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Polyisoprenylated benzophenones from *Garcinia semseii* (Clusiaceae)

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ABSTRACT

Three novel polyisoprenylated benzophenones, semsinones A–C have been isolated from the stem bark of *Garcinia semseii* together with a known monocyclic triterpene, achilleol A. The structures of the new compounds have been determined by analysis of the spectroscopic data and comparison of the NMR data with those of the closely related compounds previously reported.

1. Introduction

The genus *Garcinia* (Clusiaceae) consists of about 180 species that are mainly encountered in lowland rain forests of the tropical world, particularly in Africa and Southeast Asia (Perry and Metzger, 1980). The genus has been a major source of prenylated xanthones (Bennet and Lee, 1989; Yang et al., 2007), polyisoprenylated benzophenones (Oliveira et al., 1999; Gustafson et al., 1992), biflavonoids mainly with a 3/8-linkage (Babu et al., 1988; Mbwambo et al., 2006) and triterpenoids (Nyemba et al., 1990). Phenolic constituents from *Garcinia* species have been reported to possess various biological activities, including antibacterial (Permana et al., 2001; Suksamrarn et al., 2003), antimalarial, (Hay et al., 2004) and cytotoxic (Shadid et al., 2007), prooxidant (Wu et al., 2008), quinone reductase-inducing (Chin et al., 2008) and HIV-inhibitory activities (Gustafson et al., 1992).

As part of our search for new substances from medicinal plants, we have studied the chemical constituents of *G. semseii* Verdc., an endemic plant growing in the Kihansi Forest Reserve, Morogoro region, Tanzania. Three new polyisoprenylated benzophenones, named semsinones A (**1**), B (**2**) and C (**3**), were isolated from the ethanol extract of the stem bark of *G. semseii*. Their structures were established using spectral data and by comparison with the closely related compounds reported in the literature (Porto et al., 2000; Cuesta-Rubio et al., 2001; Wu et al., 2008). In addition to compounds **1**–**3**, the known monocyclic triterpene, achilleol A has been isolated (Akihisa et al., 1999). This is the first report of the isolation of achilleol A from *Garcinia* species. In this paper we report the isolation and structure elucidation of new compounds **1**–**3** (Fig. 1).

2. Results and discussion

Compound **1** was obtained as a gum. The positive HRESIMS of compound **1** indicated a pseudo-molecular ion at *m/z* 671.4229 $[M+H]^+$ which was consistent with the molecular formula $C_{43}H_{58}O_6$. The IR spectrum indicated the absorption bands at 3348, 1725, 1641 cm^{-1} attributed to hydroxyl, non-conjugated and conjugated carbonyl groups, respectively. The UV spectrum showed absorption bands due to an aromatic chromophore at 282 and 234 nm due to a conjugated carbonyl group. Examination of the ^1H NMR spectrum of this compound in methanol showed duplicate signals for most regions of the spectrum. However, using CD_3OD with 0.1% TFA at 600 MHz it was possible to obtain a clear and a single set of signals (Gustafson et al., 1992). In the aromatic region of the ^1H NMR spectrum, three proton ABD signals were observed at [δ_H 7.10 (1H, d, J = 1.8 Hz, H-12), 7.00 (1H, d, J = 8.5 Hz, H-15) and 7.18 (1H, dd, J = 8.5, 1.8 Hz, H-16)] due to the 1,2,4-trisubstituted benzene ring. Signals representing each of a vinyl proton of the four trisubstituted double bonds were seen at [δ_H 4.96 (1H, br, *t*, J = 8.0 Hz, H-18), 5.22 (1H, dd, J = 9.2, 7.0 Hz. H-30), 5.25 (1H, m, H-35), 4.85 (1H, br *t*, J = 7.9 Hz, H-40)], two tertiary

