α-Glucosidase Inhibitory and Antioxidant Acridone Alkaloids from the Stem Bark of *Oriciopsis glaberrima* Engl. (Rutaceae)

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The CH_2Cl_2/MeOH extract of the stem bark of *Oriciopsis glaberrima* Engl. afforded four new acridone alkaloids namely oriciacridone C, D, E and F along with six known compounds: atalaphyllidine, oleanolic acid, butulinic acid, β-sitosterol, stigmasterol, glucoside of stigmasterol and one synthetically known acridone: 1,3,5-trihydroxy-4-prenylacridone. The structures were established on the basis of MS, 1D and 2D NMR experiments. The acridones 1, 4 and 5 showed potent activity against α-glucosidase, while the acridones 1—5 showed moderate free radical scavenging activity against 1,1-diphenyl-2-picrylhydrazyl (DPPH).

Key words *Oriciopsis glaberrima*; oriciacridone C; oriciacridone F; α-glucosidase; antioxidant

As part of a program to discover potential antitumoral, anti-inflammatory and antioxidant agents from Cameroonian medicinal plants, we worked on *Oriciopsis glaberrima* Engl. The species is a monotypic genus endemic to the humid rain forests of Cameroon,[1] it is used in used as medicinal plant against infections, hypotension, mycoses, dermatitis infection and many other diseases.[2] Previous phytochemical studies of *O. glaberrima* resulted in the isolation of one tetranortriterpenoid namely oriciopsin, and one alkaloid namely flindersiamine.[3] Recently we reported the isolation of two acridone–xanthone dimmers from this genus.[4]

In this paper, we report the isolation and the structural elucidation of four new acridones designated as oriciacridone C, D, E and F, and their biological activities. We also present the ^{13}C values and biological activity of synthetically known acridone 1,3,5-trihydroxy-4-prenylacridone.[5]

Air-dried, ground stem bark of *O. glaberrima* was extracted with a mixture of CH_2Cl_2–MeOH (1/1) at room temperature. The extract was concentrated to dryness under vacuum and its antioxidant activity was evaluated. The extract showed promising antioxidant activity. Then, in order to understand what compound in the extract might govern the antioxydant factor, we were interesting to the purification of this extract. Four new acridone analogs, oriciacridone C (**1**), oriciacridone D (**2**) and oriciacridone E (**3**), oriciacridone F (**4**) were isolated, with seven known compounds namely 1,3,5-trihydroxyl-4-prenylacridone (**5**), atalaphyllidine,[6] oleanolic acid,[7] butulinic acid,[7] β-sitosterol,[8] stigmasterol[8] and the stigmasterol-3-*O*-β-D-glucoside.[8]

The ^1H-, ^{13}C-NMR and MS parameters of the known compounds were consistent with those reported in the literature.

Oriciacridone C (**1**), mp 253—254 °C, was obtained as yellow needles showing a positive reaction with the $FeCl_3$ reagent. It was formulated as $C_{18}H_{15}NO_4$ by HR-EI-MS ($[M]^+$, *m/z* 309.0966, Calcd 309.1000). The IR spectrum exhibited vibration bands due to hydroxyl groups (3427 cm^{-1}) and a conjugated carbonyl group (1639 cm^{-1}). The UV absorptions at 253, 279, 303, and 346 nm indicated **1** to be a 9-acridone derivative.[9] The ^1H-NMR spectrum of compound **1** (Table 1) revealed the presence of a chelated and free hydroxyl functions at δ 14.50 (1H, s) and at δ 10.10 (1H, br s) respectively, both of them exchangeable with D_2O. The ^1H-NMR spectrum of **1** also showed signals due to ABC-type aromatic protons at δ 7.71 (1H, dd, *J*=7.7, 1.2 Hz), 7.12 (1H, dd, *J*=7.9, 1.2 Hz) and 7.10 (1H, t, *J*=7.9 Hz), an isolated aromatic proton at δ 6.12 (1H, s) and a 2-isopropenylhydro-

