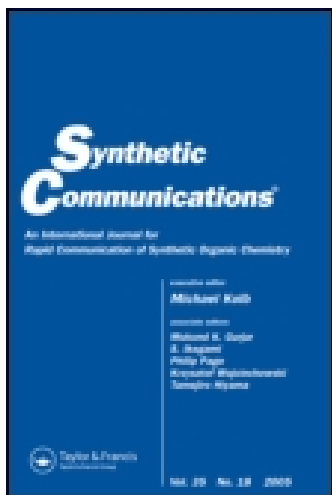


This article was downloaded by: [University of California Santa Cruz]
On: 11 November 2014, At: 15:11
Publisher: Taylor & Francis
Informa Ltd Registered in England and Wales Registered Number: 1072954
Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH,
UK



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/lcyc20>

Microwave-Assisted Dehydration and Chlorination Using Phosphonium Salt

Ken-ichi Tanji^a, Jiro Koshio^a & Osamu Sugimoto^a

^a Laboratory of Organic Chemistry, School of Food and Nutritional Sciences, University of Shizuoka, Shizuoka, Japan

Published online: 16 Aug 2006.

To cite this article: Ken-ichi Tanji, Jiro Koshio & Osamu Sugimoto (2005) Microwave-Assisted Dehydration and Chlorination Using Phosphonium Salt, *Synthetic Communications: An International Journal for Rapid Communication of Synthetic Organic Chemistry*, 35:15, 1983-1987, DOI: [10.1081/SCC-200066639](https://doi.org/10.1081/SCC-200066639)

To link to this article: <http://dx.doi.org/10.1081/SCC-200066639>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any

losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

Microwave-Assisted Dehydration and Chlorination Using Phosponium Salt

Ken-ichi Tanji, Jiro Koshio, and Osamu Sugimoto

Laboratory of Organic Chemistry, School of Food and Nutritional Sciences, University of Shizuoka, Shizuoka, Japan

Abstract: Microwave-assisted reaction using phosponium salt for dehydration of primary amides and chlorination of hydroxyheteroaromatics was carried out.

Keywords: Microwave, dehydration, chlorination, heteroaromatics

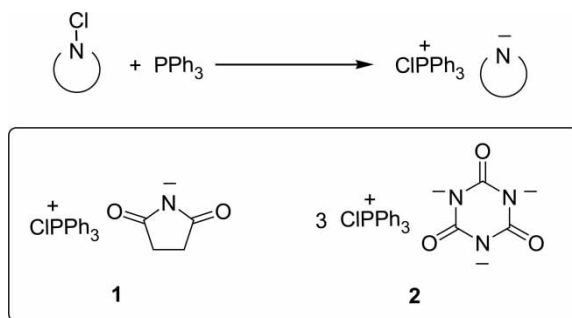
Phosponium salts^[1,2] (**1**, **2**), which are prepared by the reaction of triphenylphosphine with *N*-halo compounds, perform as substitutes for phosphorus halides (e.g., POCl₃ or PCl₅). Dehydration of primary amides,^[3] chlorination of hydroxyheteroaromatics,^[3–5] or preparation of the Vilsmeier reagent^[3] are accomplished using **1** or **2** (Scheme 1).

Several microwave-assisted organic reactions^[6] have been reported, because this reaction considerably reduces reaction time. To the best of our knowledge, however, no microwave-assisted reaction using phosponium salts as a reagent has been reported. In this article, we report a microwave-assisted, solvent-free reaction using **1** to clarify application and limitation of this method.

Phosponium salt (**1**) was prepared as described: *N*-chlorosuccinimide (25 mmol) was added little by little to a solution of triphenylphosphine (25 mmol) in dioxane (250 mL) and stirred at room temperature for 30 min.

Received in Japan January 21, 2005

Address correspondence to Ken-ichi Tanji, Laboratory of Organic Chemistry, School of Food and Nutritional Sciences, University of Shizuoka, 52-1 Yada, Shizuoka 422-8526, Japan. E-mail: tanji@smail.u-shizuoka-ken.ac.jp



Scheme 1.

The precipitate was filtered and dried under reduced pressure at 35°C to afford **1**.

A microwave oven (Matsushita NE-J720, Japan), with selectable output power (100 W, 150 W, 300 W, 600 W, 700 W, and 1000 W), was used to avoid overshooting the reaction.

At first, microwave-assisted dehydration of benzamide derivatives (benzamide and *p*-methoxybenzamide) using **1** was carried out (Table 1). The reaction was terminated when the mixture melted and turned black. Reaction of benzamide and *p*-methoxybenzamide with a stoichiometric amount of **1** at 300 W gave the corresponding nitriles in 24% and 23% yields, respectively (Table 1, entries 1 and 2). As the amount of **1** was increased, yields of the products were improved (Table 1, entries 3–5). By using microwave irradiation, shortening the reaction time became feasible. At least 4 equivalents of **1** were required to afford the products in good yields, whereas the use of 1–2 equivalents of **1** were sufficient in the same reaction in solvents (dioxane or THF) under reflux.^[3]

Chlorination of hydroxyheteroaromatics using **1** by microwave irradiation was examined. 2(1*H*)-Quinolinone was used to optimize the conditions (amount of **1**, irradiating power, and reaction time). A mixture of 2(1*H*)-quinolinone (2 mmol) and a stoichiometric amount of **1** (2 mmol) was treated with microwave irradiation until the mixture melted and turned black under various power outputs (150–1000 W), but similar yields (11–21%) were obtained (Table 2, entries 1–5). As the amount of **1** was increased, the yield of the product, 2-chloroquinoline, was improved (Table 2, entries 6–8).

