Synthesis of 2,3-Dihydrobenzofuran

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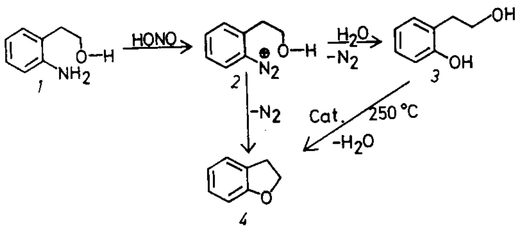
A new, one-step indole synthesis from 2-(*o*-nitrophenyl)ethanol was reported some time ago.[1] The evidence indicated that the reaction involves a heterogeneously catalysed cyclisation of 2-(*o*-aminophenyl)ethanol (*1*) to 2,3-dihydroindole followed by dehydrogenation to indole.[1] The same principle might also be used in the synthesis of other heterocyclic compounds, and we now report the formation of 2,3-dihydrobenzofuran (*4*) from 2-(*o*-hydroxyphenyl)ethanol. A recent monograph by Mustafa reviews methods for the formation of substituted 2,3-dihydrobenzofurans. However, none of these are well suited for the preparation of *4* itself.[2]

2-(*o*-Hydroxyphenyl)ethanol (*3*) was obtained (50 % yield) together with *4* (35 % yield) on diazotisation of *1*. A 70 % yield of *3* and traces only of *4* have earlier been obtained by the same reaction.[3]

2-(*o*-Aminophenyl)ethanol was completely converted to 2,3-dihydroindole by passage over silica gel at 250 °C.[1] In contrast to this, only 1.5 % of 2,3-dihydrobenzofuran was obtained when *3* was reacted under these conditions.

However, when a more acidic catalyst, alumina with 6 % silica, was used, *3* reacted completely and gave *4* in 75 % yield. 2,3-Dihydrobenzofuran was not dehydrogenated by passage over a catalyst treated to contain copper, which might have been expected from the analogous dehydrogenation of 2,3-dihydroindole.[1] However, the dehydrogenations of *4* over other catalysts are well-known.[4] A mechanism was proposed for the cyclisation of *1* to 2,3-dihydroindole in which the *o*-amino group undergoes nucleophilic attack on the 1-carbon atom.[1] Phenols are generally weaker nucleophiles than anilines, and the lower reactivity of *3* than *1* over silica gel is thus in accordance with the mechanism proposed earlier. One would also expect the rate of reaction to increase with the acidity of the catalyst,[5] as was observed when silica gel was substituted with the more acidic alumina-silica.



Experimental. The facilities for the heterogeneously catalysed reactions, the catalysts, and the analytical method have been described.[5]

2-(o-Hydroxyphenyl)ethanol (3). Sodium nitrite (22 g) in water (90 ml) was added to *1* (45 g) in water (150 ml), sulfuric acid (30 ml, 98 %) and ice (250 g) during 30 min. The temperature was raised to 50 °C for 30 min, the solution made basic and extracted with ether to give *4* (13.8 g, 35 % yield). Acidification and ether extraction gave *3* (22.7 g, 50 % yield).

Reaction of 2-(o-hydroxyphenyl)ethanol (3) over silica gel. *3* (3.3 g) in 1,2-dimethoxyethane (4.4 g) was injected on the reactor containing silica gel (10 g) at 250 °C during 1 h. The reactants were passed through with nitrogen (26 l h^{-1}). The product contained *3* (1.8 g, 55 %) and *4* (50 mg, 1.5 %). The weight of the catalyst increased by 1.2 g during the reaction.

Reaction of 2-(o-hydroxyphenyl)ethanol (3) over alumina-silica *3* (3.6 g) in 1,2-dimethoxyethane (4.7 g) was injected on alumina with 6 % silica (10 g) at 250 °C during 1 h, nitrogen flow rate 27 l h^{-1}. The product was *4* (2.4 g, 75 %). The weight of the catalyst increased by 0.6 g during the reaction.

1. Bakke, J. M., Heikman, H. and Hellgren, E. B. *Acta Chem. Scand. B 28* (1974) 393.
2. Mustafa, A. *Benzofurans*, Wiley, New York 1974.
3. Bennet, G. M. and Hafez, M. M. *J. Chem. Soc.* (1941) 652.
4. Karakhanov, E. A., Vagabov, M. V. and Viktorova, E. A. *Vestn. Mosk. Univ. Khim. 13* (1972) 133; *Chem. Abstr. 78* (1973) 15935 t.
5. Bakke, J. M. and Roholdt, H. M. *Acta Chem. Scand. B 33* (1979) 152.

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