Synthetic Communications: An International Journal for Rapid Communication of Synthetic Organic Chemistry
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/lsyc20

Novel, Water-Based Procedure for the Mono Iodination of Aromatic Amines and Phenols

R. Sathiyapriya [a] & R. Joel Karunakaran [a]
[a] Department of Chemistry, Madras Christian College, Chennai, Tamilnadu, India

Version of record first published: 18 Aug 2006

To cite this article: R. Sathiyapriya & R. Joel Karunakaran (2006): Novel, Water-Based Procedure for the Mono Iodination of Aromatic Amines and Phenols, Synthetic Communications: An International Journal for Rapid Communication of Synthetic Organic Chemistry, 36:13, 1915-1917

To link to this article: http://dx.doi.org/10.1080/00397910600602750

Synthetic Communications®, 36: 1915–1917, 2006

ISSN 0039-7911 print/1532-2432 online
DOI: 10.1080/00397910600602750

Novel, Water-Based Procedure for the Mono Iodination of Aromatic Amines and Phenols

R. Sathiyapriya and R. Joel Karunakaran
Department of Chemistry, Madras Christian College, Chennai, Tamilnadu, India

Abstract: A mixture of potassium chlorate and potassium iodide was found to be a good iodinating agent for various aromatic amines and phenols with excellent yields in the presence of mineral acid in aqueous medium.

Keywords: Aqueous medium, aromatic iodination, potassium chlorate, potassium iodide

The aromatic iodination reactions are important electrophilic substitution reactions and the resultant iodo products are useful intermediate in organic syntheses as they can be easily involved in the metal-catalyzed cross-coupling reaction.[1] Because of their potential ability as bioactive materials, most of the iodo derivatives are widely used in the biomedical area.[2]

Iodination of organic substrates simply by molecular iodine is not possible because of its least reactive nature. Hence, an oxidant is used along with diiodine to get more reactive electrophilic species. Various oxidants such as chromium oxide,[3] silver sulphate,[4] sodium iodate,[5] and HIO_3[6] have been used along with elemental iodine for the effective iodination process. These iodination reactions are routinely performed in an organic solvent in the presence of a catalytic amount of acid. The other procedures using iodonium ion-donating reagents (iodine mononochloride,[7] N-iodosuccinimide,[8] N-iodosuccinimide-trifluoroacetic acid,[9] NaI-chloramine-T,[10]

Received in India December 26, 2005
Address correspondence to R. Joel Karunakaran, Department of Chemistry, Madras Christian College, Tambaram, Chennai 600059, Tamilnadu, India. Tel.: + 91-44-22271458; E-mail: joelkarunakaran2005@yahoo.com

and NaI/conc. H_2SO_4[11]) are also reported. As in the case of aromatic iodination, some procedures have been reported using aqueous media in an environmentally friendly manner.[12,13] With a view to this concern, we become interested in developing iodination procedures in aqueous media, and herein we report our new, efficient, environmentally friendly procedure for the iodination of aromatic compounds, especially for aromatic amines and phenolic derivatives using the reagent system $KClO_3$/KI/HCl.

The test reaction was carried out on 2-naphthol (10 mmol) in aqueous medium with potassium chlorate (3.3 mmol) and potassium iodide (10 mmol) in the presence of hydrochloric acid (10 mmol) at 80°C for 2 h and gave 1-iodo 2-naphthol in good yield.

To prove the generality of the method, a variety of commercially available amines and phenols were subjected to this method under similar reaction conditions, and our results are summarized in Table 1. As expected, all the substrates underwent iodination reactions and delivered excellent yields of mono iodo products.

In conclusion, an effective, environmentally friendly, water-solvent method for the iodination of amines and phenols has been reported using potassium chlorate and potassium iodide in the presence of hydrochloric acid.

EXPERIMENTAL

Mass spectra were recorded on a GC-Mass Spec Finnigan Mat 8230MS spectrophotometer. JEOL 270 and 400-MHz spectrophotometer were used for ^{1}H NMR spectral analysis, and ^{13}C NMR spectra were measured with a Varian Gemini 300-MHz spectrophotometer.

