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NOVEL SESQUITERPENOID ESTERS FROM THE NUDIBRANCH *Dendrodoris limbata*[1,2]

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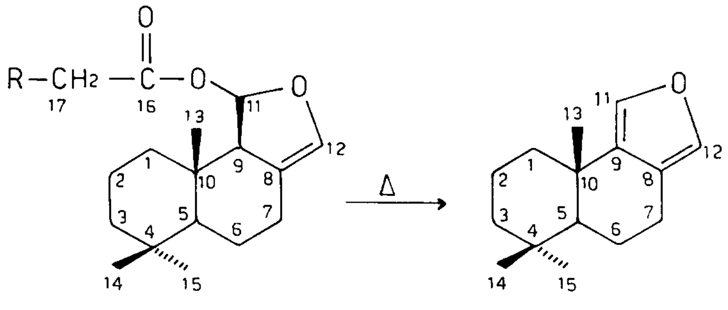
Abstract. - A novel sesquiterpenoid esterified by different fatty acids has been isolated from the digestive gland of the nudibranch Dendrodoris limbata.

As part of a program aimed at studying predator-prey relationships in the marine environment and at discovering bioactive substances in nudibranchs[3], we have examined the acetone extracts of the mediterranean nudibranch *Dendrodoris limbata (Gastropoda, Nudibranchia, Doridacea)*.

Specimens of *Dendrodoris limbata* were carefully dissected and the digestive glands extracted with acetone. The solvent was removed *in vacuo* and the residue was partitioned between ether and water. The ethereal extract was chromatographed on silica gel (light petroleum-diethyl ether, 98 : 2), to give an oily substance (*ca.* 9 mg/animal) exhibiting a single spot on silica gel tlc, while the same substance gives several spots on argentated silica gel tlc. Purification on argentated silica gel column chromatography (light petroleum and increasing amounts of diethyl ether) afforded three major products *1a* (62.5%), *1b* (30.5%), *1c* (7.0%) whose spectral properties allowed us to infer the same general formula *1* for the three fractions.

The presence of the ester moiety in *1a-c* could be readily deduced from the IR spectra (ν_{max} 1740 cm^{-1}); moreover in the mass spectra of *1a-c* the ion at higher mass is at m/z 218 (M^+ - RCH_2COOH), indicating an easy elimination of the acyl groups. The pmr spectra of *1a-c* display signals at δ 6.32 (1H, d, J 2Hz, H-11), 6.04 (1H, m, $W_{\frac{1}{2}}$ 4Hz, H-12), 0.90 (3H, s, *tert*-Me) and 0.85 (6H, s, *tert*-Me's) irradiation at δ 2.30 resulted in the collapse into singlets of the signals at δ 6.32 and 6.04. In addition the pmr spectra of *1a-c* display an intense signal at δ 1.26 (alkyl chain), while in the spectra of *1b* and *1c* a signal at δ 5.30 (vinylic protons) was present, indicating that the sesquiterpenoid moiety in *1a-c* is esterified by fatty acids of different unsaturation degree. The carbon framework of the sesquiterpenoid part was deduced to be as depicted in general formula *1* from the cmr spectra[4] by comparison with the appropriate model compounds such as perhydrophenanthrenes[5] and the



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2

structurally related marine sesterterpene heteronemin[6].

Like heteronemin, the sesquiterpenoid esters of *Dendrodoris limbata* on heating give rise to an elimination product which confirmed the supposed structures. The heating of *n*-hexane solutions of *1a-c* on silica gel for few minutes and subsequent filtration afforded in high yield the same furanosesquiterpene (*2*) while the diethyl ether elution of the remaining silica gel afforded a mixture of fatty acids which were identified as their methyl esters by glc data[7] (LAC 728 capillary column). The structure of *2* (M^+ 218, $C_{15}H_{22}O$) was readily established by spectroscopic means. The pmr spectrum displayed a signal at δ 7.05 (2H, bs) for the α-furan protons and methyl singlets at δ 1.21 (13-Me), 0.95 and 0.92 (14 and 15- Me's). The cmr spectrum, very diagnostic for the proposed structure *2*, shows resonances for the ring A similar to that of *1* and related model compounds, while the C-7, C-11, C-12 and C-13 resonate at δ 20.4, 136.8, 134.8 and 25.0 respectively, as expected if compared with the related furanoditerpenes with spongian skeleton[8].

Recent studies refer that nudibranchs, which lack other protections, may use chemical defence mechanisms. We do not tested the sesquiterpenoid esters for deterrent or antifeedant properties, however it must be observed that several compounds[9,10], reported to have the above mentioned properties, are sesquiterpenes related to the compounds isolated from *Dendrodoris limbata*. It should be added that another strictly related sesquiterpene exhibiting potent antifeedant properties, polygodial[11], has been isolated from the East African *Warburgia* plants.

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REFERENCES AND NOTES

1.- This work is part of the Progetto Finalizzato "Oceanografia e Fondi marini",CNR,Roma.

2.- A preliminary account of this work was presented at the III International Symposium on Marine Natural Products, Bruxelles, September 1980.

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4.- Fractions *1a-c* showed almost identical carbon resonances for the 17 carbons reported in the general formula *1*: $\delta(CDCl_3)$ 39.6(C-1), 18.6 (C-2), 42.2 (C-3), 33.2 (C-4), 53.1 (C-5), 22.7 (C-6), 23.3 (C-7), 114.4 (C-8), 64.0 (C-9), 37.0 (C-10), 98.1 (C-11), 134.3 (C-12), 14.0 (C-13), 21.7 (C-14), 33.6 (C-15), 172.5 (C-16), 34.5 (C-17). The carbon resonances were assigned by comparison with the model compounds[5,6], off-resonance and selective decoupling.

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7.- Fractions *1a* yielded a mixture of the *n*-,*iso*- and *anteiso*- C_{13}-C_{18} fatty acid methyl esters, the major components being *n*-C_{16} : 0 (28%) and *n*-C_{18} : 0 (11%). Fraction *1b* yielded three monounsaturated fatty acid methyl esters: C_{16} : 1 (66%), C_{17} : 1 (6%) and C_{18} : 1(28%). Fraction *1c* yielded three di-unsaturated fatty acid methyl esters: C_{16} : 2 (5%), C_{17} : 2 (6%) and C_{18} : 2 (89%).

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