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# FURANOSESQUITERPENOIDS IN SPONGES - I: PALLESCENSIN-1, -2 AND -3 FROM DISIDEA PALLESCENS

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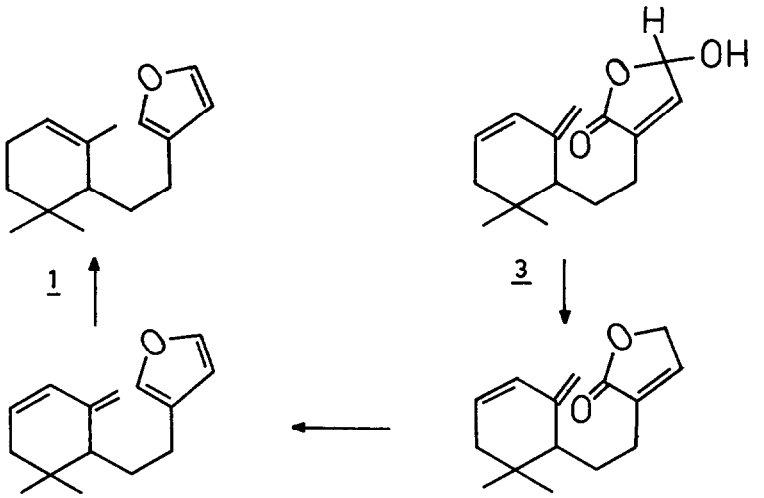
Numerous furanoid terpenes have been reported recently from sponges[1]: these have linear $C_{25}$, $C_{30}$ and $C_{35}$ chains or truncated ($C_{21}$ or $C_{31}$) chains. In the main these compounds have been isolated from the family Spongidae (order Dictioceratida). Furanosesquiterpenoids ($C_{15}$) have also been found in a marine sponge Pleraplysilla spinifera (family Aplysillidae, order Dictioceratida): two are linear and one is mono-cyclic with a new type of sesquiterpene skeleton[2].

In the course of our program on constituents of sponges we examined the extract of Disidea pallescens (family Aplysillidae) which showed to be a rich source of furanoid sesquiterpenes. Acetone extraction of the sponge followed by ether-water partition of the residue and silica gel column chromatography (light-petroleum) of the ether-soluble fraction[3] furnished an oil which was separable by column chromatography on 30% $AgNO_3$-$SiO_2$ (light-petroleum and increasing amounts of benzene) into ten new sesquiterpenes. These include three of a mono-cyclofarnesane type, named in order of elution pallescensin -1 (1), -2 (2) and -3 (3); and seven, closely related, having a 2,3-disubstituted furan ring and two more cycles in their structures, named pallescensins A - G. Lack of material and the unstability of most of them prevented extensive chemical investigation and the structure assignements are mainly based on spectral grounds, biogenetic considerations and interrelation between them.

The spectral arguments suggesting the structures 1 - 3 for pallescensin -1, -2 and -3, respectively, are the subject of this report. The following accompaining papers concern with pallescensins A - G.

All compounds were oils homogeneous on $SiO_2$-$AgNO_3$ t.l.c. and g.l.c. (1% OV-1



1 3

2 4

at 130°); the molecular formulas were derived from accurate mass measurements.

Pallescensin -2 (2; 0.02% of the dry weighted animal), $C_{15}H_{20}O$, $[\alpha]_D$= +39.5° $\lambda_{max}^{MeOH}$ 230 nm (ε 22,000; conjugated diene); $\nu_{max}^{film}$ 3020, 1600 and 880 ($C=CH_2$) $cm^{-1}$; $\delta_{TMS}^{CCl_4}$ 0.86 (s, Me), 0.98 (s, Me), 4.70 and 4.86 (2 bs $C=CH_2$), 5.54 (m, vinyl-H), 5.94 (dd, J = 10, 2Hz; vinyl-H), 6.12 (bs, furan-β-H), 7.08 (bs, furan-α-H), and 7.21 ppm (bs, furan-α-H). The n.m.r. pattern due to the olefinic protons was assigned to a conjugated butadiene system. The downfield vinyl-H (δ 5.94) is clearly an internal hydrogen of the conjugated system and the 10 Hz coupling indicates a cis double bond. Irradiation at δ 1.70 (spectrum run in $C_6D_6$; $H_2C-C=$, $HC-C=$) produced a doublet at 5.94 (J = 10Hz) and also reduced the complex multiplet at δ 5.54 into a broad doublet (J = 10Hz) and the $C=CH_2$ signals become a pair of sharp doublets (J = 1.5Hz). Hydrogenation on 5% Pd-C (ethanol, r.t. and pressure, 1h) yielded two dihydroderivatives and the major one is the 1-4 addition product (1), 1H broad multiplet at δ 5.25 and 3H broad singlet at δ 1.66 ($CH=C-CH_3$); in the mass spectrum a significant m/e 162 fragment corresponding to the elimination of isobutene by the retro-Diels-Alder process supported the presence in its structure of a 4,4-dimethylcyclohex-1-ene ring and, accordingly, confirmed that in the parent compound (2) the conjugated butadiene system must be as indicated. The structure 2, proposed for pallescensin-2, fits with all the above data and the mass spectral fragmentations (Fig. 1) added circumstantial confirmatory evidence.

