Brief Communications

Synthesis of diiodo- and triiodoanilines by iodination of aniline with potassium dichloroiodate and preparation of 1,3,5-triiodobenzene

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A new chemoselective procedure was developed for the synthesis of 2,4,6-triiodoaniline and 2,4-diiodoaniline by the reaction of aniline with potassium dichloroiodate in dilute HCl. Subsequent deamination of 2,4,6-triiodoaniline afforded 1,3,5-triiodobenzene in good yield.

Key words: iodination, diazotization, aniline, potassium dichloroiodate, 2,4,6-triiodoaniline, 2,4-diiodoaniline, 1,3,5-triiodobenzene.

Iodoanilines are of considerable interest in the synthesis of polyiodoarenes, which serve as important starting compounds in cross-coupling reactions with alkenes and alkynes[1] known as the Heck and Sonogashira reactions, respectively.

2,4,6-Triiodoaniline (**1**) is generally prepared by the reactions of aniline with iodine in the presence of oxidants,[2] with ICl vapor,[3] or starting from difficultly accessible reagents.[4] The preparation of 2,4,6-triiodoaniline (**1**) from aniline by the reactions with *N*-iodosuccinimide,[5] the pyridine—iodine chloride complex,[6] or butyl(triethyl)ammonium triiodide can also be mentioned.[7] Convenient synthetic procedures for the preparation of 2,4-diiodoaniline (**2**) are lacking.[8]

We developed a new chemoselective procedure for the synthesis of iodoanilines **1** and **2** by the reaction of aniline with potassium dichloroiodate in dilute HCl. Both compounds were prepared in one step, triiodoaniline (**1**) or diiodoaniline (**2**) being selectively prepared depending on the reaction conditions (Scheme 1).

The reaction of aniline with 2 equiv. of $KICl_2$ in a highly dilute aqueous HCl afforded 2,4-diiodoaniline **2**, which precipitated and was not subjected to further iodination. The use of more concentrated solutions led to a decrease in the yield of the target product.

The synthesis of triiodide **1** requires 3 equiv. of potassium dichloroiodate and an even more dilute solution of aniline; otherwise a mixture of compounds **1** and **2** precipitates. This can be attributed to the fact that diiodide **2**, which is formed virtually immediately, remains in solution due to its low concentration and can further react with an additional equivalent of the reagent.

1,3,5-Triiodobenzene (**3**) can be prepared by the reaction of 1,3,5-tribromobenzene with potassium iodide in the presence of iodine,[9] by the Hunsdiecker reaction from silver 1,3,5-benzenetricarboxylate,[10] from

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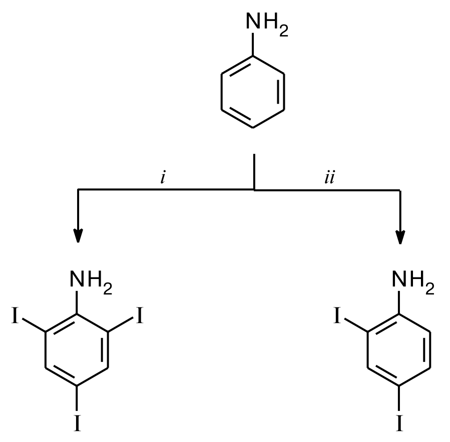
Scheme 1



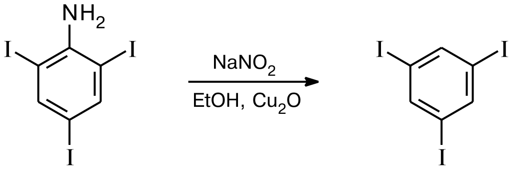
1, 87% **2**, 57%

i. HCl, 3 equiv. of $KICl_2$, *ii.* HCl, 2 equiv. of $KICl_2$.

2,6-diiodo-4-nitroaniline,[11] or by the reaction of the Grignard reagent from 1,3,5-tribromobenzene with 1,2-diiodoethane.[12] All the above-mentioned procedures afford the desired products in yields of no higher than 75% and require the synthesis of commercially unavailable starting reagents and/or drastic reaction conditions.

