1. INTRODUCTION

1.1 Introduction

1.1.1 *Garcinia scortechinii*

Figure 1 ***Garcinia scortechinii***

Garcinia scortechinii, a plant belonging to the Guttiferae family (Clusiaceae), is a treelet of 4 m or a small slender tree, occasionally reaching 15 m tall, 75 cm girth. Inner bark contains copious, opaque, yellow to orange-yellow exudates. Leaves are occasionally grey-green. Flowers and fruits are very similar to *Garcinia domosa*. Commonly, this plant is scattered through Malaya, plains, low undulating country, ridges to 700 m and primary and secondary forest (Whitmore, 1973).

1.1.2 *Garcinia hanburyi*

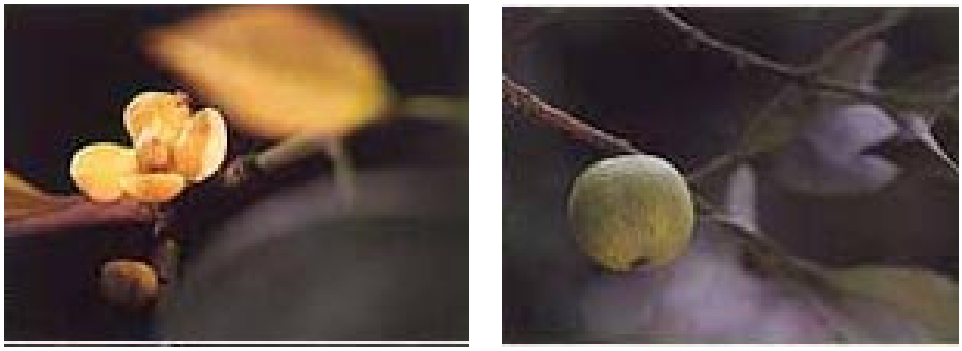


Figure 2 ***Garcinia hanburyi***

Garcinia hanburyi (Guttiferae, locally named "Rong Thong") is a small to medium-sized tree, 12-15 m high. The dark green leaves are simple and opposite, 4-6 cm wide and 8-14 cm long. The flowers are yellow. Its fruits are berry. The latex is used as a dye and folk medicine for potent purgative and infected wounds (Saralamp, 1996).

1.2 Review of literatures

1.2.1 Chemical constituents from the genus *Garcinia*

Plants in the genus *Garcinia* (Guttiferae) are well known to be rich in a variety of compounds, such as xanthones (Ho, 2002; Chiang, 2003; Ito, 2003b; Nguyen, 2003; Rukachaisirikul, 2003a, c; Suksamrarn, 2003; Merza, 2004; Chen, 2004), caged-polyprenylated xanthonoids (Asano, 1996; Cao, 1998b; Thoison, 2000; Xu, 2000; Rukachaisirikul, 2000, 2003b, 2005), benzophenones (Chiang, 2003; Ito, 2003a; Williams, 2003; Abe, 2004), biflavonoids (Li, 2002; Okunji, 2002; Permana, 2003; Abe, 2004; Parveen, 2004), chalcones (Ilyas, 2002), phloroglucinols (Weng, 2003a, b, 2004), biphenyls (Chen, 2004), benzopyrans (Chen, 2004) and triterpenes (Rukachaisirikul, 2003d; Weng, 2003a, b, 2004; Vieira, 2004a, b). Some of these compounds exhibited a wide range of biological and pharmacological activities, e.g.

antimycobacterial (Suksamrarn, 2003), NGF-potentiating (Chanmahasathien, 2003a, 2004), antituberculosis (Lin, 2001), anti-hepatitis B (Zembower, 1998), antioxidant (Sang, 2002; Chiang, 2003; Hay, 2004a), antibacterial (Permana, 2001; Rukachaisirikul, 2000, 2003c, 2004; Verdi, 2004), antifungal (Mackeen, 2002; Gopalakrishnan, 1997), anti-HIV (Kosela, 2000; Rukachaisirikul, 2003d), anti-inflammatory (Ilyas, 1994; Chairungsrilerd, 1996; Peres, 2000; Weng, 2003a, b, 2004), antiimmunosuppressive (Ilyas, 1994; Parveen, 1991), antimalarial (Hay, 2004b; Kosela, 2000), antiprotozoal (Sani, 1996), antiulcer (Saito, 1999) and cytotoxic (Vieira, 2004a; Williams, 2003; Ho, 2002; Wu, 2002; Thoison, 2000; Xu, 2000; Cao, 1998a, b; Asano, 1996) activities.

According to information from NAPRALERT database, developed by University of Illinois at Chicago and Chemical Abstracts in the year 2004, chemical constituents isolated from 64 species of the genus *Garcinia* were reported. The continuing search using SciFinder database revealed additional chemical constituents which were summarized in **Table 1**.

Table 1 Compounds from *Garcinia* species

Scientific name	**Investigation part**	**Compound**	**Structure**	**Reference**
G. assigu	Stem bark	isogarcinol 13-*O*-methyl ether	1a	Ito, *et al.*, 2003a
		garcinol 13-*O*-methyl ether	1c	
		isogarcinol	1b	
		garcinol	1d	
		clusianone	1i	
		maclurin	1m	
G. atroviridis	Roots	4-methylhydroatrovirinone	6a	Permana, *et al*., 2003
		morelloflavone	2a	
		morelloflavone7-*O*-β-D-	2b	

Scientific name	Investigation part	Compound	Structure	Reference
		glucopyranoside		
		fukugiside	2c	
		14-*cis*-docosenoic acid	10f	
G. cowa	Stem Bark	(2*E*,6*E*,10*E*)-(+)-4β-(OH)-3-methyl-5β-(3,7,11,15-tetramethylhexadeca-2,6,10,14-tetraenyl)-cyclohex-2-en-1-one	10a	Wahyuni, *et al*., 2004
		4-(1,1-dimethylprop-2-enyl)-1,5,6-tri(OH)-3-(OMe)-2-(3-methylbut-2-enyl)xanthen-9(9H)-one	9.3m	
		rubraxanthone	9.3a	
G. cuneifolia	Stem bark	cuneifolin	9.3ff	Ee, *et al*., 2003
G. dulcis	Fruits	linalool	10d	Pino, *et al*., 2003
		α-terpineol	10g	
		hexadecanoic acid	10e	
G. fusca	Stem bark	fuscaxanthone A	9.3tt	Ito, *et al*., 2003b
		fuscaxanthone B	9.3uu	
		fuscaxanthone C	9.3b	
		fuscaxanthone D	9.3c	
		fuscaxanthone E	9.2e	
		fuscaxanthone F	9.2f	
		fuscaxanthone G	9.3vv	
		fuscaxanthone H	9.3d	
		cowaxanthone	9.3e	
		β-mangostin	9.3k	

Scientific name	Investigation part	Compound	Structure	Reference
		cowanin	9.3f	
		rubraxanthone	9.3a	
		α-mangostin	9.3j	
		cowanol	9.3g	
		norcowanin	9.3h	
		7-*O*-methylgarcinone	9.3t	
		garbogiol	9.3ss	
G. indica	Stem bark	xanthochymol	1e	Lakshmi,
		isoxanthochymol	1f	*et al*., 2002
	Fruits	garcinol	1d	Sang, *et al*., 2002
G. intermedia	Leaves	guttiferone A	1g	Abe, *et al*.,
		8-desoxygartanin	9.2o	2004
		podocarpusflavone A	2h	
		amentoflavone	2i	
		friedelin	7v	
G. kola	Seeds	3″,3‴,4′,5,5″,7,7″-hepta-(OH)-4‴-(OMe)-3,8″-biflavanone	2d	Okunji, *et al*., 2002
		3″,4′,4‴,5,5″,7,7″-hepta-(OH)-3,8″-biflavanone	2e	
		7″-*O*-α-D-glucopyranosyl-oxy-3″,4′,4‴,5,5″,7-hexa-(OH)-3,8″-biflavanone	2f	
		3″,3‴,4′,4‴,5,5″,7,7‴-octa-(OH)-3,8″-biflavanone	2g	
G. linii	Roots	linixanthone A	9.4d	Chen,
		linixanthone B	9.2jj	*et al*., 2004
		linixanthone C	9.2aa	

Scientific name	Investigation part	Compound	Structure	Reference
		garcibiphenyl A	3a	
		garcibiphenyl B	3b	
		garcibenzopyran	10i	
		10-*O*-methylmaclura-xanthone	9.3kk	
		rheediachromenoxanthone	9.2ii	
		globulixanthone D	9.2bb	
		1,6-di(OH)-5,7-di(OMe)-xanthone	9.3yy	
		1,5-di(OH)xanthone	9.1a	
		1,5-di(OH)-3-(OMe)-xanthone	9.2cc	
		1,6-di(OH)-3,5-di(OMe)-xanthone	9.2dd	
		1,6-di(OH)-3,5,7-tri(OMe)-xanthone	9.4e	
		1,6-di(OH)-5-(OMe)-xanthone	9.2ee	
		1,6-di(OH)-7-(OMe)-xanthone	9.2ff	
		1,7-di(OH)xanthone	9.1c	
		5-(OH)-1-(OMe)xanthone	9.1d	
		aucuparin	3c	
G. macrophylla	Twigs	guttiferone A	1g	Williams, *et al*., 2003
		guttiferone G	1h	
		friedelin	7v	
G. mangostana	Fruits	8-desoxygartanin	9.2o	Ho, *et al*., 2002
		gartanin	9.3gg	
		garcinone E	9.3u	

Scientific name	Investigation part	Compound	Structure	Reference
		tovophyllin A	9.3rr	
		α-mangostin	9.3j	
		γ-mangostin	9.3l	
		garcinone D	9.3i	Suksamrarn,
		γ-mangostin	9.3l	*et al*., 2003
		mangostanin	9.3xx	
		1,7-di(OH)-2-(3-methylbut-2-enyl)-3-(OMe)xanthone	9.2g	
		demethylcalabaxanthone	9.2uu	
G. merguensis	Bark	merguenone	9.2v	Nguyen,
		1,5-di(OH)-6′-methyl-6′-(4-methyl-3-pentenyl)-pyrano(2′,3′:3,2)xanthone	9.2oo	*et al*., 2003
		subelliptenone H	9.3ll	
		8-desoxygartanin	9.2o	
		rheediaxanthone A	9.3qq	
		morusignin G	9.2rr	
		6-deoxyjacareubin	9.2k	
		1,3,5-tri(OH)-4,8-di(3-methylbut-2-enyl)xanthone	9.2p	
		rheediachromenoxanthone	9.2ii	
		6-deoxyisojacareubin	9.2u	
G. multiflora	Stem	garcinianone A	9.2ss	Chiang,
		garcinianone B	9.2tt	*et al*., 2003
		4,6,4′-tri(OH)-2,3′-di(OMe)-3-prenyl-benzophenone	1j	
		6,3′-di(OH)-2,4-di(OMe)-benzophenone	1k	

