	jolkinol A	<i>Euphorbia pubescens</i> , <i>Euphorbia jolkini</i> Boiss	- Growth inhibitor	100, 101, 102
190	jolkinol C	<i>Euphorbia jolkini</i> Boiss	-	102
191	jolkinol D	<i>Euphorbia jolkini</i> Boiss	-	102
192	2-hydroxy isojatrogrossidion	<i>Jatropha grossidentata</i> , <i>Jatropha wedelliana</i> , <i>Jatropha podagrica</i>	- Antibacterial	103, 104
193	2- <i>epi</i> -hydroxy isojatrogrossidion	<i>Jatropha species</i>	- Antibacterial	103, 104
194	compound 194	<i>Euphorbia aleppica</i>	-	105
195	japodagrol	<i>Jatropha podagrica</i>	- Antitumoral	104, 106
196	15- <i>epi</i> -4Z-jatrogrossidentadion	<i>Jatropha grossidentata</i> , <i>Jatropha podagrica</i>	-	103
197	multifolone	<i>Jatropha multifida</i>	-	104, 107
198	(4Z) -jatrogrossidentadion	<i>Jatropha grossidentata</i> ,	-	103

		<i>Jatropha podagrica</i>		
199	(4 <i>E</i>)-jatrogrossidentadione	<i>Jatropha multifida</i>	-	104, 107
200	(4 <i>E</i>)-jatrogrossidentadione acetate	<i>Jatropha multifida</i>	-	104, 107
201	japodagrín	<i>Jatropha podagrica Hook</i>	- Antimicrobial	108
202	3,12- <i>O</i> -diacetyl-7- <i>O</i> -tigloyl-8-methoxyingol	<i>Euphorbia ingens</i>	-	109
203	compound 203	<i>Euphorbia laurifolia</i>	-	74
204	compound 204	<i>Euphorbia laurifolia</i>	-	74
205	latazienone	<i>Euphorbia latazi Kunth</i>	-	110
206	compound 206	<i>Euphorbia villosa</i>	-	91
207	compound 207	<i>Euphorbia aellenii</i>	-	111
208	compound 208	<i>Euphorbia aellenii</i>	-	111
209	compound 209	<i>Euphorbia helioscopia</i>	-	112
210	compound 210	<i>Euphorbia helioscopia</i>	-	112
211	(2 <i>R</i> *,3 <i>S</i> *,4 <i>R</i> *,5 <i>R</i> *,9 <i>S</i> *,11 <i>S</i> *,15 <i>R</i> *)-3,5,15-triacetoxy-14-oxolathyra-6(17),12 <i>E</i> -diene	<i>Euphorbia hyberna</i> , <i>Euphorbia villosa</i>	- MDR Modulator	91, 113, 114
212	(2 <i>R</i> *,3 <i>S</i> *,4 <i>R</i> *,5 <i>R</i> *,9 <i>S</i> *,11 <i>S</i> *,15 <i>R</i> *)-5,15-diacetoxy-3-benzoyloxy-14-oxolathyra-6(17),12 <i>E</i> -diene	<i>Euphorbia hyberna</i>	-	113
213	(+)-(12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> ,4 <i>R</i> ,5 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-15-cinnamoyloxy-lathyra-6(17),12-diene-3,5-diol-14-one	<i>Euphorbia micractina</i>	-	115
214	(-)-(12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> ,4 <i>R</i> ,5 <i>R</i> ,6 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-3,15-diacetoxy-5,6-epoxylathy-12-en-14-one	<i>Euphorbia micractina</i>	-	115
215	(-)-(12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> ,4 <i>R</i> ,5 <i>R</i> ,6 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-3-acetoxy-5,6-epoxylathy-12-en-15-ol-14-one	<i>Euphorbia micractina</i>	-	115
216	(-)-(12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> ,4 <i>R</i> ,5 <i>R</i> ,6 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-15-acetoxy-5,6-epoxylathy-12-en-3-ol-14-one	<i>Euphorbia micractina</i>	-	115
217	(+)-(12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> ,4 <i>R</i> ,5 <i>R</i> ,6 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-3-cinnamoyloxy-5,6-epoxylathy-12-en-15-ol-14-one	<i>Euphorbia micractina</i>	-	115
218	(-)-(12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> ,4 <i>R</i> ,5 <i>R</i> ,6 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-3,15-dibenzoyloxy-5,6-epoxylathy-	<i>Euphorbia micractina</i>	- Vascular-relaxing activity	115

219	12-en-14-one (+)-(12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> ,4 <i>R</i> ,5 <i>R</i> , 6 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-3-benzoyloxy- 5,6-epoxylathyra- 12-en-15-ol-14-one	<i>Euphorbia micractina</i>	- Vascular-relaxing activity	115
220	(-)-(12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> ,4 <i>R</i> ,5 <i>R</i> , 6 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-3-acetoxy-15- benzoyloxy- 5,6-epoxylathyra-12-en-14-one	<i>Euphorbia micractina</i>	-	115
221	(-)-(5 <i>E</i> ,12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> , 4 <i>S</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-3,15- diacetoxy-lathyra-5,12-dien-14- one	<i>Euphorbia micractina</i>	-	115
222	(+)-(5 <i>E</i> ,12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> , 4 <i>S</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-3- cinnamoyloxy-lathyra-5,12- dien-15-ol-14-one	<i>Euphorbia micractina</i>	-	115
223	(-)-(5 <i>E</i> ,12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> , 4 <i>S</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-15- cinnamoyloxy-lathyra-5,12- dien-3-ol-14-one	<i>Euphorbia micractina</i>	- anti-HIV-1	115
224	(-)-(5 <i>E</i> ,12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> , 4 <i>S</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-15- benzoyloxy-lathyra-5,12-dien- 3-ol-14-one	<i>Euphorbia micractina</i>	- Vascular-relaxing activity	115
225	(-)-(6 <i>Z</i> ,12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> , 4 <i>R</i> ,5 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-3- cinnamoyloxy-lathyra-6,12- diene-5,15-diol-14-one	<i>Euphorbia micractina</i>	- Vascular-relaxing activity	115
226	(-)-(6 <i>Z</i> ,12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> , 4 <i>R</i> ,5 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-5- cinnamoyloxy-lathyra-6,12- diene-3,15-diol-14-one	<i>Euphorbia micractina</i>	- Vascular-relaxing activity	115
227	(-)-(6 <i>Z</i> ,12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> , 4 <i>R</i> ,5 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)- 3-acetoxy-15-benzoyloxy lathyra-6,12-dien-5-ol-14-one	<i>Euphorbia micractina</i>	-	115
228	(-)-(6 <i>Z</i> ,12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> , 4 <i>R</i> ,5 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-5- acetoxy-15-benzoyloxy lathyra-6,12-dien-3-ol-14-one	<i>Euphorbia micractina</i>	-	115
229	(-)-(6 <i>Z</i> ,12 <i>E</i> ,2 <i>S</i> ,3 <i>S</i> , 4 <i>R</i> ,5 <i>R</i> ,9 <i>S</i> ,11 <i>S</i> ,15 <i>R</i>)-15- cinnamoyloxy-3,5-di- isopropylidenelathyra- 6,12-dien-14-one	<i>Euphorbia micractina</i>	-	115
230	3 <i>β</i> ,7 <i>β</i> ,15 <i>β</i> -trihydroxy-14- oxolathyra-5 <i>E</i> ,12 <i>E</i> -dienyl-16 <i>β</i> - D-glucopyranoside	<i>Euphorbia helioscopia</i>	-	116
231	3 <i>β</i> ,5 <i>α</i> -dihydroxy-15 <i>β</i> - cinnamoyloxy-14-oxolathyra- 6 <i>Z</i> ,12 <i>E</i> -diene	<i>Euphorbia kansuensis</i>	-	117
232	3 <i>β</i> ,5 <i>α</i> ,20- trihydroxy-15 <i>β</i> -cinnamoyloxy- 14-oxolathyra-6 <i>Z</i> ,12 <i>E</i> -diene	<i>Euphorbia kansuensis</i>	-	117
233	jatrowedione	<i>Jatropha</i>	-	118

		<i>weddelliana</i>		
234	compound 234	<i>Euphorbia lathyris</i>	-	119
235	euphohelioscopin A	<i>Euphorbia helioscopia</i>	-	120
236	euphohelioscopin B	<i>Euphorbia helioscopia</i>	-	120
237	euphohelioscopin C	<i>Euphorbia helioscopia</i>	-	121
238	3,12- <i>O</i> -diacetyl-8- <i>O</i> -benzoylingol	<i>Euphorbia antiquorum</i>	-	122
239	3,12- <i>O</i> -diacetyl-8- <i>O</i> -tigloylingol	<i>Euphorbia antiquorum</i>	-	122
240	12- <i>O</i> -acetyl-8- <i>O</i> -tigloylingol	<i>Euphorbia antiquorum</i>	-	122
241	8- <i>O</i> -tigloylingol	<i>Euphorbia antiquorum</i>	-	122
242	3,7,8- <i>O</i> -triacetyl-12- <i>O</i> -tigloylingol	<i>Euphorbia kamerunica</i>	-	123
243	3,7- <i>O</i> -diacetyl-12- <i>O</i> -tigloylingol	<i>Euphorbia kamerunica</i>	-	123
244	compound 244	<i>Euphorbia characias</i>	-	124
245	compound 245	<i>Euphorbia characias</i>	-	124
246	compound 246	<i>Euphorbia characias</i>	-	124
247	compound 247	<i>Euphorbia characias</i>	-	124
248	compound 248	<i>Euphorbia characias</i>	-	124
249	compound 249	<i>Euphorbia characias</i>	-	124
		<i>Macaranga</i>		
250	6,20-epoxylathyrol-5,10- <i>O</i> -diacetate-3- <i>O</i> -phenylacetate	<i>tanarius, Euphorbia lathyris</i>	-	125
251	jatrowediol	<i>Jatropha weddelliana</i>	-	126
252	curculathyrane A	<i>Jatropha curcus</i>	-	127
253	curculathyrane B	<i>Jatropha curcus</i>	-	127

