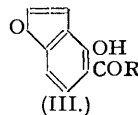
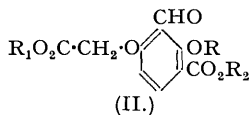
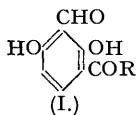


29. *Furano-compounds. Part VI. A Synthesis of Karanjic Acid.*

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Cyclisation of the dibasic acid (II; R, R₁, and R₂ = H) gave rise to karanjic acid (III; R = OH) and its acetate. A synthesis of the ketone (III; R = CH₂·OMe) could not be effected by this route.

THE experiments described in the present communication, leading to a new direct synthesis of karanjic acid (III; R = OH) (cf. Limaye, *Rasayanam*, 1936, 14), an important degradation product of the furanoflavone, karanjin, were carried out in the course of studies on a complete synthesis of the latter compound. When it was found that the ketone (III; R = CH₂·OMe) required for the synthesis of the flavone could not be obtained by the application of the standard methods to karanjol it became clear that the most feasible route was by way of karanjic acid, a procedure which has since been described by Seshadri and Venkateswarlu (*Proc. Indian Acad. Sci.*, 1941, 13, 404).



Interaction of (I; R = OMe) with ethyl bromoacetate, in boiling acetone containing potassium carbonate, gave rise to (II; R = H, R₁ = Et, R₂ = Me) with smaller amounts of (II, R = CH₂·CO₂Et, R₁ = Et, R₂ = Me) which was unexpected in view of the resistance of similar compounds to complete alkylation by this method (*e.g.*, Curd and Robertson, *J.*, 1933, 437). When ethyl bromoacetate was replaced by benzyl bromide both *mono-* and *di-benzyl ethers* were formed. On being heated with acetic anhydride and sodium acetate the dibasic acid (II; R, R₁, and R₂ = H) formed by the hydrolysis of (II; R = H, R₁ = Et, R₂ = Me) was converted into a mixture of *O-acetylkaranjic acid* and karanjic acid (III; R = OH), identical with the natural material. It was found that this procedure for the production of

karanjic acid could not be applied to the direct synthesis of the ketone (III; $R = CH_2 \cdot OMe$) from (I; $R = CH_2 \cdot OMe$) because the latter was not formed from ω -methoxyresacetophenone by Gattermann's method although under the same conditions resacetophenone gives good yields of (I; $R = Me$) (cf. Shah and Shah, *J.*, 1939, 133).

EXPERIMENTAL.

Benzylation of 2:6-dihydroxy-3-carbomethoxybenzaldehyde (Shah and Laiwalla, *J.*, 1938, 1828) 3 g.) with benzyl bromide (2.5 g.; 1.3 mols.) and potassium carbonate (5 g.) in boiling acetone for 4 hours gave a mixed product which, by means of ether and dilute aqueous sodium hydroxide, was separated into 2-hydroxy-3-carbomethoxy-6-benzoyloxy- and 3-carbomethoxy-2:6-dibenzoyloxy-benzaldehyde. The monobenzyl ether separated from alcohol in needles (0.5 g.), m. p. 118°, having a dark red ferric reaction in alcohol (Found: C, 66.9; H, 4.8. $C_{16}H_{14}O_5$ requires C, 67.1; H, 4.9%) and gave a 2:4-dinitrophenylhydrazone, forming orange needles, m. p. 230°, from ethyl acetate (Found: N, 12.2. $C_{22}H_{18}O_8N_4$ requires N, 12.0%). On hydrolysis with dilute aqueous sodium hydroxide this ether gave 2-hydroxy-3-carboxy-6-benzoyloxybenzaldehyde, forming clusters of needles, m. p. 168°, from aqueous acetone (Found: C, 66.2; H, 4.5. $C_{15}H_{12}O_6$ requires C, 66.2; H, 4.4%).

