Preparation of Some 6-Substituted 2,2-Dimethyl- and 2,2- and 2,4-Diphenyl-naphtho[1,2-*b*]pyrans

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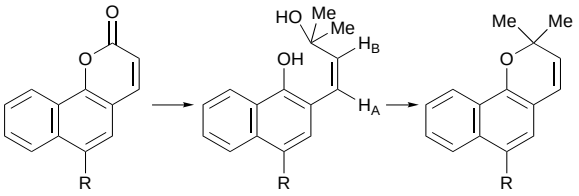
6-Chloro-, 6-bromo-, and 6-methyl-2,2-dimethyl-, and -2,2- and -2,4-diphenyl-naptho[1,2-*b*]pyrans are prepared from the appropriate 4-substituted 2*H*-naphtho[1,2-*b*]pyran-2-ones and either methylmagnesium iodide or phenylmagnesium bromide; some related compounds and derivatives are also prepared and dimerisation of cylized products from the methylmagnesium iodide reactions affords dimers including a relative of isolapachenole through addition reactions of the intermediate carbonium ion.

Decomposition of the respective Grignard complex obtained from 6-chloro-, 6-bromo- and 6-methyl-2*H*-naphtho[1,2-*b*]pyran-2-ones (**1**, **2** and **3**) and methylmagnesium iodide with an aqueous solution of ammonium chloride afforded the corresponding 3-(4-chloro-, 4-bromo- and 4-methyl-1-hydroxynaphthalen-2-yl)-1,1-dimethylprop-2-en-1-ols (**4**, **5** and **6**), all of which decomposed on standing. The structure of the diols **4**, **5** and **6** was supported by ^{1}H NMR spectral data.

The diols **4**, **5** and **6** were dehydrated and cyclized in boiling acetic acid to furnish the 6-chloro- and 6-bromo-2,2-dimethyl-2*H*-naphtho[1,2-*b*]pyrans (**7** and **8**) and the 2,2,6-trimethyl-2*H*-naphtho[1,2-*b*]pyran (**9**), respectively.

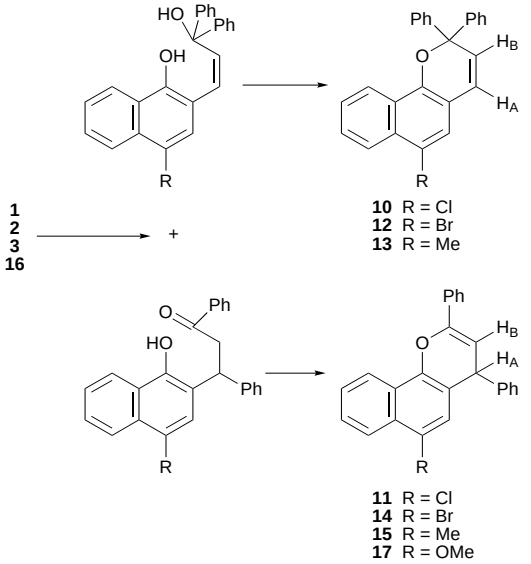


1 R = Cl
2 R = Br
3 R = Me
16 R = OMe

4 R = Cl
5 R = Br
6 R = Me

7 R = Cl
8 R = Br
9 R = Me

Treatment of 6-chloro-2*H*-naphtho[1,2-*b*]pyran-2-one (**1**) with phenylmagnesium bromide, followed by decomposition of the Grignard complex with aqueous ammonium chloride solution, yielded a gum, which on boiling in acetic acid furnished 6-chloro-2,2-diphenyl-2*H*-naphtho[1,2-*b*]pyran (**10**) and 6-chloro-2,3-diphenyl-4*H*-naphtho[1,2-*b*]pyran (**11**). Compounds **10** and **11** were thus formed *via* the initial 1,2- and 1,4-addition of the Grignard reagent to the 6-chloro-naphthopyran-2-one (**1**). Similarly 6-bromo- and 6-methyl-2*H*-naphtho[1,2-*b*]pyran-2-ones (**2** and **3**) afforded the respective 6-substituted 2,2-diphenyl-2*H*-naphtho[1,2-*b*]pyrans (**12** and **13**) and the 2,4-diphenyl-4*H*-naphtho[1,2-*b*]pyrans (**14** and **15**). Decomposition of the Grignard complex from 6-methoxy-2*H*-naphtho[1,2-*b*]pyran-2-one (**16**) gave a dark red gum, which on boiling in acetic acid afforded a small yield of 6-methoxy-2,4-diphenyl-4*H*-naphtho[1,2-*b*]pyran



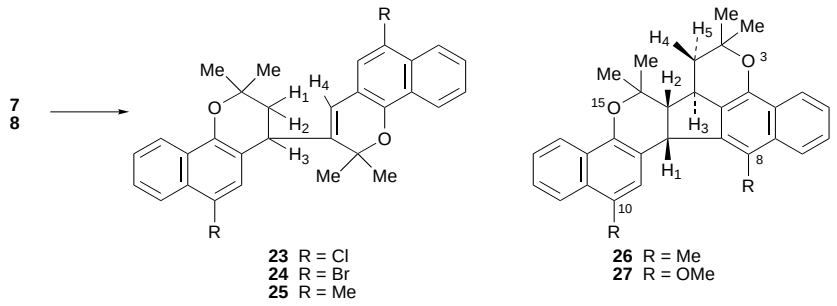
1
2
3
16

10 R = Cl
12 R = Br
13 R = Me

11 R = Cl
14 R = Br
15 R = Me
17 R = OMe

(**17**). The structures of the above compounds were supported by ^{1}H NMR spectral data.