Fig.2 The structures of naturally occurring lathyranes



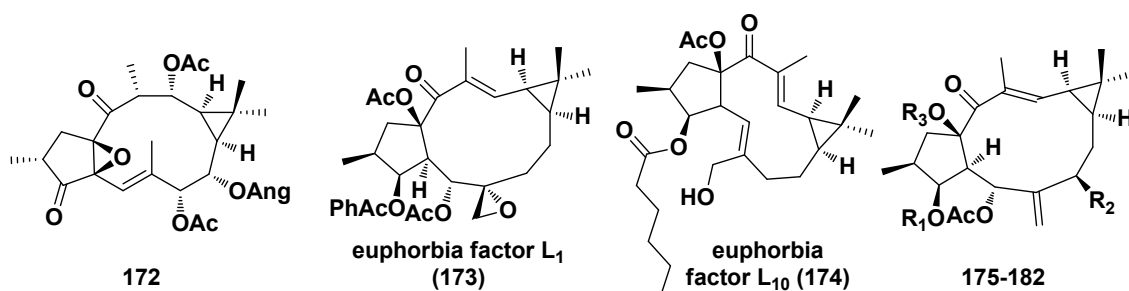
Compound	R ₁	R ₂	R ₃	R ₄	R ₅
111	2-MeBu	Ac	β -OAc	Ac	β -Me
112	Ac	2-MeBu	β -OAc	Ac	β -Me
113	Ac	Ac	β -O-(2-MeBu)	Ac	β -Me
114	Ac	Ac	β -OAc	2-MeBu	β -Me
115	2-MeBu	Ac	β -OMe	Ac	β -Me
116	Ac	2-MeBu	β -OMe	Ac	β -Me
117	Ac	Ac	β -OMe	2-MeBu	β -Me
118	Ac	Ac	α -OAc	Ac	α -Me
119	Ac	<i>i</i> Bu	α -OAc	Ac	α -Me
120	Ac	MeBu	α -OAc	Ac	α -Me
121	Ac	Bz	α -OAc	Ac	α -Me

Table 2.2 Substituents of naturally occurring lathyranes 111-121

Compound	R ₁	R ₂	R ₃	R ₄
122	β -OAc	Ac	α -OBz	α -Me
123	α -OH	Ac	α -OBz	α -Me
124	α -OH	Ac	α -O <i>i</i> Bu	α -Me
125	β -OAc	<i>i</i> Val	α -OAc	β -Me
126	β -OAc	Ang	α -OAc	β -Me
127	β -OAc	Tig	α -OTig	β -Me
128	β -OAc	Tig	α -OAc	β -Me
129	β -OAc	Tig	α -OMe	β -Me
130	β -OAc	H	α -OTig	β -Me
131	β -OAc	Ang	α -OMe	β -Me
132	β -OH	Ang	α -OMe	β -Me
133	β -OAc	Ac	α -OBz	β -Me
134	β -OAc	H	α -OBz	β -Me
135	β -OAc	Bz	α -ONic	β -Me
136	β -OAc	Ang	α -OMe	β -Me
137	β -OAc	H	α -OMe	β -Me
138	β -OAc	Ang	α -OH	β -Me
tirucalicine (139)	β -OAc	Ac	α -OMe	β -Me
140	β -OAc	Ac	α -OCOCH ₂ CHMe ₂	β -Me
141	β -OAc	H	α -OTig	β -Me
142	β -O <i>J</i>	Ac	α -OAc	β -Me
143	β -O <i>K</i>	Ac	α -OAc	β -Me
144	β -O <i>J</i>	Ac	α -OMe	β -Me
145	β -OTig	H	α -OTig	β -Me
146	β -OTig	Tig	α -OAc	β -Me
147	β -OTig	Bz	α -OTig	β -Me
148	β -OBz	Bz	α -OAc	β -Me
149	β -OAc	Bz	α -OAc	β -Me
150	β -OTig	H	α -OBz	β -Me
151	β -OBz	H	α -OBz	β -Me
152	β -OBz	H	α -OTig	β -Me
153	β -OBz	H	α -OBz	α -Me
154	β -OBz	H	α -OTig	α -Me
155	α -OAc	H	α -O <i>i</i> Val	α -Me
156	β -OAc	Tig	α -OH	β -Me
157	β -OAc	Tig	β -OH	β -Me
158	β -OAc	Ang	α -OMe	β -Me
159	β -OAc	Ac	α -OBz	β -Me
160	β -OH	Ang	α -OMe	β -Me

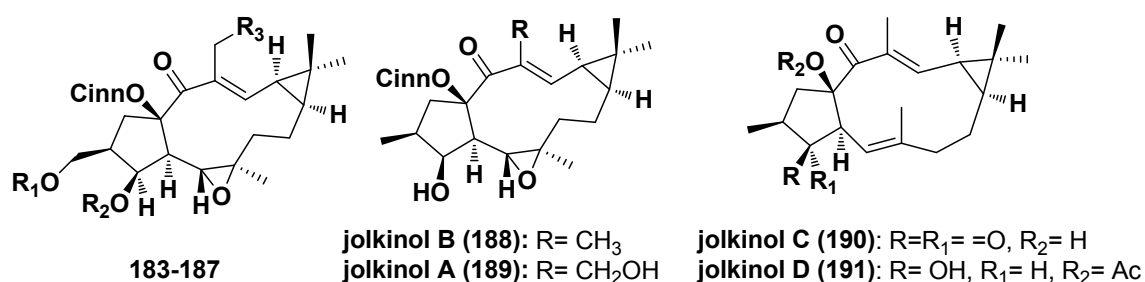
161	β -OAc	Ac	β -OAng	Me
162	β -OAc	Ac	β -OBz	Me
163	β -OAc	Ac	β -OTig	Me
164	β -OAc	Ac	α -O-(2-MeBu)	Me
165	β -OAc	H	β -OAng	Me
166	β -OAc	H	β -OBz	Me
167	β -OAc	H	β -OTig	Me
168	β -OAc	H	α -O-(2-MeBu)	Me
169	β -OAc	COC ₆ H ₅	β -OMe	β -Me
170	β -OAc	Tig	β -OMe	β -Me
171	β -OAc	Ang	β -OMe	β -Me

Table 2.3 Substituents of naturally occurring lathyranes 122-171



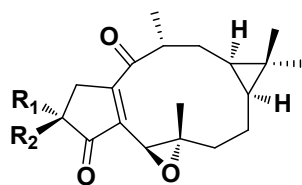
Compound	R ₁	R ₂	R ₃
deoxy euphorbia factor L ₁ (175)	PhAc	H	Ac
euphorbia factor L ₂ (176)	Bz	OBz	Ac
euphorbia factor L ₃ (177)	Bz	H	Ac
euphorbia factor L ₈ (178)	Nic	H	Ac
179	Ac	H	Ac
euphorbia factor L ₁₁ (180)	Bz	OBz	H
181	COC ₅ H ₄ N	H	Ac
euphorbia factor L ₉ (182)	Bz	OCOC ₅ H ₄ N	Ac

Table 2.4 Substituents of naturally occurring lathyranes 175-182



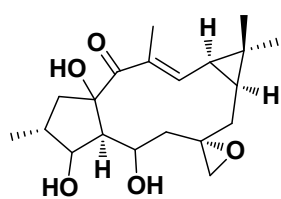
Compound	R ₁	R ₂	R ₃
latilagascene A (183)	Ac	H	H
latilagascene B (184)	H	H	H
latilagascene C (185)	Ac	Ac	H
latilagascene D (186)	Bz	H	H
latilagascene E (187)	Bz	H	OH

Table 2.5 Substituents of naturally occurring lathyranes 183-187

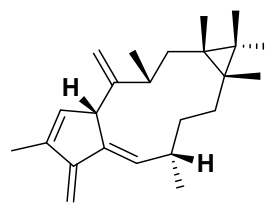


192: R₁ = OH, R₂ = Me

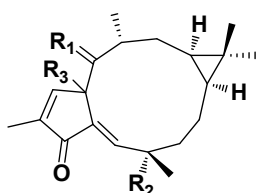
193: R₁ = Me, R₂ = OH



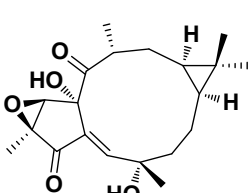
194



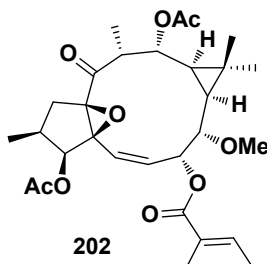
japodagrol (195)



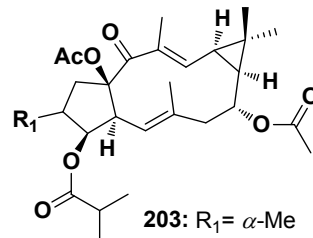
196-200



japodagrins (201)