Scientific name	Investigation part	Compound	Structure	Reference
		4,6,3′,4′-tetra(OH)-2-(OMe) benzophenone	1l	
		maclurin	1m	
		2,4,6,3′-tetra(OH)-benzophenone	1n	
		a mixture of (1*E*,22*Z*)-1,22-diferuloyloxydocosane and (1*E*,24*Z*)-1,24-diferuloyloxytetracosane	10c	
		1,6-di(OH)-3,5,7-tri(OMe)xanthone	9.4e	
		naringenin	4e	
G. nervosa	Leaves	I-3,II-3,I-5,II-5,I-7,II-7, I-4′,II-4′-octa(OH)-[I-2′,II-2′]biflavone	2j	Parveen, *et al*., 2004
		2,4-di(OMe)-6-(OH) acetophenone	10h	
		quercetin	4a	
		apigenin	4b	
G. nigrolineata	Stem bark	nigrolineaxanthone A	9.2a	Rukachai-sirikul, *et al*., 2003a
		nigrolineaxanthone B	9.3w	
		nigrolineaxanthone C	9.2b	
		nigrolineaxanthone D	9.2d	
		nigrolineaxanthone E	9.3m	
		nigrolineaxanthone F	9.2nn	
		nigrolineaxanthone G	9.3oo	
		nigrolineaxanthone H	9.2ll	
		nigrolineaxanthone I	9.3mm	
		1,3,5-tri(OH)-4-(3-(OH)-3-	9.2c	

Scientific name	Investigation part	Compound	Structure	Reference
		methylbutyl)xanthone		
		latisxanthone D	9.3x	
		1,3,7-tri(OH)-2-(3-(OH)-3-methylbutyl)xanthone	9.2h	
		6-deoxyisojacreubin	9.2u	
		morusignin C	9.3pp	
		1,5-di(OH)-6′,6′-dimethyl-pyrano[2′,3′:3,2]xanthone	9.2k	
		tovoxanthone	9.2mm	
		rheediaxanthone A	9.3qq	
		brasillixanthone	9.3nn	
	Leaves	nigrolineaxanthone J	9.2r	Rukachai-sirikul, *et al*., 2003c
		nigrolineaxanthone K	9.2i	
		nigrolineaxanthone L	9.2s	
		nigrolineaxanthone M	9.2j	
		nigrolineaxanthone N	9.2l	
		nigrolineaxanthone O	9.2m	
		nigrolineaxanthone P	9.2n	
		nigrolineaxanthone Q	9.2qq	
		nigrolineaxanthone R	9.2t	
		nigrolineaxanthone S	9.2pp	
		nigrolineaquinone A	6b	
		nigrolineaisoflavone A	4c	
		friedelin	7v	
		8-desoxygartanin	9.2o	
		ananixanthone	9.2w	
		1,5-di(OH)-3-(OMe)-2-(3-methylbut-2-enyl)xanthone	9.2hh	
		1,7-di(OH)-3-(OMe)-2-(3-	9.2g	

Scientific name	Investigation part	Compound	Structure	Reference
		methylbut-2-enyl)xanthone		
G. parvifolia	Bark	rubraxanthone	9.3a	Jantan,
		isocowanol	9.3v	*et al*., 2002
G. porrecta	Stem bark	dulxanthone E	9.4a	Sherley,
		dulxanthone F	9.4b	*et al*., 2004
		dulxanthone G	9.4c	
G. scortechinii	Latex	scortechinone A	9.5a	Rukachaisi-
		scortechinone B	9.5b	rikul,
		scortechinone D	9.5c	*et al*., 2003b
		scortechinone E	9.5d	
		scortechinone F	9.5e	
		scortechinone G	9.5f	
		scortechinone H	9.5g	
		scortechinone I	9.5k	
		scortechinone J	9.5n	
		scortechinone K	9.5o	
G. scortechinii	Stem bark	scortechinone A	9.5a	Rukachaisi-
		scortechinone B	9.5b	rikul,
		scortechinone D	9.5c	*et al*., 2005
		scortechinone F	9.5d	
		scortechinone I	9.5k	
		scortechinone J	9.5n	
		scortechinone L	9.5h	
		scortechinone M	9.5i	
		scortechinone N	9.5j	
		scortechinone O	9.5l	
		scortechinone P	9.5m	
		4″,5″-dihydro-1,5-di(OH)-6′,6′-dimethylpyrano-	9.3hh	

Scientific name	Investigation part	Compound	Structure	Reference
		(2′,3′:6,7)-4″,4″,5″-trimethyl-furano(2″,3″:3,4)xanthone		
		stigmasterol	10j	
G. speciosa	Trunk bark and Stem	garciosaterpene A	7s	Rukachaisi-rikul, *et al*., 2003d
		garciosaterpene B	7t	
		garciosaterpene C	7u	
		garciosaphenone A	1p	
		8-desoxygartanin	9.2o	
		(-)-epicatechin	4d	
		stigmasterol	10j	
		a mixture of achilleol A and achilleol C	10b	
	Bark	methyl (24*E*)-3α,23α(=R)-di(OH)-17,14-friedolano-stan-8,14,24-trien-26-oate	7g	Vieira, *et al*., 2004a
		methyl (24*E*)-3α,16α,-23α(=6*R*,23*R*)-epoxy-17,14-friedolan-8,14,24-trien-26-oate	7h	
		methyl (24*E*)-3α,23α-di-(OH)-8α,9α-epoxy-15-oxo-17,14-friedolanostan-24-en-26-oate	7i	
		methyl (24*E*)-3α,23α-di-(OH)-15-oxo-17,15-friedolanostan-8(14),24-dien-26-oate	7j	
		25*R*-3β-(OH)-23-oxo-9,16-lanostandien-26-oic acid	7l	

Scientific name	Investigation part	Compound	Structure	Reference
		methyl (25*R*)-3β-(OH)-23-oxo-9,16-lanostandien-26-oate	7m	
		(25*R*)-3α-(OH)-23-oxo-9,16-lanostandien-26-oic acid	7n	
		3β,9α-di(OH)lanost-24-en-26-ol	7k	
		methyl (24*E*)-9α,23α-di-(OH)-3,15-dioxo-17,15-friedolanostan-8(14),24-dien-26-oate	7o	Vieira, *et al*., 2004b
		14β,15β-epoxy-3β-(OH)-9-oxo-11(10→8)-abeolanosta-22-*cis*,24-*trans*-diene-26-oic acid	7p	
		14β,15β-epoxy-3β-(OH)-9-oxo-11(10→8)-abeolanosta-24-*trans*-en-26-oic acid	7q	
		14β,15β-epoxy-3α-(OH)-9-oxo-11(10→8)-abeolanosta-24-*trans*-en-26-oic acid	7r	
G. subelliptica	Seeds	garcinielliptone A	5a	Weng, *et al*., 2003a
		garcinielliptone B	5b	
		garcinielliptone C	5c	
		garcinielliptone D	5d	
		garcinielliptone E	7a	

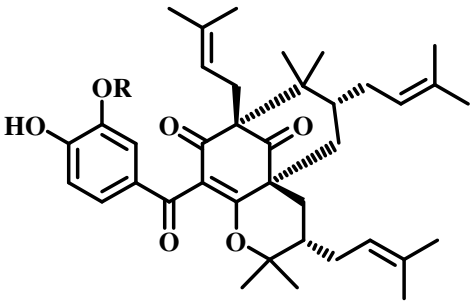
Scientific name	Investigation part	Compound	Structure	Reference
		garsubellin A	5e	
		garcinielliptin oxide	7f	
		garsubellin D	5f	
		garcinielliptone F	5g	Weng,
		garcinielliptone G	7b	*et al*., 2003b
		garcinielliptone H	5h	
		garcinielliptone I	5i	
		garcinielliptone J	7c	
	Stem bark	garciniaxanthone A	9.2x	Abe, *et al*.,
		garciniaxanthone B	9.2kk	2003
		garciniaxanthone E	9.3o	
		subelliptenone A	9.3z	
		subelliptenone B	9.3dd	
		subelliptenone H	9.3ll	
		4-(OH)brasilixanthone B	9.4f	
		1,3,5,6-tetra(OH)-4,7,8-tri(3-methyl-2-butenyl)-xanthone	9.3n	
		1,4,5-tri(OH)-2-(1,1-dimethyl-2-propenyl)-xanthone	9.2y	
		fukugetin	2a	
	Seeds	garcinielliptone K	5j	Weng,
		garcinielliptone L	5k	*et al*., 2004
		garcinielliptone M	5l	
		garcinielliptone N	7d	
		garcinielliptone O	7e	
G. thorelii	Wood	macluraxanthone	9.3jj	Chanmaha-sathien,

Scientific name	Investigation part	Compound	Structure	Reference
				et al., 2004.
G. vieillardii	Stem bark	6-*O*-methyl-2-deprenyl-rheediaxanthone B	9.3cc	Hay, *et al*., 2004a
		vieillardixanthone	9.3p	
		forbexanthone	9.3y	
		buchanaxanthone	9.2gg	
		isocudraniaxanthone A	9.3q	
		5,7-di(OH)chromone	10k	
		1,6-di(OH)xanthone	9.1b	Hay, *et al*., 2004b
		pancixanthone A	9.2q	
		isocudraniaxanthone A	9.3q	
		isocudraniaxanthone B	9.3r	
		2-deprenylrheedia-xanthone B	9.3bb	
		1,4,5-tri(OH)xanthone	9.2z	
G. virgata	Stem bark	virgataxanthone A	9.3s	Merza, *et al*., 2004
		virgataxanthone B	9.3ii	
		5-formyl-δ-tocotrienol	8a	
		7-formyl-δ-tocotrienol	8b	
		δ-tocotrienol	8c	
		bis-xanthone-griffipavixanthone	9.6a	
		cotoin	1o	
G. xanthochymus	Wood	1,4,5,6-tetra(OH)-7,8-di-(3-methylbut-2-enyl)-xanthone	9.3aa	Chanmahas athien, *et al*., 2003a
		1,2,6-tri(OH)-5-(OMe)-7-(3-methylbut-2-enyl)-xanthone	9.3ee	

