

## Furano Compounds. XIII \*)

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### Summary

The synthesis of 3-methyl-6,7-benzo-5'(4')-methyl furano-(2',3',1,2) xanthenes has been recorded.

The wide occurrence of phloroglucinol unit in natural products of physiological importance is well-known. The various furanobenzopyrones-coumarins and chromones which are shown by MUSAJO and RODIGHIERO<sup>1)</sup> to possess appreciable photodynamic activity are based on a phloroglucinol unit. Hence the synthesis of a large number of furanoxanthenes as analogues of the physiologically active pyrono compounds like khellin and visnagin has been carried out in these laboratories and the results recorded<sup>2)</sup>. All these are based on phloroglucinol unit. A fundamental nucleus other than phloroglucinol which is of significance in the evolution of natural products is that of orcinol. In recent years have been isolated hydroxyxanthenes based on an orcinol unit. Thus pinselin produced by a strain of penicillium amarum and isolated by MUNEKATA<sup>3)</sup> is a 1,7-dihydroxy-3-methyl xanthone derivative. It is quite possible that furanobenzoxanthenes based on an orcinol unit may be expected to be isolated from nature. Further such compounds may also be expected to possess photodynamic activity.

Hence in continuation of our work<sup>4)</sup> the synthesis of 3-methyl-6,7-benzo-5'-methyl furano (2',3',1,2) xanthone(III) and 3-methyl-6,7-benzo-4'-methyl furano (2',3',1,2) xanthone(IV) has been attempted and the results recorded. For the synthesis of III 2-hydroxy-3-naphthoic acid has been condensed with orcinol using zinc chloride and phosphorousoxychloride

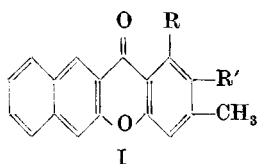
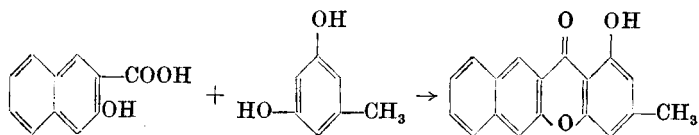
\*) Forms part of the material for the Ph. D. thesis to be submitted by A. NAGANAGOUND to the Karnatak University, Dharwar. S. India.

1) L. MUSAJO and G. RODIGHIERO, *Experientia (Basel)* **18**, 153 (1962).

2) Y. S. AGASIMUNDIN and S. RAJAGOPAL, Paper presented at the Indian Science Congress Session, January 1967.

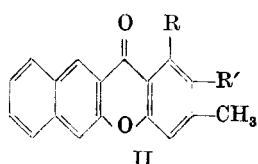
3) H. MUNEKATA, *F. Biochem.*, Tokyo **40**, 451 (1953).

4) A. NAGANAGOUND and S. RAJAGOPAL, *Tetrahedron* **23** (1967).



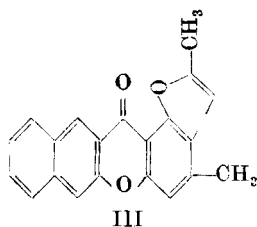
I

- I a, R, OH, R'H  
 b, RO-CH<sub>2</sub>-CH=CH<sub>2</sub>, R'H  
 c, ROH, R'CH<sub>2</sub>-CH=CH<sub>2</sub>  
 d, RCOCH<sub>3</sub>, R'CH<sub>2</sub>-CH=CH<sub>2</sub>  
 e, RCOCH<sub>3</sub>, R'CH<sub>2</sub>-CH-CH<sub>2</sub>  
   |          |  
   Br          Br

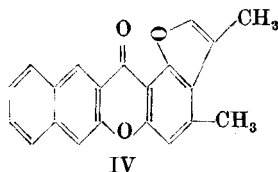


II

- II a, ROH, R'COCH<sub>3</sub>  
 b, RO-CH<sub>2</sub>-COOC<sub>2</sub>H<sub>5</sub>, R'COCH<sub>3</sub>



