REACTION OF BENZALDEHYDE AND UREA WITH β-NAPHTHOL

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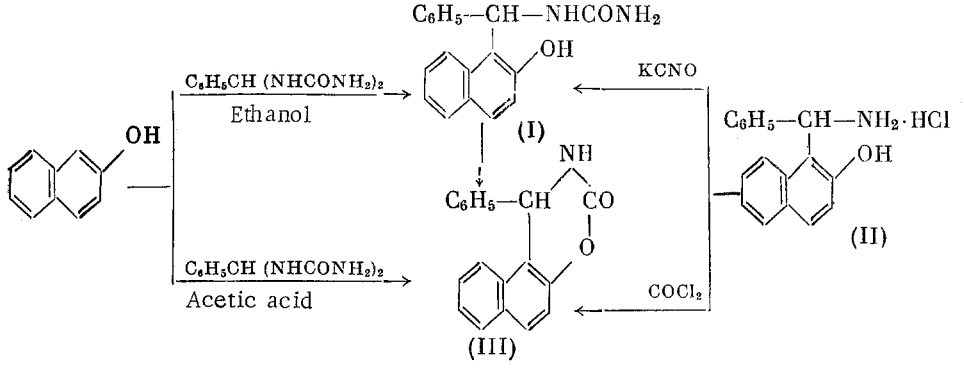
Previously one of us had shown that the reaction of an aldehyde, urea and compounds, containing the $-CH_2CO$ group, yields substituted pyrimidines [1]. The theory was expressed that a peculiar amidoalkylation reaction takes place at the start, leading to the formation of the ureido derivative; the latter is then cyclized to the pyrimidine ring. From this it follows that compounds, capable of entering into the amido- and aminoalkylation reaction, in the presence of a reactive $-CO$ group (or enolic hydroxyl), may be converted to the pyrimidine derivatives. To verify this theory, we reacted benzaldehyde and urea, and also benzalbisurea, with β-naphthol. The latter, as is known, easily enters into the aminoalkylation reaction [2], while the hydroxy group in β-naphthol may be regarded as being an enolic hydroxyl. When the reaction was run in alcohol medium, in the presence of hydrochloric acid, we failed to obtain the pyrimidine derivative, and instead 1-(α-ureidobenzyl)-2-naphthol (I) was isolated in high yield. The structure of (I) was proved by counter synthesis from 1-(α-aminobenzyl)-2-naphthol hydrochloride (II) and potassium cyanate.



In our opinion, the formation of (I) confirms the validity of the reaction scheme proposed in [1] for the condensation. The absence of the pyrimidine derivative among the reaction products is probably associated with the difficulty of cleaving a hydroxyl group from the aromatic ring. When the reaction was run at a higher temperature (in acetic acid), and also when (I) was heated, the obtained product, based on the elemental composition, was not the expected pyrimidine. It is known that the cyclization of the α-ureido derivatives of cyclohexanol yields oxazines [3], and not pyrimidines. For this reason it could be assumed that 1-phenyl-2,3-dihydro-3-keto-1H-naphth [1, 2e] [1, 3] oxazine (III) is obtained when (I) is cyclized. The analysis data and the infrared spectrum agree with this assumption. The structure of (III) was confirmed by its synthesis from (II) and phosgene. In the synthesis of (III) from (I) we isolated 4-phenyl-[dinaphtho-2',1' : 2,3;1",2" : 5,6]pyran (IV) as a by-product.

EXPERIMENTAL

The purity of the obtained products was controlled by ascending paper chromatography in the system butanol-acetic acid-water (4 : 1 : 2). The spots were detected by using ultraviolet light, and also by using a solution of p-dimethylaminobenzaldehyde [4]. The ultraviolet spectra were taken on an SF-4 spectrophotometer; the solvent was ethyl alcohol. The infrared spectra of the compounds, taken as KBr pellets, were recorded on a UR-10 spectrophotometer.

1-(α-Aminobenzyl)-2-naphthol (II) was obtained as described in [5], m. p. 110-114°. From the literature [6]: m. p. 113-114°; [5]: 124-125°.