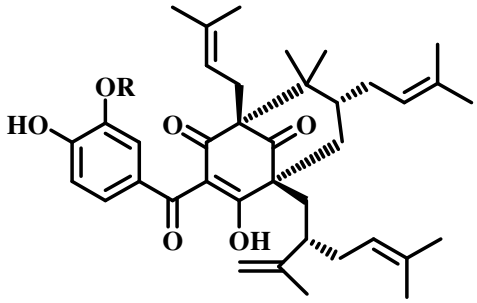
Scientific name	Investigation part	Compound	Structure	Reference
		12b-(OH)-des-D-garcigerrin A	9.2y	
		1,3,5,6-tetra(OH)-4,7,8-tri(3-methyl-2-butenyl)-xanthone	9.3n	Chanmahasathien, *et al*., 2003b
		garciniaxanthone E	9.3o	

Structures of Compounds Isolated from Plants of the genus *Garcinia*

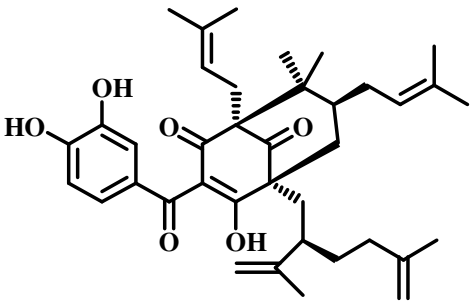
1. Benzophenones



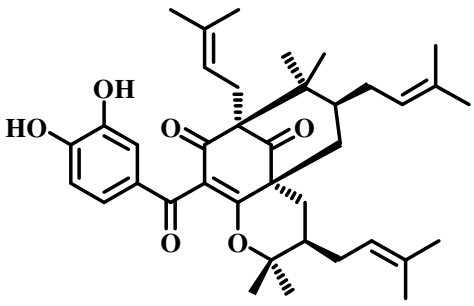
1a: R = Me : isogarcinol 13-*O*-methyl ether
1b: R = H : isogarcinol



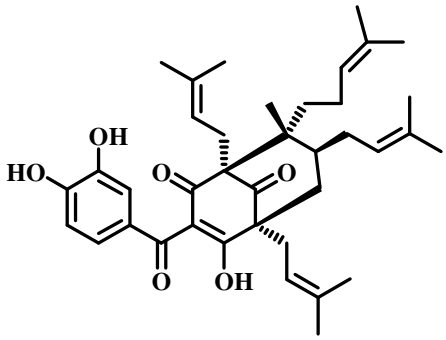
1c: R = Me : garcinol 13-*O*-methyl ether
1d: R = H : garcinol



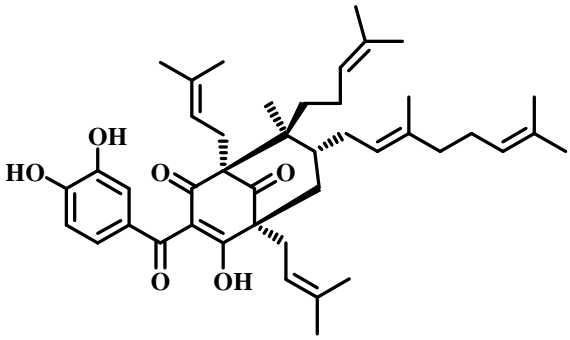
1e: xanthochymol



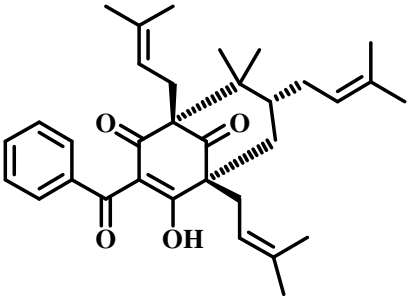
1f: isoxanthochymol



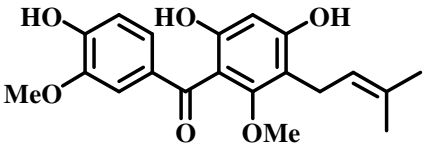
1g: guttiferone A



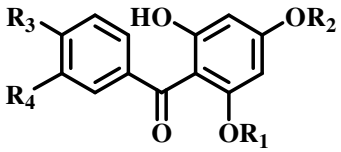
1h: guttiferone G



1i: clusianone



1j: 4,6,4′-tri(OH)-2,3′-di(OMe)-3-prenylbenzophenone



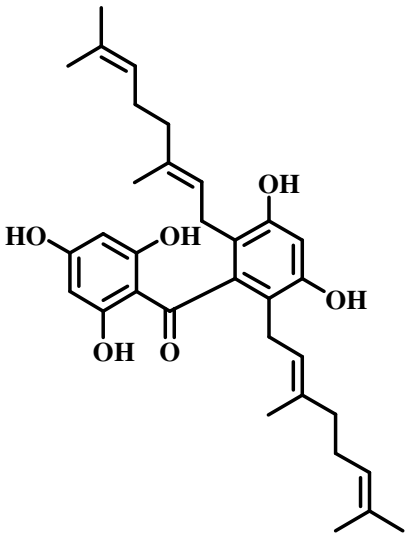
1k : $R_1 = R_2 = Me$, $R_3 = H$, $R_4 = OH$: 6,3′-di(OH)-2,4-di(OMe)benzophenone

1l : $R_1 = Me$, $R_2 = H$, $R_3 = R_4 = OH$: 4,6,3′,4′-tetra(OH)-2-(OMe)benzophenone

1m : $R_1 = R_2 = H$, $R_3 = R_4 = OH$: maclurin

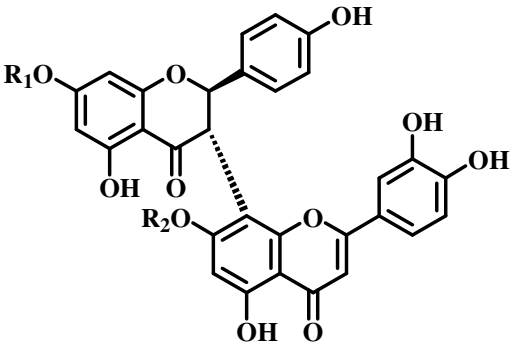
1n : $R_1 = R_2 = R_3 = H$, $R_4 = OH$: 2,4,6,3′-tetra(OH)benzophenone

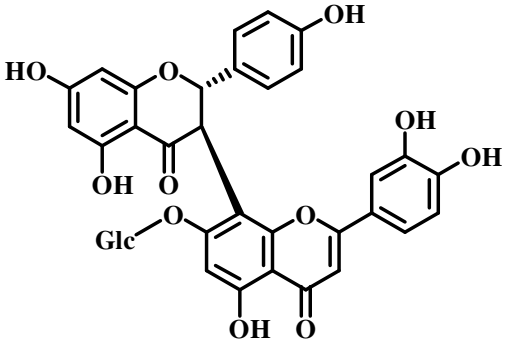
1o : $R_1 = R_3 = R_4 = H$, $R_2 = Me$: cotoin



1p: garciosaphenone A

2. Biflavonoids

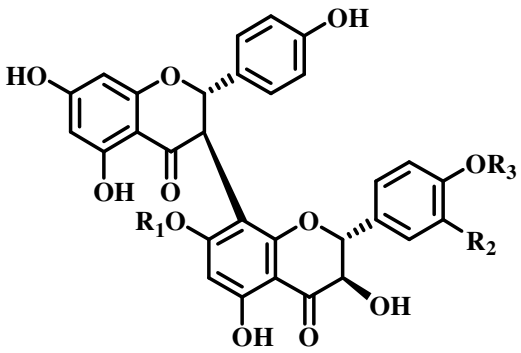




2a: $R_1 = R_2 = H$: morelloflavone (fukugetin)

2b: R_1 = Glc, R_2 = OH : morelloflavone 7-*O*-β-D-glucopyranoside

2c: R_1 = OH, R_2 = Glc : fukugiside

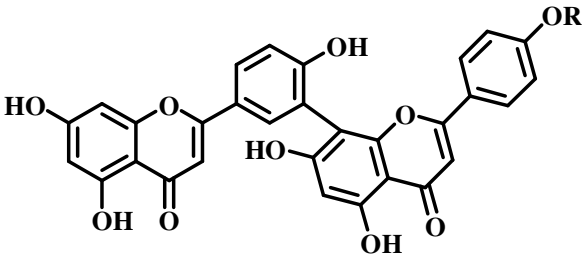


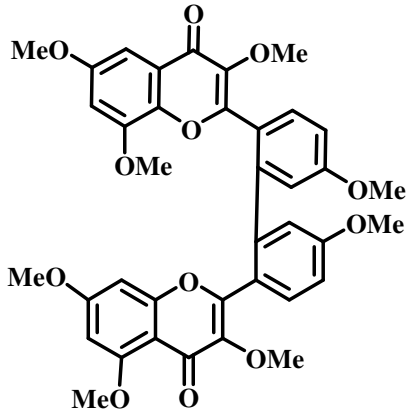
2d: $R_1 = R_2 = H$, $R_3 = Me$: 3″,3‴,4′,5,5″,7,7″-hepta(OH)-4‴-(OMe)-3,8″-biflavanone

2e: $R_1 = R_2 = R_3 = H$: 3″,4′,4‴,5,5″,7,7″-hepta(OH)-3,8″-biflavanone

2f: R_1 = Glc, $R_2 = R_3 = H$: 7″-*O*-α-D-glucopyranosyloxy-3″,4′,4‴,5,5″,7-hexa(OH)-3,8″-biflavanone

2g: $R_1 = H$, R_2 = OH, $R_3 = H$: 3″,3‴,4′,4‴,5,5″,7,7‴-octa(OH)-3,8"-biflavanone



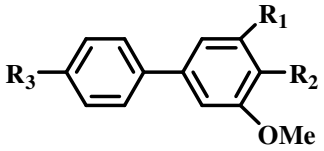


2h: R = Me : podocarpusflavone A

2i : R = H : amentoflavone

2j : I-3,II-3,I-5,II-5,I-7,II-7,I-4′,II-4′-octa(OH)-[I-2′,II-2′]biflavone

3. Biphenyls

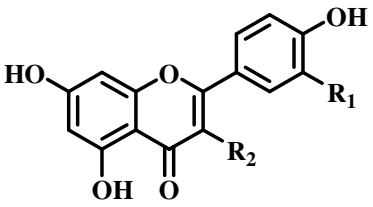


3a: $R_1 = R_3$ = OH, $R_2 = H$: garcibiphenyl A

3b: $R_1 = R_3$ = OH, $R_2 = CH_2CH{=}C(CH_3)_2$: garcibiphenyl B

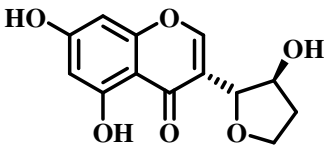
3c: R_1 = OMe, R_2 = OH, $R_3 = H$: aucuparin

