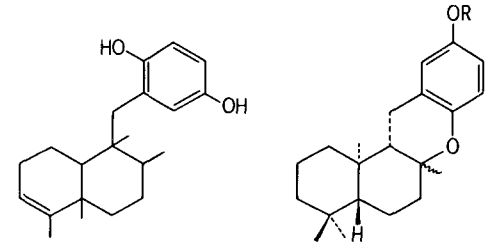
ent - Chromazonarol, a Chroman-Sesquiterpenoid from the Sponge *Disidea pallescens*

Sponges were previously shown to contain compounds of mixed biogenesis, originating partly from mevalonate and partly from a benzenoid precursor. Isoprenologous 2-polyprenylbenzoquinones and the corresponding quinols were found in *Ircinia spinosula*[1] and *I. muscarums*[2], and a group of sesquiterpenoid hydroquinones, the paniceins, were isolated from *Halichondria panicea*[3]. More recent investigations of the genus Disidea have led to the isolation of a further sesquiterpenoid hydroquinone, avarol (**1**), from *D. avara*[4] and of a pentacyclic sesterterpene fused with an hydroxyhydroquinone moiety, accompanied by small amounts of 2-pentaprenyl-1,4-benzoquinone, from *D. pallescens*[5]. The same sponge also elaborates several oily furanosesquiterpenoids[6] and a chroman-sesquiterpenoid in very low yield (0.03% of dry animal), which is the subject of this report. It is shown to be the chromanol **2**, the antipodal cyclic isomer of the hydroquinone zonarol (**3**), recently isolated from the brown alga *Dictyopteris undulata* (*zonarioides*)[7]. Accordingly it has been named *ent*-Chromazonarol.



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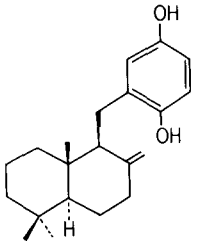
2, R = H
4, R = Ac; $[\alpha]_D$ +39°



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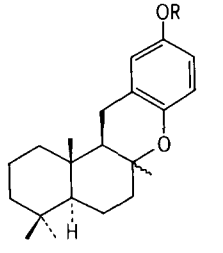
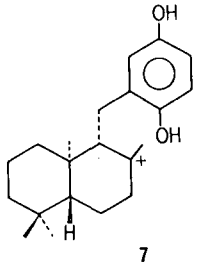


5, R = H
6, R = Ac; $[\alpha]_D$ −42°



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ent-Chromazonarol (**2**), isolated[8] as a non-crystalline gum, gave a positive Pauly reagent test (blue colour), and showed hydroxyl band (ν_{max} liquid film 3340 cm^{-1}) in the IR- and UV-absorption at 293 nm (ε; 4,500) bathochromically shifted by addition of alkali to 311 nm. It formed a crystalline phenolic monoacetate (acetic anhydride-pyridine at 25° for 3 h), **4**, m.p. 118–121° (from light petroleum), $[\alpha]_D$ +39° (c, 1 in $CHCl_3$), M^+/e 356, ν_{max} 1760 cm^{-1}. The NMR-spectrum (CCl_4) of **2** showed three aromatic protons at δ 6.42 as a complex band and one hydroxyl proton at δ 4.9 (exchangeable with D_2O). A 2H doublet (J 7 Hz) at δ 2.47 for a benzylic methylene, multiple bands from δ 2.0 to 1.2 for CH_2 and CH, a 3H singlet at δ 1.14 for a methyl on an etheral carbon, and overlapping sharp signals centred at δ 0.90 for 3 *tert*-methyls, completed the NMR-spectrum. The mass spectrum (M^+/e 314) and the integration of the NMR-bands were consistent in indicating the molecular formula $C_{21}H_{30}O_2$.

In C_6D_6 the aromatic region of the NMR was clearer – δ 6.38–6.5 (2H, m) and 6.81 (1H, d, J 8 Hz) – indicating an 1,2,4-substituted phenyl.

These data coupled with lack of olefinic signals in the NMR suggested that the sponge metabolite is represented most favourably by formula **2** (a part from the stereochemistry). This was proved by treatment of authentic zonarol (**3**)[9] with BF_3-etherate (in methanol, 25°, 10 min) which gave quantitatively the chromanol **5**, identical with the natural compound in TLC and NMR.

