

# THE PREPARATION AND PROPERTIES OF 4-PHENYLACETYL-RESORCINOL AND 4-PHENYL- ACETYL-PYROGALLOL

BY K. S. BHUMGARA, R. D. DESAI AND W. S. WARAVDEKAR

(From the Department of Chemical Technology and the Chemistry Department,  
St. Xavier's College, Bombay)

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IN course of his preparation of C-alkyl and C-alkaryl-resorcinols for the study of antiseptic action, Klarmann<sup>1</sup> prepared 4-phenylacetyl resorcinol by Hoesch's method.<sup>2</sup> We now find that the same hydroxy-ketone can be most conveniently prepared either by the application of Nencki or the Friedel Crafts Reaction. As the chemical properties of this substance do not appear to have been studied, we have examined them in detail. The ketone gave readily the 4-nitrophenyl hydrazone, 2:4-dinitrophenyl hydrazone, diacetyl and dibenzoyl derivatives. Bromination gave the mono—as well as the dibromo-derivatives, and as they were unaffected by heating with alkali solution, the halogen atoms were present in the nucleus. Nitration gave the mono-nitro-derivative while the Clemmensen reduction gave 4-B-phenylethyl resorcinol. Kostanecki acetylation gave the mixture of 7-hydroxy-2-methyl-3-phenyl-chromone and its 7-acetyl derivative, and the original ketone was obtained on its alkaline hydrolysis. It was not possible to prepare 2:4- or 4:6-di-phenylacetyl-resorcinol by the application of the Friedel-Crafts Reaction to 4-phenyl-acetyl resorcinol.

4-Phenylacetyl-pyrogallol which was prepared by the identical method behaved similarly, in most of the reactions, and its derivatives are also described.

## EXPERIMENTAL

### A. *Condensation of Resorcinol with phenylacetic acid. Preparation of 4-phenyl-acetyl-resorcinol by Nencki's method.*

An intimate mixture of resorcinol (20 gm.) phenyl acetic acid (30 gm.) and powdered anhydrous zinc chloride (20 gm.) was heated in an oil-bath at 120° C. for two and half hours and then poured in acidulated ice-cold water. The product was purified through alkali and crystallised from alcohol in lustrous, long needles m.p. 115-116° (depressed by resorcinol to 90° C.) (Yield = 70 per cent).

Its alcoholic solution gave red coloration with aqueous ferric chloride. It was soluble in usual organic solvents. (Found: C, 73.0; H, 5.3; Calc. for C<sub>14</sub>H<sub>12</sub>O<sub>2</sub>; C, 73.2; H, 5.3 per cent.)

By Friedel and Crafts method.

Solutions of resorcinol (20 gm.) in nitrobenzene (60 c.c.) and of phenylacetyl chloride (30 gm.) in nitrobenzene (30 c.c.) were alternately added to a cooled solution of anhydrous aluminium chloride (20 gm.) in nitrobenzene (100 c.c.). The reaction mixture was kept at room temperature for 48 hours, decomposed and steam distilled. The product obtained was purified and crystallised from alcohol in long lustrous needles m.p. 115-116° C. Undepressed by 4-phenyl-acetyl-resorcinol prepared by the previous method (yield = 60 per cent).

*p*-nitrophenyl hydrazone of 4-phenyl-acetyl-resorcinol was prepared by heating the ketone (0.5 gm.) with *p*-nitro-phenyl hydrazine (0.5 gm.) in alcohol (30 c.c.) on water-bath under reflux for six hours. The alcoholic solution on cooling gave short, orange-red needles m.p. 220° C. (Found: N, 11.4;  $C_{20}H_{17}O_4N_3$  requires N, 11.6 per cent.)

2:4-Dinitrophenyl hydrazone of 4-phenyl acetyl-resorcinol.—A mixture of the ketone (0.5 gm.) and 2:4-dinitrophenyl-hydrazine (0.5 gm.) dissolved in acetic acid (20 c.c.) was heated on sand-bath under reflux for six hours. The product crystallised in small, orange red needles m.p. 189-191° C. depressed by 2:4-dinitrophenyl-hydrozine to 158° C. (Found: N, 13.4;  $C_{20}H_{16}N_4O_6$  requires N, 13.7 per cent.)

1:3-diacetoxy-4-phenyl-acetyl-resorcinol was prepared by heating a mixture of 4-phenyl-acetyl resorcinol (1 gm.) and acetic anhydride (4 c.c.) with a drop of pyridine on sand-bath for three hours and then pouring on powdered ice. The separated solid crystallised from acetic acid in yellow, short needles m.p. 114° C., depressed by the original ketone to 77° C. Its alcoholic solution gave no coloration with ferric chloride (Found: C, 69.9; H, 4.9;  $C_{18}H_{16}O_5$  requires C, 69.2 × H, 5.1 per cent.)

