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SYNTHESIS OF SOME NATURALLY OCCURRING PRENYLATED JUGLONE DERIVATIVES

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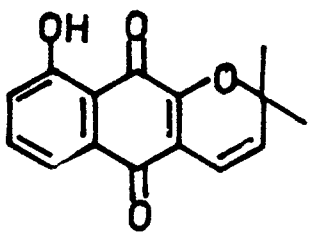
Abstract Synthesis of ∝-caryopterone (I), ∝-dihydrocaryopterone (II), 9-methoxy-∝-lapachone (III) and 4,9-dihydroxy-∝-lapachone (IV) has been carried out starting from juglone via 2,8-dihydroxy-1,4-naphthoquinone.

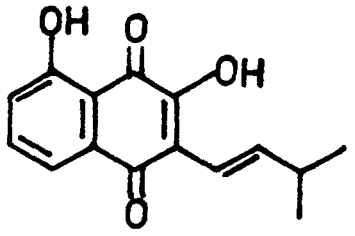
Matsumoto et al.[1] reported the isolation of a prenylated juglone derivative, ∝-caryopterone (I) (= 9-hydroxy-dehydro-∝-lapachone), from Caryopteris clandonensis. Later, Inouye et al.[2] isolated three more prenylated juglone derivatives from Catalpa ovata wood which were characterised to be ∝-dihydrocaryopterone (II) (= 9-hydroxy-∝-lapachone), 9-methoxy-∝-lapachone (III) and 4,9-dihydroxy-∝-lapachone (IV). All the above structures were based on the spectral data. In this paper we report the synthesis of these naturally occurring compounds.

1,5-Dihydroxynaphthalene was oxidised with chromic acid[3] to 5-hydroxy-1,4-naphthoquinone (juglone) (V), which on treatment with chlorine yielded 2-chloro-8-hydroxy-1,4-naphthoquinone[4] (VI). Treatment of VI with alcoholic sodium hydroxide converted it to 2,8-dihydroxy-1,4-naphthoquinone[5] (VII). VII was then condensed with isovaleraldehyde in presence of hydrochloric acid and acetic acid when it afforded 2,8-dihydroxy-3-(3-methyl-but-1-enyl)-1,4-naphthoquinone (VIII). Oxidative cyclisation of VIII with dichlorodicyanobenzoquinone (DDQ) afforded three compounds, viz., 2-isopropylfurano-8-hydroxy-1,4-naphthoquinone (IX), 9-hydroxy-dehydro-∝-lapachone (I) and 2-isopropylfurano-6-hydroxy-1,2-naphthoquinone (X). I was found to be the major. I was then catalytically hydrogenated using palladium charcoal as the catalyst when it yielded another naturally occurring compound, i.e., 9-hydroxy-∝-lapachone (II). Methylation of II with dimethylsulfate, potassium carbonate and acetone method yielded 9-methoxy-∝-lapachone (III). For the synthesis of 4,9-dihydroxy-∝-lapachone (IV), compound II was treated with N-bromosuccinimide when it underwent allylic bromination to yield 4-bromo-9-hydroxy-∝-lapachone (XI) which on hydrolysis with aqueous acetone gave IV. The structure of IV was confirmed by converting it into I by dehydration with p-toluene sulphonic acid.

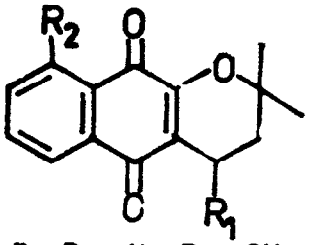
The structures of the these compounds were based on spectral data (IR, UV and NMR) and were found to be identical with the data mentioned in the literature for their respective naturally occurring compound. Direct comparison (m.m.p. and co-TLC) of II and III with their respective natural samples further proved their structures.



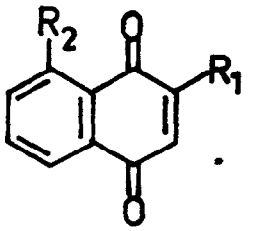
I



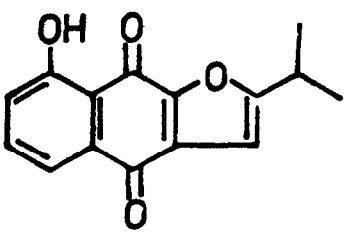
VIII



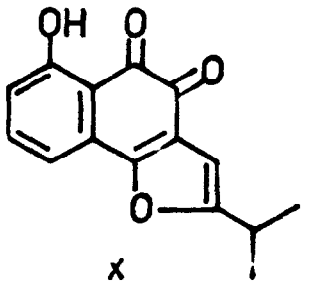
II. R_1 = H, R_2 = OH
III. R_1 = H, R_2 = OCH_3
IV. R_1 = R_2 = OH
XI. R_1 = Br, R_2 = OH



V. R_1 = H, R_2 = OH
VI. R_1 = Cl, R_2 = OH
VII. R_1 = R_2 = OH



IX



X

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