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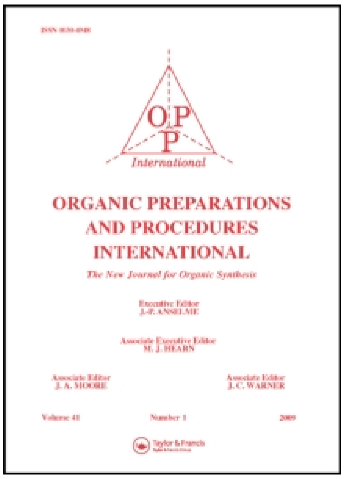

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EFFICIENT REDUCTION OF NTTROARENES TO AMINES BY SODIUM BOROHYDRIDE AND CUPROUS BROMIDE-DIMETHYL SULFIDE

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ORGANIC PREPARATIONS AND PROCEDURES INT., 27 (1), 81-125 (1995)

OPPI BRIEFS

EFFICIENT REDUCTION OF NITROARENES TO AMINES BY SODIUM BOROHYDRIDE AND CUPROUS BROMIDE-DIMETHYL SULFIDE

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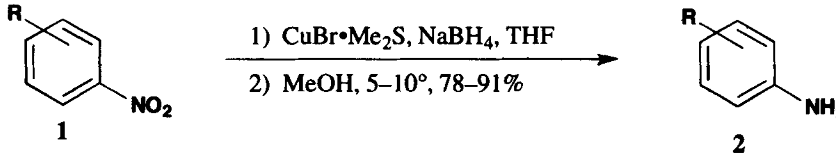
Sodium borohydride is a valuable and convenient reducing agent in organic synthesis.[1] Recently there have been a number of reports on reduction of nitroarenes by sodium borohydride using transition metal catalysts.[2] Few reports, however, describe the use of Cu^{+2} and Cu^{+1} reagents in combination with sodium borohydride.[3,4] We now report that sodium borohydride and the cuprous bromide-dimethyl sulfide complex constitutes an efficient system for the reduction of nitroarenes to amines.

A mixture of nitroarenes (**1**) and $CuBr{\bullet}Me_2S$ complex in THF was treated with $NaBH_4$ at 10° for 10 min. Subsequent addition of methanol to the mixture at 5-10° gave the amines (**2**) in good to excellent yields (73-91%). The data of Table 1 demonstrates the versatility and efficiency (5-30 min. at 5-10°) of this method. Under these conditions, nitroarenes having electron-donating groups *ortho* or *para* to the nitro group, which are otherwise resistant to reduction, were reduced under extremely mild conditions. A limitation of this method, however, is that the nitro group in nitroarenes bearing the carbonyl or cyano functionality could not be reduced selectively under these conditions. A possible mechanism of this reaction may involve an intermediate copper borohydride complex analogous to that reported,[5] which in the presence of MeOH, could be the active reducing species. Alternatively, the possibility of an alkoxyborohydride complex[6] as the reducing species cannot be ruled out completely. In the absence of MeOH, almost no reaction occurred for 50 min at r.t., whereas upon addition of MeOH, reduction was complete in a few minutes (see Table).



In a previously reported procedure,[4] utilizing $NaBH_4$-CuCl system in EtOH, reduction was carried out at reflux for 2 hrs. We found that addition of MeOH at a later stage, *i. e.* after the generation of copper borohydride complex, effects reduction under extremely mild conditions, and shortens the reaction times considerably. Addition of ethanol in place of methanol yielded essentially the same results under identical conditions.

TABLE 1. Yields and Physical Data of Compounds **2**

Cmpd.	R	Time (min)	Yield (%)	mp./bp. (lit) (°C)[a]
2a	H	5	81	185-186[b](184-186)[7]
2b	4-Cl	5	82	70-71(72.5)[7]
2c	3-Cl	7	79	229-231[b](230.5)[7]
2d	3-F	15	73	185-188[b](187-189)[7]
2e	2-OMe	20	88	226-227[b](225)[7]
2f	4-NH_2	30	75	145-146(145-147)[7]
2g	2-Ph	20	91	51-53(49-50)[7]
2h	3-CF_3	10	76	187-189[b](187-189)[7]
2i	3-Me	8	80	202-204[b](203-204)[7]
2j	4-OMe	25	78	55-56(57)[7]

a) Uncorrected. b) Liquid

In conclusion, the $NaBH_4$-CuBr•Me_2S system has been demonstrated to be an efficient system for the reduction of nitroarenes to amines under extremely mild conditions, in good yields.

EXPERIMENTAL SECTION

Melting points were determined using a Buchi 510 apparatus and are uncorrected. IR spectra were recorded on a Perkin-Elmer FT-IR 1600 instrument. Proton NMR spectra were obtained on a Varian XL-200, 200 MHz spectrometer using TMS as an internal standard. Low-resolution mass spectra were recorded on a JMS-D100 mass spectrometer

