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SYNTHETIC COMMUNICATIONS®
Vol. 33, No. 6, pp. 935–939, 2003

A Green Preparation of *N*-Chloro- and *N*-Bromosaccharin

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ABSTRACT

The reaction of the sodium salt of saccharin, potassium chloride or bromide and oxone® in water at room temperature for 24 h produced pure *N*-chloro- and *N*-bromosaccharin in 58% and 64% yield, respectively.

Key Words: Green chemistry; Saccharin; *N*-Halosaccharin.

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DOI: 10.1081/SCC-120016353
0039-7911 (Print); 1532-2432 (Online)

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INTRODUCTION

Although *N*-halosaccharins are more electrophilic than the structurally analogue *N*-haloimides,[1] they have found little attention in the literature. Whereas *N*-iodo-[1,2] and *N*-fluorosaccharin[3] are scarcely mentioned, *N*-chloro- and *N*-bromosaccharin are mostly described as analytical[4,5] and/or oxidizing reagents. These compounds are mild oxidants of aldehydes,[6,7] alcohols,[8,9] glycols,[9] α-amino-[10] and α-hydroxyacids,[9] etc, and their application as halogenating reagent for aromatic compounds[11,12] and allylic,[13] benzylic,[13,14] and α-carbonylic [14,15] positions is very useful.

With few exceptions,[16,17] the classical [18] procedure for preparation of *N*-chloro- and *N*-bromosaccharin is reaction of sodium salt of saccharin with the halogen. However, the handling and manipulation of the toxic and corrosive halogens is problematic at multigram-scale.

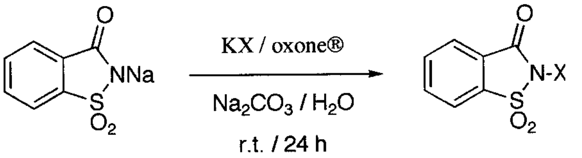
Recently, Curini published the *N*-chlorination of amides and carbamates by the reaction with sodium chloride and oxone® ($2\ KHSO_5 \cdot KHSO_4 \cdot K_2SO_4$) in a suspension of wet alumina in chloroform at 45°C.[19] The role of oxone® in these reactions is to oxidize the chloride anion and generate chlorine *in situ*.[20]

The utilization of environmentally acceptable, healthy, safe, and readily available materials in a simple process is very attractive nowadays and consistent with green chemistry challenges.[21] Based on this precedent we present here our results on an alternate and safe route to *N*-chloro and *N*-bromosaccharin.

RESULTS

The reaction of the sodium salt of saccharin with potassium halide (1 equiv. mol) and oxone® (1 equiv. mol) was performed in water at room temperature for 24 h. Using these conditions on a 10 mmol scale, the corresponding *N*-halosaccharin precipitates at the end of the reaction. The products were obtained in high purity (no need of recrystallization), albeit in moderate yield after washing with cold water (Sch. 1 and Table 1). The purity of the *N*-halosaccharins obtained was determined by iodometric titration[1] and they were characterized by spectroscopic methods and their melting point. The reaction was performed at 50-mmol scale and the products were obtained in similar yield and purity.

In summary we propose a new preparation of *N*-chloro- and *N*-bromosaccharin that does not use or handle toxic and corrosive halogens. The reaction conditions are mild, the yield is moderate and



Scheme 1.

Table 1. Preparation of *N*-halosaccharin.

X	Yield/%	Purity/%[a]	M.p. [lit.]/°C	ν_{KBr}/cm^{-1}
Cl	58	>96	145–148 [152 [18]]	3094; 1739 (C=O); 1361 (SO_2); 1235 (N-Cl); 1194 (SO_2); 955, 748; 757
Br	64	>99	165–167 [170–172[17]]	3094; 1709 (C=O); 1352 (SO_2); 1231 (N-Br); 1191 (SO_2); 949; 748; 574

[a] Determined by iodometric titration.[1]

the isolation of the products in high purity is simple. Our methodology is easier and safer than the predecessors, the reaction can be scaled up and water is the reaction solvent, all of which is in accordance with the green chemistry philosophy.[22]

EXPERIMENTAL

Typical procedure for the preparation of *N*-halosaccharin: To a well-stirred solution of sodium saccharin (10.25 g, 50 mmol), Na_2CO_3 (2.65 g, 25 mmol) and KCl or KBr (3.78 g or 6.00 g, respectively—50 mmol) in water (250 mL), a solution of oxone® (30.75 g, 50 mmol) in water (30 mL) was added slowly at 0°C. After stirring for 24 h at room temperature, the solid was filtered off, washed with cold water and dried to give the pure *N*-halosaccharin. The results obtained are shown in Table 1.

ACKNOWLEDGMENTS

SPLS thanks CNPq for a fellowship. We thank Prof. W. Bruce Kover and Joel Jones Jr. for helpful discussions. We also thank Prof. Carlos A.S. Riehl for technical assistance in the *N*-halosaccharin titration.

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Received in the USA April 3, 2002

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