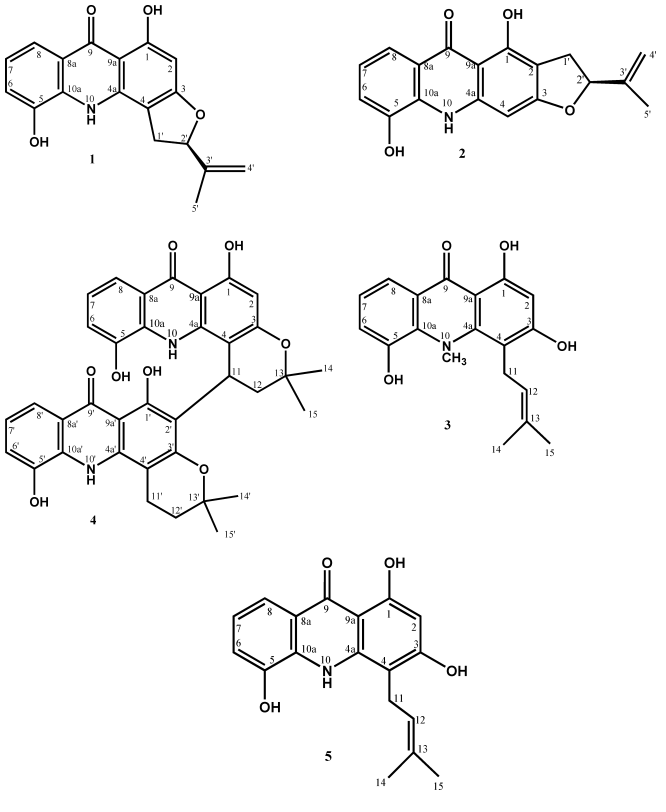

Chart 1

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Table 1. ^{1}H (500 MHz) and ^{13}C (125 MHz) Assignments of Oriciacridone C (**1**) and D (**2**) in CD_3OD

Attribution	**1**		**2**	
	^{13}C	^{1}H [m, *J* (Hz)]	^{13}C	^{1}H [m, *J* (Hz)]
1	166.2	—	166.7	—
2	91.9	6.12 (s)	105.0	—
3	167.7	—	167.8	—
4	101.0	—	87.0	6.21 (s)
4a	139.1	—	139.3	—
5	146.4	—	146.4	
6	117.3	7.12 (dd, 7.9, 1.2)	117.4	7.06 (dd, 7.6, 2.4)
7	122.6	7.10 (t, 7.9)	122.5	7.08 (t, 7.9)
8	116.6	7.71 (dd, 7.7, 1.2)	116.7	7.92 (dd, 6.1, 2.4)
8a	121.7	—	121.7	—
9	182.6	—	182.7	—
9a	105.5	—	105.5	—
10a	132.5	—	132.5	—
1′	32.1	3.13 (dd, 14.5. 7.6)	30.7	3.05 (dd, 14.2, 6.9)
		3.51 (dd, 14.5, 9.7)		3.39 (dd, 14.2, 9.8)
2′	89.0	5.40 (dd, 9.7, 7.6)	89.1	5.38 (dd, 9.8, 6.9)
3′	145.3	—	145.3	—
4′	112.6	4.94 (s)	112.6	4.95 (s)
		5.12 (s)		5.11 (s)
5′	17.1	1.79 (s)	17.1	1.72 (s)
1-OH[a)]	—	14.50 (s)	—	14.53 (s)
5-OH[a)]	—	10.10 (s)	—	9.98 (br s)

a) Observed in DMSO.

