Br_2-$CO(NH_2)_2$-AcOH SYSTEM FOR THE HIGHLY SELECTIVE α-MONOBROMINATION OF KETONES

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The search for convenient, selective methods for the halogenation of ketones is one of the important problems in organic chemistry [1-5].

We are the first to establish that the Br_2-$CO(NH_2)_2$-AcOH system may be used for the highly selective α-monobromination of ketones and the 1-bromination of 2-alkanones

$$\underset{\text{(Ia, b)}}{BrCH_2COCH_2R} \qquad \underset{\text{(IIa, b)}}{CH_3COCHBrR}$$

R = Bu (a), Am (b).

A sample of 1.4 ml (27.5 mmoles) Br_2 was added with stirring and ice water cooling to a mixture of 4 ml (25.6 mmoles) 2-octanone and 2.5 g (41.7 mmoles) $CO(NH_2)_2$ in 10 ml acetic acid and stirred at 18-20°C until the bromine disappeared (~4 h). This mixture was diluted with water and extracted with CH_2Cl_2. The extract was washed with aqueous sodium carbonate, dried over $MgSO_4$, and evaporated to give 3.8 g (71%) 1-bromo-2-octanone (Ib), bp 117-120°C (19 mm), n_D^{18} 1.4660. PMR spectrum in CCl_4 (δ, ppm): 0.81 m (CH_3), 1.30 m $(CH_2)_4$, 2.56 t (CH_2CO, J = 7 Hz), 3.75 s ($COCH_2Br$). Gas-liquid chromatography indicated that the sample of bromoketone (Ib) contained 10% of the isomeric 3-bromoketone (IIb).

The analogous procedures for 2-heptanone (5 h at ~18-20°C), acetophenone (24 h at ~20°C and then 1 h at 45-50°C), and cyclohexanone (0.5 h at ~20°C) correspondingly gave 1-bromo-2-heptanone (Ia), 7% of the isomeric 3-bromoketone (IIa), bp 105-109°C (20 mm), n_D^{20} 1.4640, α-bromoacetophenone, mp 48-49°C, and 2-bromocyclohexanone, bp 108-111°C (19 mm), n_D^{20} 1.5130. The yields of these products were 74, 80, and 69%, respectively.

The bromination of 2-heptanone and 2-octanone in acetic acid without $CO(NH_2)_2$ gave (IIa) and (IIb), while the reactions in methanol with $CO(NH_2)_2$ gave ~82:18 mixtures of (Ia) and (IIa) and of (Ib) and (IIb).

It is interesting to note that the combined use of $CO(NH_2)_2$ and acetic acid, which have opposite effects on the orientation of the bromination of 2-alkanones, enhances one of these effects. In light of its simplicity and high selectivity, the proposed method for the α-monobromination of ketones may be competitive with other methods [1-5].

LITERATURE CITED

1. V. Calo, L. Lopez, and D. S. Valentino, Synthesis, 139 (1978).
2. G. Grank and H. R. Khan, Aust. J. Chem., 38, 447 (1985).
3. A. Delgado, R. Granados, D. Maulion, and F. Soucheiron, Can. J. Chem., 63, 3193 (1988).
4. R. Bloch, Synthesis, 140 (1978).
5. S. Magen, J. Oren, and B. Fuchs, Tetrahedron Lett., 25, 3369 (1984).

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