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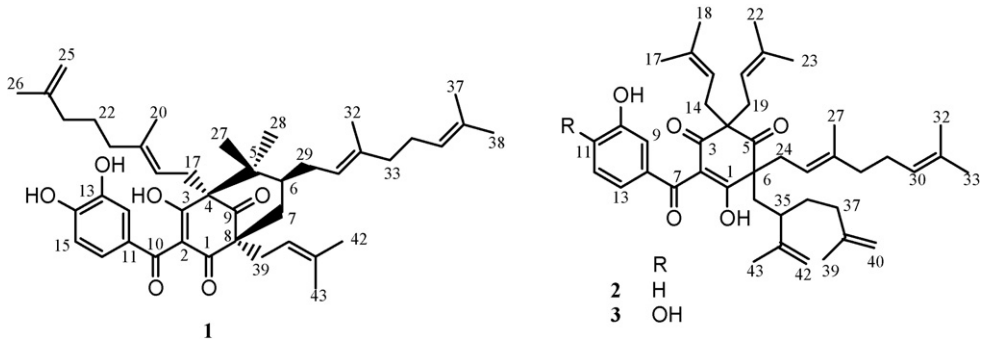

Fig. 1. Chemical structures of compounds isolated from *G. semseii*.

methyl protons [δ_H. 1.30 (3H, s, H-27) and 1.22 (3H, s, H-28)], one resonance for a terminal alkene at $\delta_{H\alpha}$ 4.66 and $\delta_{H\beta}$ 4.69 [2H, d, J = 1.7 Hz each, H-25], eight allylic methylene protons at δ_H 2.0–2.50 (16H, m) and signals for seven vinylic methyl groups (s, 3H each) at [δ_H 1.68 (H-20), 1.72 (H-26), 1.72 (H-32), 1.96 (H-37), 1.99 (H-38), 1.89 (H-42) and 1.91 (H-43)] were observed. Inspection in the ^{13}C NMR spectrum indicated the presence of a conjugated carbonyl group at δ_C 196.8 (C-10) and six aromatic carbon signals at δ_C 130.1 (C-11), 116.0 (C-12), 158.2 (C-13), 156.7 (C-14), 129.6 (C-15), 127.6 (C-16). The ^{13}C NMR spectrum also showed carbon signals that are characteristic of the bicyclo [3.3.1] nonane ring system of a polyisoprenylated benzophenone at δ_C 205.9 (C-9) for a non-conjugated carbonyl, a methine carbon signal at δ_C 41.9 (C-6), a methylene carbon signal at δ_C 40.6 (C-7) and six quaternary carbon signals at δ_C 195.3 (C-1), 115.0 (C-2), 194.9 (C-3), 67.2 (C-4) and 63.7 (C-8) (Gustafson et al., 1992; Lokvam et al., 2000).

The location of the side chains was determined by the use of NOESY and HMBC experiments. The methylene proton signals at [δ_H 2.69 (H_α-17) and 2.50 (H_β-17)] showed correlations in the HMBC spectrum to four quaternary carbon signals at δ_C 194.9, 67.2, 53.2, 205.9 ascribed to C-3, C-4, C-5 and C-9, respectively, and a methine carbon signal at δ_C 124.2 due to C-18. This allowed the placement of the geranyl group with a terminal alkene at C-4. The correlations of the methylene protons at δ_H 2.10 (H-29) to a single quaternary carbon signal at δ_C 53.2 (C-5), a methine carbon signal at δ_C 41.9 (C-6) and a methylene carbon signal at δ_C 40.6 (C-7) required the placement of a geranyl group at C-6. The double doublet proton signals at [δ_H 2.49 (H_α-39) and 2.40 (H_β-39)] showed correlations to three quaternary carbon signals at δ_C 195.3, 63.7 and 205.9 attributed to C-1, C-8, and C-9, respectively, and a methylene carbon signal at δ_C 40.6 (C-7). This confirmed the placement of a 3-methylbut-2-enyl group at C-8. Further inspection of the HMBC spectrum indicated cross peaks between the proton signals at δ_H 1.30 (H-27) and 1.22 (H-28) due to the *gem*-methyl groups and carbon signals at δ_C 67.2, 53.2 and 41.9 ascribed to C-4, C-5 and C-6, respectively.