furan group at δ 5.40 (1H, dd, J=9.7, 7.6 Hz), 5.12 (1H, s), 4.94 (1H, s), 3.51 (1H, dd, J=14.5, 9.7 Hz), 3.13 (1H, dd, J=14.5, 7.6 Hz), 1.79 (3H, s). The lower-field signal at δ 7.71 of the ABC-type aromatic protons was deshielded by a carbonyl group revealed presence of the protons H-8, H-7, and H-6 of the acridone skeleton. The presence of the 2-isopropenylhydrofuran moiety was further confirmed by the ^{13}C-NMR spectrum (Table 1) that showed characteristic signals at C-5′ (δ 17.1), C-1′ (δ 32.1), C-2′ (δ 89.0), C-4′ (δ 112.6), and C-3′ (δ 145.3) and the EI-MS which showed the base peak at m/z 294 $[M-15]^+$. The position of the 2-isopropenylhydrofuran moiety was determined by the 2D NMR techniques (HMBC and NOESY). In the HMBC spectrum, cross peaks between the singlet aromatic signal at (δ 6.12) and carbon signals at C-1 (δ 166.2), C-3 (δ 167.7), C-9a (δ 105.5) and C-4 (δ 101.0) suggested the singlet aromatic proton to be located at C-2. The HMBC spectrum also showed cross peaks between the two benzylic protons H-1′a (δ 3.13) and H-1′b (δ 3.51) and the carbons C-3 (δ 167.7), C-4a (δ 139.1), C-2′ (δ 89.0) and C-3′ (δ 145.3) while the NOESY spectrum showed no interaction between these protons and the chelated hydroxyl group OH-1 (δ 14.50). This finding clearly indicated that the 2-isopropenylhydrofuran ring was fused in the angular position (C-3/C-4) to the acridone.[10] On the other hand, the HMBC cross-peak between the proton H-7 (δ 7.10) and carbon signals at C-5 (δ 146.4) and C-8a (δ 121.7) indicated that the second hydroxyl group was located at the C-5 position. From the above spectroscopic studies, the structure of oriciacridone C (**1**) was assigned as (+)-1,5-dihydroxy-2-isopropenyldihydrofuran[3,4-*c*]acridone.

Oriciacridone D (**2**), mp 265—266 °C, was obtained as yellow crystals and reacted positively with $FeCl_3$ reagent. It was formulated as $C_{18}H_{15}NO_4$ by HR-EI-MS ($[M]^+$, m/z 309.0966, Calcd 309.1000). These data, combined with those obtained from IR (3900, 3130, 1650 cm^{-1}), UV (255, 300, 346 nm), and ^{1}H-, ^{13}C-NMR (Table 1) suggested that compound **2** was a position isomer of oriciacridone C (**1**). Except an isolated aromatic proton shifted to δ 6,21 ppm, other signals in ^{1}H-NMR spectrum were closely similar to those of compound **1**. Furthermore, after comparison with the NMR values of (±)-rutacridone and (±)-isorutacridone, our results in agreement with the fact that the 2-isopropenylhydrofuran was fused in linear manner.[10] This structure was confirmed by the HMBC and NOESY spectra. In the HMBC spectrum, cross-peaks between the benzylic protons H-1′a (δ 3.05) and H-1′b (δ 3.39) and the carbon signals C-3 (δ 167.8), C-1 (δ 166.7) and C-3′ (δ 89.1) were observed. These data established the structure of alkaloid **2** as (+)-1,5-dihydroxy-2-isopropenyldihydrofuran[2,3-*b*]acridone.

Oriciacridone E (**3**) isolated as a yellow amorphous powder, had the molecular formula $C_{19}H_{19}NO_4$ deduced from its HR-EI-MS spectrum ($[M]^+$ m/z 325.1314, calcd 325.1325). The ^{13}C-NMR spectrum (Table 2) revealed 19 carbon signals that were sorted by DEPT into three methyl groups, one methylene, five sp^2 methine and ten quaternary carbons of which one was a carbonyl carbon. The IR spectrum showed vibration bands at 3340 cm^{-1} due to a free hydroxyl group and a chelated carbonyl group at 1643 cm^{-1}. These findings and those obtained from the UV spectrum (233, 253, 289, 303, 397 nm) and the ^{1}H- and ^{13}C-NMR spectra (Table 2) suggested that compound **3** contain a substituted acridone pattern. Furthermore the ^{1}H-NMR spectrum of **3** (Table 2) showed as well the presence of a γ,γ-dimethylallyl group at δ 1.79 (3H, s), 1.98 (3H, s), 3.48 (2H, d, J=8.4 Hz), 5.13 (1H, t, J=8.4 Hz)], a chelated hydroxyl at δ 14.08 (1H, s), ABC-type aromatic protons at δ 7.60 (1H, dd, J=8.3, 2.5 Hz), 7.20 (1H, d, J=2.5 Hz) and 7.11 (1H, d, J=8.3 Hz), an isolated aromatic proton at δ 6.20 (1H, s) and a N–Me group at δ 3.63 (3H, s). The single aromatic proton was located at the position C-2 and the prenyl group linked to C-4, in agree-

Table 2. ^{1}H (500 MHz) and ^{13}C (125 MHz) Assignments of Oriciacridone E (**3**), F (**4**) and Compound (**5**) in CD_3OD