General Procedure.- To a suspension of CuBr•Me_2S (405 mg, 2.0 mmol, 1 equiv) in THF (15 mL) was added nitroarene (**1**, 2.0 mmol, 1 equiv) under an atmosphere of N_2. Sodium borohydride (195 mg, 5 mmol, 2.5 equiv) was added and the mixture stirred for 10 min at 10°. The above reaction mixture was cooled to 0°, MeOH (10 mL) was slowly added to it and stirring was continued at 5-10°. The progress of the reaction was monitored by TLC analysis (5-35 min). The reaction mixture was quenched with cold water and cold aq. NH_4Cl. The contents were extracted with ether (3 x 40 mL), washed with water (2 x 40 mL) and brine (40 mL) and dried ($MgSO_4$). The solvent was removed under reduced pressure to give **2** which was ~92-96% pure in most cases (GC, NMR analyses). It was further purified by recrystallization from appropriate solvents or by column chromatography using ethyl acetate-pet ether as eluent. Spectral data of **2a**: ^1H NMR (200 MHz, $CDCl_3$): δ 3.46 (br, s, 2 H, NH_2), 6.63 (d, 2 H, $J = 8.1$ Hz, H-2, H-6), 6.75 (t, 1 H, $J = 7.7$ Hz, H-4), 7.14 (m, 2 H, H-3, H-5); IR (neat): 3425, 3342, 3202, 3035, 1615, 1497, 1466 cm^{-1}; MS *m/z* (relative intensity) 93 (M^+, 100), 67 (6), 66 (37), 65 (17); **2d**: ^1H NMR (200 MHz, $CDCl_3$): δ 3.78 (br, s, 2 H, NH_2), 6.37-6.50 (m, 3 H, H-2, H-4, H-6), 7.07-7.14 (m, 1 H, H-5); IR (neat): 3399, 3368, 3229, 1614, 1143; MS *m/z* 111 (M^+, 100), 91 (6), 84 (34), 83 (32), 64 (8); **2e**: ^{1}H NMR (200 MHz, $CDCl_3$): δ 3.82 (br, s, 2 H, NH_2), 3.85 (s, 3 H, OCH_3), 6.74-6.82 (m, 4 H); IR (neat): 3416, 3216, 2941, 2886, 1601, 1224; MS *m/z* 123 (M^+, 94), 108 (100), 92 (4), 80 (67); **2g**: ^{1}H NMR (200 MHz, $CDCl_3$): δ 3.70 (br, s, 2 H, NH_2), 6.73 (d, 2 H, J = 7.9 Hz, ArH), 6.82 (t, 2 H, J = 7.2 Hz, ArH), 7.12-7.17 (m, 2 H, ArH), 7.32-7.45 (m, 5 H, ArH); IR (KBr): 3457, 3369, 3196, 1612, 1501; MS *m/z* 169 (M^+, 100), 168 (89), 167 (41), 139 (5); **2h**: ^{1}H NMR (200 MHz, $CDCl_3$): δ 3.74 (br, s, 2 H, NH_2), 6.82 (dd, 1 H, J = 7.7, 2.0 Hz, H-6), 6.90 (s, 1 H, H-2), 7.01 (d, 1 H, J = 7.7 Hz, H-4), 7.23-7.28 (m, 1 H, H-5); IR (neat): 3440, 3232, 1621, 1467, 1130; MS *m/z* 161 (M^+, 100), 142 (33), 140 (12), 114 (32), 111 (20), 75 (6). Compounds **2b**, **2c**, **2f**, **2i** and **2j** were characterized by spectroscopic means (IR, mass and NMR).

REFERENCES

1. A. Pelter, K. Smith and H. C. Brown, *Borane Reagents*, Academic Press, London, 1988; H. C. Brown, G. W. Kramer, A. B. Levy and M. M. Midland, *Organic Synthesis via Boranes*, Wiley Interscience, New York, 1975.

2. S. Kano, Y. Tanaka, E. Sugino and S. Hibino, *Synthesis.*, 695 (**1980**); A. Ono, H. Sasaki and F. Yaginuma, *Chem. Ind. (London)*, 480 (**1983**); T. Satoh, S. Suzuki, Y. Miyaji and Z. Imai, *Tetrahedron Lett.*, 4555 (**1969**); K. Hanaya and T. Ono, *J. Chem. Soc. Japan*, **92**, 1225 (1971); A. Nose and T. Kudo, *Chem. Pharm. Bull. Japan*, **29**, 1159 (1981).

3. K. Hanaya, T. Muramatsu, H. Kudo and Y. L. Chow, *J. Chem. Soc., Perkin Trans. 1*, 2409 (**1979**); J. A. Cowan, *Tetrahedron Lett.*, **27**, 1205 (1986) and references cited therein.

4. A. Ono, M. Hiroi and K. Shimazaki, *Chem. Ind. (London)*, 75 (**1984**).

5. T. N. Sorell and P. S. Pearlman, *J. Org. Chem.*, **45**, 3449 (1980); M. F. Semmelhack, R. D. Stauffer and A. Yamashita, *ibid.*, **42**, 3180 (1977); G. M. Whitesides, J. San Fillipo, Jr., E. R. Stredronsky and C. P. Casey, *J. Am. Chem. Soc.*, **91**, 6542 (1969). T. Tsuda, T. Fujii, K. Kawasaki and T. Saegusa, *Chem. Commun.*, 1013 (**1980**).

6. A. L. Gemal and J.-L. Luche, *J. Am. Chem. Soc.*, **103**, 5454 (1981).

7. *Dictionary of Organic Compounds*, Buckingham, J. Ed.; 5th ed.; Chapman and Hall: New York, 1982; see also: Merck Index (Merck & Co. Inc.), 1989, 11th ed; commercially available, *Catalog Handbook of Fine Chemicals;* Aldrich Chemical: Milwaukee, 1990-1991.

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