Treatment of 6-chloro- and 6-bromo-2,2-dimethyl-2*H*-naphtho[1,2-*b*]pyrans (**7** and **8**) in acetic acid with a few drops of sulfuric acid gave, after 2 days standing, the dimers 6-chloro/bromo-3,4-dihydro-2,2-dimethyl-4-(6-chloro/bromo-2,2-dimethyl-2*H*-naphtho[1,2-*b*]pyran-3-yl)-2*H*-naphtho[1,2-*b*]pyrans (**23** and **24**), respectively. The same treatment of 2,2,6-trimethyl-2*H*-naphtho[1,2-*b*]pyran (**9**) furnished a mixture (*ca.* 1:1) of two dimers, separated by fractional crystallization. They were identified as 3,4-dihydro-2,2,6-trimethyl-4-(2,2,6-trimethyl-2*H*-naphtho[1,2-*b*]pyran-3-yl)-2*H*-naphtho[1,2-*b*]pyran (**25**) and 6,6a,6b,7,8,14b-hexahydro-6,6,8,8,14,16-hexamethyldibenzo[*h*,*h'*]cyclopenta[1,2-*c*:5,4,3-*d'e'*]bis[1]benzopyran (**26**). The structure of dimer **26** was verified by comparing its ^{1}H NMR spectrum



7
8

23 R = Cl
24 R = Br
25 R = Me

26 R = Me
27 R = OMe

and mass spectrum with those of isolapachenole (**27**),[1] the dimer of 6-methoxy-2,2-dimethyl-2*H*-naphtho[1,2-*b*]pyran (lapachenole).

The mechanism for the formation of dimers **23**, **24** and **25** is probably similar to that for the dimerization of 3,3,10-trimethyl-3*H*-naphtho[2,1-*b*]pyran.[2] It is, therefore, proposed

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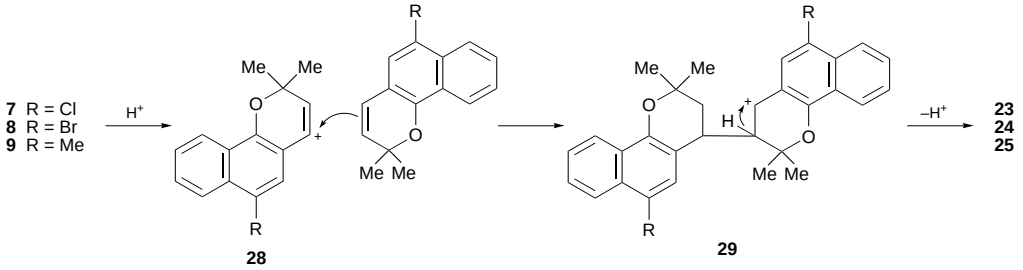
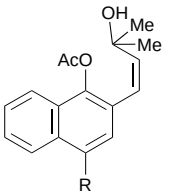


that the olefinic bond of the pyran ring of a molecule of the naphthopyran is protonated to give carbonium ion **28**, which reacts with another molecule of the naphthopyran to afford carbonium ion **29**. This then loses a proton to form the respective dimers **23**, **24** and **25**.

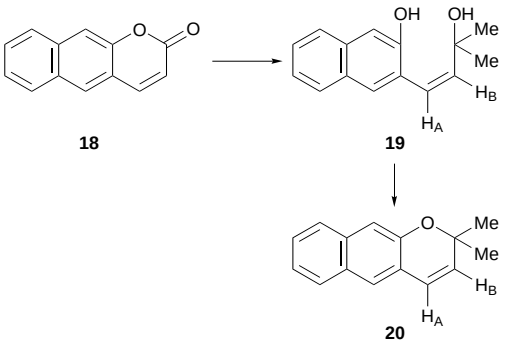
The dimerization of lapachenole (6-methoxy-2,2-dimethyl-2*H*-naphtho[1,2-*b*]pyran) under acidic conditions affords only isolapachenole (**27**) (85%),[3] due to the activating effect of the methoxy group at the 6-position of the monomer. With the weaker activating methyl group at the 6-position, dimer **26** (49%), similar in structure to isolapachenole, and dimer **25** (35%) are formed. However, with the deactivating halogeno group at the 6-position in compounds **7** and **8** only the respective dimer **23** (79%) or **24** (69%) is formed.

Treatment of the diols **4** and **5** in pyridine with acetic anhydride resulted in the acetylation of the more nucleophilic phenolic OH to give the monoacetates, 3-(1-acetoxy-4-chloro/bromo-2-naphthyl)-1,1-dimethylprop-2-en-1-ol (**21** and **22**, respectively).



21 R = Cl
22 R = Br

To complete the series of dimethylnaphthopyrans, 2,2-dimethyl-2*H*-naphtho[2,3-*b*]pyran (**20**) was prepared. Decomposition of the Grignard complex from 2*H*-naphtho[2,3-*b*]pyran-2-one (**18**) and methylmagnesium iodide with aqueous ammonium chloride solution yielded



3-(3-hydroxy-2-naphthyl)-1,1-dimethylprop-2-en-1-ol (**19**), which on boiling with acetic acid gave 2,2-dimethyl-2*H*-naphtho[2,3-*b*]pyran (**20**).

Techniques used: IR and ^{1}H NMR, MS

References: 15

Figures: 2

Tables 1–4: ^{1}H NMR data

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References cited in this synopsis

1 W. D. Cotterill, R. Livingstone, K. D. Bartle and D. W. Jones, *Tetrahedron*, 1968, **24**, 1981.
2 W. D. Cotterill, S. A. Fairbank, R. Livingstone and R. Peace, *J. Chem. Res*., 1994, (*S*) 254; (*M*) 1489.
3 R. Livingstone and M. C. Whiting, *J. Chem. Soc*., 1955, 3631.