202

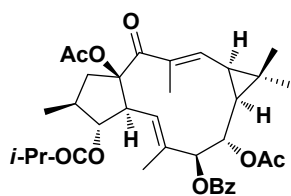


203: R₁ = α -Me

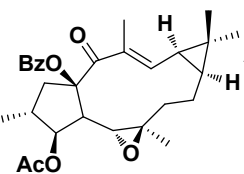
204: R₁ = β -Me

Compound	R ₁	R ₂	R ₃
196	=O	OH	α -OH
multifolone (197)	β -OH	H	β -OH
198	=O	OH	β -OH
199	=O	OAc	β -OH
200	=O	OH	β -OH

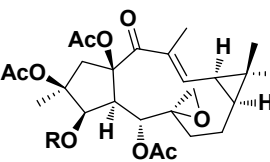
Table 2.6 Substituents of naturally occurring lathyranes 196-200



latazienone (205)

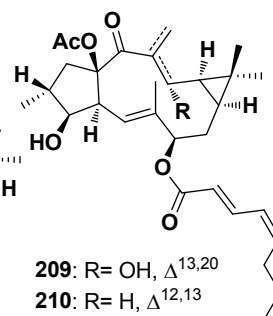


206



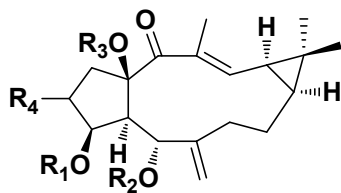
207: R = Nic

208: R = Ac

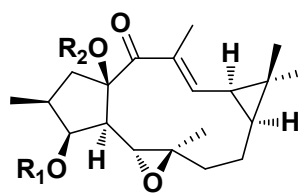


209: R = OH, $\Delta^{13,20}$

210: R = H, $\Delta^{12,13}$



211-213



214: R₁ = R₂ = Ac

215: R₁ = Ac, R₂ = H

216: R₁ = H, R₂ = Ac

217: R₁ = Cinn, R₂ = H

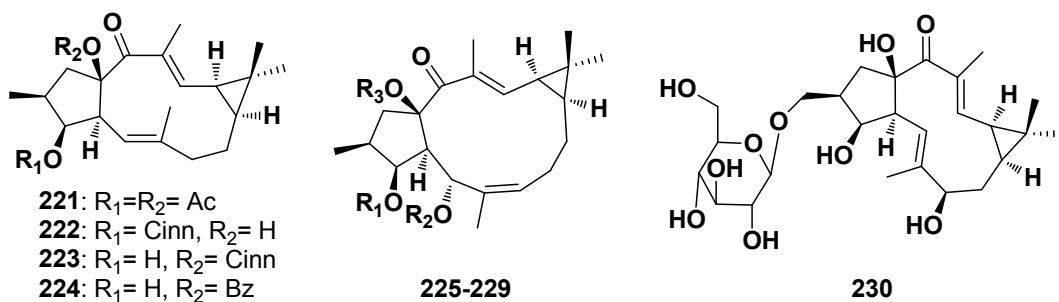
218: R₁ = R₂ = Bz

219: R₁ = Bz, R₂ = H

220: R₁ = Ac, R₂ = Bz

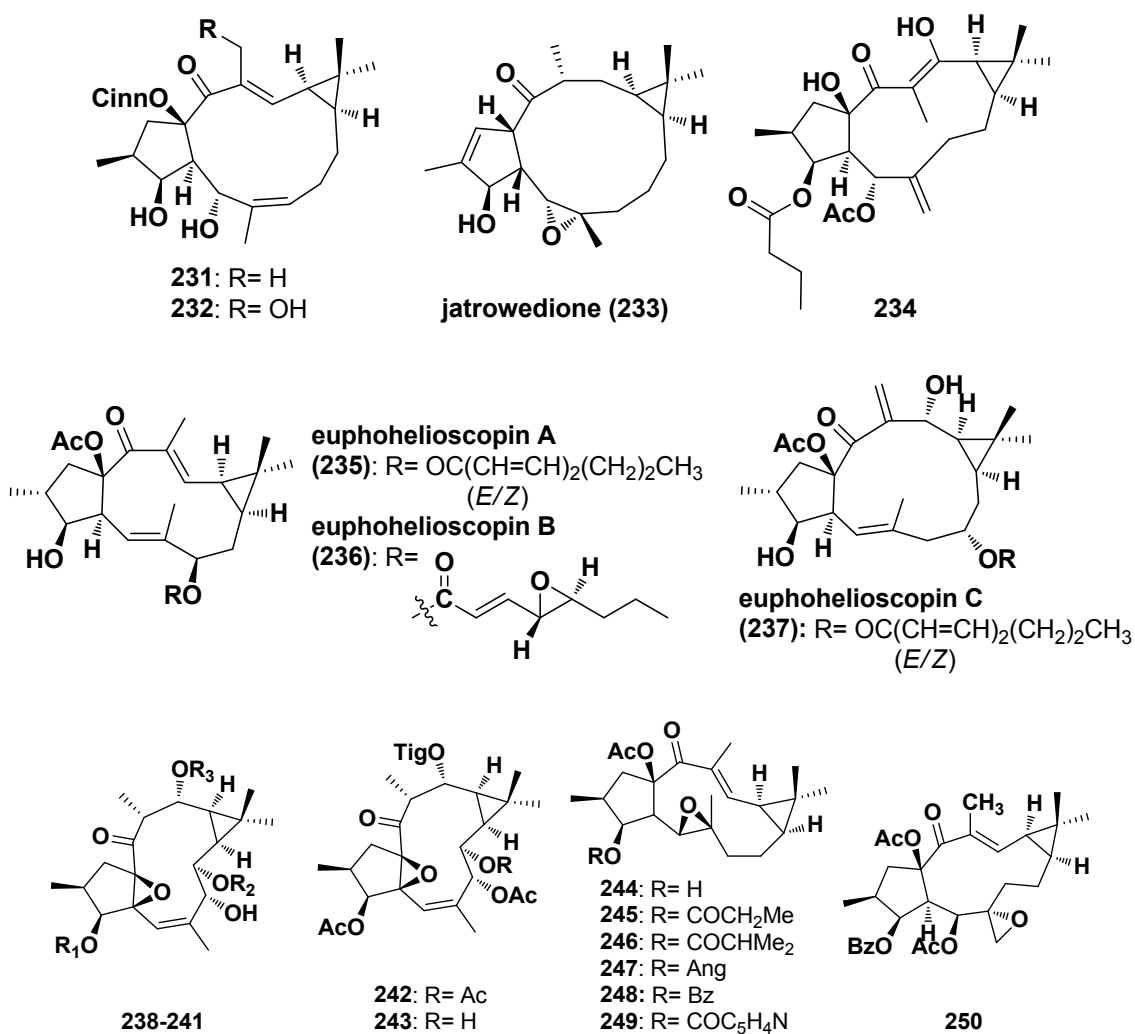
Compound	R ₁	R ₂	R ₃	R ₄
211	Ac	Ac	Ac	α -Me
212	Bz	Ac	Ac	α -Me
213	H	H	Cinn	β -Me

Table 2.7 Substituents of naturally occurring lathyranes 211-213



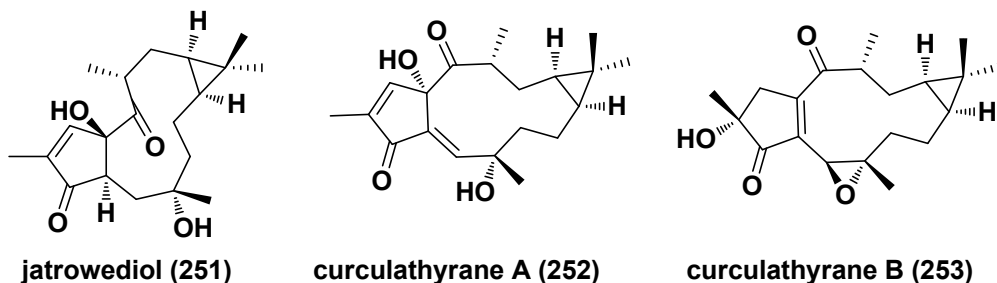
Compound	R ₁	R ₂	R ₃	Compound	R ₁	R ₂	R ₃
225	Cinn	H	H	228	H	Ac	Bz
226	H	Cinn	H	229	isopropylidene	isopropylidene	Cinn
227	Ac	H	Bz				

Table 2.8 Substituents of naturally occurring lathyranes 225-229



Compound	R ₁	R ₂	R ₃	Compound	R ₁	R ₂	R ₃
238	Ac	Bz	Ac	240	H	Tig	Ac
239	Ac	Tig	Ac	241	H	Tig	H

