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Constituents of *Agave americana* and *Agave barbadensis*

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Abstract

An investigation of *Agave americana* and *Agave barbadensis* resulted in the isolation of a new homoisoflavanoid, 7-hydroxy-3-(4-methoxybenzyl)-chroman (**3**), together with known compounds 7-hydroxy-3-(4-methoxybenzyl)-chroman-4-one (**1**), 5,7-dihydroxy-3-(4-methoxybenzyl)-chroman-4-one (**2**), cantalasaponin-1 (**4**), and 2-hydroxy-butanedioic acid-1-methyl ester (**5**).

Keywords: *Agave americana*; *Agave barbadensis*; Homoisoflavanoid

1. Plant

We used *Agave americana* (Agavaceae) aerial parts and *Agave barbadensis* rhizomes, collected in 2000 in the parishes of St. Phillip and St. Lucy, respectively, in Barbados. Dr. Claire Durant identified the plants and voucher specimens (Agave-2 and Agave-1, respectively) deposited in Tanaud Ireland, Inc., University of the West Indies, Cave Hill Campus.

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2. Uses in traditional medicine

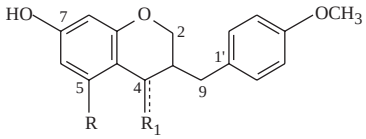
Several *Agave* spp. have been used in the treatment of scabies, tumors, syphilis, and dysentery, and as insecticides. They are also a source of fiber and produce steroidal sapogenins and saponins, the raw materials for steroid hormone synthesis [1].

3. Previously isolated constituents

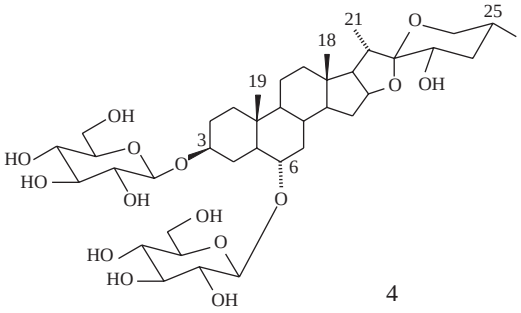
Previously isolated constituents are steroidal sapogenins and saponins [2,3], chromones, alcohols, and esters [4–6]. No phytochemical study on *A. barbadensis* has been reported.

4. Newly isolated constituents

Newly isolated constituents from the EtOAc extract of *A. barbadensis* rhizomes were: 7-hydroxy-3-(4-methoxybenzyl)-chroman-4-one (**1**) (yield: 0.0007%) [7,8], 5,7-dihydroxy-3-(4-methoxybenzyl)-chroman-4-one (**2**) (yield: 0.0004%) [9], 7-hydroxy-3-(4-methoxybenzyl)-chroman (**3**) (yield: 0.0003%), and cantalasaponin-1 (**4**) (yield: 0.014%) [10]. Newly isolated constituent from the EtOAc extract of the aerial part of *A. americana* was 2-hydroxy-butanedioic acid-1-methyl ester (**5**) (yield: 0.025%).



	R	R_1
1	H	O
2	OH	O
3	H	H_2



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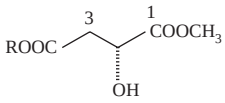