Table 1. Iodination of aromatics with $KClO_3$/KI/HCl in aqueous medium

Entry	Substrate	Time (h)	Product	Yield %[c]
1	Phenol	1	Iodophenol[a]	95
2	4-Chlorophenol	1.5	4-Chloro 2-iodophenol	93
3	2-Nitrophenol	1.5	4-Iodo 2-nitrophenol	88
4	2-Naphthol	2	1-Iodo 2-naphthol	90
5	Aniline	2	Iodoaniline[b]	81
6	4-Nitro aniline	2.5	2-Iodo 4-nitroaniline	86
7	Salicylic acid	2.5	2-Hydroxy-5-iodobenzoic acid	74
8	N-phenylacetamide	2.5	N-(4-Iodophenyl)acetamide	86
9	4-Chloroaniline	2.5	4-Chloro 2-iodoaniline	91
10	2-Aminonaphthalene	2	2-Amino-1-iodonaphthalene	94

[a]Para: ortho ratio is 95 : 5 by GC analysis.
[b]Para: ortho ratio is 90 : 10 by GC analysis.
[c]All the compounds showed satisfactory spectroscopic data.

General Procedure

A solution of 2-naphthol (1.44 g, 10 mmol), potassium chlorate (0.403 g, 3.33 mmol), and potassium iodide (1.66 g, 10 mmol) was prepared in methanol (5 mL) and water (45 mL). To this mixture, hydrochloric acid (10 mmol) was added at 80°C. After completion of the reaction (measured by TLC monitoring), the reaction mixture was extracted with diethyl ether (40 mL). The ether extract was washed with 5% aqueous sodium thiosulphate and water and dried over anhydrous Na_2SO_4. Removal of the solvent gave a residue, which was purified on silica gel using hexane as eluent to afford 1-iodo 2-naphthol (2.43 g, 90%), mp 92°C (lit. 92°C). Mass: $m/e = 270$. ^1H NMR ($CDCl_3$): δ 7.98 (d, 1H, $J = 9$ Hz, 8-H), 7.75 (overlapping doublets, 2H, 4-H and 5-H), 7.58 (t, 1 H, $J = 8$ Hz, 7-H), 7.35 (t, 1 H, $J = 8$ Hz, 6-H), 7.22 (d, 1 H, $J = 8$ Hz, 3-H); ^{13}C NMR ($CDCl_3$): δ 154.8, 135.6, 131.8, 130.7, 130.5, 126.95, 126.9, 125.0, 117.2, 86.8.

REFERENCES

1. Diederich, F.; Stang, P. J. *Metal Catalysed Cross-Coupling Reactions*; Wiley-VCH: Weinheim, Germany, 1998.
2. The Merck Index, 10th ed.; Merck: New Jersey, USA, 1983; pp. 4890–4918.
3. Lulinski, P.; Skulski, L. The direct iodination of arenes with chromium(VI) oxide as the oxidant. *Bull. Chem. Soc. Jpn.* **1997**, *70*, 1665–1669.
4. Sy, W. W. Iodination of methoxyamines with iodine and silver sulfate. *Tetrahedron Lett.* **1993**, *34*, 6223–6224.
5. Lulinski, P.; Skuski, L. Iodination of both deactivated and activated arenes with sodium periodate or sodium iodate as oxidants. *Bull. Chem. Jpn.* **2000**, *73*, 951–956.
6. Merkushev, E. B. Advances in the synthesis of iodoaromatic compounds. *Synthesis* **1988**, 923.
7. Chaikovskii, V. K.; Filimonov, V. D. Iodination and chlorination of aromatic polycyclic hydrocarbons with iodine monochloride in aqueous sulfuric acid. *Russian J. Org. Chem.* **2001**, *37*, 1130–1133.
8. Carreno, M. C.; Ruano, J. L. T.; Sanz, G.; Toledo, M. A.; Urbano, A. Mild and regiospecific nuclear iodination of methoxybenzenes and napthalenes with N iodosuccinimide in acetonitrile. *Tetrahedron Lett.* **1996**, *37*, 4081–4084.
9. Castanet, A.-S.; Colobert, F.; Broutin, P.-E. Mild and regioselective iodination of electron-rich aromatics with N-iodo succinimide and catalytic trifluoroacetic acid. *Tetrahedron Lett.* **2002**, *43*, 5047–5048.
10. Hatanaka, Y.; Hashimoto, M.; Kurihara, H.; Nakayama, H.; Kanaoka, Y. A. Novel family of aromatic diazirines for photoaffinity labeling. *J. Org. Chem.* **1994**, *59*, 383–387.
11. Pasha, M. A.; Yi Yi Myint. Acid-catalysed selective monoiodination of electron-rich arenes by alkali metal iodides. *Synth. Commun.* **2004**, *34* (15), 2829–2833.
12. Edgar, K. J.; Falling, S. N. An efficient and selective method for the prepartion of iodophenols. *J. Org. Chem.* **1990**, *55*, 5287–5291.
13. Adimurthy, S.; Ramachandraiah, G.; Ghosh, P. K.; Dedekar, A. V. A new, enviroment friendly protocol for iodination of electron-rich aromatic compounds. *Tetrahedron Lett.* **2003**, *44*, 5099–5101.