Table 2.9 Substituents of naturally occurring lathyranes 238-241



3 Ingenanes

Table 3.1 The occurrence and biological activity of ingenanes

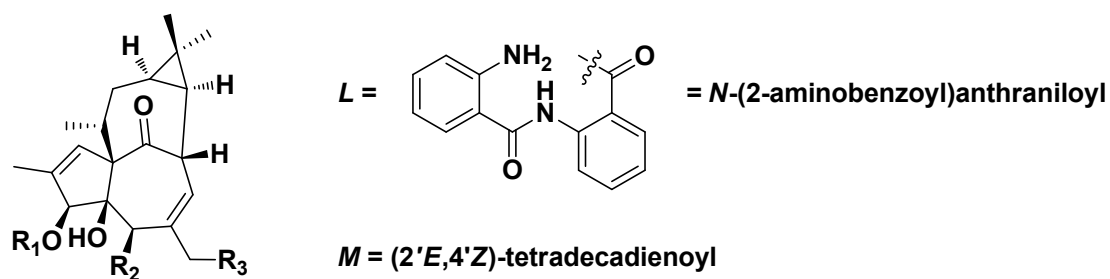
N°	Compound	Species	Biological activities	Ref.
254	ingenol	<i>Euphorbia lathyris</i>	- Irritant	89, 128
255	compound 255	<i>Euphorbia leuconeura</i>	-	129
256	compound 256	<i>Euphorbia canariensis</i>	-	67
257	3- <i>O</i> -angeloyl-5,20- <i>O</i> -diacetylingenol	<i>Euphorbia canariensis</i> , <i>Euphorbia acurensis</i> , <i>Euphorbia royleana</i>	- Antiangiogenic activity	67, 69, 79
258	3- <i>O</i> -angeloyl-20- <i>O</i> -acetyl-5-deoxyingenol	<i>Euphorbia canariensis</i>	-	67
259	compound 259	<i>Euphorbia paralias</i> , <i>Euphorbia peplus</i>	-	130, 131
260	3- <i>O</i> -(2 <i>E</i> ,4 <i>Z</i> -decadienoyl)-20-deoxyingenol	<i>Euphorbia kansui</i>	- Effects in the cellular division	132,
261	3- <i>O</i> -(2 <i>E</i> ,4 <i>E</i> -decadienoyl)-20-deoxyingenol	<i>Euphorbia kansui</i>	- Effects in the cellular division	132
262	kansuiphorin C	<i>Euphorbia kansui</i>	- Cytotoxic	133, 134, 135
263	3- <i>O</i> -benzoyl-20-deoxyingenol	<i>Euphorbia kansui</i>	-	133
264	3- <i>O</i> -(2' <i>E</i> ,4' <i>Z</i> -decadienoyl)-20-acetoxingenol	<i>Euphorbia kansui</i>	- Effects in the cellular division	136, 133
265	3- <i>O</i> -(2' <i>E</i> ,4' <i>Z</i> -decadienoyl)ingenol	<i>Euphorbia kansui</i>	- Effects in the cellular division - Pesticide - Cytotoxic	136, 137, 138
266	20- <i>O</i> -(2' <i>E</i> ,4' <i>E</i> -decadienoyl)ingenol	<i>Euphorbia kansui</i>	- Effects in the cellular division	136
267	20- <i>O</i> -(2' <i>E</i> ,4' <i>Z</i> -decadienoyl)ingenol	<i>Euphorbia kansui</i>	- Effects in the cellular division	136
268	3- <i>O</i> -(2' <i>E</i> ,4' <i>Z</i> -decadienoyl)-5-	<i>Euphorbia</i>	- Effects in the	136

	acetylingenol	<i>kansui</i>	cellular division	
269	3- <i>O</i> -(2' <i>E</i> ,4' <i>E</i> -decadienoyl)-20-acetylingenol	<i>Euphorbia kansui</i>	- Effects in the cellular division	136
270	20- <i>O</i> -(decanoyl)ingenol	<i>Euphorbia kansui</i>	- Effects in the cellular division	136
271	5- <i>O</i> -(2' <i>E</i> ,4' <i>E</i> -decadienoyl)ingenol	<i>Euphorbia kansui</i>	- Effects in the cellular division	136
272	PEP-005 (3- <i>O</i> -angeloylingenol)	<i>Euphorbia species</i>	- Antitumoral - Antileukemic - PKC activator - Irritant	67, 139, 140, 141
273	PEP-008 (3- <i>O</i> -angeloyl-20-acetylingenol)	<i>Euphorbia peplus</i>	- PKC activator	142
274	euphorbia factor L ₅	<i>Euphorbia serrata</i> , <i>Euphorbia lathyris</i>	- Tumor promoter - Irritant - Cocarcinogenic activity	143, 168, 144
275	3- <i>O</i> -angeloyl-20-deoxyingenol	<i>Euphorbia peplus</i>	- Irritant	145
276	20- <i>O</i> -octanoylingenol	<i>Euphorbia peplus</i>	- Irritant	145
277	compound 277	<i>Euphorbia cotinifolia</i>	- Piscicidal activity	146
278	compound 278	<i>Euphorbia cotinifolia</i>	- Piscicidal activity	146
279	compound 279	<i>Euphorbia cotinifolia</i>	- Piscicidal activity	146
280	compound 280	<i>Euphorbia cotinifolia</i>	- Piscicidal activity	146
281	3,5,20- <i>O</i> -triacetylingenol	<i>Euphorbia species</i>	- Piscicidal activity	146, 147, 148
282	compound 282	<i>Euphorbia cotinifolia</i>	- Piscicidal activity	146
283	compound 283	<i>Euphorbia cotinifolia</i>	- Piscicidal activity	146
284	3,20- <i>O</i> -dibenzoylingenol	<i>Euphorbia esula</i>	- Cytotoxic - Antileukemic	19, 149
285	20- <i>O</i> -eicosanoylingenol	<i>Euphorbia iberica</i>	-	150
286	20- <i>O</i> -acetyl-3- <i>O</i> -decadienoylingenol	<i>Euphorbia broteri</i>	-	151
287	3,20- <i>O</i> -diacetyl-5- <i>O</i> -(2' <i>E</i> ,4' <i>Z</i>)-tetradecadienoylingenol	<i>Euphorbia petiolata</i>	-	152
288	5,20- <i>O</i> -diacetyl-3- <i>O</i> -(2' <i>E</i> ,4' <i>Z</i>)-tetradecadienoylingenol	<i>Euphorbia petiolata</i>	-	152
289	3- <i>O</i> -(2' <i>E</i> ,4' <i>Z</i>)-tetradecadienoylingenol	<i>Euphorbia petiolata</i>	-	152, 153
290	5,20- <i>O</i> -isopropylidenyl-3-(2' <i>Z</i> ,4' <i>Z</i>)-tetradecadieniloxyingenol	<i>Euphorbia petiolata</i>	-	152
291	3- <i>O</i> -(<i>N</i> -(2-aminobenzoyl)anthraniloyl-5-acetyl-20-angelylingenol)	<i>Euphorbia cornigera</i>	- Molluscicidal activity	154
292	3- <i>O</i> -(<i>N</i> -(2-aminobenzoyl)anthraniloyl-5-angelyl-20- <i>O</i> -acetylingenol)	<i>Euphorbia cornigera</i>	- Molluscicidal activity	154
293	3- <i>O</i> -acetyl-5- <i>O</i> -(<i>N</i> -(2-aminobenzoyl)anthraniloyl-20- <i>O</i> -angeloylingenol)	<i>Euphorbia cornigera</i>	- Molluscicidal activity	154
294	3- <i>O</i> -acetyl-5- <i>O</i> -angeloyl-20- <i>O</i> -(<i>N</i> -(2-aminobenzoyl)anthraniloyl)ingenol	<i>Euphorbia cornigera</i>	- Molluscicidal activity	154

295	3- <i>O</i> -angelyl-5- <i>O</i> -acetyl-20- <i>O</i> -(<i>N</i> -(2-aminobenzoyl))-anthraniloxygenol	<i>Euphorbia cornigera</i>	-	154
296	3- <i>O</i> -angeloyl-5- <i>O</i> -(<i>N</i> -(2-aminobenzoyl))anthraniloyl-20- <i>O</i> -acetylingenol	<i>Euphorbia cornigera</i>	-	154
297	3,20- <i>O</i> -diacetyl-5- <i>O</i> -(<i>N</i> -(2-aminobenzoyl))anthraniloxygenol	<i>Euphorbia cornigera</i>	-Molluscicidal activity	154
298	5,20- <i>O</i> -diacetyl-3- <i>O</i> -(<i>N</i> -(2-aminobenzoyl))anthraniloxygenol	<i>Euphorbia cornigera</i>	-Molluscicidal activity	154
299	3- <i>O</i> -(<i>N</i> -(2-aminobenzoyl))anthraniloyl-20- <i>O</i> -acetylingenol	<i>Euphorbia cornigera</i>	-Molluscicidal activity	154
300	20- <i>O</i> -(<i>N</i> -(2-aminobenzoyl))anthraniloyl-3- <i>O</i> -acetylingenol	<i>Euphorbia cornigera</i>	-Molluscicidal activity	154
301	20- <i>O</i> -acetyl-3- <i>O</i> -(2' <i>E</i> ,4' <i>Z</i>)-decadienoyl)-ingenol	<i>Euphorbia kansui</i>	- Antinematodal activity	155
302	20- <i>O</i> -acetyl-5- <i>O</i> -(2' <i>E</i> ,4' <i>Z</i>)decadienoyl)-ingenol	<i>Euphorbia kansui</i>	- Antinematodal activity	155
303	3- <i>O</i> -(2' <i>E</i> ,4' <i>Z</i>)-decadienoylingenol	<i>Euphorbia kansui</i>	- Effects in the cellular division - Antinematodal activity	136, 155
304	kansuiphorin D	<i>Euphorbia kansui</i>	- Cytotoxic	135
305	3,20- <i>O</i> -diacetyl-5-deoxyingenol	<i>Euphorbia myrsinites</i> , <i>Euphorbia biglandulosa</i>	-	148
306	3- <i>O</i> -acetyl-20- <i>O</i> -((<i>Z</i>)-2-methyl-2-butenoyl)ingenol	<i>Euphorbia canariensis</i>	-	156
307	3- <i>O</i> -benzoyl-13- <i>O</i> -octanoyloxyingenol	<i>Euphorbia esula</i>	- Anticancer	157
308	3- <i>O</i> -(2,3-dimethylbutanoyl)-13-octanoyloxyingenol	<i>Euphorbia esula</i>	- Anticancer	157
309	kansuiphorin A	<i>Euphorbia kansui</i>	- Cytotoxic - Antiviral - Antileukemic	132, 158, 159
310	3- <i>O</i> -(2,3-dimethylbutanoyl)-13-dodecanoyloxy-20-acetylingenol	<i>Euphorbia kansui</i>	-	132
311	3- <i>O</i> -(2,3-dimethylbutanoyl)-13-dodecanoyloxy-20-deoxyingenol	<i>Euphorbia kansui</i>	-	132
312	compound 312	<i>Euphorbia kansui</i>	-	132
313	compound 313	<i>Euphorbia kansui</i>	- Effects in the cellular division	132
314	compound 314	<i>Euphorbia kansui</i>	- Effects in the cellular division	132
315	compound 315	<i>Euphorbia kansui</i>	-	132
316	3- <i>O</i> -(2,3-dimethylbutanoyl)-13-dodecanoyloxyingenol	<i>Euphorbia kansui</i>	- Pesticide -Cytotoxic - Antinematodal activity	137, 138, 147
317	3- <i>O</i> -(2,3-dimethylbutanoyl)-13-decanoyloxyingenol (DBDI)	<i>Euphorbia kansui</i>	- Antinematodal - IgE supressor	147, 160
318	kansuiphorin B	<i>Euphorbia kansui</i>	- Antileukemic activity	158
319	4- <i>O</i> -acetyl-5- <i>O</i> -benzoyl-3 β -hydroxy-20-deoxyingenol	<i>Euphorbia kansui</i>	-	161