4. Flavonoids

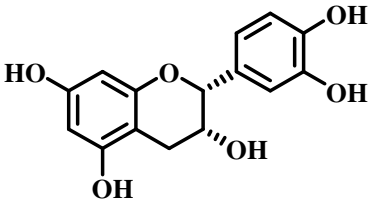


4a: $R_1 = R_2 = OH$: quercetin

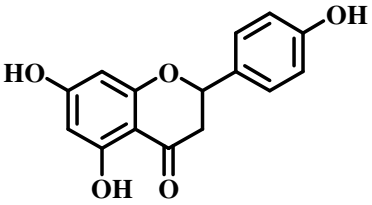
4b: $R_1 = R_2 = H$: apigenin



4c: nigrolineaisoflavone A

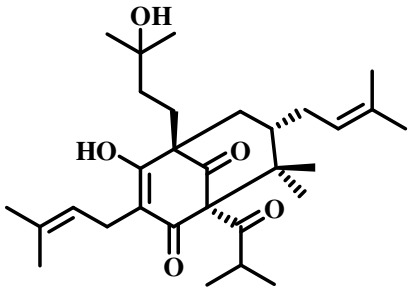


4d: (-)-epicatechin

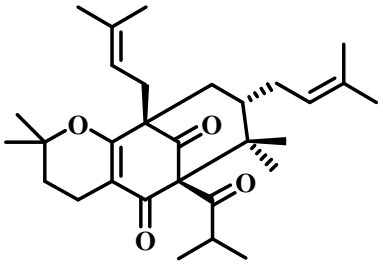


4e: naringenin

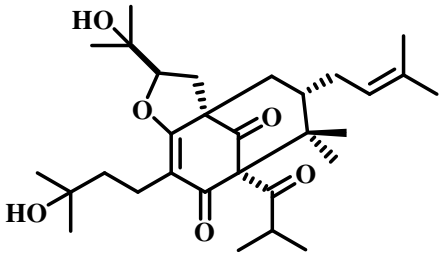
5. Phloroglucinol derivatives



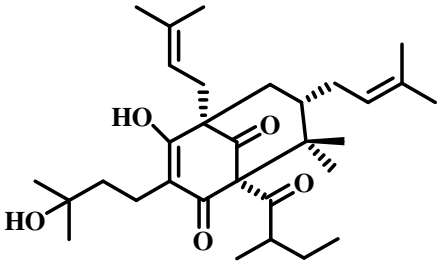
5a: garcinielliptone A



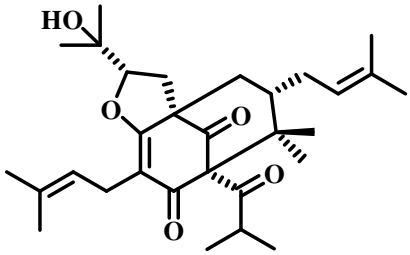
5b: garcinielliptone B



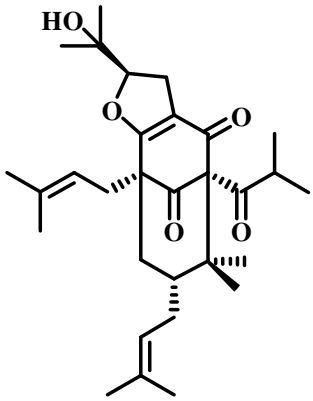
5c: garcinielliptone C



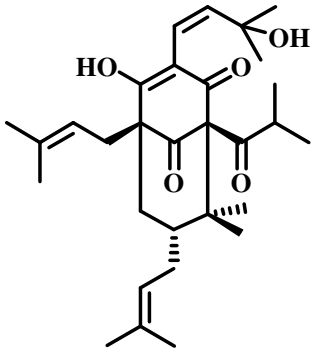
5d: garcinielliptone D



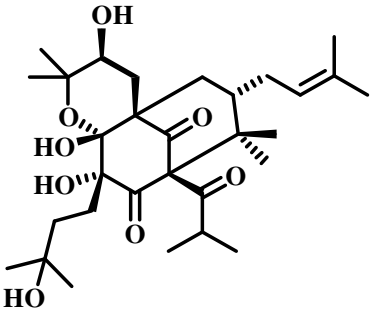
5e: garsubellin A



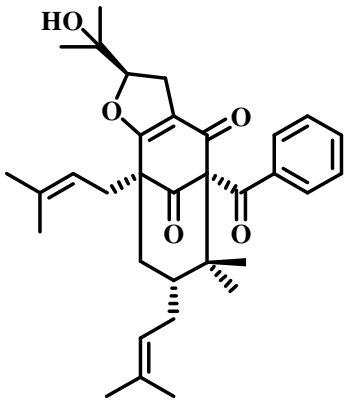
5f: garsubellin D



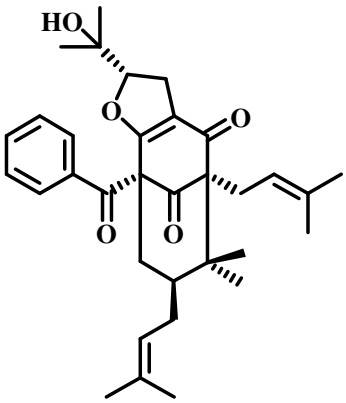
5g: garcinielliptone F



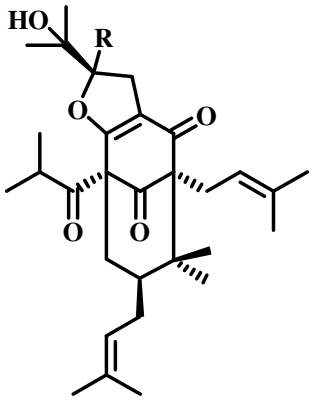
5h: garcinielliptone H



5i: garcinielliptone I

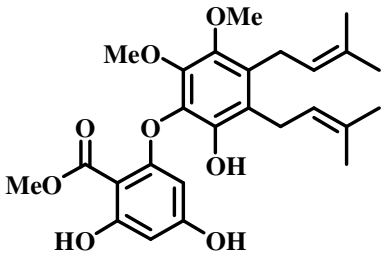


5j: garcinielliptone K

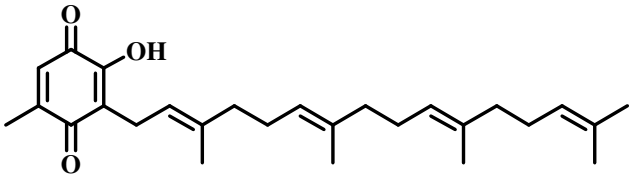


5k: R = H (α) : garcinielliptone L
5l : R = H (β) : garcinielliptone M

6. Quinone and hydroquinone

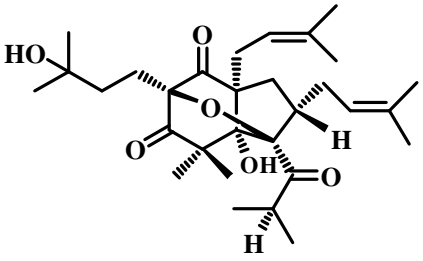


6a: 4-methylhydroatrovirinone

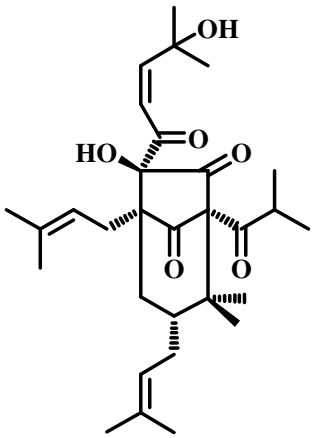


6b: nigrolineaquinone A

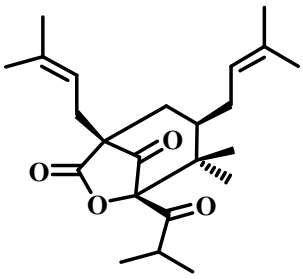
7. Terpenoids and triterpenes



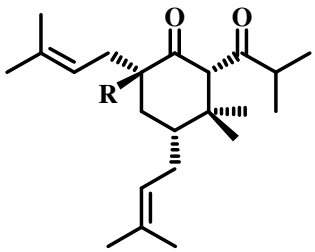
7a: garcinielliptone E



7b: garcinielliptone G

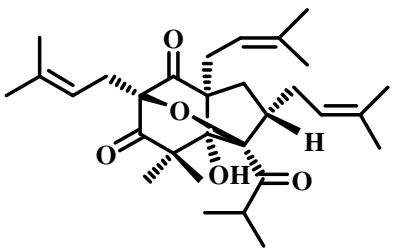


7c: garcinielliptone J

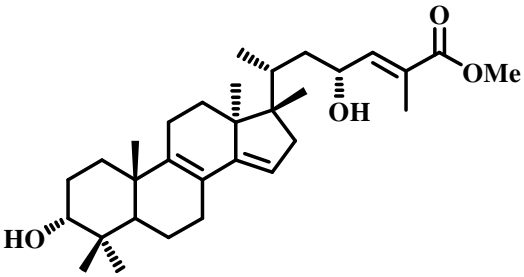


7d: R = H : garcinielliptone N

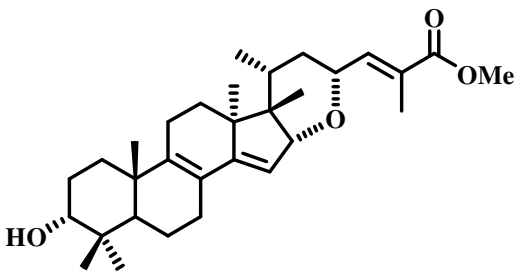
7e: R = COOMe : garcinielliptone O



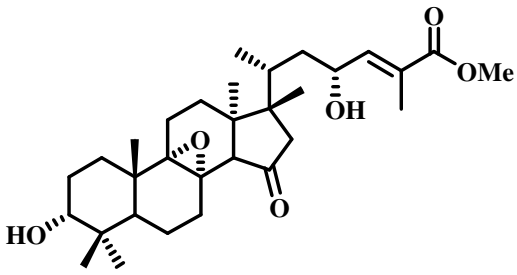
7f: garcinielliptin oxide



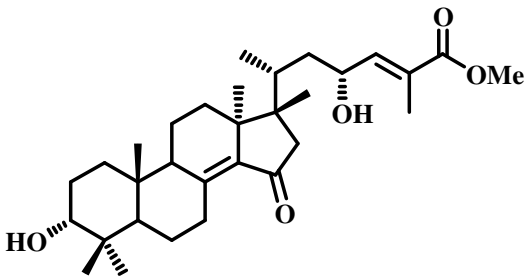
7g: methyl (24*E*)-3α,23α(=R)-di(OH)-17,14-friedolanostan-8,14,24-trien-26-oate



