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CONSTITUTION OF LASERPITINE - A SESQUITERPENIC COMPOUND FROM LASERPITIUM LATIFOLIUM L. ROOT

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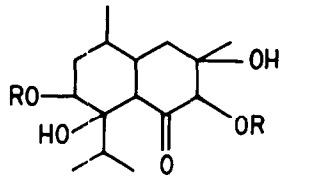
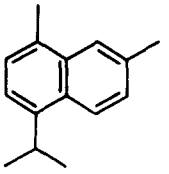
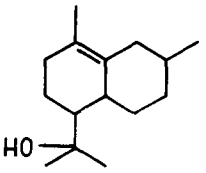
In a previous communication (1) we suggested structure I for laserpitine, a compound from Laserpitium latifolium L. root. The carbon skeleton was proposed on the basis of dehydrogenation of some laserpitine derivatives which afforded 1,7-dimethyl-4-isopropylnaphthalene (2) (daucalene (3)) (II). The unusual 1,7-dimethyl-4-isopropyldecaline skeleton was, at that time, considered, on the basis of dehydrogenation experiments as well, for the sesquiterpenic alcohol carotol (III) (4). Later however, there has been proved that carotol has structure IV (2, 5, 6) and carbon skeleton of 6,10-dimethyl-1-isopropylbicyclo-(0,3,5)-decane (daucane) (V). Thus the structure of laserpitine became doubtful and therefore we revised the structure I and arrived at new structure VI the carbon skeleton of which corresponded with that of carotol. The new structure is based on independent results obtained by chemical degradation and x-ray analysis.



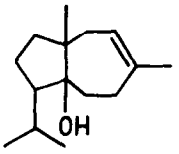
I. R=CO.C (CH_3)=CH.CH_3



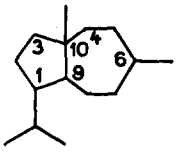
II.



III.



IV.



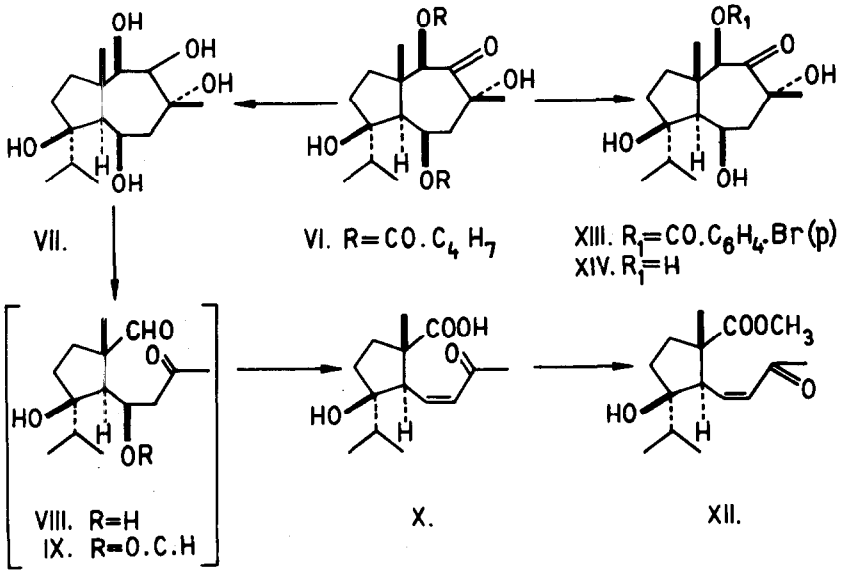
V.

From the chemical point of view, the most important sequence of reactions for elucidation of the structure of laserpitine was sodium periodate cleavage of dihydrolaserol (VII) (8) which afforded a mixture containing mainly dihydroxyketo aldehyde VIII and its formiate IX (Scheme I). This mixture was oxidized directly with potassium permanganate in alkaline medium to acid X ($C_{14}H_{22}O_4$, m.p. 120–122°C; UV-spectrum: λ_{max} 240 mu, log ε 4.17). The latter on oxidation with potassium permanganate in acidic medium yielded succinic acid. Mild hydrogenation of compound X led to saturated hydroxyketo acid which was converted into methyl ester $C_{15}H_{26}O_4$ (XI). The compound X according NMR spectrum contained isopropyl group (doublet,

9.08 τ, J = 6.4 cps), methyl group bound to quaternary carbon atom carrying carbonyl group (8.66 τ), methyl group attached to carbonyl group (7.72 τ) conjugated with disubstituted double bond (trans, doublet at 3.86 τ, J = 16.5 cps and quartet at 9.01 τ, J = 9.5 cps and J = 16.5 cps); in α-position to the double bond is a carbon atom with one proton (doublet, 6.88 τ, J = 9.0 cps).

From the above mentioned follows that cleavage of the vicinal triol dihydrolaserol (VII) (cf. Scheme I) leads to formic acid on one side (1) and to formation of an aldehydic group on the other; the latter was then converted into carboxyl group (compound X). The carboxyl group, according to NMR spectrum is bound to quaternary carbon atom carrying methyl group. Finally the tertiary hydroxyl group of the triol afforded methyl ketone, the carbonyl group of which was in β-position to hydroxyl group. The latter in alkaline medium is splitt off under formation of a double bond, disubstituted according to NMR spectrum; this corroborates the original hydroxyl group to be secondary in character. The presence of methyl keto group in compound X is in accordance also with the infra-red maxima of methyl ester of saturated hydroxyketo acid XI (ν 1356 cm^{-1}).

All the facts discussed above indicate that one of the two dihydrolaserol rings (VII) and namely that which contains the three vicinal hydroxyl groups must have at least seven carbon atoms. Therefore, for carbon skeleton of dihydrolaserol (and laserpitine as well) the 1,7-dimethyl--4-isopropyl decaline cannot be taken as we had assumed previously (1), but as a product formed by rearrangement.



Scheme I.

As dehydrogenations of a series of laserpitine derivatives yielded, besides daucalene (II), also a certain amount of azulenic products, we assume that the original carbon skeleton, like that of carotol (2), is bicyclo-(0,3,5)--decane and the location of its substituents facilitates relatively easy rearrangement into daucalene (II).

On the basis of the above facts and mainly of the location of methyl groups in compound X, we arrived at daucane carbon skeleton (V) as the most probable one for laserpitine and considering the previously reported data (1) also at complete structure VI.

The x-ray analysis of p-bromobenzoyllaserol (XIII; $C_{22}H_{29}O_6Br$, m.p. 90°C)(7) corroborates fully this assumption. The bromo derivative was prepared from laserol (XIV) and p-bromobenzoyl bromide; the x-ray analysis proved unambiguously structure XIII for the bromo derivative. In view of the previously reported relationship between laserol and laserpitine (1) and behaviour of the latter towards chromium trioxide (1), laserpitine has structure VI even according to x-ray analysis. The relative configurations in the formulae follow from x-ray analysis as well (7).

This work is hoped to be published in full detail in Collection of Czechoslovak Chemical Communications.

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