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CAESPITOL, A NEW HALOGENATED SESQUITERPENE FROM LAURENCIA CAESPITOSA[1]

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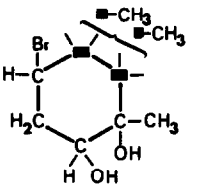
Seaweed of the genus Laurencia, family Rhodomelaceae, have proved to be a rich source of halogenated natural products[2]. The present work describes the isolation from L. caespitosa of a new sesquiterpenoid containing chlorine and bromine, designated as caespitol for which, on the basis of its chemical and spectroscopic behaviour, we propose formula (III) as the most favorable structure.

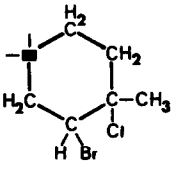
Ether extracts of the dried seaweed were washed successively with dil KOH soln, dil HCl and water, and the neutral oil thus obtained was carefully chromatographed on standard silica gel. The 75% ether: 25% benzene eluent contained crystalline (m.p. 109-111º/n-hexane) caespitol, in 0.03% yield.

Caespitol (III), was analyzed for $C_{15}H_{25}O_2Br_2Cl$: m/e M^+ 430, 432, 434; high resolution m/e 353.075 (calcd for $C_{15}H_{25}O_2{}^{80}Br^{35}Cl$, 353.070), and m/e 237.192 (calcd for $C_{15}H_{25}O_2$, 237.185). The ir spectra (ν_{max}^{KBr} 3540, 3320, 1460, 1220, 970 and 785 cm^{-1}; $\nu_{max}^{CCl_4}$ 3620, 3400 and 3240 cm^{-1}). The pmr spectrum (60 MHz, $CDCl_3$, τ-scale), 5.61 (1H, dd, J=12 and 4 Hz, -ĊHBr-), 5.69 (1H, dd, J=12 and 5 Hz, -ĊHBr-), 6.43 [1H, t, J=2.5 Hz, -ĊH(OH)-]. The spectrum showed, furthermore, a broad envelope from 7.3 to 8.3 arising from eight methylene protons, and four tertiary methyl signals at 8.33 (Me-ĊCl-), 8.63 [Me-Ċ(OH)-], 8.69 and 8.83 (gem-dimethyl).

Acetylation of III (Ac_2O/py) give the monoacetate (IIIa): m.p. 132-134º, ir (ν_{max}^{KBr} 3320, 1740 cm^{-1}), pmr 5.4 [1H, t, J=2.5 Hz, -CH(OAc)-]; from which caespitol could be regenerated by mild saponification. Upon oxidation of III at 0º with Jones' reagent yield the unstable ketone (IV), ir (ν_{max}^{KBr} 3320, 1710 cm^{-1}); pmr 5.75 (1H, dd, J=10 and 8 Hz) and 7.01 (2H, d, J=10 Hz), consistent with the system ■-CHBr-CH_2-C(=O)-■. Dehydrobromination of IV afforded in good yield the α,β-unsaturated ketone (V), m.p. 78-80º, $C_{15}H_{21}O_2BrCl$; uv[λ_{max}^{EtOH} 234 nm (log ε 3.77)]; ir ($\nu_{max}^{CCl_4}$ 3340, 1685 cm^{-1}); pmr 3.22 and 4.22 [each 1H, d, J=11 Hz, ■-CH=CH-C(=O)-■], 5.63 (1H, dd, J=12 and 4 Hz, $-CH_2-\underline{C}HBr-$■), 7.5-8.2 (6H, m, $-\underline{C}H_2-$), 8.33 (3H, s, Me-CCl-), and 8.54, 8.58 and 8.69 (each 3H, s). All these results indicate the presence of the two partial formulas I and II in caespitol.



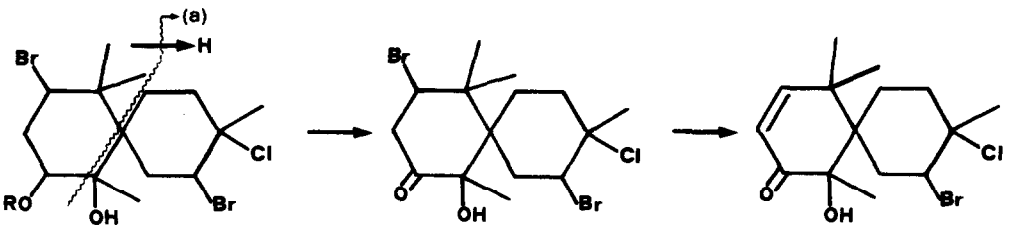
I

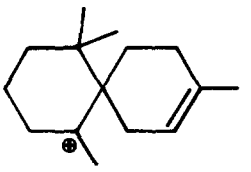


II

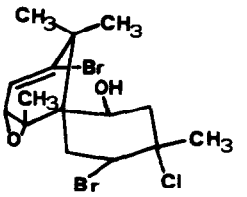
In view of the molecular formula, from where a bicyclic system is easily deduced, the two afore-mentioned structural units I and II must be conected by one quaternary carbon atom, giving the formula III as the most favorable (planar) structure for caespitol. This was further supported by the mass spectrum of (III), pronounced peaks at m/e 252, 254, 256; high resolution 254.9995 (calcd for $C_9H_{15}O^{80}Br^{35}Cl$, 254.9970) and m/e 139.1108 (calcd for $C_9H_{15}O$, 139.1123) could only arise from the fragment (a), as is showed in (III).

The structure (III) is also well explained from the standpoint of biogenesis, thus caespitol can be derived formally from the ion (VI), a cyclization product of γ-bisabolene, which has been proposed as the common precursor for pacifenol[3], johnstonol[4], and prepacifenol (VII)[5], all three compounds isolated by Sims and collaborators from alga genus Laurencia. Caespitol may be a biogenetic precursor of prepacifenol.



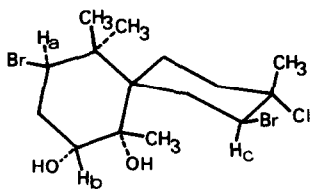


VI



VII

The relative stereochemistry of caespitol is assigned on spectral data, mainly pmr spectrum (Figure 1). Use of decoupling, along with critical comparison with the pmr spectra of prepacifenol and johnstonol[6], lead to the structure (VIII), which will be discussed in detail in a full paper.



VIII

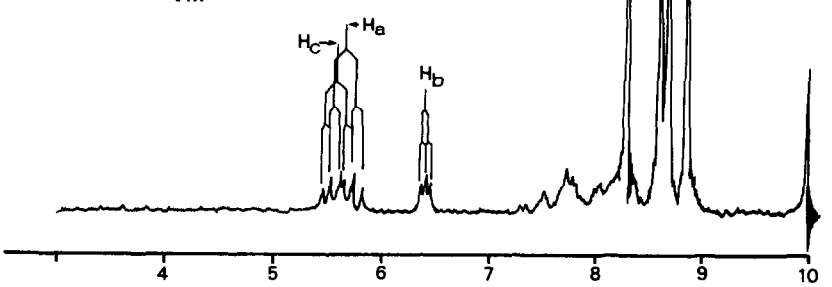


FIG. 1. 60 MHz PMR Spectrum of Caespitol.

The elemental analyses, mass-spectrometric and spectral data of all the compounds reported were in agreement with the structures shown.

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