1:3-Di-benzoyl-4-phenyl-acetyl resorcinol was prepared by treating a solution of 4-phenyl acetyl-resorcinol (2 gm.) in sodium hydroxide (10%; 80 c.c.) with benzoyl chloride (5 c.c.) gradually with constant stirring. The separated solid crystallised from acetic acid in fine needles m.p. 95-96° C. (Found: C, 76.9; H, 4.3;  $C_{28}H_{20}O_5$  requires C, 77.1; H, 4.6 per cent.)

Bromination of 4-phenylacetyl-resorcinol with one mol. of Bromine-Preparation of 6-Bromo-4-phenylacetyl-resorcinol.—4-phenyl acetyl resorcinol (1 gm.) was dissolved in acetic acid (20 c.c.) and bromine (0.25 c.c.) in acetic acid (10 c.c.) was added drop by drop with constant shaking. The mixture was kept at room temperature for 24 hours and then poured in ice-cold water. The yellow solid crystallised from alcohol in yellowish,

short needles m.p. 103° C. (Found : Br., 25.9;  $C_{14}H_{11}O_3$ . Br. requires Br. 26.1 per cent.)

*Bromination with two mols. of Bromine-Preparation of 2:6-dibromo-4-phenyl acetyl-resorcinol.*—A solution of bromine (0.5 c.c.) in acetic acid (10 c.c.) was gradually added to the cold solution of 4-phenyl-acetyl-resorcinol (1 gm.) in acetic acid (40 c.c.). The product obtained on keeping the reaction for 48 hours crystallised from chloroform in short, orange needles m.p. 180° C. (Found: Br., 41.0;  $C_{14}H_{10}O_3$ .  $Br_2$  requires Br. 41.3 per cent.)

The mono as well as the dibromo-derivatives were unaffected by heating with 10 per cent. alkali solution.

*Nitration of 4-phenyl-acetyl-resorcinol with one mol. of fuming nitric acid and preparation of 6-nitro-4-phenyl-acetyl-resorcinol.*—Solution of fuming nitric acid (d = 1.5; 0.4 c.c.) in acetic acid (5 c.c.) was gradually added, with constant shaking to an ice-cold solution of 4-phenyl-acetyl-resorcinol (2 gm.) in acetic acid (30 c.c.). The reaction mixture was kept for 48 hours and then poured in water. The reddish orange solid crystallised from alcohol in small, yellow needles m.p. 156–157° C. (Found: N, 5.6;  $C_{14}H_{11}O_5N$  requires N, 5.7 per cent.)

*Clemmensen Reduction of 4-phenyl-acetyl-resorcinol-preparation of 4-(B-phenyl-ethyl)-resorcinol.*—A mixture of 4-phenyl-acetyl-resorcinol (2 gm.), amalgamated zinc (7 gm.) and hydrochloric acid (1:1; 60 c.c.) was heated on sand-bath under reflux for eight hours. The mixture on cooling was extracted with ether and the latter was shaken thrice with 5 per cent. solution of caustic soda. On acidifying the alkaline solution, a brown precipitate was obtained which crystallised from alcohol in pale-yellow needles m.p. 133–134° C.

Its alcoholic solution gave no coloration with ferric chloride. It was soluble in usual organic solvents. (Found : C, 78.3 H, 6.4;  $C_{14}H_{14}O_2$  requires C, 78.5 × H, 6.5 per cent.)

*Kostanecki Reaction of 4-phenyl-acetyl-resorcinol-Preparation of 7-hydroxy-2-methoxy-3-phenyl chromone and 7-acetoxy-2-methyl 3-phenyl chromone.*—A mixture of 4-phenyl-acetyl-resorcinol (3 gm.) anhydrous sodium acetate (3 gm.) and acetic anhydride (25 c.c.) was heated in an oil-bath at 180–190° C. for 16 hours. It was then poured in water and the solid was treated with 5% alkali. The alkali soluble product crystallised from alcohol in pale-yellow, lustrous needles m.p. 244–246° C. It was soluble in alcohol, benzene, acetic acid and acetone, and dissolved in concentrated sulphuric acid giving bluish-purple fluorescence. (Found: C, 75.9; H, 4.68;  $C_{16}H_{12}O_3$  requires C, 76.2; H, 4.82 per cent.)

The alkali insoluble product, crystallising from alcohol in shining needles m.p. 165–166° C. was *7-acetoxy-2-methyl-3-phenyl chromone*.—It dissolved in concentrated sulphuric acid giving bluish-purple fluorescence. (Found: C, 73.3; H, 4.6;  $C_{18}H_{14}O_4$  requires C, 73.5; H, 4.8 per cent.)

*Conversion of 7-acetoxy-2-methyl-3-phenyl chromone into 7-hydroxy-2-methyl-3-phenyl chromone*.—A solution of 7 acetoxy-2-methyl-3-phenyl-chromone (0.2 gm.) in concentrated sulphuric acid (5 c.c.) was allowed to stand overnight and poured over ice. The solid crystallised from alcohol in pale-yellow needles m.p. 244–246° C. undepressed by the pure sample of 7-hydroxy-2-methyl-3-phenyl-chromone.