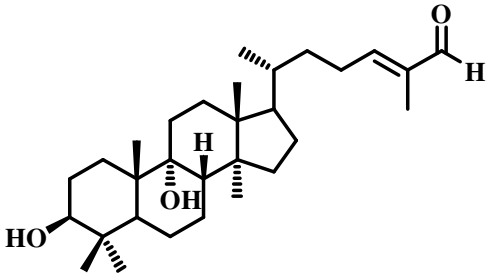
7h: methyl (24*E*)-3α,16α,23α(=6*R*,23*R*)-epoxy-17,14-friedolan-8,14,24-trien-26-oate



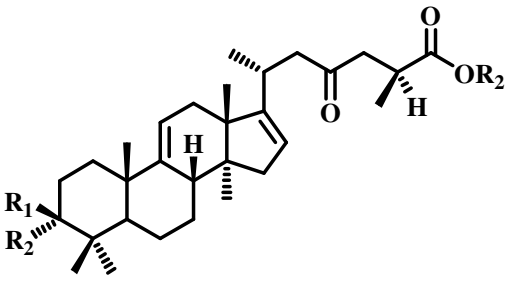
7i: methyl (24*E*)-3α,23α-di(OH)-8α,9α-epoxy-15-oxo-17,14-friedolanostan-24-en-26-oate



7j: methyl (24*E*)-3α,23α-di(OH)-15-oxo-17,15-friedolanostan-8(14),24-dien-26-oate



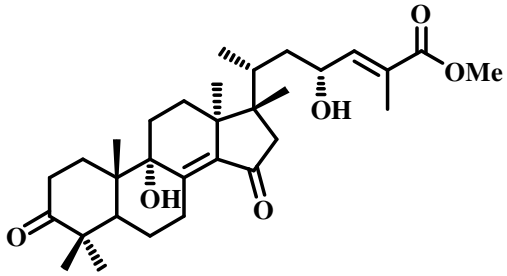
7k: 3β,9α-di(OH)lanost-24-en-26-ol



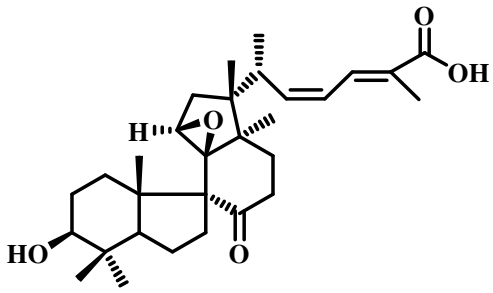
7l: R_1 = OH, R_2 = R_3 = H : (25*R*)-3β-(OH)-23-oxo-9,16-lanostandien-26-oic acid

7m: R_1 = OH, R_2 = H, R_3 = Me : methyl (25*R*)-3β-(OH)-23-oxo-9,16-lanostandien-26-oate

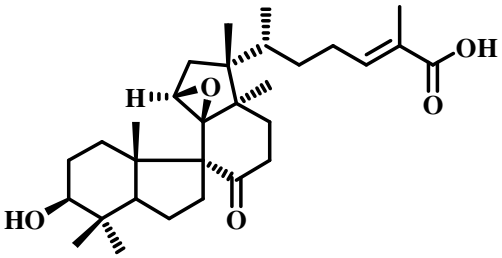
7n: R_1 = R_3 = H, R_2 = OH : (25*R*)-3α-(OH)-23-oxo-9,16-lanostandien-26-oic acid



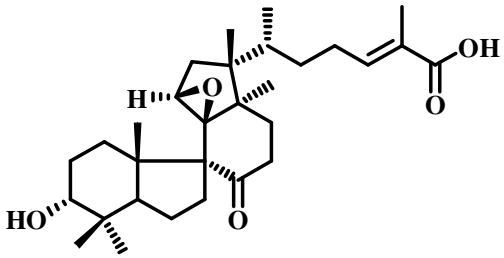
7o: methyl (24*E*)-9α,23α-di(OH)-3,15-dioxo-17,15-friedolanostan-8(14),-24-dien-26-oate



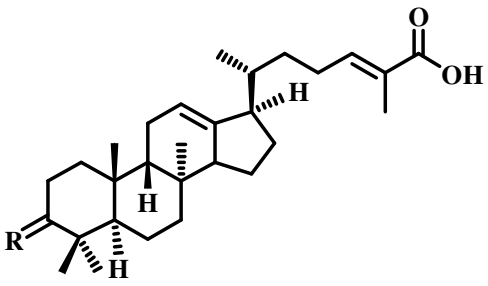
7p: 14β,15β-epoxy-3β-(OH)-9-oxo-11(10→8)-abeolanosta-22-*cis*,-24-*trans*-dien-26-oic acid



7q: 14β,15β-epoxy-3β-(OH)-9-oxo-11(10→8)-abeolanosta-24-*trans*-en-26-oic acid



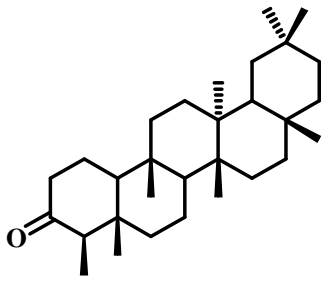
7r: 14β,15β-epoxy-3α-(OH)-9-oxo-11(10→8)-abeolanosta-24-*trans*-en-26-oic acid



7s: R = β-OCOMe, H : garciosaterpene A

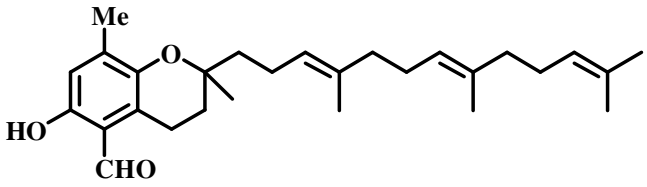
7t: R = β-OH, H : garciosaterpene B

7u: R = O : garciosaterpene C

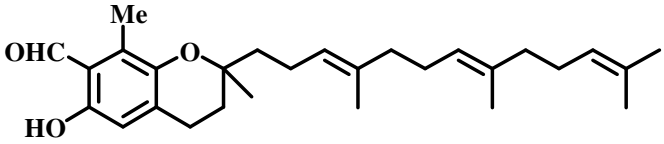


7v: friedelin

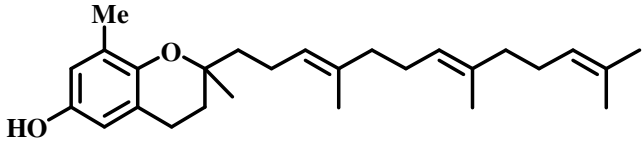
8. **δ-Tocotrienols**



8a: 5-formyl-δ-tocotrienol



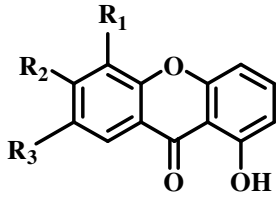
8b: 7-formyl-δ-tocotrienol



8c: δ-tocotrienol

9. Xanthones

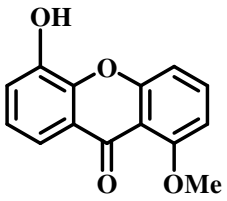
9.1 Dioxygenated xanthone



9.1a: R_1 = OH, R_2 = R_3 = H : 1,5-di(OH)xanthone

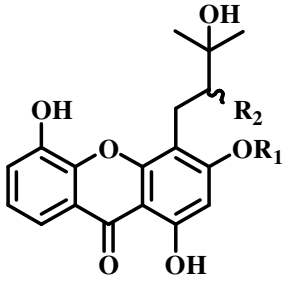
9.1b: R_1 = R_3 = H, R_2 = OH : 1,6-di(OH)xanthone

9.1c: R_1 = R_2 = H, R_3 = OH : 1,7-di(OH)xanthone



9.1d: 5-(OH)-1-(OMe)xanthone

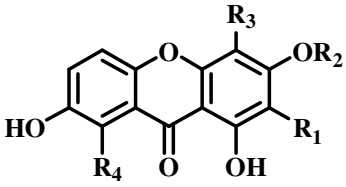
9.2 Trioxygenated xanthones

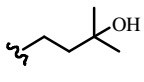


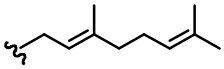
9.2a: R_1 = Me, R_2 = H : nigrolineaxanthone A

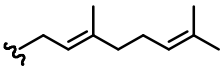
9.2b: R_1 = Me, R_2 = OH : nigrolineaxanthone C

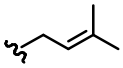
9.2c: R_1 = R_2 = H : 1,3,5-tri(OH)-4-(3-(OH)-3-methylbutyl)xanthone

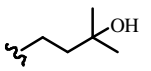


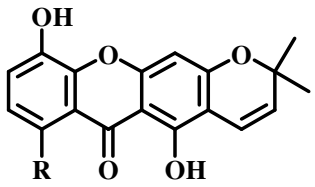
9.2d: R_1 = R_2 = R_3 = H, R_4 =  : nigrolineaxanthone D

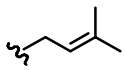
9.2e: R_1 = R_2 = R_4 = H, R_3 =  : fuscaxanthone E

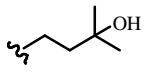
9.2f: R_1 = R_2 = R_3 = H, R_4 =  : fuscaxanthone F

9.2g: R_1 =  , R_2 = Me, R_3 = R_4 = H : 1,7-di(OH)-3-(OMe)-2-(3-methylbut-2-enyl)xanthone

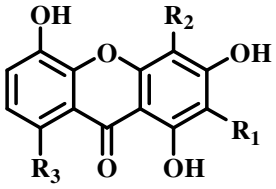
9.2h: R_1 =  , R_2 = R_3 = R_4 = H : 1,3,7-tri(OH)-2-(3-(OH)-3-methylbutyl)xanthone

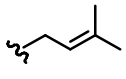
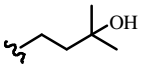


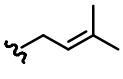
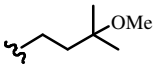
9.2i: R =  : nigrolineaxanthone K

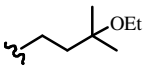
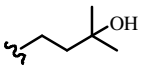
9.2j: R =  : nigrolineaxanthone M

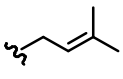
9.2k: R = H : 6-deoxyjacareubin

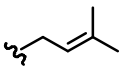


9.2l: R_1 =  , R_2 = H, R_3 =  : nigrolineaxanthone N

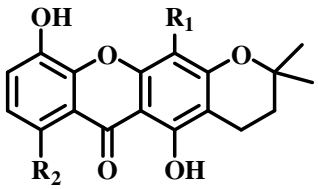
9.2m: R_1 =  , R_2 = H, R_3 =  : nigrolineaxanthone O