Attribution	**4**		**3**		**5**	
	^{13}C	^{1}H [m, *J* (Hz)]	^{13}C	^{1}H [m, *J* (Hz)]	^{13}C	^{1}H [m, *J* (Hz)]
1	164.1	—	161.5	—	161.5	—
2	99.7	6.28 (s)	95.8	6.20 (s)	95.5	6.19 (s)
3	162.7	—	161.1	—	161.0	—
4	97.2	—	99.9	—	100.7	—
4a	139.3	—	139.8	—	140.0	—
5	146.4	—	144.7	—	144.7	—
6	116.7	6.68 (dd, 7.5, 1.3)	114.7	7.20 (d, 2.5)	114.7	7.17 (d, 2.5)
7	122.9	6.95 (t, 7.9)	121.3	7.11 (d, 8.3)	121.3	7.10 (d, 8.2)
8	115.8	7.55 (dd, 7.9, 1.3)	115.8	7.60 (dd, 8.3, 2.5)	115.8	7.59 (dd, 8.2, 2.5)
8a	121.3	—	119.3	—	119.3	—
9	182.7	—	180.5	—	180.5	—
9a	105.9	—	103.5	—	103.4	—
10 N–Me	—	—	44.3	3.63 (s)	—	—
10a	131.8		133.3	—	133.3	—
11	26.8	5.31 (dd, 12.0, 7.1)	21.4	3.48 (d, 8.4)	21.4	3.50 (d, 8.2)
12	39.7	2.29 (dd, 13.8, 7.1) 2.14 (dd, 13.8, 12.0)	121.7	5.13 (t, 8.3)	121.7	5.10 (t, 8.2)
13	77.4	—	130.6	—	130.6	—
14	23.7	1.45 (s)	17.9	1.79 (s)	17.9	1.78 (s)
15	29.4	1.34 (s)	25.9	1.98 (s)	25.9	1.98 (s)
1′	161.6	—	—	—	—	—
2′	101.6	—	—	—	—	—
3′	161.5	—	—	—	—	—
4′	112.2	—	—	—	—	—
4a′	141.5	—	—	—	—	—
5′	146.0	—	—	—	—	—
6′	116.7	6.64 (dd, 7.5, 0.9)	—	—	—	—
7′	122.4	6.93 (t, 7.5)	—	—	—	—
8′	115.9	7.52 (dd, 8.2, 0.9)	—	—	—	—
8a′	120.6	—	—	—	—	—
9′	182.6	—	—	—	—	—
9a′	105.7	—	—	—	—	—
10a′	131.8	—	—	—	—	—
11′	18.5	2.99 (m), 2.92 (m)	—	—	—	—
12′	42.8	1.88 (m), 1.84 (m)	—	—	—	—
13′	72.1	—	—	—	—	—
14′	29.5	1.39 (s)	—	—	—	—
15′	29.9	1.51 (s)	—	—	—	—
1-OH[a)]	—	14.86 (s)	—	14.08 (s)	—	14.10 (s)
3-OH[a)]	—	—	—	10.78 (br s)	—	10.72 (br s)
5-OH[a)]	—	10.10 (br s)	—	10.78 (br s)	—	10.72 (br s)
1′-OH[a)]	—	14.35 (s)	—	—	—	—
5′-OH[a)]	—	10.10 (br s)	—	—		—

a) Observed in DMSO.

ment with the ^{13}C-NMR spectrum that showed the C-2 signal at δ 95.8 as described in the literature.[11,12] Detailed analysis of the HMBC spectrum revealed cross-peaks between the aromatic proton H-2 (δ 6.20) and the carbon signals of C-1 (δ 161.5), C-3 (δ 161.0), C-9a (δ 103.4) and C-4 (δ 99.9) and between the benzylic protons H-11 (δ 3.48) and the carbon signals of C-3 (δ 161.1), C-4a (δ 139.8) and C-4 (δ 99.9). These correlations confirmed also the positions of the single aromatic proton and the prenyl group. From the above spectroscopic studies, oriciacridone E (**3**) was identified as 1,3,5-trihydroxy-4-(γ,γ-dimethylallyl)-10-methylacridone.