The relative stereochemistry of the side chains of compound **1** was deduced from NOESY experiments, by analysis of coupling constants and by comparing the ^{13}C NMR spectral data of reference compounds. The side chains on the bicyclo [3.3.1] nonane were found to have equatorial orientation at positions C-4 and C-8. In the proton spectra the high coupling constant (J = 9.8 Hz) between H-7ax and H-6 suggested an equatorial position of the geranyl group at C-6. The upfield chemical shift of the C-28 (δ_C 16.3) signal was caused by the γ-*gauche* interaction with C-29 of the geranyl group at C-6 (Nilar et al., 2005; Cuesta-Rubio et al., 2001). Furthermore, the high vicinal J-values observed were due to the chair conformation for the B-ring of the bicyclo [3.3.1] nonane system of compound **1**. In the NOESY spectrum, the proton signal for H-6 (δ_H 1.64) correlated with the proton signal at δ_H 2.20 ascribed to H-7_{eq} together with one of the methylene protons for H-29. Further inspection in the NOESY spectrum indicated a correlation between the H-6 proton signal with the proton signal at δ_H 1.22, integrating to three protons attributable to the H-28 protons. The literature search for compound **1** led to a previous report of a compound, aristophenone B (Cuesta-Rubio et al., 2001) isolated from *Garcinia aristata* (Clusiaceae) which has a basic skeleton similar to **1** but with a difference in the side chains. In aristophenone B, all the side chains at positions C-4, C-6 and C-8 were 3-methylbut-2-enyl groups while compound **1** has a (3,7-dimethyloct-2,7-dienyl group at C-4, a geranyl group at C-6 and a 3-methylbut-2-enyl group at C-8. Thus, **1** was identified as a new polyisoprenylated benzophenone, 5,5-dimethyl-6-geranyl-3-hydroxy-2-(13,14-dihydroxybenzoyl)-4-(3,7-dimethyloct-2,7-dienyl)-8-(3-methylbut-2-enyl)-bicyclo[3.3.1]nonan-2-en-1,9-dione and a trivial name, semsinone A, is proposed for this novel compound.

Compound **2** was obtained as a brownish oil. The high resolution mass (HRESIMS) spectrum showed the pseudo-molecular ion at m/z 655. 4279 $[M + H]^+$ that was consistent with the molecular formula $C_{43}H_{58}O_5$. The UV spectrum indicated absorption bands at 250 and 352 nm. The ^{1}H NMR spectrum, showed nine singlet methyl proton signals (s, 3H each) at δ_H 1.58, 1.76, 1.71, 1.60, 1.67, 1.67, 1.54, 1.65 and 1.64 corresponding to H-17, H-18, H-22, H-23, H-27, H-32, H-33, H-39 and H-43, respectively. Further analysis in the ^{1}H NMR spectrum, indicated four vinyl proton signals at δ_H 4.98 (1H, m, H-15), 5.00 (1H, m, H-20), 4.97 (1H, t, J = 7.0 Hz, H-26) and 4.98 (1H, t, J = 6.1 Hz, H-30) ascribed to H-15, H-20, H-26 and H-30, respectively. Signals were observed at $\delta_{H\alpha}$ 4.68 and $\delta_{H\beta}$ 4.66 [2H, d, J = 1.9 Hz each, H-40] and at $\delta_{H\alpha}$ 4.65 and $\delta_{H\beta}$ 4.63 [2H, d, J = 1.8 Hz each, H-42] due to two terminal alkenes. In the aromatic region, four proton signals were observed at δ_H 7.25 (1H, d, J = 1.5 Hz), 7.18 (1H, dd, J = 8.8, 1.5 Hz), 7.11 (1H, t, J = 9.0, Hz), 7.21 (1H, dd, J = 8.8, 1.5 Hz) attributed to H-9, H-11, H-12 and H-13, respectively, that were consistent with a monosubstituted benzoyl group.