The acetate **6**, m.p. 120–122°, was except for rotation, $[\alpha]_D$ −42° (c, 1 in $CHCl_3$), – and therefore configuration – identical with the sponge – derived *ent*-chromazonaryl acetate **4**, which is dextrorotatory, $[\alpha]_D$ +39° (c, 1 in $CHCl_3$).

The identity of the two chromanols **2** and **5** was based on m.p. and GLC behaviour of the derived acetates **4** and **6**, which, when coinjected (1% OV-1 on Gas Chrom 100–200 mesh, 200°) gave a single peak, and mass spectrometry and NMR in different solvents, which were superimposable. Thus the sponge-derived chromanol is enantiomeric to the *Dictyopteris* chromanol.

TLC of the crude extract of the sponge and comparison with authentic zonarol excluded the presence of any sesquiterpenoid hydroquinone, indicating that **2** is a genuine natural product.

Beyond that, the biosynthesis of antipodal terpenoids by different organisms is of considerable interest. Moreover, the occurrence of avarol (**1**), with a rearranged

[1] G. Cimino, S. De Stefano and L. Minale, Tetrahedron *28*, 1315 (1972).
[2] G. Cimino, S. De Stefano and L. Minale, Experientia *28*, 1401 (1972).
[3] G. Cimino, S. De Stefano and L. Minale, Tetrahedron *29*, 2565 (1973).
[4] L. Minale, R. Riccio and G. Sodano, Tetrahedron Lett. *1974*, 3401.
[5] G. Cimino, P. De Luca, S. De Stefano and L. Minale, Tetrahedron *31*, 271 (1975).
[6] G. Cimino, S. De Stefano, A. Guerriero and L. Minale, Tetrahedron Lett. *1975*, 1417; 1421; 1425.
[7] W. Fenical, J. J. Sims, R. M. Wing and P. Radlick, J. org. Chem. *38*, 2383 (1973).
[8] According to essentially the same procedure described in the previous paper[5], the fresh tissues of the sponge were exhaustively extracted with acetone; solvent was removed and the aqueous residue was extracted with ether and *n*-butanol. Chromatography on silica gel in benzene and increasing amounts of ether of the ether-soluble material gave in the benzene-ether, 9:1 fractions the crude chromanol (**2**), which was further purified by chromatography on silica gel in light petroleum-ether, 8:2. The acetate **4** was purified by TLC on silica gel in light petroleum-ether, 9:1 (Rf 0.3) and subsequent TLC in benzene (Rf 0.4).
[9] Authentic zonarol was obtained by fractionating the chloroform extract of *Dictyopteris zonarioides*, kindly supplied by Dr. W. Fenical (University of California, San Diego) to whom the authors express their sincere thanks.

skeleton, and *ent*-chromazonarol (**2**) in two sponges of the same genus is remarkable and suggests a common biogenetic origin from an intermediate cation such **7**, from which avarol could also probably be derived by a 'friedo' rearrangement and deprotonation. The stereochemistry of avarol (**1**) is now under active investigation in this Laboratory.

Riassunto. Si descrive il ritrovamento nella spugna *D. pallescens* di un croman-sesquiterpenoide, *ent*-chromazonarolo (**2**), enantiomero del cromanolo dello zonarolo, sesquiterpene idrochinonico isolato dall'alga *Dictyopteris undulata* (*zonarioides*).

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Plant Constituents of *Tamarix aphylla* Flowers (Tamaricaceae)

The polyphenolic and flavonoid components of two Tamarix species (Tamaricaceae), growing in Egypt, were previously investigated[1-3]. Extensive investigation of the polyphenols of *T. nilotica* leaves led to the isolation and identification of the 3-glucoside of the rare aglycone kaempferol-4′,7-dimethyl ether together with the aglycone itself. Another aglycone was also found (in trace amount), its identity as rhamnocitrin was not confirmed[4].

The flowers of *T. aphylla*, collected from the Barrage Gardens, Cairo, were extracted with 70% ethanol, followed by column chromatography (polyamide). 6 fractions were collected. The first fraction (eluted with water) contained the free sugars together with rhamnetin-3′-glucuronide-3,5,4′-trisulphate (co-chromatography, electrophoretic and UV-data) which was previously isolated from the leaves of the same plant[2].