*Hydrolysis of the chromone by 5 per cent. alkali*.—The above chromone (0.2 gm.) was refluxed with 5 per cent. sodium hydroxide (15 c.c.) on water-bath for three hours. The solution on acidification with hydrochloric acid gave a solid which crystallised from alcohol in long, yellow needles m.p. 115–116° C. undepressed by 4-phenyl acetyl-resorcinol.

*Bromination of 7-hydroxy-2 methyl-3-phenyl-chromone with one mol. of bromine and Preparation of diperbromide of 7-hydroxy-2-methyl-3-phenyl chromone*.—A solution of bromine (0.2 c.c.) in chloroform (10 c.c.) was gradually added to a cold solution of 7-hydroxy-2- methyl-3-phenyl chrome (1 gm.) in chloroform (30 c.c.) with constant shaking and kept overnight. The substance crystallised from chloroform in yellow needles m.p. 282–283° C. (Found: Br. 38.9;  $C_{16}H_{12}O_3$ .  $Br_2$  requires Br. 38.8 per cent.)

*Action of sulphur dioxide water on the di-perbromide of 7-hydroxy-2-methyl-3-phenyl-chromone*.—The above perbromide (0.2 gm.) was allowed to stand for 24 hours with an aqueous solution of sulphur dioxide (50 c.c.), filtered, and crystallised from chloroform in white needles m.p. 244–246° C. undepressed by 7-hydroxy-2-methyl 3-phenyl-chromone.

*Action of glacial acetic acid on di-perbromide of 7-hydroxy-2-methyl-3-phenyl-chromone*.—The dibromide (0.2 gm.) was heated with glacial acetic acid (10 c.c.) on water-bath under reflux for three hours. The solution was then poured in large quantity of water and the solid was crystallised from chloroform in white needles m.p. 282–283° C. undepressed by the original di-perbromide.

*B. Synthesis and properties of 4-phenylacetyl-pyrogallol 4-phenylacetyl-pyrogallol*.—prepared either by Nencki method (yield = 60 per cent.) or Friedel-crafts Method (yield = 50 per cent.) crystallised from alcohol in brown needles m.p. 144–145° C. Its alcoholic solution gave deep violet coloration with ferric chloride. (Found: C, 68.6; 4.8.  $C_{14}H_{14}O_4$  requires C, 68.8; H, 4.9 per cent.)

The 4-nitrophenyl hydrazone crystallised from alcohol in short, reddish needles m.p. 223–224° C. (Found: N, 10·8.  $C_{20}H_{17}O_5N_3$  requires N, 11·1 per cent.)

The 2:4-dinitrophenylhydrazone crystallised from alcohol in orange needles m.p. 242–244°. (Found: N, 12·4;  $C_{20}H_{16}O_7N_4$  requires N 12·2 per cent.)

The Triacetyl derivative crystallised from dilute acetic acid in short needles m.p. 140° (depressed by the original ketone to 120°). Its alcoholic solution did not give any coloration with ferric chloride. (Found: C, 64·6; H, 4·7.  $C_{20}H_{18}O_7$  requires C, 64·8; H, 4·8 per cent.)

The Tribenzoyl derivative crystallised from alcohol in needles m.p. 153–154°. (Found: C, 75·3; H, 4·1.  $C_{35}H_{24}O_7$  requires C, 75·6; H, 4·3 per cent.)

6-Bromo-4-phenylacetylpyrogallol crystallised from alcohol in pale-yellow needles m.p. 155–156° C. (Found: Br., 24·5.  $C_{14}H_{11}O_4$  Br. requires Br., 24·8 per cent.)

6-nitro-4-phenylacetyl pyrogallol crystallised from benzene in small, brown needles m.p. 179–180°. (Found: N, 4·6.  $C_{14}H_{11}O_6$  N requires N, 4·8 per cent.)

4-(*B*-phenyl-ethyl)-pyrogallol crystallised from alcohol in pale-yellow plates m.p. 137–138° (depressed to 105 by the original ketone). (Found: C, 72·7; H, 5·9.  $C_{14}H_{14}O_3$  requires C, 73·0; H, 6·1 per cent.)

7:8-dihydroxy-2-methyl-3-phenyl-chromone crystallised from alcohol in yellow needles m.p. 221–222°. It dissolved in concentrated sulphuric acid with red colour, and gave the original ketone on alkaline hydrolysis. (Found: C, 71·5; H, 4·3.  $C_{16}H_{12}O_4$  requires C, 71·7; H, 4·5 per cent.)

The Di-perbromide crystallised from chloroform in yellow needles m.p. 287–288°. It gave the original chromone on treatment with aqueous sulphurous acid, while its solution in glacial acetic acid remained unchanged on heating. (Found: Br., 37·2;  $C_{16}H_{12}O_2$  Br<sub>2</sub> requires Br., 37·4 per cent.)

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#### SUMMARY

The preparation and properties of 4-phenylacetyl-resorcinol and 4-phenyl-acetyl-pyrogallol have been described.

#### REFERENCE

1. Klarmann *J. Amer. Chem. Soc.*, 1926, 48, 791.