The ^{13}C NMR spectrum showed 43 signals with fifteen quaternary carbon signals, nine methine carbon signals, ten methylene carbon signals and nine methyl carbon signals (Table 1). Comparison of the carbon spectra recorded for **2** with those of **1** showed the absence of signals observed for the quaternary carbon signals at δ_C 53.2 (C-5), a methine at δ_C 41.9 (C-6) and methylene carbon signal at δ_C 40.6 (C-7), that are characteristic of the bicyclo [3.3.1] nonane ring system. Instead, the observed data were consistent with a cyclohex-2-enone skeleton (Porto et al., 2000). In the HMBC spectrum, two methylene proton signals at (δ_H 3.11, 3.06, $H_{\alpha,\beta}$-14) and (δ_H 2.99, 2.89, $H_{\alpha,\beta}$-19) both displayed cross peaks with three quaternary carbon signals at δ_C 195.4 (C-3), 63.4 (C-4) and 208.6 (C-5), this confirmed the placement of the two prenyl groups at position C-4. Further

Table 1
NMR assignments of compounds **1–3** (CD_3OD with 0.1% TFA, 600 MHz).

C	**1**		**2**		**3**	
	δ_H	δ_C	δ_H	δ_C	δ_H	δ_C
1		195.3 (C)		195.2 (C)		195.6 (C)
2		115.0 (C)		113.2 (C)		112.4 (C)
3		194.9 (C)		195.4 (C)		195.1 (C)
4		67.2 (C)		63.4 (C)		61.8 (C)
5		53.2 (C)		208.6 (C)		207.9 (C)
6	1.64 (1H, m)	41.9 (CH)		50.9 (C)		51.1 (C)
7	α 2.20 (1H, dd, J = 12.9, 2.8 Hz) β 2.09 (1H, dd, J = 12.9, 9.8 Hz)	40.6 (CH_2)		195.3 (C)		195.8 (C)
8		63.7 (C)		129.2 (C)		130.1 (C)
9		205.9 (C)	7.25 (1H, d, J = 1.5 Hz)	116.4 (CH)	7.13 (1H, d, J = 1.7 Hz)	118.1 (CH)
10		196.8 (C)		145.2 (C)		145.0 (C)
11		130.1 (C)	7.18 (1H, dd, J = 8.8, 1.5 Hz)	121.0 (CH)		150.3 (C)
12	7.10 (1H, d, J = 1.8 Hz)	116.0 (CH)	7.11 (1H, t, J = 9.0 Hz)	129.6 (CH)	6.72 (1H, d, J = 8.3 Hz)	117.2 (CH)
13		158.2 (C)	7.21 (1H, dd, J = 8.8, 1.5 Hz)	124.6 (CH)	7.04 (1H, dd, J = 8.3, 1.7 Hz)	123.2 (CH)
14		156.7 (C)	α 3.11 (1H, dd, J = 14.9, 5.1) β 3.06 (1H, dd, J = 14.9, 6.0)	23.6 (CH_2)	α 3.08 (1H, dd, J = 15.0, 5.3 Hz) β 3.02 (1H, dd, J = 15.0, 6.5 Hz)	22.7 (CH_2)
15	7.00 (1H, d, J = 8.5 Hz)	129.6 (CH)	4.98 (1H, m)	124.1 (CH)	5.01 (1H, m)	123.8 (CH)
16	7.18 (1H, dd, J = 8.5, 1.8 Hz)	127.6 (CH)		131.2 (C)		133.1 (C)
17	α 2.69 (1H, dd, J = 13.8, 7.7 Hz) β 2.50 (1H, dd, J = 7.7, 5.6 Hz)	26.9 (CH_2)	1.58 (3H, s)	17.1 (CH_3)	1.58 (3H, s)	16.9 (CH_3)
18	4.96 (1H, br, *t*, J = 8.0 Hz)	124.2 (CH)	1.76 (3H, s)	25.0 (CH_3)	1.76 (3H, s)	24.8 (CH_3)