Oriciacridone F (**4**) was isolated as yellow crystals, mp 187—189 °C. The molecular formula $C_{36}H_{32}N_2O_8$ was established from the EI-MS and HR-EI-MS ($[M]^+$, *m/z* 620.2150, Calcd 620.2158). The UV (233, 254, 277, 281, 348, 389 nm) and IR (3853, 1735, 1643 cm^{-1}) spectra indicated the presence of an acridone nucleus. The ^{1}H-NMR spectrum (Table 2) which showed two characteristic signals of chelated hydroxyl groups at δ 14.86 (1H, s) and 14.35 (1H, s) (disappearing upon addition of D_2O), suggested the presence of two acridone nuclei in **4**.[13] In the aromatic proton region, two ABC-type proton signals at δ 7.55 (1H, dd, J=7.9, 1.3 Hz), 6.95 (1H, t, J=7.9 Hz), 6.68 (1H, dd, J=7.5, 1.3 Hz) and 7.52 (1H, dd, J=8.2, 0.9 Hz), 6.93 (1H, t, J=7.5 Hz), 6.64 (1H, dd, J=7.5, 0.9 Hz) and an isolated proton singlet signal at δ 6.28 (1H, s) were observed. The lowest signals of the ABC-type at H-8 (δ 7.55) and H-8′ (δ 7.52) were deshielded by the carbonyl groups at C-9 and C-9′. Thus oriciacridone F was assumed to be a bis-alkaloid of two acridone moieties. The presence of two 2,2-dimethyl chroman rings was indicated by signals at δ 5.31 (1H, dd, J=12.0, 7.1 Hz), 2.29 (1H, dd, J=13.8, 7.1 Hz), 2.14 (1H, dd, J=13.8, 12.0 Hz), 1.45 (3H, s), 1.34 (3H, s), and 2.99 (1H, m), 2.92 (1H, m), 1.88 (1H, m), 1.84 (1H, m), 1.51 (3H,

Table 3. α-Glucosidase Enzyme Inhibition

Compounds	Concentration (μM)	% Inhibition	$IC_{50}\pm$S.E.M.
Oriciacridone C (**1**)	100	81.8	56±5.4
	50	44.4	
1,3,5-Trihydroxy-4-(γ,γ-dimethylallyl)-acridone (**5**)	100	96.0	17±1
	50	87.8	
	25	61.8	
	13	41.3	
	6	22.5	
	3	0.0	
Oriciacridone F (**4**)	100	77.4	34.05±17
	50	53.2	
	25	25.5	
	6	18.6	
Deoxynojirimycin	0.3[a)]	95.6	330±8.14

a) In mM.

s), 1.39 (3H, s), and also confirmed by the ^{13}C-NMR spectrum. In the HMBC spectrum cross-peaks between the aromatic proton singlet at δ 6.28 and the carbon signals at C-1 (δ 164.1), C-3 (δ 162.7), C-9a (δ 105.9) and C-4 (δ 97.2) suggested this proton to be located at C-2.

The orientation of the two dimethylchroman rings was precisely determined by 2D NMR techniques HMBC, HMQC and NOESY. Again, in the HMBC spectrum, one benzylic proton H-11 (δ 5.31) showed cross-peaks with the carbon signals at C-4a (δ 139.3), C-3 (δ 162.7), C-4 (δ 97.2) and C-12 (δ 39.7) and on the other hand, the two benzylic protons H-11′a (δ 2.92) and H-11′b (δ 2.99) showed cross-peak with the carbon signals at C-3′ (δ 161.5), C-4a′ (δ 141.5), C-4′ (δ 112.2). These findings clearly indicated that the two dimethylchroman rings were fused in an angular fashion to the acridones nucleus at positions C-3/C-4 and C-3′/C-4′. Therefore, it remained to establish the linkage between the two nuclei. In the ^{1}H-NMR, the lower-field signal at δ 5.31 of the benzylic proton H-11 was deshielded by two aromatic rings and revealed the presence of the C–C′ linkage. In the HMBC spectrum, the ^2J and ^3J correlations of the benzylic proton H-11 (δ 5.31) with the carbons C-2′ (δ 101.6), C-3′ (δ 161.5) and C-1′ (δ 161.6) supported the position of the linkage between C-11 and C-2′, in agreement with the literature.[14)] From the above spectroscopic studies, the structure of oriciacridone F (**4**) was assigned as bis-5-hydroxy-(10*H*)-hydronoracromycine.