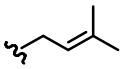
9.2n: R_1 =  , R_2 = H, R_3 =  : nigrolineaxanthone P

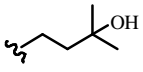
9.2o: $R_1 = R_2$ =  , R_3 = H : 8-desoxygartanin

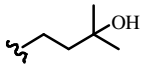
9.2p: R_1 = H, $R_2 = R_3$ =  : 1,3,5-tri(OH)-4,8-di(3-methylbut-2-enyl)xanthone

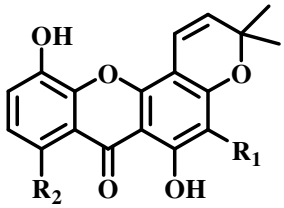
9.2q: $R_1 = R_3$ = H, R_2 =  : pancixanthone A



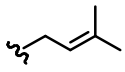
9.2r: R_1 = H, R_2 =  : nigrolineaxanthone J

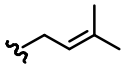
9.2s: R_1 = H, R_2 =  : nigrolineaxanthone L

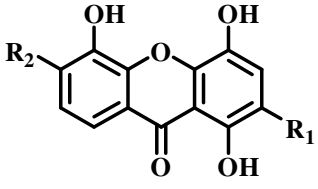
9.2t: R_1 =  , R_2 = H : nigrolineaxanthone R

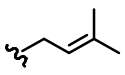


9.2u: R_1 = R_2 = H : 6-deoxyisojacareubin

9.2v: R_1 = H, R_2 =  : merguenone

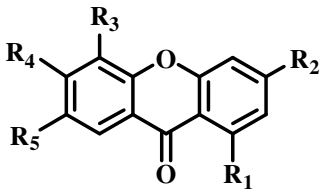
9.2w: R_1 =  , R_2 = H : ananixanthone

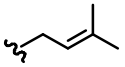


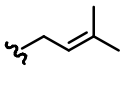
9.2x: R_1 =  , R_2 =  : garciniaxanthone A

9.2y: R_1 =  , R_2 = H : 12b-(OH)-des-D-garcigerrin A [1,4,5-tri(OH)-2-(1,1-dimethyl-2-propenyl)xanthone

9.2z: R_1 = R_2 = H : 1,4,5-tri(OH)xanthone



9.2aa: R_1 = OH, R_2 = H, R_3 = R_4 = OMe, R_5 =  : linixanthone C

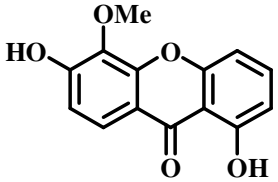
9.2bb: R_1 = R_4 = OH, R_2 = H, R_3 = OMe, R_5 =  : globulixanthone D

9.2cc: R_1 = R_3 = OH, R_2 = OMe, R_4 = R_5 = H : 1,5-di(OH)-3-(OMe)xanthone

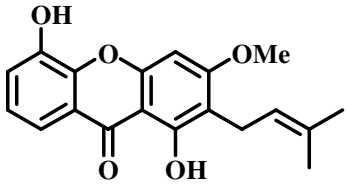
9.2dd: R_1 = R_4 = OH, R_2 = R_3 = OMe, R_5 = H : 1,6-di(OH)-3,5-di(OMe)xanthone

9.2ee: R_1 = R_4 = OH, R_2 = R_5 = H, R_3 = OMe : 1,6-di(OH)-5-(OMe)xanthone

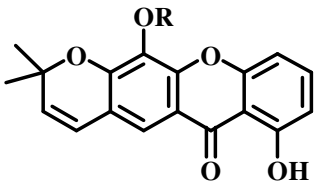
9.2ff: R_1 = R_4 = OH, R_2 = R_3 = H, R_5 = OMe : 1,6-di(OH)-7-(OMe)xanthone



9.2gg: buchanaxanthone

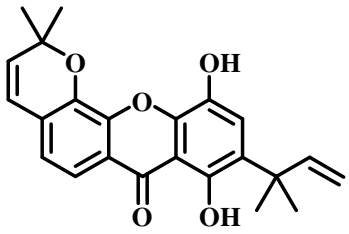


9.2hh: 1,5-di(OH)-3-(OMe)-2-(3-methylbut-2-enyl)-xanthone

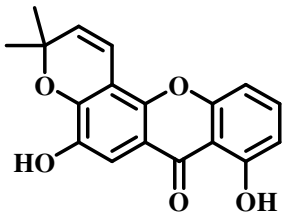


9.2ii: R = H : rheediachromenoxanthone

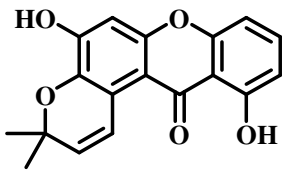
9.2jj: R = Me : linixanthone B



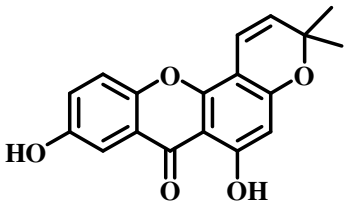
9.2kk: garciniaxanthone B



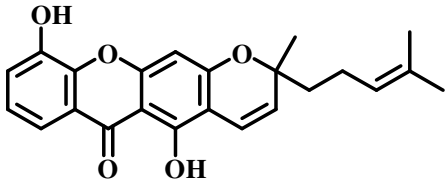
9.2ll: nigrolineaxanthone H



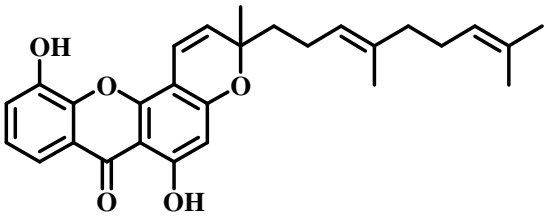
9.2mm: tovoxanthone



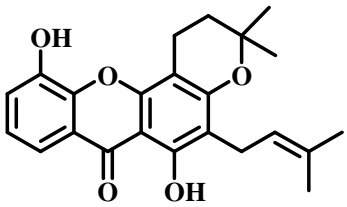
9.2nn: nigrolineaxanthone F



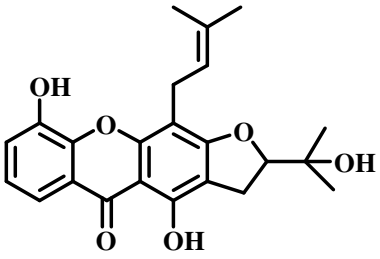
9.2oo: 1,5-di(OH)-6′-methyl-6′-(4-methyl-3-pentenyl)pyrano(2′,3′:-3,2)xanthone



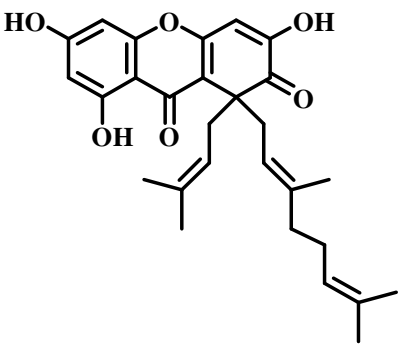
9.2pp: nigrolineaxanthone S



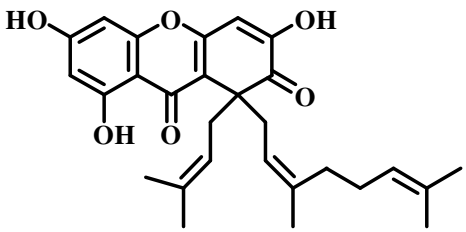
9.2qq: nigrolineaxanthone Q



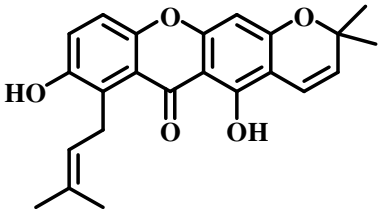
9.2rr: morusignin G



9.2ss: garcinianone A

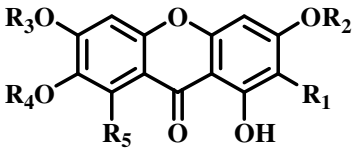


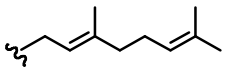
9.2tt: garcinianone B

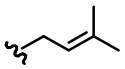


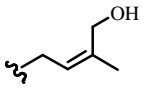
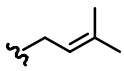
9.2uu: demethylcalabaxanthone

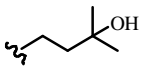
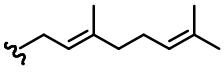
9.3 Tetraoxygenated xanthones



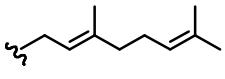
9.3a: $R_1 = R_2 = R_3 = H$, $R_4 = Me$, $R_5 =$  : rubraxanthone

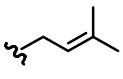
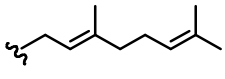
9.3b: $R_1 = R_5 =$  , $R_2 = R_3 = R_4 = Me$: fuscaxanthone C

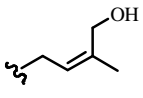
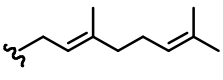
9.3c: $R_1 =$  , $R_2 = R_4 = Me$, $R_3 = H$, $R_5 =$  ,: fuscaxanthone D

9.3d: $R_1 =$  , $R_2 = R_3 = H$, $R_4 = Me$, $R_5 =$ 

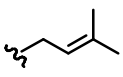
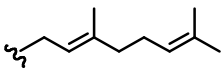
: fuscaxanthone H

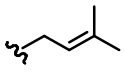
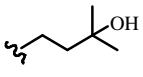
9.3e: $R_1 =$  , $R_2 = R_3 = R_5 = H$, $R_4 = Me$: cowaxanthone

9.3f: $R_1 =$  , $R_2 = R_3 = H$, $R_4 = Me$, $R_5 =$  : cowanin

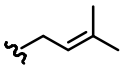
9.3g: $R_1 =$  , $R_2 = R_3 = H$, $R_4 = Me$, $R_5 =$  :

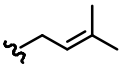
cowanol

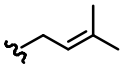
9.3h: $R_1 =$  , $R_2 = R_3 = R_4 = H$, $R_5 =$  : norcowanin

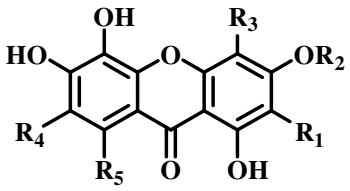
9.3i: R_1 =  , $R_2 = R_3 = H$, $R_4 = Me$, R_5 = 