320	4-deoxyingenol	<i>Euphorbia megalantha</i>	-	162
321	13-hydroxy-5-deoxyingenol	<i>Belizian Mabea excelsa</i>	-	163
322	milliamine A	<i>Euphorbia milii</i>	-	164, 165
323	milliamine B	<i>Euphorbia milii</i>	-	165
324	milliamine C	<i>Euphorbia milii</i>	- Irritant	165, 166
325	milliamine D	<i>Euphorbia milii</i>	-	164
326	milliamine E	<i>Euphorbia milii</i>	-	164
327	milliamine J	<i>Euphorbia milii</i>	-	164
328	milliamine K	<i>Euphorbia milii</i>	-	165
329	milliamine L	<i>Euphorbia splendens, Euphorbia milii</i>	-Molluscicide	164, 167
330	milliamine M	<i>Euphorbia milii</i>	-	164
331	milliamine N	<i>Euphorbia milii</i>	-	164
332	euphorbia factor L ₄	<i>Euphorbia species</i>	-	46, 144, 168, 169
333	euphorbia factor L ₆	<i>Euphorbia lathyris</i>	- Irritant	168, 144
334	3β-O-(2,6-dimethylnonanoyl)ingenol	<i>Euphorbia resinifera</i>	-	170
335	20-O-myristoylingenol	<i>Euphorbia wallichii</i>	-	171
336	3β-O-myristoylingenol	<i>Euphorbia wallichii, Euphorbia ebracteolata</i>	-	171, 172
337	compound 337	<i>Euphorbia peplus</i>	-	141

Fig.3 The structures of naturally occurring ingenanes



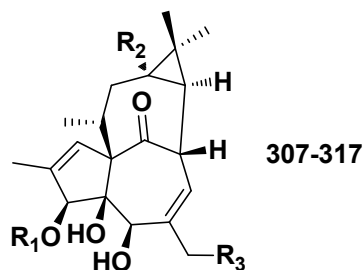
254-306 and 332-337

Compound	R ₁	R ₂	R ₃
ingenol (254)	H	OH	OH
255	<i>L</i>	OH	OAc
256	Ang	OH	OAc
257	Ang	OAc	OAc
258	Ang	H	OAc
259	Ang	OH	H
260	CO(CH=CH) ₂ (CH ₂) ₄ CH ₃ (<i>E/Z</i>)	OH	H
261	CO(CH=CH) ₂ (CH ₂) ₄ CH ₃ (<i>E/E</i>)	OH	H
kansuiphorin C	Ac	OBz	H

(262)			
263	Bz	OH	H
264	CO(CH=CH) ₂ (CH ₂) ₄ CH ₃ (<i>E/Z</i>)	OH	OAc
265	CO(CH=CH) ₂ (CH ₂) ₄ CH ₃ (<i>E/Z</i>)	OH	OH
266	H	OH	OCO(CH=CH) ₂ (CH ₂) ₄ Me <i>E/E</i>
267	H	OH	OCO(CH=CH) ₂ (CH ₂) ₄ Me (<i>E/Z</i>)
268	CO(CH=CH) ₂ (CH ₂) ₄ Me (<i>E/Z</i>)	OCOMe	OH
269	CO(CH=CH) ₂ (CH ₂) ₄ Me (<i>E/E</i>)	OH	OCOMe
270	H	OH	OCO(CH ₂) ₈ Me
271	H	OCO(CH=CH) ₂ (CH ₂) ₄ Me (<i>E/E</i>)	OH
PEP-005 (272)	Ang	OH	OH
PEP-008 (273)	Ang	OH	OAc
euphorbia factor L5 (274)	CO(CH ₂) ₁₄ Me	OH	OH
275	Ang	OH	H
276	H	OH	octanoyl
277	COEt	OH	OCOCHMeEt
278	H	OH	OCOCHMe ₂
279	COEt	OH	OCOCHMe ₂
280	COCHMe ₂	OH	OCOCHMe ₂
281	Ac	OAc	OAc
282	H	OH	OCOCHMeEt
283	COEt	OCOEt	OCOCHMe ₂
284	Bz	OH	OBz
285	H	OH	OCO(CH ₂) ₁₈ Me
286	CO(CH=CH) ₂ (CH ₂) ₄ Me	OH	OAc
287	Ac	<i>OM</i>	OAc
288	<i>M</i>	OAc	OAc
289	<i>M</i>	OH	OH
290	<i>M</i>	<i>O</i> -isopropylidenyl	<i>O</i> -isopropylidenyl
291	<i>L</i>	OAc	OAng
292	<i>L</i>	OAng	OAc
293	Ac	<i>OL</i>	OAng
294	Ac	OAng	<i>OL</i>
295	Ang	OAc	<i>OL</i>
296	Ang	<i>OL</i>	OAc
297	Ac	<i>OL</i>	OAc
298	<i>L</i>	OAc	OAc
299	<i>L</i>	OH	OAc
300	Ac	OH	<i>OL</i>
301	CO(CH=CH) ₂ (CH ₂) ₄ CH ₃ (<i>E/Z</i>)	OH	OAc
302	H	OCO(CH=CH) ₂ (CH ₂) ₄ CH ₃ (<i>E/Z</i>)	OAc
303	CO(CH=CH) ₂ (CH ₂) ₄ CH ₃ (<i>E/Z</i>)	OH	OH
304	Bz	OAc	H
305	Ac	H	OAc
306	Ac	OH	OAng
euphorbia factor L ₄ (332)	H	OH	OCO(CH ₂) ₁₄ Me
euphorbia factor L ₆ (333)	CO(CH ₂) ₁₃ Me	OH	OH

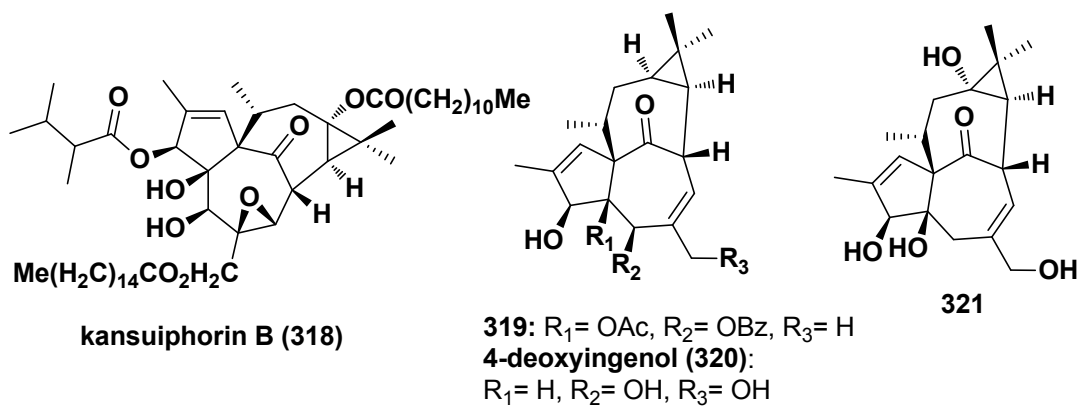
334	2,6-dimethylnonanoyl	OH	OH
335	H	OH	OCO(CH ₂) ₁₂ Me
336	CO(CH ₂) ₁₂ Me	OH	OH
337	H	OAng	H

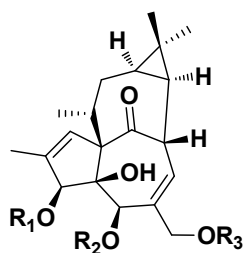
Table 3.2 Substituents of naturally occurring ingenanes 254-306 and 332-337