The hydrochloride of (II) had m. p. 190-200° (with decompn.). From the literature [5]: m. p. 190-220° (with decompn.).

1-(α-Ureidobenzyl)-2-naphthol (I). To a solution of 2.86 g of (II) hydrochloride in 30 ml of methanol was added a solution of 1 g of potassium cyanate in 3 ml of water, in which connection a white crystalline precipitate was obtained, which failed to dissolve on heating. The mixture was refluxed for 4 h, cooled, diluted with 30 ml of water, and placed in the refrigerator. The precipitate was filtered, washed with water, and dried in a vacuum-desiccator. The dry precipitate was purified by triturating with ether. We obtained 2.6 g (89%) of (I) as colorless crystals with m. p. 179-181°. The compound is soluble in alcohol or acetone, and is insoluble in water, ether or carbon tetrachloride. Infrared spectrum (ν, cm^{-1}) 1670 (CO in the ureido group). Found: C 74.5; 74.3; H 5.81; 5.88; N 9.58; 9.74%. $C_{18}H_{16}N_2O_2$. Calculated: C 74.0; H 5.48; N 9.59%.

A mixture of 1.44 g of β-naphthol, 2.08 g of benzalbisurea, 6 ml of absolute alcohol and several drops of hydrochloric acid solution was refluxed for 2 h. Then the solution was cooled, poured into 75 ml of water, and the obtained precipitate was filtered to give 2.7 g (92%) of product with m. p. 174-176° (from aqueous alcohol). The mixed melting point with the product obtained in the preceding experiment was not depressed. The infrared spectra of the two compounds were identical.

1-Phenyl-2,3-dihydro-3-keto-1H-naphth[1,2e][1,3]oxazine (III). A stream of phosgene was passed into a solution of 5 g of (II) in 100 ml of benzene, containing a 10 mole % excess of triethylamine, at room temperature for 4 h. The obtained precipitate was filtered, and then washed first with benzene and then with water. We obtained 4.2 g (76% yield) of (III) as colorless crystals with m. p. 222-224° (from alcohol). The compound is difficultly soluble in benzene, acetone or alcohol, and is insoluble in water, ether or carbon tetrachloride. Ultraviolet spectrum [λ_{max} mμ (log ε)]: 228-230 (4.51); 278 (3.73); 287-290 (3.62); 308-310 (3.02); 316 (2.93); 324 (3.16). Infrared spectrum (ν, cm^{-1}) 1230 (C—O—C in esters); 1730-1740 (CO in urethanes). Found: C 79.2; 79.1; H 4.76; 4.85; N 5.14; 4.90%. $C_{18}H_{13}NO_2$. Calculated: C 78.6; H 4.73; N 5.09%.

A solution of 1.65 g of (I) in 10 ml of glacial acetic acid was refluxed for 21 h. The solvent was vacuum-distilled. The residue was washed in succession with ether and methyl alcohol, and then it was chromatographed on aluminum oxide (neutral, No. 3 activity). When the material was chromatographed in a thin layer, using benzene as the moving phase, we detected two spots: product (IV) (the yield was insignificant) with R_f 1.0, which was identified by the mixed melting point and comparing the infrared spectrum with that of an authentic sample, obtained as described in [7], and product (III), which stayed back at the start, the yield of which was 0.5 g (33.3%); m. p. 222-224°. Methyl alcohol was used to elute the products at room temperature.

A mixture of 2.88 g of β-naphthol, 2.12 g of benzaldehyde and 1.2 g of urea in 10 ml of glacial acetic acid was refluxed for 24 h. The isolation and purification of (III) were carried out in the same manner as described in the preceding experiment. The yield of (III) was 1.3 g (23.6%), m. p. 220-223°. The mixed melting points with the products obtained in the preceding experiments were not depressed. Also, the infrared spectra of these compounds were identical.

SUMMARY

1. The reaction of benzaldehyde and urea with β-naphthol yields 1-(α-ureidobenzyl)-2-naphthol.

2. 1-Phenyl-2,3-dihydro-3-keto-1H-naphth[1,2e][1,3] oxazine is obtained if the reaction is run at a higher temperature (in glacial acetic acid), and also if the ureido derivative is heated.

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