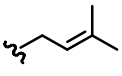
: garcinone D

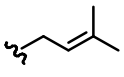
9.3j: $R_1 = R_5$ =  , $R_2 = R_3 = H$, $R_4 = Me$: α-mangostin

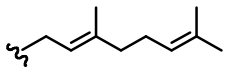
9.3k: $R_1 = R_5$ =  , $R_2 = R_4 = Me$, $R_3 = H$: β-mangostin

9.3l: $R_1 = R_5$ =  , $R_2 = R_3 = R_4 = H$: γ-mangostin



9.3m: R_1 =  , R_2 = Me, R_3 =  , $R_4 = R_5 = H$:
nigrolineaxanthone E [4-(1,1-dimethylprop-2-enyl)-1,5,6-tri(OH)-3-(OMe)-2-(3-methylbut-2-enyl)xanthen-9(9H)-one]

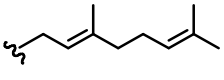
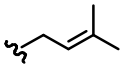
9.3n: $R_1 = R_2 = H$, $R_3 = R_4 = R_5$ =  : isogarciniaxanthone E [1,3,5,6-tetra(OH)-4,7,8-tri(3-methyl-2-butenyl)xanthone]

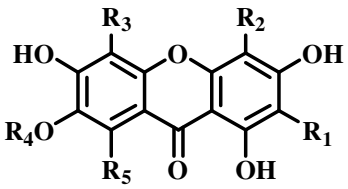
9.3o: $R_1 = R_2 = R_3 = H$, R_4 =  , R_5 = : garciniaxanthone E

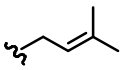
9.3p: $R_1 = R_4 = R_5 = H$, $R_2 = Me$, R_3 =  : vieillardixanthone

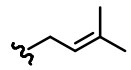
9.3q: $R_1 = R_2 = R_4 = R_5 = H$, R_3 =  : isocudraniaxanthone A

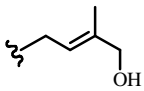
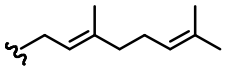
9.3r: $R_1 = R_4 = R_5 = H$, $R_2 = Me$, R_3 =  : isocudraniaxanthone B

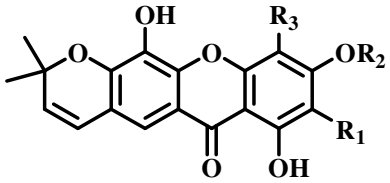
9.3s: $R_1 = R_2 = R_4 = H$, R_3 =  , R_5 =  :
virgaxanthone A

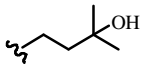


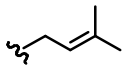
9.3t: $R_1 = R_3 = R_5 =$  , $R_2 = H$, $R_4 = Me$: 7-*O*-methylgarcinone

9.3u: $R_1 = R_3 = R_5 =$  , $R_2 = R_4 = H$: garcinone E

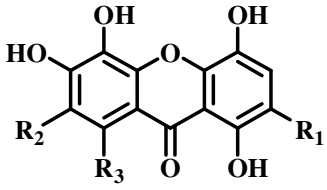
9.3v: $R_1 = R_3 = H$, $R_2 =$  , $R_4 = Me$, $R_5 =$  :
isocowanol

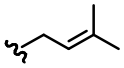


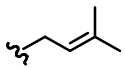
9.3w: $R_1 = H$, $R_2 = Me$, $R_3 =$  : nigrolineaxanthone B

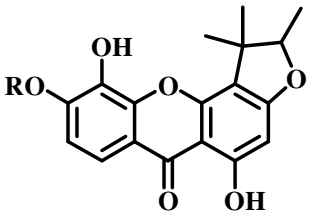
9.3x: $R_1 =$  , $R_2 = R_3 = H$: latisxanthone D

9.3y: $R_1 = R_3 = H$, $R_2 = Me$: forbexanthone



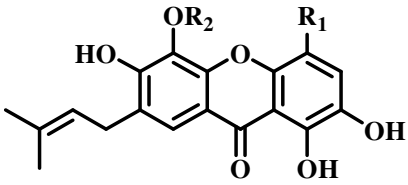
9.3z: $R_1 =$  , $R_2 = R_3 =$  : subelliptenone A

9.3aa: $R_1 = H$, $R_2 = R_3 =$  : 1,4,5,6-tetra(OH)-7,8-di(3-methylbut-2-enyl)xanthone



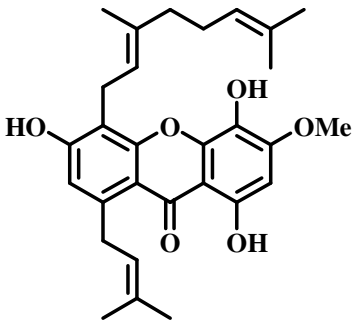
9.3bb: R = H : 2-deprenylrheediaxanthone B

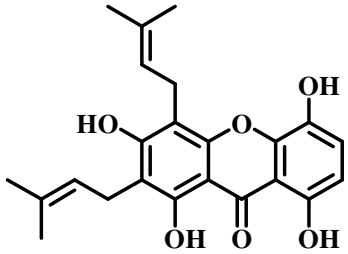
9.3cc: R = Me : 6-*O*-methyl-2-deprenylrheediaxanthone B



9.3dd: R_1 =  , R_2 = H : subelliptenone B

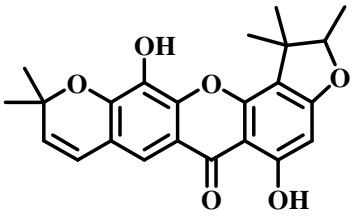
9.3ee: R_1 = H, R_2 = Me : 1,2,6-tri(OH)-5-(OMe)-7-(3-methylbut-2-enyl)xanthone



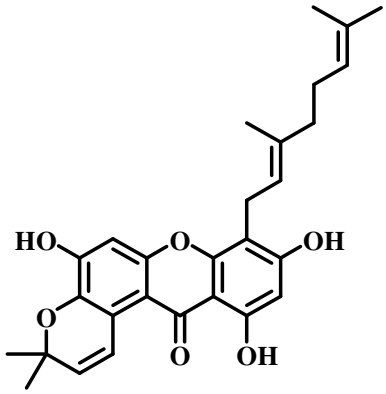


9.3ff: cuneifolin

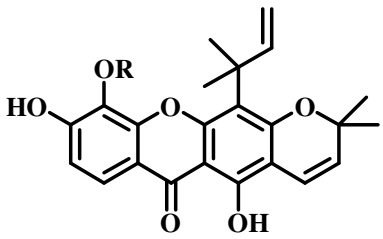
9.3gg: gartanin



9.3hh: 4″,5″-dihydro-1,5-di(OH)-6′,6′-dimethylpyrano(2′,3′:6,7)-4″,4″,5″-trimethylfurano(2″,3″:3,4)xanthone

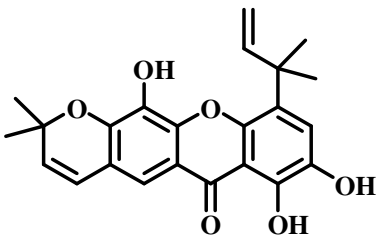


9.3ii: virgaxanthone B

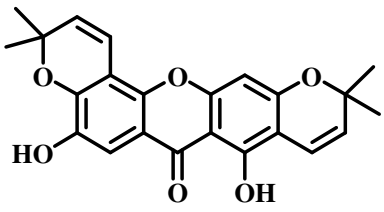


9.3jj: R = H : macluraxanthone

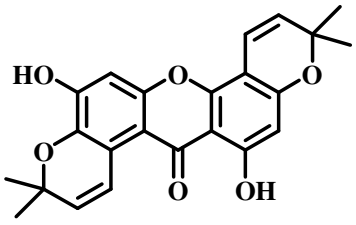
9.3kk: R = Me : 10-*O*-methylmacluraxanthone