	R
5	H
6	CH_3

7-Hydroxy-3-(4-methoxybenzyl)-chroman (**3**): white solid; $[\alpha]_D^{20}$ + 34.3° (c 0.01, $CHCl_3$); IR bands (film): 3421, 1647 cm^{-1}; UV max: 282 (logε 3.63), 224 (4.10), 210 (4.22) nm; ^{1}H-NMR (500 MHz, CD_3OD): δ 7.10 (2H, *d*, *J* 8.9 Hz, H2′ and H6′), 6.85 (3H, *m*, H-5, H-3′, and H-5′), 6.34 (1H, *dd*, *J* 8.1 and 2.5 Hz, H-6), 6.30 (1H, *d*, *J* 2.5 Hz, H-8), 4.15 (1H, *ddd*, *J* 10.8, 2.8, and 1.4 Hz, H-2a), 3.80 (3H, *s*, 4′-OMe), 3.78 (1H, *dd*, *J* 10.8 and 2.3 Hz, H-2b), 2.71 (1H, *dd*, *J* 15.6 and 5.7 Hz, H-4a), 2.63 (1H, *dd*, *J* 14.1 and 7.1 Hz, H-9a), 2.55 (1H, *dd*, *J* 14.1 and 7.1 Hz, H-9b), 2.42 (1H, *dd*, *J* 15.6 and 8.5 Hz, H-4b), 2.24 (1H, *m*, H-3); ^{13}C-NMR (125 MHz, CD_3OD): δ 158.1 (C-4′), 155.3 (C-8a), 154.7 (C-7), 131.4 (C-1′), 130.5 (C-5), 129.9 (C-2′ and C-6′), 113.8 (C-3′, C-4a, C-5′), 107.8 (C-6), 103.1 (C-8), 70.0 (C-2), 54.9 (4′-OMe), 37.2 (C-9), 34.3 (C-3), 30.4 (C-4); HRMS: $[M]^+$ *m/z*: 270.1251. Calc. for $C_{17}H_{18}O_3$ 270.1256.

The ^{1}H-NMR data for **3** closely resembled that for **1** [11], except that it showed a multiplet at δ 2.24 and a double doublet at δ 2.42 (*J* 3.6, 9.1 Hz) and both protons showed correlations with C-4 (δ 30.4). This suggested the presence of a methylene group at C-4 instead of a carbonyl group. The isolation of compounds **1**–**3** from the genus *Agave* is the second report of flavanoid-type compounds being isolated from this genus, the first report being that of agamanone [4].

Compound **5** from *A. americana* is a methyl ester of malic acid, a product of the tricarboxylic acid cycle [12], but extensive literature searches failed to provide references with NMR data for this compound.

2-Hydroxy-butanedioic acid 1-methylester (**5**): pale yellow solid; $[\alpha]_D^{20}$ − 4.0° (c 0.63, CH_3OH); IR bands (film): 3446, 1739, 1636 cm^{-1}; UV max 268 (logε 1.96), 208 (2.75) nm; ^{1}H-NMR (300 MHz, CD_3OD): δ 5.08 (1H, *s*, OH), 4.50 (1H, *dd*, *J* 8.5 and 4.7 Hz, H-2), 3.74 (3H, *s*, OMe), 2.78 (1H, *dd*, *J* 16.5 and 4.7 Hz, H-3a), 2.67 (1H, *dd*, *J* 16.5 and 8.5 Hz, H-3b); ^{13}C-NMR (75 MHz, CD_3OD): δ 173.9 (C-1), 172.7 (C-4), 67.5 (C-2), 51.7 (C-OMe), 38.8 (C-3); HREIMS: $[M+H]^+$ *m/z*: 149.0446. Calc. for $C_5H_9O_5$ 149.0450.

Compound **6** was prepared by methylation of **5**.

2-Hydroxy-butanedioic acid dimethylester (**6**): colourless solid; $[\alpha]_D^{20}$ + 1.1° (c 1.34, $CHCl_3$); IR bands (film): 3440, 1644 cm^{-1}; UV max : 214 (logε 2.51 nm); ^{1}H-NMR (300 MHz, CD_3OD): δ 4.51 (1H, *dd*, *J* 6.2 and 4.7 Hz, H-2), 3.81 (3H, *s*, 4-OMe), 3.71 (3H, *s*, 1-OMe), 2.88 (1H, *dd*, *J* 14.1 and 4.7 Hz, H-3a), 2.78 (1H, *dd*, *J* 14.1 and 6.2 Hz, H-3b); ^{13}C-NMR (75 MHz, CD_3OD): δ 173.8 (C-1), 171.1 (C-4), 67.5 (C-2), 53.1 (4-OMe), 52.3 (1-OMe), 38.8 (C-3); EIMS: $[M+H]^+$ *m/z* 163, 146, 131, 114, 103, 71.

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