19		137.3 (C)	α 2.99 (1H, dd, J = 14.9, 5.1) β 2.89 (1H, dd, J = 14.9, 6.0)	24.3 (CH_2)	α 3.00 (1H, dd, J = 14.8, 5.0 Hz) β 2.92 (1H, dd, J = 14.8, 5.4 Hz)	23.9 (CH_2)
20	1.68 (3H, s)	15.5 (CH_3)	5.00 (1H, m)	120.8 (CH)	5.04 (1H, m)	123.2 (CH)
21	2.06 (2H, m)	39.9 (CH_2)		134.2 (C)		134.0 (C)
22	1.51 (2H, m)	24.8 (CH_2)	1.71 (3H, s)	25.5 (CH_3)	1.73 (3H, s)	25.0 (CH_3)
23	1.75 (2H, m)	36.5 (CH_2)	1.60 (3H, s)	17.6 (CH_3)	1.62 (3H, s)	17.1 (CH_3)
24		144.8 (C)	2.47 (2H, d, J = 6.9 Hz)	26.5 (CH_2)	2.42 (2H, d, J = 7.0 Hz)	24.6 (CH_2)
25	α 4.66 (1H, d, J = 1.7 Hz) β 4.69 (1H, d, J = 1.7 Hz)	109.9 (CH_2)		134.1 (C)		135.1 (C)
26	1.72 (3H, s)	21.3 (CH_3)	4.97 (1H, t, J = 7.0 Hz)	124.8 (CH)	5.10 (1H, t, J = 7.3 Hz)	125.0 (CH)
27	1.30 (3H, s)	27.5 (CH_3)	1.67 (3H, s)	16.8 (CH_3)	1.70 (3H, s)	17.0 (CH_3)
28	1.22 (3H, s)	16.3 (CH_3)	1.99 (2H, m)	38.7 (CH_2)	1.95 (2H, m)	39.9 (CH_2)
29	2.10 (2H, m)	28.4 (CH_2)	1.97 (2H, m)	35.8 (CH_2)	1.99 (2H, m)	36.5 (CH_2)
30	5.22 (1H, dd, J = 9.2, 7.0 Hz)	124.6 (CH)	4.98 (1H, t, J = 6.1 Hz)	124.2 (CH)	5.03 (1H, t, J = 6.6 Hz)	124.8 (CH)
31		131.3 (C)		131.3 (C)		132.1 (C)
32	1.72 (3H, s)	16.8 (CH_3)	1.67 (3H, s)	16.9 (CH_3)	1.69 (3H, s)	17.0 (CH_3)
33	2.11 (2H, m)	39.6 (CH_2)	1.54 (3H, s)	25.1 (CH_3)	1.54 (3H, s)	25.3 (CH_3)
34	1.96 (2H, m)	23.6 (CH_2)	1.84 (2H, m)	28.9 (CH_2)	1.87 (2H, m)	28.2 (CH_2)
35	5.25 (1H, m)	122.8 (CH)	2.69 (1H, d, J = 13.1 Hz)	39.8 (CH)	2.66 (1H, d, J = 13.4 Hz)	39.3 (CH)
36		131.3 (C)	α 1.92 (1H, m) β 2.15 (1H, m)	28.6 (CH_2)	α 1.95 (1H, m) β 2.11 (1H, m)	30.1 (CH_2)
37	1.96 (3H, s)	16.9\(CH_3)	1.86 (2H, m)	38.7 (CH_2)	1.88 (2H, m)	38.3 (CH_2)
38	1.99 (3H, s)	24.9 (CH_3)		147.8 (C)		148.9 (C)
39	α 2.49 (1H, dd, J = 14.0, 7.9 Hz) β 2.40 (1H, dd, J = 7.9, 6.0 Hz)	25.5 (CH_2)	1.65 (3H, s)	21.8 (CH_3)	1.69 (3H, s)	22.1 (CH_3)
40	4.85 (1H, br *t*, J = 7.9 Hz)	123.8 (CH)	α 4.68 (1H, d, J = 1.9 Hz) β 4.66 (1H, d, J = 1.9)	109.5 (CH_2)	α 4.69 (1H, d, J = 1.9) β 4.68 (1H, d, J = 1.9)	109.4 (CH_2)
41		133.8 (C)		145.9 (C)		150.0 (C)
42	1.89 (3H, s)	24.8 (CH_3)	α 4.65 (1H, d, J = 1.8 Hz) β 4.63 (1H, d, J = 1.8 Hz)	109.7 (CH_2)	α 4.67 (1H, d, J = 1.8 Hz) β 4.65 (1H, d, J = 1.8 Hz)	109.9 (CH_2)
43	1.91 (3H, s)	17.3 (CH_3)	1.64 (3H, s)	17.9 (CH_3)	1.62 (3H, s)	17.8 (CH_3)