Next, chlorination of some hydroxyheteroaromatics shown in Table 3 was examined. Microwave-assisted (300 W) halogenation of substrates [4-hydroxy-2(1*H*)-quinolinone, 1-phenyl-1*H*-pyrazolo[3,4-*d*]pyrimidin-4(5*H*)-one, 2(1*H*)-quinoxalinone, 2,3(1*H*,4*H*)-quinoxalinedione, 4(3*H*)-quinazolinone, and 4-phenyl-2(1*H*)-quinazolinone] with **1** (4 eq.) was carried out to give the corresponding chloroheteroaromatics in variable yields (0–64%). Because

Table 1. Microwave-assisted dehydration of amides
$$\text{RCONH}_2 \xrightarrow{\text{1, Microwave}} \text{RCN}$$


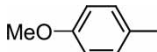
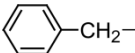

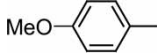
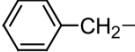

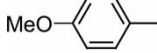
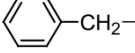
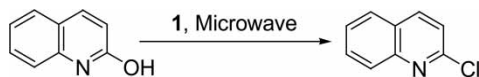
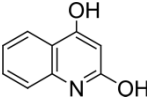
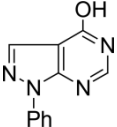
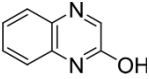
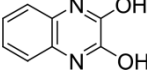
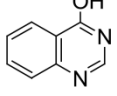
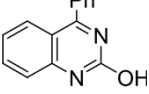
| Entry | Amount of 1 (eq.) | R | Condition | Yield (%) |
|-------|--------------------------|--|----------------|-----------|
| 1 | 1 |  | 300 W, 6 min | 24 |
| 2 | 1 |  | 300 W, 6.5 min | 23 |
| 3 | 1 |  | 300 W, 4 min | 34 |
| 4 | 2 |  | 300 W, 6.5 min | 48 |
| 5 | 2 |  | 300 W, 6.5 min | 46 |
| 6 | 2 |  | 300 W, 5 min | 73 |
| 7 | 4 |  | 300 W, 4.5 min | 56 |
| 8 | 4 |  | 300 W, 5 min | 95 |
| 9 | 4 |  | 300 W, 6 min | 66 |

Table 2. Microwave-assisted chlorination of 2(1H)-quinolinone

| Entry | Amount of 1 (eq.) | Condition | Yield (%) |
|-------|--------------------------|-----------------|-----------|
| 1 | 1 | 150 W, 30 min | 15 |
| 2 | 1 | 300 W, 11.5 min | 21 |
| 3 | 1 | 600 W, 8 min | 3 |
| 4 | 1 | 700 W, 3.5 min | 13 |
| 5 | 1 | 1000 W, 5.5 min | 11 |
| 6 | 2 | 300 W, 8 min | 22 |
| 7 | 3 | 300 W, 7.5 min | 38 |
| 8 | 4 | 300 W, 7 min | 64 |

Table 3. Microwave-assisted chlorination of some hydroxy-heteroaromatics

Het-OH $\xrightarrow{\text{1, Microwave (300 W)}}$ Het-Cl

| Entry | Substrate (Het-OH) | Condition | Yield (%) |
|-------|---|----------------|-----------|
| 1 |  | 300 W, 5 min | 42 |
| 2 |  | 300 W, 6 min | 19 |
| 3 |  | 300 W, 5 min | 64 |
| 4 |  | 300 W, 2.5 min | 10 |
| 5 |  | 300 W, 3 min | 27 |
| 6 |  | 300 W, 6.5 min | 0 |

some chloroheteroaromatics such as fused chlorodiazines are unstable at higher temperature, decomposition of the products would occur in the microwave-irradiated process.

In summary, microwave-assisted reaction using chlorophosphonium salt (**1**) was examined, and it shortened the reaction time as compared with a thermal reaction. Although chlorination of some hydroxyheteroaromatics using excess amount of **1** afforded the product in low to moderate yields, dehydration of primary amides gave nitriles in moderate to excellent yields.

REFERENCES

1. Froyen, P. *Phosphorus, Sulfur Silicon Relat. Elem.* **1995**, *102*, 253–259.
2. Hiegel, G. A.; Ramirez, J.; Barr, R. K. *Synth. Commun.* **1999**, *29*, 1415–1419.

3. Sugimoto, O.; Mori, M.; Moriya, K.; Tanji, K. *Helv. Chim. Acta* **2001**, *84*, 1112–1118.
4. Sugimoto, O.; Mori, M.; Tanji, K. *Tetrahedron Lett.* **1999**, *40*, 7477–7478.
5. Sugimoto, O.; Tanji, K. *Heterocycles* **2005**, *65*, 181–185.
6. Lidstrom, P.; Tierney, J.; Wathey, B.; Westman, J. *Tetrahedron* **2001**, *57*, 9225–9283.