III



IV

to give 1-hydroxy-3-methyl-6,7-benzoxanthone (Ia). The formation of 1-hydroxy-3-methyl-6,7-benzoxanthone is based on the reactivity of  $\nu$ -position of orcinol molecule. This is arrived at by analogy<sup>5)</sup> and depends on the fact that Ia gives positive ferric chloride test indicating the orthohydroxy ketonic group. The alternate mode of reaction would have yielded a 3-hydroxy-1-methyl-6,7-benzoxanthone which gives negative ferric chloride test. This is also supported by infrared absorption at  $1600\text{ cm}^{-1}$  indicating hydrogen bonding. The next step is allylation of Ia with allylbromide in the presence of potassium carbonate and the allylether allowed to undergo claisen migration to yield 1-hydroxy-2-allyl-3-methyl-6,7-benzoxanthone. It has been acetylated to prevent any possible nuclear bromination in the subsequent step viz. addition of bromine. The resulting dibromocompound is heated with alcoholic potassium hydroxide resulting in simultaneous dehydrobromination and cyclisation to give the desired 5'-methyl furano (2',3',1,2)-3-methyl-6,7-benzoxanthone.

For the synthesis of  $\beta$ -methyl furanocompound the alternate method of furan ring building has been adopted. Thus Ia has been treated with acetyl-

<sup>5)</sup> V. V. KANE, A. B. KULKARNI and R. C. SHAH, J. Sci. Ind. Research 18 B, 28 (1959).

chloride in the presence of anhydrous aluminium chloride to yield the appropriate 2-acetyl derivative. This has been condensed with bromoacetic ester in presence of potassium carbonate to yield 1-O-carbethoxy derivative which on hydrolysis with aqueous sodium carbonate gives the corresponding carbonylic acid. The internal claisen condensation of the acid has been effected by sodium acetate and acetic anhydride to yield 4'-methyl furano (2', 3', 1, 2)-3-methyl-6, 7-benzoxanthone(IV), cyclisation and decarboxylation having occurred simultaneously.

## Experimental

### 1-Hydroxy-3-methyl-6,7-benzoxanthone (Ia)

2-Hydroxy-3-naphthoic acid (10 g), orcinol (10 g), freshly fused zinc chloride (30 g) and phosphorousoxychloride (70 ml) were heated at 60–70° for two hours. The mixture was cooled and poured into ice-water. The solid that separated was filtered, washed with aqueous sodium bicarbonate and with water. The xanthone crystallised from alcohol as yellow rods. m.p. above 300°.

(Found: C 77.75; H 4.6. Calc. for  $C_{18}H_{12}O_3$ ; C 78.27; H 4.34.)

### 1-Allyloxy-3-methyl-6,7-benzoxanthone (Ib)

The above xanthone (2 g) in acetone (200 ml) was treated with potassium carbonate (6 g) and allylbromide (4 ml) and the mixture was refluxed for twenty hours. The reaction product was filtered from the potassium salts and the solvent was removed from the filtrate. The residual allyloxy compound when crystallised from alcohol was obtained as colourless plates m.p. 133–134°.

(Found: C 79.75; H 5.06. Calc. for  $C_{21}H_{18}O_3$ ; C 79.75; H 4.7.)

### 2-Allyl-1-hydroxy-3-methyl-6,7-benzoxanthone (Ic)

1-Allyloxy-3-methyl-6,7-benzoxanthone (2 g) in freshly distilled diethyl aniline (20 ml) was refluxed for two hours. The cooled reaction mixture was acidified with dilute hydrochloric acid and after two hours the product was collected by filtration. It crystallised from alcohol as orange yellow rectangular plates m.p. 204–205°.

(Found: C 79.4; H 4.7. Calc. for  $C_{21}H_{18}O_3$ ; C 79.75; H 4.7.)

### 2-Allyl-1-acetoxy-3-methyl-6,7-benzoxanthone (Id)

2-Allyl-1-hydroxy-3-methyl-6,7-benzoxanthone (1 g), freshly fused sodium acetate (2 g) and acetic anhydride (10 ml) was refluxed for two hours. It was cooled and poured into ice-water. The solid was collected by filtration and crystallised from alcohol when acetoxy compound was obtained as yellow rectangular plates, m.p. 179–180°.