correlations were observed in the HMBC between the proton signals at δ_H 2.47 (H-24) and δ_H 1.84 (H-34) and carbon signals at δ_C 195.2, 50.9 and 208.6, ascribed to C-1, C-6 and C-5, respectively. This also confirmed the placement of geranyl and 2-(1-methylethenyl)-5-methylhex-5-enyl groups at position C-6. Hence compound **2** was established as novel 4,4-di(3-methylbut-2-enyl)-6-geranyl-1-hydroxy-2-(10-hydroxybenzoyl)-6-[2-(1-methylethenyl)-5-methylhex-5-enyl]-cyclohex-1-en-3,5-dione and the name semsinone B was adopted.

Compound **3** had a similar UV spectrum with that of **2** (250 and 352 nm), and had similar chromophore groups. The HRESIMS of compound **3** showed a pseudo-molecular ion at *m/z* 671.4233 $[M + H]^+$ that was consistent with the molecular formula $C_{43}H_{58}O_6$ indicating the addition of an OH group to the molecular mass of compound **2**. In the ^1H NMR spectrum, proton signals were similar to that of compound **2** except for the signal at δ_H 7.18 (H-11) for **2** that was missing in compound **3**. Hence, only three proton signals were observed in the benzoyl moiety of compound **3**. Similarly, in the ^{13}C NMR spectrum of compound **3** there was the addition of one quaternary carbon at [δ_C 150.3 (C-11)] as compared to compound **2** (Table 1). The remaining of the carbon and proton signals of **3** were similar to those of compound **2**. Hence compound **3** was characterised as a new 4,4-di(3-methylbut-2-enyl)-6-geranyl-1-hydroxy-2-(10-hydroxybenzoyl)-6-[2-(1-methylethenyl)-5-methylhex-5-enyl]-cyclohex-1-en-3,5-dione, semsinone C (**3**).

3. Experimental

3.1. General experimental procedures

NMR (^1H, ^{13}C, COSY, DEPT 135, NOESY, HMBC and HSQC) spectra were recorded in CD_3OD with 0.1% TFA on a Bruker

instrument operating at 600 MHz for ^{1}H and 150 MHz for ^{13}C nuclei. Chemical shifts (δ) are expressed in ppm with residual solvent peaks as internal references. IR spectra were recorded on a PerkinElmer System 2000 FTIR spectrometer, using NaCl windows with dichloromethane as solvent against an air background. HRESIMS was performed on a Micromass Q-TOF Ultima mass spectrometer. Optical rotations were measured on a PerkinElmer 241 polarimeter. Silica gel type 60 (Merck) particle size 230–400 mesh ASTM were used for column chromatography. Prep.TLC utilized silica gel 60 $PF_{254\&366}$ spread on a 20 × 20 cm glass plates, 0.5 mm thick. Analytical TLC was performed on 20 × 20 cm pre-coated plates. 1 g vanillin + 95% MeOH + 5% conc. H_2SO_4 and $FeCl_3$ were used as spraying reagents. Sephadex® LH-20 was used for the final purifications.