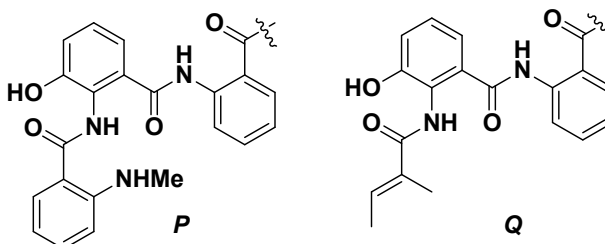
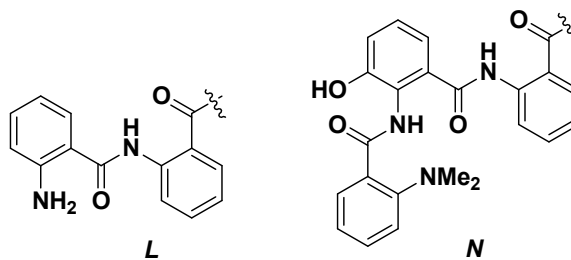
Compound	R ₁	R ₂	R ₃
307	Bz	octanoyloxy	OH
308	2,3-dimethylbutanoyl	octanoyloxy	OH
kansuiphorin A (309)	2,3-dimethylbutanoyl	dodecanoyloxy	OCO(CH ₂) ₁₄ Me
310	2,3-dimethylbutanoyl	dodecanoyloxy	OAc
311	2,3-dimethylbutanoyl	dodecanoyloxy	H
312	H	dodecanoyloxy	2,3-dimethylbutanoyl
313	2,3-dimethylbutanoyl	dodecanoyloxy	OH
314	Bz	dodecanoyloxy	OH
315	H	dodecanoyloxy	OBz
316	2,3-dimethylbutanoyl	dodecanoyloxy	OH
DBDI (317)	2,3-dimethylbutanoyl	decanoyloxy	OH

Table 3.3 Substituents of naturally occurring ingenanes 307-317





milliamine A (322): $R_1 = N$, $R_2 = H$, $R_3 = Ac$
 milliamine B (323): $R_1 = H$, $R_2 = H$, $R_3 = N$
 milliamine C (324): $R_1 = N$, $R_2 = H$, $R_3 = H$
 milliamine D (325): $R_1 = H$, $R_2 = N$, $R_3 = Ac$
 milliamine E (326): $R_1 = N$, $R_2 = Ac$, $R_3 = H$
 milliamine J (327): $R_1 = P$, $R_2 = H$, $R_3 = Ac$
 milliamine K (328): $R_1 = Q$, $R_2 = H$, $R_3 = Ac$
 milliamine L (329): $R_1 = L$, $R_2 = H$, $R_3 = Ac$
 milliamine M (330): $R_1 = H$, $R_2 = L$, $R_3 = Ac$
 milliamine N (331): $R_1 = Ac$, $R_2 = L$, $R_3 = Ac$



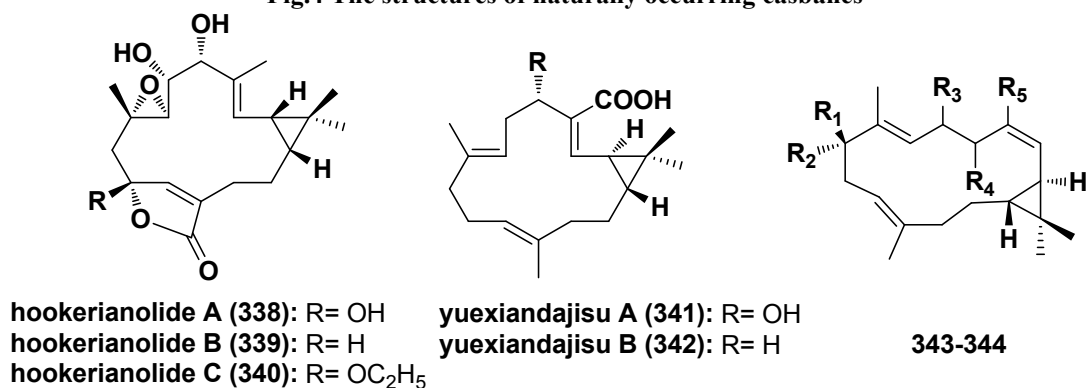
4 Casbanes

Table 4.1 The occurrence and biological activity of casbanes

N°	Compound	Species	Biological activities	References
338	hookerianolides A	<i>Mallotus hookerianus</i>	-	173
339	hookerianolides B	<i>Mallotus hookerianus</i>	-	173
340	hookerianolides C	<i>Mallotus hookerianus</i>	-	173
341	yuexiandajisu A	<i>Euphorbia ebracteolata</i>	- Antibacterial	174
342	yuexiandajisu B	<i>Euphorbia ebracteolata</i>	- Inhibitor of proliferation of B lymphocytes	174
343	pekinenal	<i>Euphorbia pekinensis</i>	- Cytotoxic	175
344	1-hydroxy-(2E,6Z,12E)-casba-2,6,12-triene-4,5-dione	<i>Croton argyrophyllus</i>	-	176
345	microclavatin	<i>Sinularia microclavata</i>	- Cytotoxic	177
346	6E,12E-casba-1,3,6,12-tetraen-1,4-epoxy-5-one	<i>Croton argyrophyllus</i>	-	176
347	agrostistachin	<i>Agrostistachys hookeri</i>	- Cytotoxic	178
348	14-dehydroagrostistachin	<i>Agrostistachys Hookeri</i>	- Anticancer	179
349	depressin	<i>Sinularia depressa</i>	-	180
350	1- <i>epi</i> -depressin	<i>Sinularia depressa</i>	-	180
351	1- <i>epi</i> -10-hydroxydepressin	<i>Sinularia depressa</i>	-	180
352	10-hydroxydepressin	<i>Sinularia depressa</i>	- Cytotoxic - Antibacterial	180
353	1- <i>epi</i> -10-oxodepressin	<i>Sinularia depressa</i>	-	180
354	10-oxo-11,12-	<i>Sinularia</i>	-	180

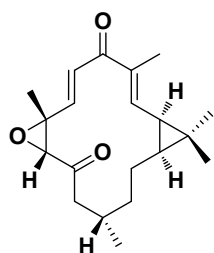
	dihydrodepressin	<i>depressa</i>		
355	1- <i>epi</i> -10-oxo-11,12-dihydrodepressin	<i>Sinularia depressa</i>	-	180
356	2- <i>epi</i> -10-oxo-11,12-dihydrodepressin	<i>Sinularia depressa</i>	-	180
357	8,10-dihydroxy-iso-depressin	<i>Sinularia depressa</i>	-	180
358	1,4-dihydroxy-2 <i>E</i> ,6 <i>E</i> ,12 <i>E</i> -trien-5-one-casbane	<i>Croton nepetaefolius</i>	- Antimicrobial	181
359	koumbalone A	<i>Maprounea africana</i>	-	182
360	koumbalone B	<i>Maprounea africana</i>	-	182
361	agroskerin	<i>Agrostistachys Hookeri</i>	- Anticancer	179
362	1,4-dihydroxy-2 <i>E</i> ,6 <i>E</i> ,12 <i>E</i> -trien-5-one-casbane	<i>Croton nepetaefolius</i>	-	183
363	4-hydroxy-2 <i>E</i> ,6 <i>E</i> ,12 <i>E</i> -5-one-casbane	<i>Croton nepetaefolius</i>	-	183
364	crotonitenone	<i>Croton nitens sw.</i>	-	184
365	pekinenin A	<i>Euphorbia pekinensis</i>	- Cytotoxic	185
366	pekinenin B	<i>Euphorbia pekinensis</i>	-	185
367	pekinenin C	<i>Euphorbia pekinensis</i>	- Cytotoxic	186
368	pekinenin D	<i>Euphorbia pekinensis</i>	- Cytotoxic	186
369	pekinenin E	<i>Euphorbia pekinensis</i>	- Cytotoxic	186
370	pekinenin F	<i>Euphorbia pekinensis</i>	- Cytotoxic	186
371	(3 <i>E</i> ,7 <i>Z</i> ,11 <i>E</i>)-19-hydroxycasba-3,7,11-trien-5-one	<i>Ricinus communis</i>	-	187
372	6 <i>α</i> -hydroxy-10 <i>β</i> -methoxy-7 <i>α</i> ,8 <i>α</i> -epoxy-5-oxocasbane-20,10-olide	<i>Ricinus communis</i>	-	187

Fig.4 The structures of naturally occurring casbanes

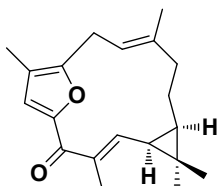


Compound	R ₁	R ₂	R ₃	R ₄	R ₅
pekinenal (343)	H	H	H	<i>α</i> -OH	CHO
344	Me	OH	=O	=O	Me

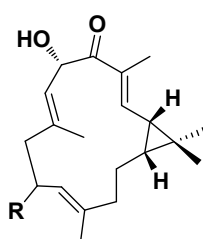
Table 4.2 Substituents of naturally occurring casbanes 343-344



microclavatin (345)



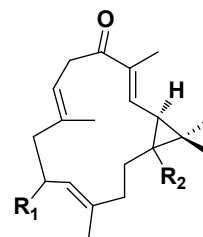
346



agrostistachin (347):

R = β -OH

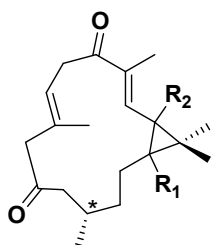
348: R = =O



349-353

Compound	R ₁	R ₂
depressin (349)	H	α -H
350	H	β -H
351	OH	β -H
352	OH	α -H
353	=O	β -H

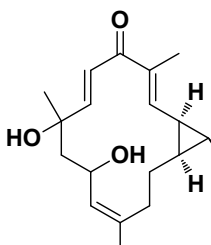
Table 4.3 Substituents of naturally occurring casbanes 349-353