Reductive deamination of triiodoaniline **1** according to a standard procedure[13] gives rise to triiodobenzene **3** in 84% yield (Scheme 2).

Scheme 2



1 **3**, 84%

1,3,5-Triiodobenzene is used in the cascade Heck—Diels—Alder reaction for the synthesis of various spiro compounds,[14] for the preparation of trigonal and tetragonal connectors in the construction of supramolecular systems,[15] in the synthesis of organometallic compounds,[16] for the preparation of porphyrin derivatives,[17] and in the Stille reaction with organotin compounds.[18]

Experimental

The starting reagents were purified according to standard procedures.[19] Potassium dichloroiodate was synthesized according to a known procedure.[20]

The ^1H and ^{13}C NMR spectra were recorded on a Varian-XR-400 instrument operating at 400 and 100 MHz, respectively. The chemical shifts are given in the δ scale relative to HMDS as the internal standard.

The melting points were determined on a Termoelectric 9100 block in an open capillary. All melting points are uncorrected.

2,4-Diiodoaniline (2). Freshly distilled aniline (1 mL, 11 mmol) was dissolved in concentrated HCl (50 mL) and diluted with water to 0.5 L. Then $KICl_2$ (5.2 g, 22 mmol) was added portionwise with vigorous stirring at ≈20 °C, this being followed by the gradual formation of a grayish precipitate. After completion of the reaction (3 h), the precipitate was filtered off and recrystallized from benzene with addition of activated carbon. The yield of diiodoaniline **2** was 2.14 g (57%), m.p. 95 °C (*cf.* lit. data[**8**]: m.p. 95 °C). ^1H NMR ($CDCl_3$), δ: 3.74 (br.s, 2 H, NH_2); 6.49 (d, 1 H, C(6)H, $J = 8.2$ Hz); 7.36 (dd, 1 H, C(5)H, $J_1 = 1.0$ Hz; $J_2 = 8.2$ Hz); 7.87 (d, 1 H, C(3)H, $J = 1$ Hz).

2,4,6-Triiodoaniline (1) was prepared analogously to compound **2** with the use of 3 equiv. of $KICl_2$. The mixture of aniline and HCl was diluted to 0.75 L. The yield of triiodoaniline **1** was 4.51 g (87%), m.p. 185 °C (*cf.* lit. data[**2**]: m.p. 185 °C). ^1H NMR ($CDCl_3$), δ: 4.63 (br.s, 2 H, NH_2); 7.85 (s, 2 H, ArH).

1,3,5-Triiodobenzene (3).[13] Finely ground $NaNO_2$ (1.95 g, 0.028 mol) was slowly added with stirring to sulfuric acid (3.5 mL). Then a solution of 2,4,6-triiodoaniline (**1**) (2.90 g, 6.16 mmol) in glacial AcOH (130 mL) was added dropwise with stirring and cooling at such a rate that the temperature of the reaction mixture was kept below 20 °C. Following addition of the amine, the reaction mixture was stirred at ≈20 °C for about 30 min. The resulting solution of the diazonium salt was added dropwise to a suspension of copper(I) oxide (2.52 g) in dry ethanol (70 mL) with vigorous stirring over 15 min. The reaction mixture was brought to boiling and stirred for 30 min until elimination of nitrogen ceased. Then the mixture was cooled, kept for one day, poured into ice water (300 mL), and extracted with benzene (3×50 mL). The benzene extracts were dried with anhydrous Na_2SO_4 and the solvent was distilled off *in vacuo*. The residue was repeatedly recrystallized from benzene. The yield was 2.01 g (84%), m.p. 182 °C (*cf.* lit. data[**11**]: m.p. 183 °C). ^1H NMR ($CDCl_3$), δ: 8.02 (s, 3 H, CH). ^{13}C NMR ($CDCl_3$), δ: 79; 128.

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