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# A NOVEL SYNTHESIS OF 3-PHENYL-4-HYDROXY-COUMARINS

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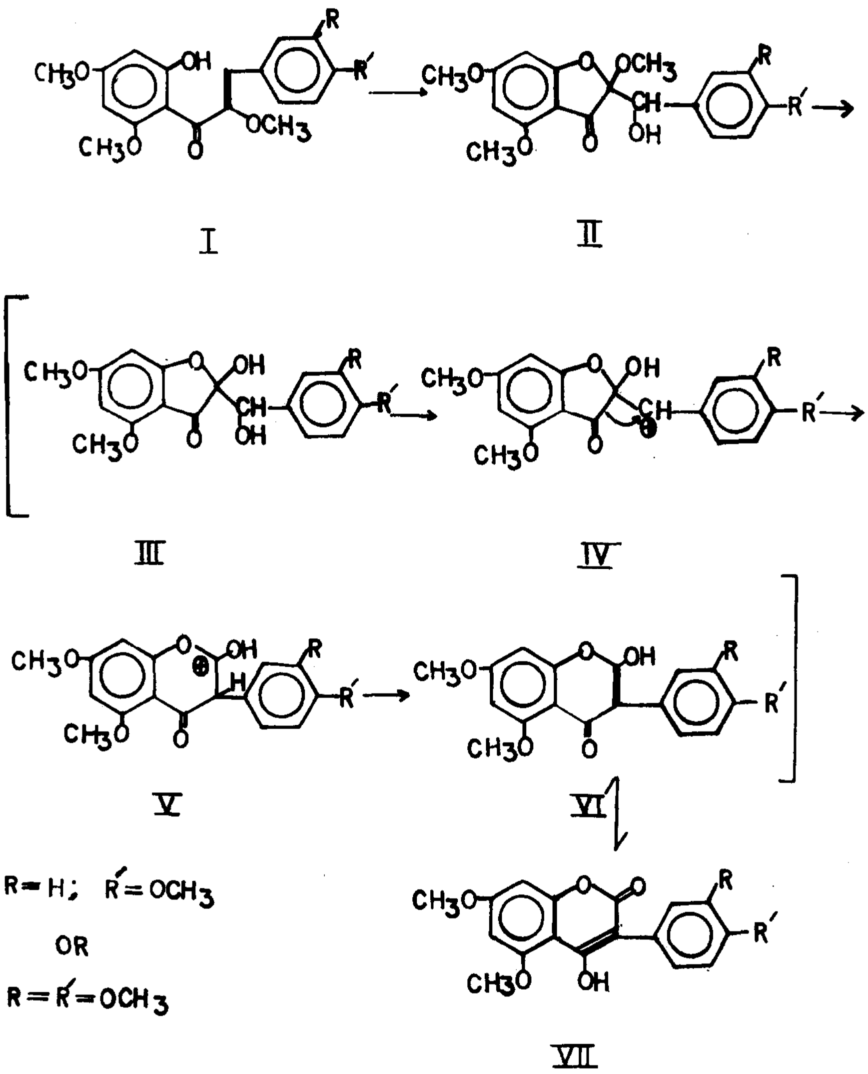
Though 3-phenyl 4-hydroxycoumarins had earlier been known synthetically[1], they have been discovered in Nature only recently. Three sources have so far been found to contain these compounds and some of them provide a mixture of as many as five components[2]. A species of Lonchocarpus yielded the first member called lonchocarpic acid; significantly other species yield rotenone[3,4]. The roots of Derris scandens contain scandenin, lonchocarpic acid, robustic acid, chandanin and nallanin. Similarly D. robusta yields a mixture; besides robustic acid, known earlier, Ollis[5] has isolated five other members of this series from these roots and designated them DR-5, DR-6 etc. Earlier one of these compounds viz. scandenin had been considered to be a 3-substituted flavanone derivative[6] but as a result of n.m.r. and mass spectral and degradative studies[7-9], they have now been found to be 3-phenyl 4-hydroxycoumarins. These are acidic substances and are rather stable to alkali hydrolysis. They are also tautomeric with 2-hydroxyisoflavonols (see VI and VII).

The method of synthesis that has been used for such compounds is to incorporate a single carbon atom in the form of either ethyl carbonate or alkyl chloroformate with the appropriate o-hydroxydesoxybenzoin[1]. During a recent study of the products obtained by oxidation of 2'-hydroxy-α-methoxychalkones (I) with alkaline hydrogen peroxide[10], an important rearrangement has been noted which affords 3-phenyl-4-hydroxycoumarins in very good yields and the results are reported briefly here.

In an earlier publication[10], it was noted that oxidation of 2'-hydroxy-α-methoxychalkones (I) with alkaline hydrogen peroxide yields invariably 2-methoxy-2-(α-hydroxy) benzyl coumaran-3-ones (II). When these compounds (II) are treated with boron trifluoride etherate in benzene medium, the products are only the corresponding 3-phenyl-4-hydroxy coumarins (VII). The possible mechanism of the change is indicated below.



R = H; R′ = OCH$_3$

OR

R = R′ = OCH$_3$

The molecule (II) being a ketal undergoes in the presence of acid ready demethylation to give (III) which being a benzylic alcohol in turn loses hydroxyl anion in favourable cases giving a carbonium ion (IV). Subsequent rearrangement gives first (V) and then the isoflavonol structure (VI) which is tautomeric to 3-phenyl 4-hydroxycoumarin (VII). This mechanism is similar to that of the rearrangement of chalkone epoxides to isoflavone derivatives. The analogy is supported by the fact that just as with 2'-benzyloxychalkone epoxides with the same reagent[11], the present rearrangement does not occur when there is no substituent in the ring B. Thus 2,4,6-trimethoxy-2-(α-hydroxy)-benzyl coumaran-3-one (II, R=R'=H) gave only 2-hydroxy-4,6-dimethoxy 2-(α-hydroxy)-benzyl coumaran-3-one (III, R=R'=H).

The above rearrangement thus affords a novel synthesis of 3-phenyl 4-hydroxycoumarins starting from chalkones. The only limitation is that the ring B should be substituted, as mentioned above.

This fact emphasises the important role of chalkones and dihydroflavonols in the biogenesis of flavonoids as mentioned earlier by Seshadri[12]. Just as α-methoxychalkone, the related α-hydroxychalkone which is equivalent to the corresponding dihydroflavonol can also react similarly yielding 2-hydroxy-2-(α-hydroxy)-benzyl coumaran-3-one which would undergo the reaction mentioned in this paper to yield 3-phenyl-4-hydroxycoumarin.

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