3.2. Plant material

The stem bark of *G. semseii* was collected in July 2002 from Kihansi Forest Reserve, Morogoro region, Tanzania by Mr. Frank Mbago who also confirmed the identity of the plant. A voucher specimen # FM 1629, has been deposited at the Herbarium of the Institute of Traditional Medicine, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania.

3.3. Extraction and isolation of compounds

The air-dried and powdered stem bark (200 g) of *G. semseii* was macerated with ethanol for 48 h. The extract was concentrated under reduced pressure at 40 °C at which 35 g of the crude extract was obtained. The column was packed using silica gel in petroleum ether, then 15 g of the crude extract was introduced and eluted with 100% petroleum ether, then adding EtOAc in increasing amount up to 100% then followed by increasing amount of MeOH up to 100% from which 40 fractions (each 100 ml) were collected. Fractions 1–5 contained less polar fatty acids as indicated in the TLC analysis and were not followed-up. Fractions 6–14 showed similar compositions hence were combined and fractionated by CC (gravity) on silica gel with Pet ether:EtOAc, 9:1 (250 ml) to give achilleol A (10 mg). Fractions 15–25 were combined and fractionated by CC (gravity) on silica gel with Pet ether:EtOAc, 1:1 (150 ml) followed by prepTLC using EtOAc:Pet ether, 1:4 (200 ml) to afford **1** (25 mg) and **2** (10 mg). Each compound was further purified on CC packed with Sephadex LH-20 and flushed with MeOH (100 ml). Fractions 26–40 were combined and fractionated by CC (gravity) on silica gel eluting with MeOH:$CHCl_3$, 1:19 (150 ml) to afford compound **3** (7.5 mg).

5,5-dimethyl-6-geranyl-3-hydroxy-2-(13,14-dihydroxybenzoyl)-4-(3,7-dimethyloct-2,7-dienyl)-8-(3-methylbut-2-enyl)-bicyclo[3.3.1]nonan-2-en-1,9-dione, semsinone A (**1**): colourless oil (25 mg), HRESIMS: m/z 671.4229 $[M + H]^+$ (calcd. for $C_{43}H_{58}O_6$, 670.4233), IR: υ_{max} (NaCl) cm^{-1}: 3348, 1725, 1641; UV–vis: λ_{max} (MeOH) nm (log ε): 282 (4.9), 320 (4.6), $[\alpha]_D^{20} = +52^{\circ}(c0.1,\ CHCl_3)$, ^{1}H and ^{13}C NMR data, see Table 1.

4,4-di(3-methylbut-2-enyl)-6-geranyl-1-hydroxy-2-(10-hydroxybenzoyl)-6-[2-(1-methylethenyl)-5-methylhex-5-enyl]-cyclohex-1-en-3,5-dione, semsinone B (**2**): Brownish oil (10 mg), HRESIMS: m/z 655.4279 $[M + H]^+$ (calcd. for $C_{43}H_{58}O_5$, 654.4284), IR: υ_{max} (NaCl) cm^{-1}: 3350, 1730, 1650; UV–vis: λ_{max} (MeOH) nm (log ε): 250 (4.4), 352 (4.1); ^{1}H and ^{13}C NMR data, see Table 1.

4,4-di(3-methylbut-2-enyl)-6-geranyl-1-hydroxy-2-(10,11-dihydroxybenzoyl)-6-[2-(1-methylethenyl)-5-methylhex-5-enyl]-cyclohex-1-en-3,5-dione, semsinone C (**3**): yellow gum (7.5 mg), HRESIMS: m/z 671.4265 $[M + H]^+$ (calcd. for $C_{43}H_{58}O_5$, 670.4233); IR: υ_{max} (NaCl) cm^{-1}: 3350, 1730, 1650; UV–vis: λ_{max} (MeOH) nm (log ε): 250 (4.4), 352 (4.1); ^{1}H and ^{13}C NMR data, see Table 1).

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