Crystallised from ethyl acetate, the dibenzyl ether was obtained in elongated prisms (0.5 g.), m. p. 105°, having a negative ferric reaction (Found: C, 73.7; H, 5.4. $C_{23}H_{20}O_5$ requires C, 73.4; H, 5.3%); it gave a 2:4-dinitrophenylhydrazone, forming clusters of orange-red needles, m. p. 185°, from ethyl acetate (Found: N, 10.3. $C_{23}H_{24}O_8N_4$ requires N, 10.1%).

The solid potassium salts remaining after the filtration of the acetone solution of the mixed product gave unchanged 2:6-dihydroxy-3-carbomethoxybenzaldehyde (1.8 g.) on treatment with dilute hydrochloric acid.

3-Hydroxy-2-formyl-4-carboxyphenoxyacetic Acid (II; R, R_1 , and $R_2 = H$).—A mixture of 2:6-dihydroxy-3-carbomethoxybenzaldehyde (3 g.), ethyl bromoacetate (2 ml.; 1.1 mols.), potassium carbonate (6 g.), and acetone (200 ml.) was refluxed for 6 hours and the acetone containing a flocculent yellow product was decanted from the potassium salts. On being treated with dilute hydrochloric acid this yellow solid gave ethyl 3-hydroxy-2-formyl-4-carbomethoxyphenoxyacetate (II; $R = H, R_1 = Et, R_2 = Me$) which formed elongated rectangular prisms (2 g.), m. p. 87°, from aqueous acetone, having a violet red ferric reaction in alcohol (Found: C, 55.4; H, 4.9. $C_{13}H_{14}O_7$ requires C, 55.3; H, 5.0%). The 2:4-dinitrophenylhydrazone separated from alcohol in clusters of orange needles, m. p. 195° (Found: N, 12.3. $C_{19}H_{18}O_{10}N_4$ requires N, 12.1%). Hydrolysis of this ester (2 g.) with 4% aqueous sodium hydroxide (30 ml.) on the steam-bath for 5 minutes gave the dibasic acid which separated from water in small glistening plates (1.6 g.), m. p. 240° (decomp.), having a dark red ferric reaction in alcohol (Found: C, 50.0; H, 3.5. $C_{10}H_8O_7$ requires C, 50.0; H, 3.3%).

Concentration of the acetone filtrate from the flocculent solid left a viscous oil which did not solidify. A solution of this in ether was washed with dilute sodium hydroxide, dried, and evaporated, leaving an oil which did not give a ferric reaction, appeared to be mainly (II; $R = CH_2 \cdot CO_2Et, R_1 = Et, R_2 = Me$), and was characterised by the formation of a 2:4-dinitrophenylhydrazone, forming clusters of orange needles, m. p. 168°, from alcohol (Found: C, 50.0; H, 4.4; N, 10.4. $C_{23}H_{24}O_{12}N_4$ requires C, 50.4; H, 4.4; N, 10.2%).

Karanjic Acid (III; $R = OH$).—A mixture of the acid (II; R, R_1 , and $R_2 = H$) (8 g.), acetic anhydride (80 ml.), and sodium acetate (20 g.) was refluxed for 1.5 hours and treated with excess of water. Next day a small amount of brown solid was removed by filtration and the liquid treated with sodium hydrogen carbonate (80 g.) and repeatedly extracted with ether. Evaporation of the combined dried extracts left a mixture of karanjic acid and its acetate which were separated by trituration with cold alcohol. Crystallisation of the residual solid from aqueous acetic acid gave the acetate in colourless, elongated prisms (1 g.), m. p. 173°, having a negative ferric reaction (Found: C, 60.1; H, 3.7. $C_{11}H_8O_5$ requires C, 60.0; H, 3.6%). Concentration of the alcoholic washings of the acetate yielded karanjic acid which formed colourless rectangular prisms (2 g.), m. p. 218° (decomp.), from aqueous alcohol, having a blue ferric reaction, identical with a specimen obtained by hydrolysis of the acetate (Found: C, 60.9; H, 3.4. Calc. for $C_9H_6O_4$: C, 60.7; H, 3.4%).

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