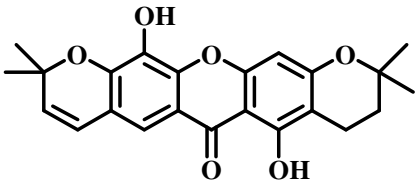
9.3ll: subelliptenone H



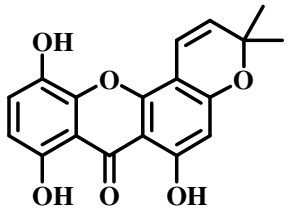
9.3mm: nigrolineaxanthone I



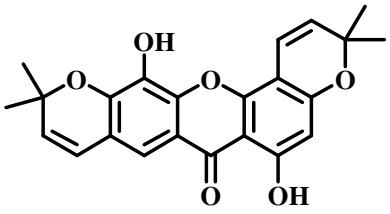
9.3nn: brasillixanthone



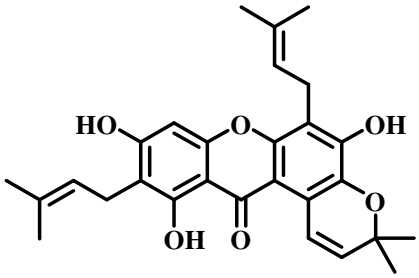
9.3oo: nigrolineaxanthone G



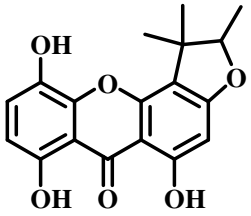
9.3pp: morusignin C



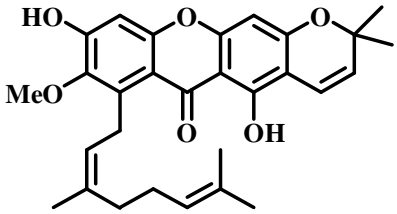
9.3qq: rheediaxanthone A



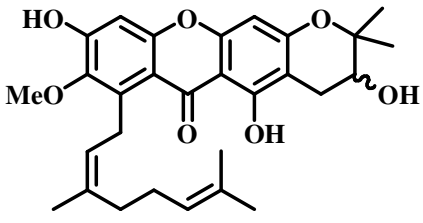
9.3rr: tovophyllin A



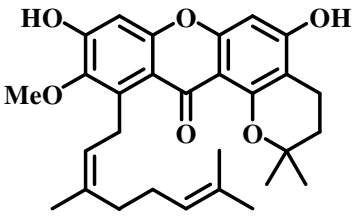
9.3ss: garbogiol



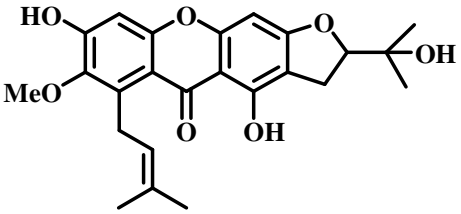
9.3tt: fuscaxanthone A



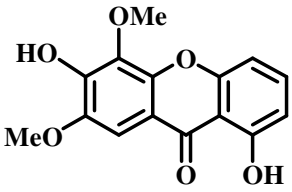
9.3uu: fuscaxanthone B



9.3vv: fuscaxanthone G

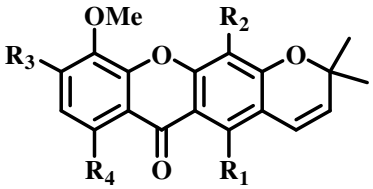


9.3xx: mangostanin



9.3yy: 1,6-di(OH)-5,7-di(OMe)-xanthone

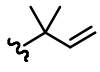
9.4 Penta- and hexaoxygenated xanthones

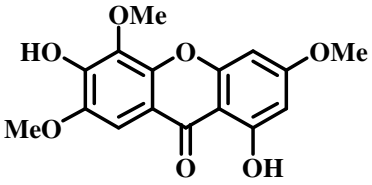


9.4a: $R_1 = R_2 = R_3 = OMe$, $R_4 = H$: dulxanthone E

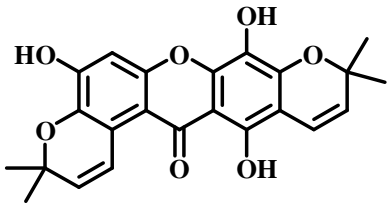
9.4b: $R_1 = OH$, $R_2 = H$, $R_3 = R_4 = OMe$: dulxanthone F

9.4c: $R_1 = OH$, $R_2 = R_3 = R_4 = OMe$: dulxanthone G

9.4d: $R_1 = R_3 = R_4 = OH$, $R_2 =$  : linixanthone A

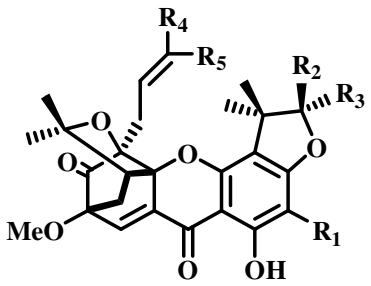


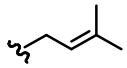
9.4e: 1,6-di(OH)-3,5,7-tri(OMe)xanthone

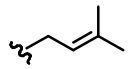


9.4f: 4-(OH)brasilixanthone B

9.5 Caged-polyprenylated xanthones

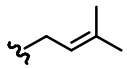


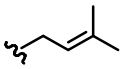
9.5a: R_1 =  , $R_2 = R_4 = R_5 = Me$, $R_3 = H$: scortechinone A

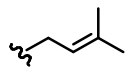
9.5b: R_1 =  , $R_2 = H$, $R_3 = R_4 = Me$, $R_5 = CO_2H$: scortechinone B

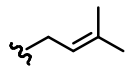
9.5c: $R_1 = R_3 = H$, $R_2 = R_4 = R_5 = Me$: scortechinone D

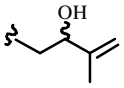
9.5d: $R_1 = R_2 = H$, $R_3 = R_4 = R_5 = Me$: scortechinone E

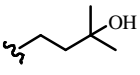
9.5e: R_1 =  , $R_2 = H$, $R_3 = R_5 = Me$, $R_4 = CO_2H$: scortechinone F

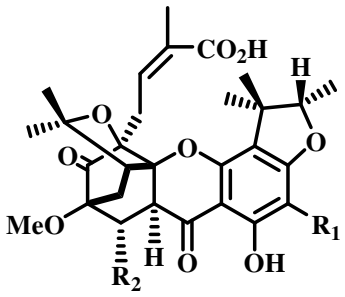
9.5f: R_1 =  , $R_2 = H$, $R_3 = R_5 = Me$, $R_4 = CO_2Me$: scortechinone G

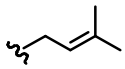
9.5g: R_1 =  , $R_2 = H$, $R_3 = R_5 = Me$, $R_4 = CHO$: scortechinone H

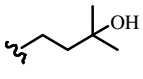
9.5h: R_1 =  , $R_2 = H$, $R_3 = R_4 = R_5 = Me$: scortechinone L

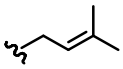
9.5i: R_1 =  , $R_2 = H$, $R_3 = R_4 = Me$, $R_5 = CO_2H$: scortechinone M

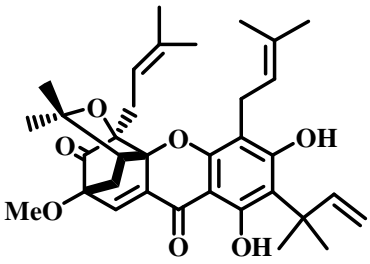
9.5j: R_1 =  , $R_2 = H$, $R_3 = R_4 = Me$, $R_5 = CO_2H$: scortechinone N



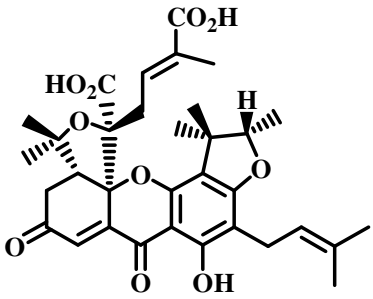
9.5k: R_1 =  , R_2 = OMe : scortechinone I

9.5l: R_1 =  , R_2 = OMe : scortechinone O

9.5m: R_1 =  , R_2 = OH : scortechinone P

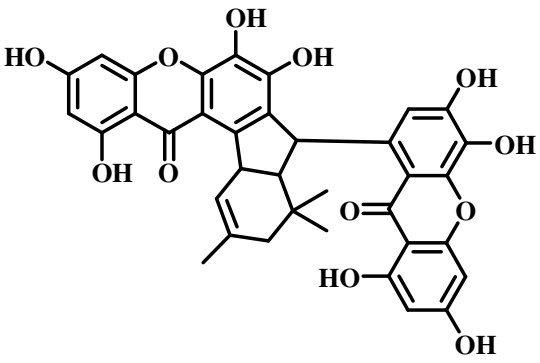


9.5n: scortechinone J



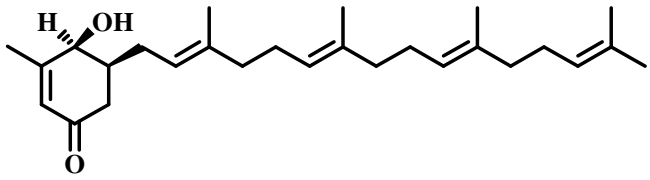
9.5o: scortechinone K

9.6 Xanthone dimer

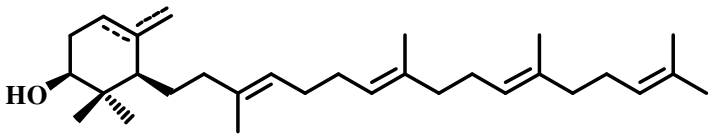


9.6a: bis-xanthone griffipavixanthone

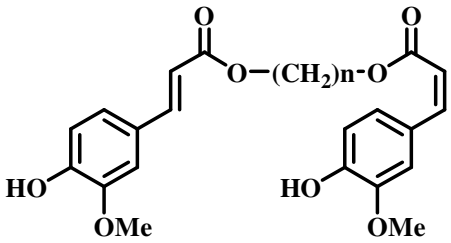
10. Miscellaneous



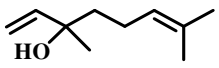
10a: (2*E*,6*E*,10*E*)-(+)-4β-(OH)-3-methyl-5β-(3,7,11,15-tetramethylhexadeca-2,6,10,-14-tetraenyl)cyclohex-2-en-1-one



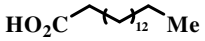
10b: a mixture of achilleol A and achilleol C



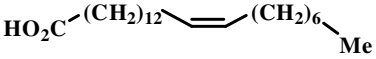
10c: n = 22 or 24 : a mixture of (1*E*,22*Z*)-1,22-diferuloyloxydocosane and (1*E*,24*Z*)-1,24-diferuloyloxytetracosane



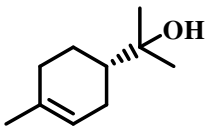
10d: linalool



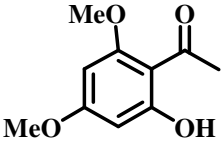
10e: hexadecanoic acid



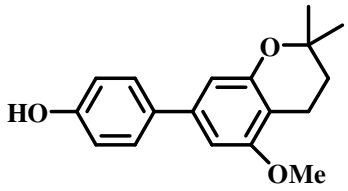
10f: 14-*cis*-docosenoic acid



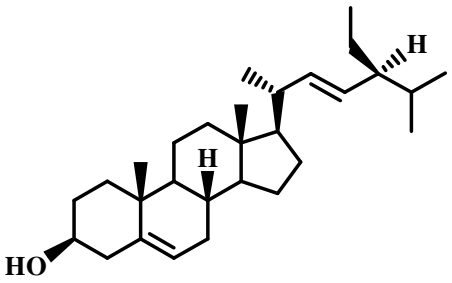
10g: α-terpineol



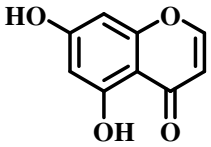
10h: 2,4-di(OMe)-6-(OH)acetophenone



10i: garcibenzopyran



10j: stigmasterol



10k: 5,7-di(OH)chromone

1.3 The objectives

Based on the literature search, phytochemical investigation on the twigs (Rukachaisirikul, 2000), latex (Rukachaisirikul, 2003b) and stem bark (Rukachaisirikul, 2005) of *G. scortechinii* resulted in the isolation of fifteen caged-polyprenylated xanthones and one degraded caged-tetraprenylated xanthone. Among these xanthones, scortechinone B, the major component in all investigated parts of the plant, exhibited strong antibacterial activity against methicillin-resistant *Staphylococcus aureus* (MRSA) (Rukachaisirikul, 2000, 2005). In addition, phytochemical investigation on the latex of *G. hanburyi* (Asano, 1996) led to the identification of eleven new and four known caged-polyprenylated xanthones. There is no report on the constituents from their fruits. Therefore, we are interested in investigating the fruits of these plants with the hope that additional new caged-polyprenylated xanthones with better antibacterial activity against MRSA will be isolated. This research involved isolation, purification and structure elucidation of the chemical constituents from the fruits of *G. scortechinii* and *G. hanburyi* which were collected at the Ton Nga Chang Wildlife Sanctuary and Sri Pang Nga National Park, respectively.