

New Bromo-pyrrole Derivatives from the Sponge *Agelas oroides*

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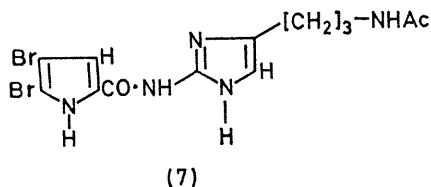
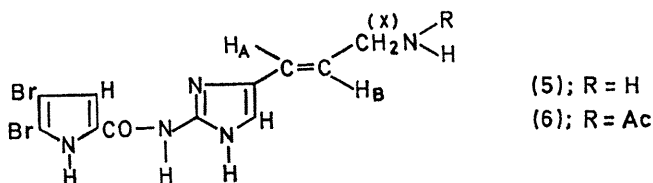
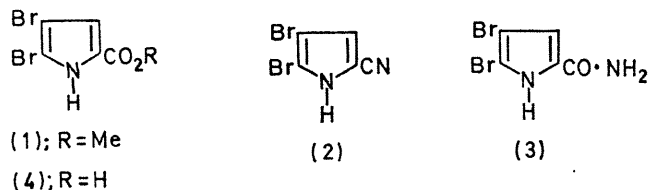
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Summary The sponge *Agelas oroides* contains 4,5-dibromopyrrole-2-carboxylic acid (4), the corresponding nitrile and amide; oroidin contains an amide derived from (4) and a substituted 2-aminoimidazole.

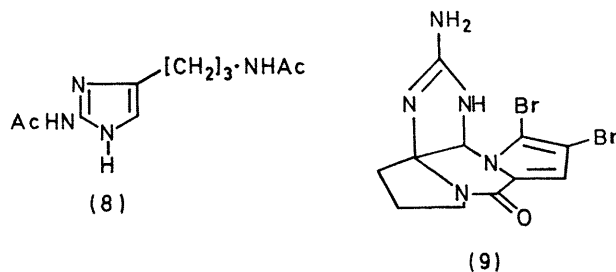
In our studies of the metabolites of Porifera¹, new bromo-pyrroles have been isolated from the sponge *Agelas oroides*, collected in the bay of Naples. Fresh material was extracted with methanol; solvent was removed and the aqueous residue was extracted with ether and then with n-butanol.



The ether-soluble material afforded four bromopyrroles: (1) (0.012% dry weight), m.p. 159—160°, m/e 281, 283, and 285 (M^+) identical with a synthetic sample;² (2) (0.02%), m.p. 172—173°, m/e 248, 250, and 252 (M^+); ν_{\max} (CHCl_3)

2220 (CN) cm^{-1} ; (3) (trace), m.p. 164—166°, m/e 266, 268, and 270 (M^+), λ_{\max} (MeOH) 233 and 273 nm (ϵ 6200 and 11,800), λ_{\max} ($N\text{-KOH-MeOH}$) 296 nm (ϵ 18,800) ν_{\max} (Nujol) 1655 and 1590 cm^{-1} , and (4) (0.21%), subl. 148°, m/e 267, 269, and 271 (M^+), ν_{\max} (Nujol) 3350 and 3120 (NH), and 1655 (CO) cm^{-1} .

Treatment of nitrile (2) with aqueous 20% KOH under reflux for 2 h gave a mixture of the amide (3) and the acid (4); after a longer period under reflux the acid (4) was the sole product. The ester (1) was an artefact derived from the acid (4); when acetone was used for isolation in place of methanol (1) was not obtained.



From the n-butanol-soluble material we isolated (2.3%) a new dibromo-compound, oroidin, to which we assign structure (5) on the following evidence: λ_{\max} (MeOH) 278 nm (ϵ 21,000), λ_{\max} ($N\text{-KOH-MeOH}$) 296 nm (ϵ 24,500), [cf. (3)]; ν_{\max} (Nujol) 3360, 3240, 1685, and 1570 cm^{-1} (sec. amide); n.m.r. spectrum ($\text{CD}_3\text{OD-C}_6\text{H}_6$) δ 6.84 and 6.45 (s, each 1H) p.p.m., and an ABX_2 system [δ 6.29 (1H, dt, J_{AB} 16 Hz, H_A), 5.90 (1H, dt, J_{AB} 16 Hz, J_{BX} 5 Hz, H_B), and 4.01br (2H, d, J 5 Hz, H_X) p.p.m.; on irradiation at δ 4.01 p.p.m. the olefinic proton signals collapse to a sharp AB quartet], in agreement with the presence of the partial structure $-\text{CH}=\text{CH}-\text{CH}_2-\text{N} < (\text{trans})$.

On acetylation, oroidin (5) afforded a crystalline *N*-acetyl derivative (6), $\text{C}_{13}\text{H}_{13}\text{Br}_2\text{N}_5\text{O}_2$, m.p. 256—258°, ν_{\max} (Nujol)

1685 (pyrrole amide $>CO$), 1640 (acetamide $>CO$) cm^{-1} , which on hydrolysis with 20% aqueous KOH gave both (3) and (4). The obtention of (3) indicates that the amidonitrogen atom of the 4,5-dibromopyrrole-2-carboxamide residue must be linked to a hydrolysable group, and it is known that 2-aminoimidazole fails to behave like an 'aromatic' amine, and is best regarded as a guanidine derivative³

Catalytic reduction of (6) gave the dihydro-derivative (7), m p 244—247°, m/e 431, 433, and 435 (M^+), the uv spectrum of which [λ_{max} (MeOH) 249 and 276 (ϵ 14,600 and 13,400)] is consistent with the presence in the molecule of dibromopyrrole-2-carboxy (276 nm) and 2-aminoimidazole (249 nm)⁴ chromophores. The dihydro-derivative (7), on treatment with concentrated alkali gave, as expected, both (3) and (4) and, on acid hydrolysis, yielded 2-amino-4 (or 5)-

(3-aminopropyl)-imidazole, identified as its diacetate (8), m p 238—240°, λ_{max} (MeOH) 249 nm (ϵ 10,700), by direct comparison with a synthetic sample. Authentic (8) was prepared by reduction⁵ with $SnCl_2$ and subsequent acetylation of 2-(*p*-bromophenylazo)-4 (or 5)-(3-acetamidopropyl)-imidazole, m p 200—203°, obtained by coupling between 4(or 5)-(3-acetamidopropyl)imidazole and *p*-bromobenzene-diazonium chloride.

Oroidin (5) appears to be closely related, biogenetically, to the bromo-containing alkaloid dibromophakellin (9), recently isolated from the sponge *Phakellia flabellata* by Sharma and Burkholder⁶

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