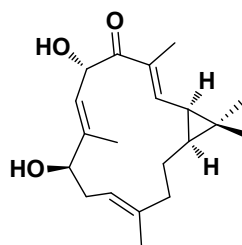
354: R₁ = α -H, R₂ = α -H

355: R₁ = β -H, R₂ = α -H

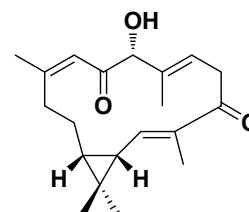
356: R₁ = α -H, R₂ = β -H



357

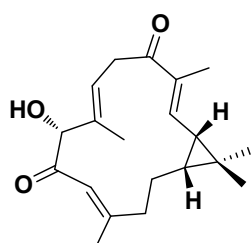


358

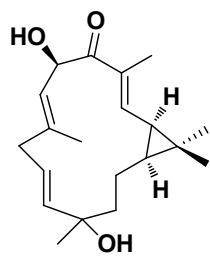


koumbalone A (359)

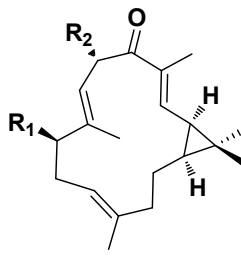
* Configuration tentatively assigned



koumbalone B (360)

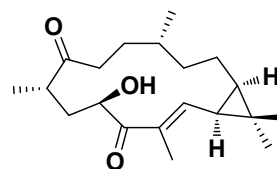


agroskerin (361)

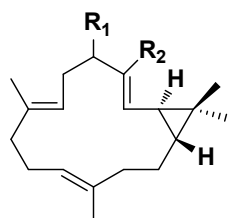


362: R₁ = R₂ = OH

363: R₁ = H, R₂ = OH



crotonitenone (364)



pekinenin A (365):

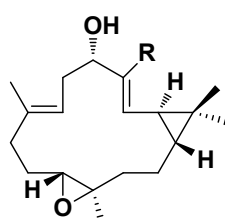
R₁ = =O, R₂ = OH

pekinenin B (366):

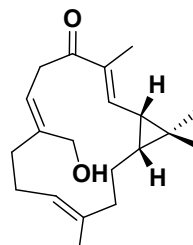
R₁ = α -OMe, R₂ = COOH

pekinenin C (367):

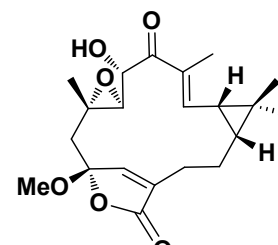
R₁ = =O, R₂ = CHO



pekinenin D (367): R = CHO
pekinenin E (368): R = COOH



371



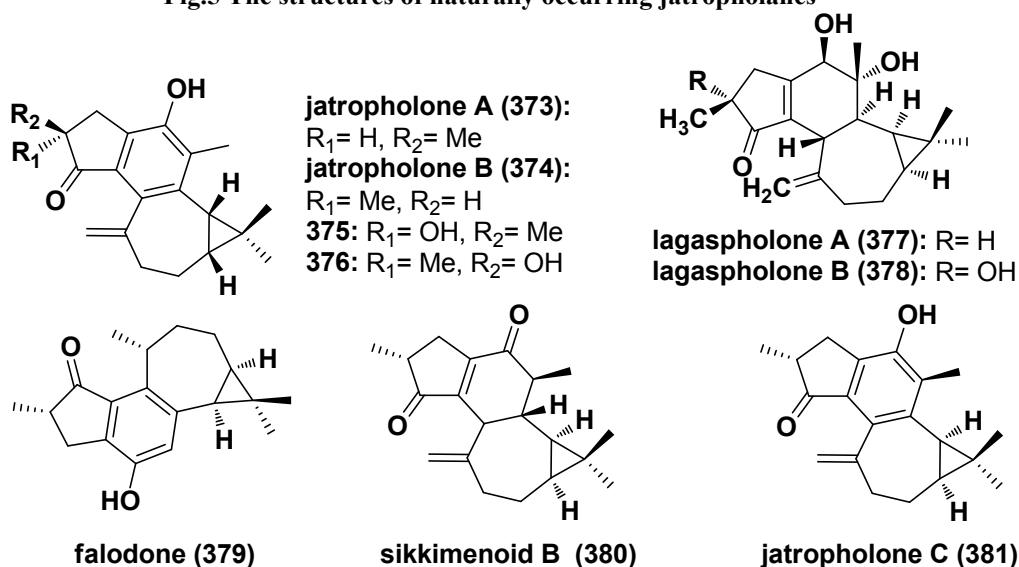
372

5 Jatrophanes

Table 5.1 The occurrence and biological activity of jatrophanes

N°	Compound	Species	Biological activities	References
373	jatropholone A	<i>Jatropha isabelli</i> , <i>Jatropha gossypifolia</i> , <i>Jatropha integerrima</i>	- Gastroprotective - Cytotoxic - Antiplasmodial - Antitumoral	188, 189, 190, 192
374	jatropholone B	<i>Jatropha isabelli</i> , <i>Jatropha gossypifolia</i> , <i>Jatropha integerrima</i>	- Gastroprotective - Antitumoral	188, 190, 191, 192
375	2 α -hydroxyjatropholone	<i>Jatropha integerrima</i>	- Antiplasmodial	190
376	2 β -hydroxyjatropholone	<i>Jatropha integerrima</i>	- Cytotoxic	190
377	lagaspholone A	<i>Euphorbia lagascae</i>	-	193
378	lagaspholone B	<i>Euphorbia lagascae</i>	-	193
379	falodone	<i>Jatropha gossypifolia</i>	- Anticancer	194
380	sikkimenoid B	<i>Jatropha curcas</i>	- Antimicrobial	195
381	jatropholone C	<i>Jatropha curcas</i>	-	195

Fig.5 The structures of naturally occurring jatrophanes



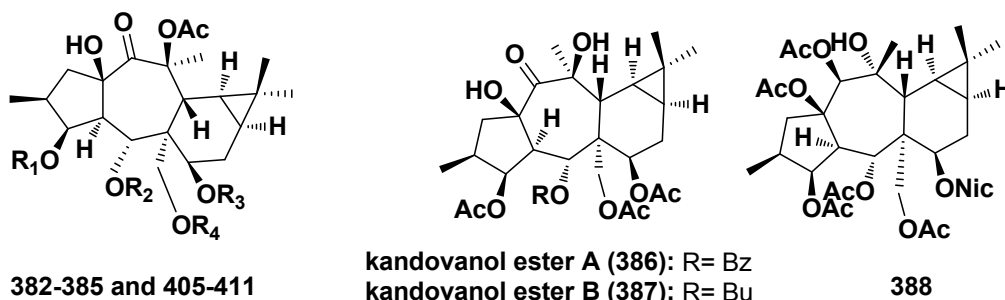
6 Premyrinanes

Table 6.1 The occurrence and biological activity of premyrinanes

N°	Compound	Species	Biological activities	References
382	compound 382	<i>Euphorbia macroclada</i>	-	24
383	compound 383	<i>Euphorbia macroclada</i>	-	24
384	compound 384	<i>Euphorbia macroclada</i>	-	24
385	compound 385	<i>Euphorbia macroclada</i>	-	24
386	kandovanol ester A	<i>Euphorbia decipiens</i>	-	196
387	kandovanol ester B	<i>Euphorbia decipiens</i>	-	196
388	3,5,14,15,17-pentaacetyl-7-nicotinoyl-euphoppin	<i>Euphorbia decipiens</i>	-	196
389	compound 389	<i>Euphorbia falcata</i>	- Synergistic antiproliferative effect with doxorubicin	197, 198
390	compound 390	<i>Euphorbia falcata</i>	- Synergistic	197, 198

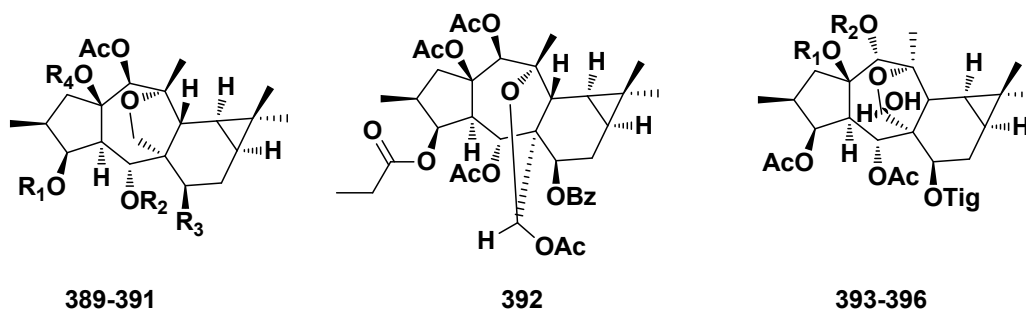
			antiproliferative effect with doxorubicin	
391	compound 391	<i>Euphorbia falcata</i>	- Synergistic antiproliferative effect with doxorubicin	197, 198
392	compound 392	<i>Euphorbia falcata</i>	- Synergistic antiproliferative effect with doxorubicin	197, 198
393	euphoppin A	<i>Euphorbia aleppica</i>	-	199
394	euphoppin B	<i>Euphorbia aleppica</i>	-	199
395	euphoppin C	<i>Euphorbia aleppica</i>	-	199
396	euphoppin D	<i>Euphorbia aleppica</i>	-	199
397	euphoboteol-3,5,17-triacetate	<i>Euphorbia boetica</i>	-	200
398	euphorbiaproliferin I	<i>Euphorbia prolifera</i>	- Neuroprotective activity	201
399	euphorbiaproliferin J	<i>Euphorbia prolifera</i>	- Neuroprotective activity	201
400	euphoreppinol	<i>Euphorbia aleppica</i>	-	202
401	3,14,15,17-tetraacetyl-5-lactoyleuphoreppinol-7-yl isopropenylacetate	<i>Euphorbia aleppica</i>	-	202
402	aleppicatine A	<i>Euphorbia aleppica</i>	-	203
403	aleppicatine B	<i>Euphorbia aleppica</i>	-	203
404	euphoreppine A	<i>Euphorbia aleppica</i>	-	204, 205
405	premyrsinol-3-propanoate-5-isobutyrate-7,13,17-triacetate	<i>Euphorbia pithyusa</i>	-	87
406	premyrsinol-3-propanoate-5-isobutyrate-7,13-diacetate-17-nicotinate	<i>Euphorbia pithyusa</i>	-	87
407	premyrsinol-3-propanoate-5-(<i>R</i> -methyl)butyrate-7,13-diacetate-17-isobutyrate	<i>Euphorbia pithyusa</i>	-	87
408	premyrsinol-3-propanoate-5,17-diisobutyrate-7,13-diacetate	<i>Euphorbia pithyusa</i>	-	87
409	premyrsinol-3,17-dipropanoate-5-isobutyrate-7,13-diacetate	<i>Euphorbia pithyusa</i>	-	87
410	premyrsinol-3-propanoate-5-benzoate-7,13,17-triacetate	<i>Euphorbia pithyusa</i>	-	87
411	premyrsinol-3-acetate-5-isobutyrate-7,13,17-triacetate	<i>Euphorbia pithyusa</i>	-	87