Pallescensin -3 (3; 0.08% of dry weighted animal), $C_{15}H_{20}O_3$, $\lambda_{max}$ 230 nm (ε, 24600); $\nu_{max}^{film}$ 3310 (b); 3020, 1750, 1600, 1010, 920, 880 $cm^{-1}$, is closely related to pallescensin -2 (2) in which the furan ring is modified as a γ-hydroxy-α,β-butenolide. The n.m.r. spectrum showed signals corresponding to those assigned

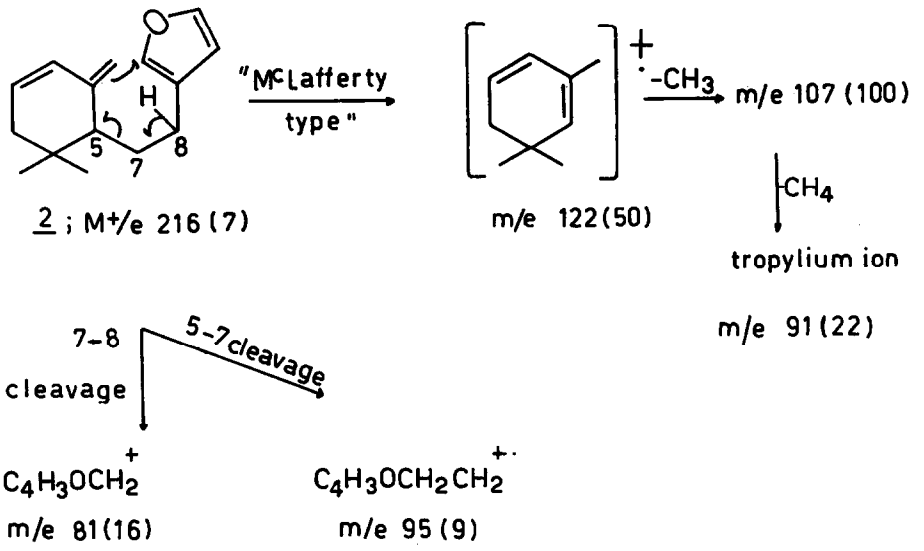



Fig. 1.- Mass spectral fragmentation of pallescensin -2; figures in parentheses indicate relative intensities.

in the spectrum of pallescensin-2 (2) to the conjugated diene system (δ 5.92, 5.56, 4.86 and 4.73 ppm) and to the tert-Me's (δ 0.98 and 0.86 ppm); in the low-field region of the spectrum two broad singlets at δ 5.96 (CHOH) and 6.70 (O=C--C=CH) could be assigned to an α-substituted-γ-hydroxy-α,β-butenolide system[4,5], in agreement with i.r. and the formation of a monoacetate (acetic anhydride-pyridine at r.t.), $M^+$/e 290, $\nu_{max}$ 1750, 1775 $cm^{-1}$, $\delta^{CCl_4}_{TMS}$ 2.08 (Me-$CO_2$-), 6.72 (2H, broad singlets, protons of the butenolide moiety)[5]. This was proven by conversion of 3 to 2, which was accomplished by $NaBH_4$ reduction of the lactol ring followed by treatment with di-isobutyl aluminium hydride[6] of the resulting α,β-unsaturated-γ-lactone 4; $\nu_{max}$ 1750 $cm^{-1}$; ms:232 ($M^+$), 217, 135, 122, 121, 107 (base); $\delta^{CCl_4}_{TMS}$ 6.91 (bs, O=C-C=CH), 5.96 (dd, J = 11, 2Hz, vinyl-H), 5.58 (m, vinyl-H), 4.88 and 4.74 (2 bs, $C=CH_2$), 4.62 ($CH_2$-O, apparent q, J 2Hz; converted into a doublet on irradiation at δ 2.2 and into a triplet on irradiation at δ 6.91), 1.00 and 0.87 ppm (tert-Me's). Coöccurrence of terpenoid furan - γ-hydroxy-α,β-butenolide pairs have already reported in marine sponges[7] and the inability to detect in the extract of Disidea pallescens any of the oxidized counter-part except for 2 seems indicate that 3 is a genuine natural product, in agreement with our previous suggestion[7].

Pallescensin -1 (1, 0.02% of dry weighted animal), $C_{15}H_{22}O$, ms:218 ($M^+$, 5),

203 (3), 162 [$\dot{M}$-$(CH_3)_2C{=}CH_2$, 6], 147 (18), 133 (16), 123 (11), 109 (28), 95 (56), 81 (base); $\delta^{C_6D_6}_{TMS}$ 0.95 and 0.88 (tert-Me's), 1.66 (vinyl-Me), 5.25 (vinyl-H, bt, $W_{\frac{1}{2}}$ 10Hz), 7.22, 7.11 and 6.14 ppm (furan protons), was shown identical (ms, n.m.r., g.l.c., t.l.c.) with the 1-4 hydrogenation product of pallescensin-2.

The mono-cyclofarnesane skeleton is rather rare in sesquiterpenoids[8]. Notably, the first occurrence of trans-γ-mono-cyclofarnesic acid has been reported from the sponge Halichondria panicea, which also contains a group of "triprenylphenols" having an aromatic sesquiterpenoid moiety biogenetically derivable from a mono-cyclofarnesyl precursor[9].

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