Absolute configuration at C-2′ was established to be *R* by the positive cotton effect of compound **1** and **2**[15,16)]

The α-glucosidase activity of compounds **1**, **4** and **5** was screened (Table 3) and all the compounds showed very potent activity against the α-glucosidase enzyme. This effect is supported by the electron donating on nitrogen which creating an electrostatic environment, this environment playing a crucial role in the active binding site of the enzymes. Acridone chromophore itself gives the molecule a planar structure that allows them to bind with the active site. All the compounds are inhibiting the enzymes in quite low concentrations and thus showed its novelty.

The alkaloids **1**, **2**, **4** and **5** were also screened against scavenging effects and showed a moderate antioxidant activity as regarding to reference BHA (IC_{50} 44.2±0.02 mM) (Table 4).[17)] This activity against the antioxidant showed the moderate free radical scavenging activity of the acridones.

Table 4. Radical Scavenging Activity of Alkaloids **1**—**5** for DPPH (1,1-Diphenyl-2-picrylhydrazyl)

Compounds	% Inhibition	$IC_{50}\pm$S.E.M. (mM)[a)]
Oriciacridone C (**1**)	94.2	60.79±1.23
Oriciacridone D (**2**)	90.5	194.10±1.72
Oriciacridone F (**4**)	79.1	482.00±1.80
1,3,5-Trihydroxy-4-(γ,γ-dimethylallyl)-acridone (**5**)	91.9	118.70±4.24
Standard (BHA)[b)]	92.6	44.20±0.02

All samples were tested at 1 mM. *a*) Standard mean error. *b*) BHA=3-*t*-butyl-4-hydroxyanisole.

Experimental

General Experimental Methods The melting points were recorded on a micro melting point apparatus and are uncorrected. Optical rotations were measured on a digital polarimeter in methanol. Ultraviolet spectra were recorded in methanol. Infrared spectra were recorded on a IR spectrophotometer. The mass spectra were recorded on a double focusing mass spectrometer. Accurate mass measurements were carried out with FAB source using glycerol as matrix, and HR-EI-MS were recorded. The ^{1}H-NMR spectra were recorded at 500 MHz, while ^{13}C-NMR spectra were recorded at 125 MHz. Methyl, methylene and methine carbons were distinguished by DEPT experiments. Homonuclear ^{1}H–^{1}H connectivities were determined by using the COSY experiment. One-bond ^{1}H–^{13}C connectivities were determined with HMQC gradient pulse factor selection. Two- and three-bond ^{1}H–^{13}C connectivities were determined by HMBC experiment. Chemical shifts were reported in δ (ppm) and coupling constants (*J*) were measured in Hz. Precoated TLC plates (silica gel) were used to check the purity of compounds and ceric sulphate spraying reagent was used for the staining of compounds on TLC. All the reagents used were of analytical grade.

Plant Material The stem bark of *Oriciopsis glaberrima* Engl. was collected in January 2002 in the forest around Bertoua, East province of Cameroon. A voucher specimen (1888/HNC) documenting the collection is on deposit at the National Herbarium, Yaounde, Cameroon.

Extraction and Isolation Air dried powdered stem bark of *O. glaberrima* (5.0 kg) was extracted with a mixture of CH_2Cl_2/MeOH (1/1) at room temperature for 4 d. The extract was filtered and concentrated under reduced pressure to yield a brown viscous extract (99.0 g). A sample (50.0 mg) of this crude extract was used for antioxidant activity. A sample (60.0 g) was subjected to flash column chromatography on silica gel (70—230 mesh, Merck) and eluted with a mixture of hexane–EtOAc–MeOH in increasing polarity. A total of 90 sub-fractions (*ca.* 250 ml each) were collected and combined on the basis of TLC analysis leading to four main fractions A—D. Sub-fractions 1—20, eluted with a mixture of hexane–EtOAc (17 : 3) gave the main fraction A (15.5 g). Fraction B (20.3 g) was constituted of sub-fractions 21—40 eluted with a mixture of hexane–EtOAc (1 : 1), main fraction C (10.1 g) was constituted of sub-fractions 41—66 eluted with hexane–EtOAc (1 : 4), and main fraction D (4.5 g) was constituted of sub-fractions 67—90 eluted with EtOAc–MeOH (19 : 1). Main fraction A was further chromatographed on a silica gel column with a hexane–EtOAc gradient. A total of 20 fractions (*ca.* 100 ml each) were collected and combined on the basis of TLC. Fractions 11—20 eluted with a mixture of hexane–EtOAc (8.5 : 1.5) yielded stigmasterol (11.0 mg) and β-sitosterol (7.0 mg).