Fig.6 The structures of naturally occurring premyrsinanes



Compound	R ₁	R ₂	R ₃	R ₄
382	CH ₃ (CH ₂) ₂ CO	Tig	H	Nic
383	CH ₃ CH ₂ CO	Tig	H	Nic
384	<i>i</i> Val	Tig	Ac	Nic
385	CH ₃ (CH ₂) ₂ CO	OCCH(Me)CH ₂ CH ₃	Ac	Nic
405	propanoyl	<i>i</i> Bu	Ac	Ac
406	propanoyl	<i>i</i> Bu	Ac	Nic
407	propanoyl	MeBu	Ac	<i>i</i> Bu
408	propanoyl	<i>i</i> Bu	Ac	<i>i</i> Bu
409	propanoyl	<i>i</i> Bu	Ac	propanoyl
410	propanoyl	Bz	Ac	Ac
411	Ac	<i>i</i> Bu	Ac	Ac

Table 6.2 Substituents of naturally occurring premyrsinanes 382-385 and 405-411

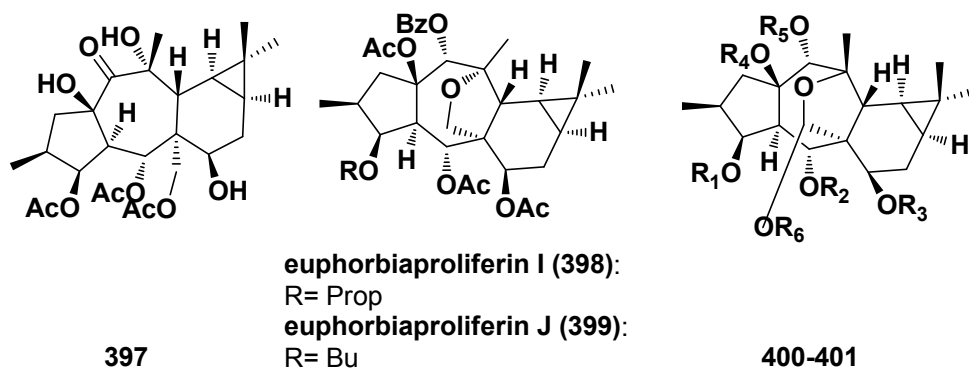


Compound	R ₁	R ₂	R ₃	R ₄
389	<i>n</i> -hexanoyl	H	H	H
390	propanoyl	Ac	OBz	Ac
391	isobutanoyl	H	OBz	Ac

Table 6.3 Substituents of naturally occurring premyrsinanes 389-391

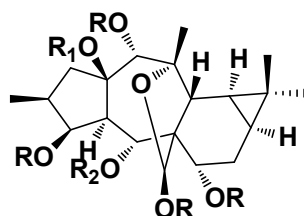
Compound	R ₁	R ₂
393	Ac	H
394	Tig	H
395	Bz	H
396	Tig	Ac

Table 6.4 Substituents of naturally occurring premyrsinanes 393-396

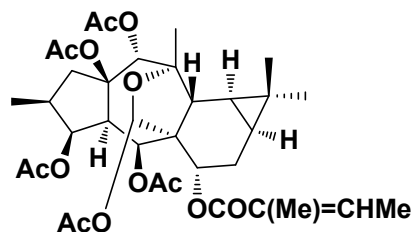


Compound	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆
400	H	H	H	H	H	H
401	Ac	COCH(OH)Me	COCH ₂ C(Me)=CH ₂	Ac	Ac	Ac

Table 6.5 Substituents of naturally occurring premyrsinanes 400-401



aleppicatin A (402): R=R₁= OAc, R₂= Tig
aleppicatin B (403): R= OAc, R₁=R₂= Tig



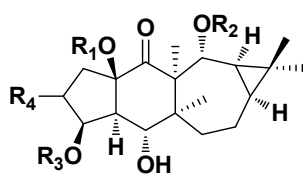
euphoreppine (404)

7 Euphoractine group

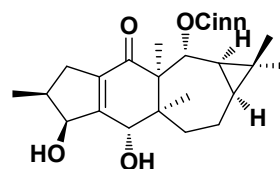
Table 7.1 The occurrence and biological activity of euphoractines

N°	Compound	Species	Biological activities	References
412	compound 412	<i>Euphorbia villosa</i>	-	91
413	euphoractine B	<i>Euphorbia micractina</i>	-	206, 207
414	euphoractine E	<i>Euphorbia micractina</i>	-	208

Fig.7 The structures of naturally occurring euphoractines



412-413



euphoractine E (414)

Compound	R ₁	R ₂	R ₃	R ₄
412	Bz	Me	Ac	α -Me
euphoractine B (413)	H	Cinn	H	β -Me

Table 7.2 Substituents of naturally occurring euphoractines 412-413

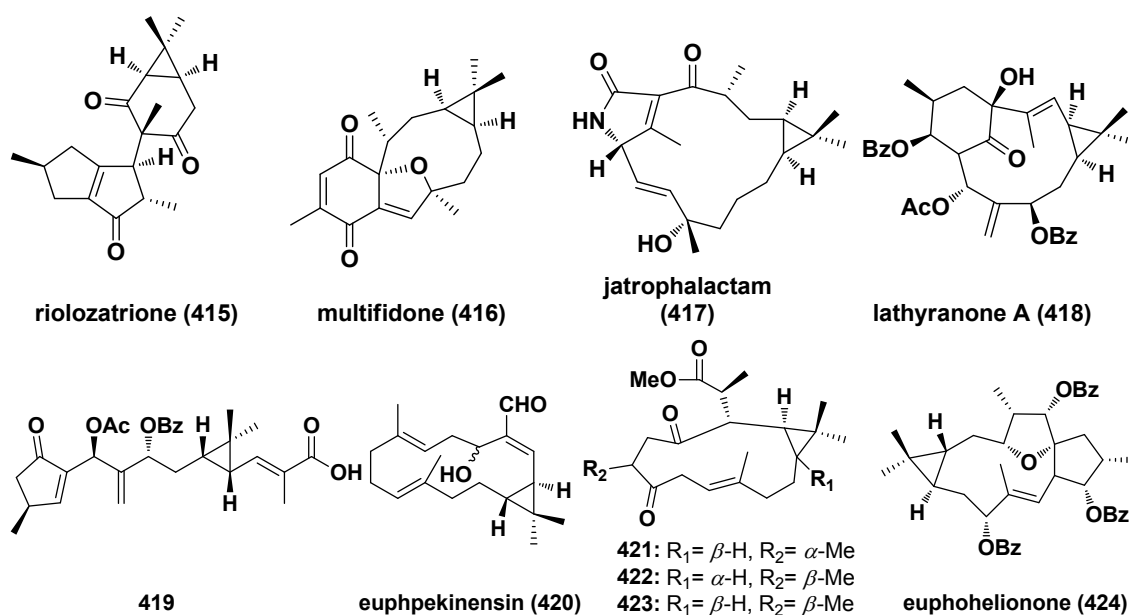
8 Other diterpenes

Table 8.1 The occurrence and biological activity of other diterpenes

N°	Compound	Species	Biological activities	References
415	riolozatrione	<i>Jatropha dioica</i>	- Antibiotic	209, 210
416	multifidone	<i>Jatropha multifida</i>	- Cytotoxic	211
417	jatrophalactam	<i>Jatropha curcas</i>	-	212
418	lathyrane A	<i>Euphorbia lathyris</i>	-	92
419	lathyranoic acid A	<i>Euphorbia lathyris</i>	-	93

420	euphpekinensin	<i>Euphorbia pekinensis</i>	- Cytotoxic	213
421	compound 421	<i>Bertya dimerostigma</i>	-	214
422	compound 422	<i>Bertya dimerostigma</i>	-	214
423	compound 423	<i>Bertya dimerostigma</i>	-	214
424	euphohelionone	<i>Euphorbia helioscopia</i>	-	215

Fig.8 The structures of naturally occurring other diterpenes



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