The new flavonol glycosides (G_1, m.p. 228 °C, decomp. and G_2, m.p. 174 °C) were eluted from the column with 40% and 60% EtOH, respectively. Both glycosides were glycosylated in position 3 through chromatographic properties as well as UV-data (Table). Acid hydrolysis of G_1 released glucose and the aglycone F which was identified as rhamnocitrin[5] (kaempferol-7-monomethyl ether) (m.p. 260–262 °C; lit. 224–224[6]; Rf-values and UV-properties are outlined in Table). Demethylation of F with HI gave rise to keampferol and on careful alkali fusion, *p*-hydroxybenzoic acid and phloroglucinol monomethyl ether were released (co-chromatography with authentic samples). Methylation of G_1 followed by hydrolysis gave rise to kaempferol-5,7,4′-trimethyl ether (m.p. 152 °C; lit. 151 °C[7]) which further confirmed the glycosylation in position 3. Mild acid hydrolysis (0.1 *N* HCl) gave no intermediate, thus indicating the presence of only 1 molecule of glucose. The new glycoside G_1 is thus postulated as rhamnocitrin-3-glucoside.

Rf-values and UV-spectra of new glycosides and their aglycones

	Rf (×100) BAW[a]	15%[b]	H_2O	60%[c]	λ_{max} (nm) in EtOH	$AlCl_3$	$\Delta\lambda$ (nm) NaOAc[d]	NaOEt[e]
Rhamnocitrin-3-glucoside	70	40	19	—	264.350	45	0	stable
Rhamnocitrin-3-rhamnoside	79	47	22	—	266.345	55	0	stable
Rhamnocitrin	89	—	—	57	267.268	57	0	decomp.
Kaempferol[f]	85	—	—	51				

[a] *n*-Butanol:acetic acid:water (4:1:5). [b] Acetic acid:water (15:85). [c] Acetic acid:water (60:40). [d] Band I. [e] Band II. [f] For reference.

G_2 was eluted from the column together with quercitrin (quercetin-3-rhamnoside). These were separated by applying elution technique on paper chromatograms using the solvent system *n*-butanol: 2 *N* ammonium hydroxide (1:1). Acid hydrolysis of G_2 gave rise to rhamnose and rhamnocitrin. Methylation of G_2 followed by hydrolysis released kaempferol-5,7,4′-trimethyl ether and mild hydrolysis gave no intermediate. The second new glycoside G_2 is thus postulated as rhamnocitrin3-rhamnoside (Rf-values and UV-data are outlined in the Table).

This is the first report of the 3-glucoside and the 3-rhamnoside of rhamnocitrin. Rhamnocitrin was also isolated in the free form together with rhamnetin (quercitin-7-methyl ether), kaempferol 4′,7-dimethyl ether and quercetin from the last fraction of the polyamide column.

Zusammenfassung. Aus *Tamarix aphylla*-Blüten wurden das 3-Glukosid und das 3-Rhamnosid des Kaempferol-7-monomethyläthers (Rhamnocitrin), zusammen mit dem 3-Rhamnosid des Quercetin (Quercitrin) und den Aglykonen Rhamnocitrin, Kaempferol-4′,7-dimethyläther und Quercetin isoliert.

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[1] M. S. ISHAK, H. I. EL SISSI, M. A. M. NAWWAR and A. E. A. EL SHERBEINY, Planta med. *21*, 246 and 374 (1972).
[2] N. A. M. SALEH, H. I. EL SISSI and M. A. M. NAWWAR, Phytochemistry *14*, 312 (1975).
[3] M. A. M. NAWWAR, Ph. D. thesis (1974).
[4] H. I. EL SISSI, M. A. M. NAWWAR and N. A. M. SALEH, Experientia *29*, 1064 (1973).
[5] E. C. BATE-SMITH and J. B. HARBORNE, Phytochemistry *10*, 1055 (1971).
[6] J. M. GUIDER, T. H. SIMPSON and D. B. THOMAS, J. chem. Soc. *1955*, 170.
[7] F. E. KING and R. M. ACHESON, J. chem. Soc. *1950*, 168.