Main fraction B was further chromatographed on a silica gel column with a hexane–EtOAc gradient. A total of 25 fractions (*ca.* 100 ml each) were collected and combined on the basis of TLC. Fractions 1—10 eluted with a mixture of hexane–EtOAc (8.5 : 1.5) yielded two new acridone named oriciacridone C (**1**) (25.0 mg) and oriciacridone D (**2**) (17.0 mg). Fractions 11—25 eluted with a mixture of hexane–EtOAc (7 : 3) yielded oleanolic acid (8.8 mg) and butelenic acid (5.0 mg). Main fraction C was chromatographed on a silica gel column with a hexane–EtOAc gradient. A total of 55 fractions of *ca.* 100 ml each were collected and combined on the basis of TLC. Fractions 1—25 eluted with a mixture of hexane–EtOAc (7 : 3) yielded a new bis-acridone named oriciacridone F (**4**) (25.0 mg), oriciacridone E (**3**) (8.0 mg), and 1,3,5-trihydroxy-4-(γ,γ-dimethylallyl)acridone (**5**) (21.0 mg) and glucoside of stigmasterol (32.5 mg).

Oriciacridone C (**1**): Yellow needles (MeOH); mp 253—254 °C; $[\alpha]_D^{25}$ +21.8° (*c*=0.39, MeOH); UV (MeOH): λ_{max} (log ε) 253 (6.09), 277 (5.76),

279 (5.77), 303 (5.66), 346 (4.76) nm; IR (KBr): ν_{max} 3955, 3427, 2923, 2854, 1742, 1639, 1602, 1398, 1122, 761 cm^{-1}; ^{1}H- and ^{13}C-NMR see Table 1; EI-MS: *m/z* (rel. int. %) 309 $[M]^+$ (61), 294 (18), 293 (100), 280 (23), 267 (11), 266 (25), 238 (17), 77 (11); HR-EI-MS *m/z* 309.0966 (Calcd for $C_{18}H_{15}NO_4$, 309.1000). CD: $\Delta\varepsilon_{210\,nm}$ +1.65, $\Delta\varepsilon_{234\,nm}$ −0.54, $\Delta\varepsilon_{265\,nm}$ +0,25 (*c* 5.0×10^{-4} mol l^{-1}).

Oriciacridone D (**2**): Yellow crystals (MeOH); mp 265—266 °C; $[\alpha]_D^{25}$ +87.4° (*c*=0.50, MeOH); UV (MeOH): λ_{max} (log ε) 255 (6.05), 279 (5.62), 291 (5.60), 295 (5.67), 300 (5.58), 346 (4.58) nm; IR (KBr): ν_{max} 3900, 3130, 2850, 2832, 1750, 1640, 1600, 1602, 1390, 1012, 750 cm^{-1}; ^{1}H- and ^{13}C-NMR see Table 1; EI-MS: *m/z* (rel. int. %) 309 $[M]^+$ (15), 308 (73), 294 (19), 293 (100), 279 (24), 266 (13), 153 (10), 91 (14); HR-EI-MS *m/z* 309.0966 (Calcd for $C_{18}H_{15}NO_4$, 309.1000). CD: $\Delta\varepsilon_{210\,nm}$ +0.85, $\Delta\varepsilon_{234\,nm}$ −0.25, $\Delta\varepsilon_{265\,nm}$ +0.35 (*c* 5.0×10^{-4} mol l^{-1}).

Oriciacridone E (**3**): Yellow amorphous powder (MeOH); $[\alpha]_D^{25}$ +63.6° (*c*=0.70, MeOH); UV (MeOH): λ_{max} (log ε) 235 (1.50), 253 (2.00), 275 (1.80), 280 (1.75), 290 (1.50), 303 (1.60), 342 (1.00), 420 (1.21) nm; IR (KBr): ν_{max} 3800, 3740, 3612, 3350, 2980, 2850, 1700, 1643, 1546, 1510, 1438, 1394, 1280, 1224, 1169 cm^{-1}; ^{1}H- and ^{13}C-NMR see Table 2; EI-MS: *m/z* (rel. int. %) 325 (16) $[M]^+$, 310 (60), 295 (25), 267 (30), 256 (10), 255 (46), 254 (44), 242 (100), 226 (20), 198 (7), 55 (6); HR-EI-MS *m/z* 325.1314 (Calcd for $C_{19}H_{19}NO_4$, 325.1325).