(Found: C 77.32; H 5.7. Calc. for  $C_{23}H_{18}O_4$ ; C 77.09; H 5.7.)

**2-(2',3'-dibromopropyl)-1-acetoxy-3-methyl-6,7-benzoxanthone (Ie)**

To a solution of 2-allyl-1-acetoxy-3-methyl-6,7-benzoxanthone (0.65 g) in chloroform (30 ml) a solution of bromine (0.28 g) in chloroform (15 ml) was added dropwise with stirring. After stirring for a further period of one hour, the solvent was removed. The residue was washed with alcohol and crystallised from alcohol and acetic acid as yellow long plates, m.p. 194—195°.

(Found: C 52.87; H 3.6. Calc. for  $C_{23}H_{28}O_4Br_2$ ; C 53.28; H 3.46.)

**5'-Methyl-furano-(2',3',1,2)-3-methyl-6,7-benzoxanthone (III)**

2-(2,3-dibromopropyl)-1-acetoxy-3-methyl-6,7-benzoxanthone (0.56 g) in a solution of potassium hydroxide (0.48 g) in alcohol (12 ml) was refluxed for two hours. After cooling, the reaction product was diluted with water, acidified with dilute hydrochloric acid and left overnight. The precipitate thus obtained was collected and washed with water. It crystallised from alcohol as pale yellow needles, m.p. 286—287°.

(Found: C 79.86; H 5.45. Calc. for  $C_{21}H_{14}O_3$ ; C 80.26; H 4.45.)

**2-Acetyl-1-hydroxy-3-methyl-6,7-benzoxanthone (IIa)**

A mixture of 1-hydroxy-3-methyl-6,7-benzoxanthone (2 g) in redistilled nitrobenzene (25 ml) and acetylchloride (1.6 g) was treated with aluminium chloride (5 g) in portions as rapidly as it dissolved. The reaction mixture was heated for three hours on a steam bath and kept at room temperature overnight. It was poured into ice-water containing hydrochloric acid and steam distilled. The solid residue when crystallised from alcohol was obtained as colourless needles, m.p. 227—228°.

(Found: C 75.06; H 4.6. Calc. for  $C_{20}H_{24}O_4$ ; C 75.48; H 4.40.)

**Ethyl-2-acetyl-3-methyl-6,7-benzo-9-oxo-1-xanthoxy-acetate (IIb)**

2-Acetyl-1-hydroxy-3-methyl-6,7-benzoxanthone (1 g) in acetone (50 ml) was treated with bromoacetic ester (1 g) and potassium carbonate (3 g) and the mixture refluxed for twenty hours. The reaction product was filtered from potassium salts and the solvent was removed from the filtrate. The residue on crystallisation from rectified spirit was obtained as colourless needles, m.p. 203—204°.

(Found: C 70.80; H 6.00. Calc. for  $C_{24}H_{20}O_6$ ; C 71.29; H 4.95.)

**4'-Methyl-furano-(2',3',1,2)-3-methyl-6,7-benzoxanthone (IV)**

a) Ethyl-2-acetyl-3-methyl-6,7-benzo-9-oxo-1-xanthoxy-acetate (1 g) in acetone (60 ml) was refluxed with sodium carbonate (30 ml, 5%) for five hours. The solution after cooling was acidified with dilute hydrochloric acid and acetone was removed under reduced pressure. The residue in the flask was treated with water, filtered and further purified by dissolving in aqueous sodium bicarbonate and reprecipitating with dilute hydrochloric acid.

b) The above acid (0.5 g) in acetic anhydride (4 ml) and freshly fused sodium acetate (1 g) were heated under reflux for two hours. The reaction product was diluted with water and the precipitate thus obtained was filtered and treated with sodium bicarbonate solu-

tion. It was filtered and washed with water. On crystallisation from alcohol 4'-methyl furano (2',3',1,2)-3-methyl-6,7-benzoxanthone was obtained as colourless needles, m.p. 200–202°.

(Found: C 79.76; H 5.0. Calc. for  $C_{21}H_{14}O_3$ ; C 80.26; H 4.45.)

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