Oriciacridone F (**4**): Yellow powder (MeOH); mp 187—189 °C; $[\alpha]_D^{25}$ +35.6° (*c*=0.62, MeOH); UV (MeOH) λ_{max} (log ε) 233 (1.69), 254 (2.06), 277 (1.84), 281 (1.85), 295 (1.62), 303 (1.64), 348 (0.93), 389 (1.18) nm; IR (KBr): ν_{max} 3853, 3735, 2923, 2854, 1735, 1643, 1543, 1477, 1271, 960, 738 cm^{-1}; ^{1}H- and ^{13}C-NMR see Table 2; EI-MS: *m/z* (rel. int. %) 620 (10) $[M]^+$, 310 (100), 309 (20), 295 (19), 267 (40), 256 (7), 255 (50), 243 (17), 227 (100), 170 (5), 55 (5); HR-EI-MS: *m/z* 620.2150 (Calcd for $C_{36}H_{32}N_2O_8$, 620.2158).

1,3,5-Trihydroxy-4-(γ,γ-dimethylallyl)acridone (**5**): Yellow powder (MeOH); mp 250 °C; $[\alpha]_D^{25}$ +51.6° (*c*=0.62, MeOH); UV (MeOH): λ_{max} (log ε) 233 (1.49), 253 (1.99), 276 (1.73), 278 (1.75), 289 (1.50), 303 (1.56), 341 (0.86), 397 (1.20) nm; IR (KBr): ν_{max} 3801, 3737, 3612, 3340, 2925, 2862, 1643, 1546, 1510, 1438, 1394, 1280, 1224, 1769 cm^{-1}; ^{1}H- and ^{13}C-NMR see Table 2; EI-MS: *m/z* (rel. int. %) 311 (14) $[M]^+$, 310 (64), 295 (20), 267 (18), 256 (7), 255 (46), 254 (44), 242 (100), 226 (20), 198 (7), 55 (6); HR-EI-MS *m/z* 311.1138 (Calcd for $C_{18}H_{17}NO_4$, 311.1140).

α-Glucosidase Activity The inhibitory activity of the compounds has been determined against α-glucosidase, (E.C. 3.2.1.20), from *Saccharomyces* sp. purchased from Wako Pure Chemical Industries Ltd. Osaka, Japan (Wako 076-02841). The inhibition was measured spectrophotometrically at pH. 6.9 and 37 °C using 1 mM *p*-nitrophenyl α-D-glucopyranoside (PNP-G) as a substrate and 500 mUnits/ml enzyme, in 50 mM sodium phosphate buffer containing 100 mM NaCl. 1-Deoxynojirimycin (0.3 mM) was used as positive control.[14] The increment in absorption at 400 nm due to the hydrolysis of PNP-G by α-glucosidase was monitored continuously with the spectrophotometer (Molecular Devices, U.S.A.), S.E.M=standard error of the mean=standard deviation/$\pm\sqrt{n}$; *n*=number of replicates for IC_{50} value (*n*=3). Experiments were performed by using 1-deoxynojirimycin as a positive control (IC_{50} 330±8.14 μM).[14]

Determination of the Radical Scavenging Activity The reaction mixture containing 5 μl of test sample (1 mM in DMSO) and 95 μl of DPPH (1,1-diphenyl-2-picrylhydrazyl) (Sigma, 300 μM) in ethanol was taken in a 96-well micro titer plate (Molecular Devices, U.S.A.) and incubated at 37 °C for 30 min. The absorbance was measured at 515 nm. Percent radical scavenging activity was determined by comparison with a DMSO containing control (Table 4). IC_{50} values represent concentration of compounds to scavenge 50% of DPPH radicals. BHA (3-*t*-butyl-4-hydroxyanisole) was used as a positive control. All the chemicals used were of analytical grade (Sigma, U.S.A.).

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