Kinetic studies on the peroxyoxalate reaction using "green" oxalic esters and non-toxic biodegradable solvents.

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Abstract

The peroxyoxalate system is formed by the reaction of oxalic esters and hydrogen peroxide in the presence of a base and an activator and is one of the few high-efficiency chemiluminescence systems, reaching quantum yields up to 50%, only comparable to enzymatic bioluminescence reactions. Over the past 25 years, this system has gained importance associated with its analytical applicability and more recently for its utilization in bioimaging systems, where it is used for the efficient detection of hydrogen peroxide, which plays a central role in several life-threatening human diseases, like cancer. The most commonly utilized oxalic esters in analytical applications and chemiluminescence demonstrations are the commercially available derivatives bis(2,4,6-trichlorophenyl) oxalate and bis(2,4-dinitrophenyl) oxalate, and these compounds are dissolved in volatile, nonbiodegradable, and generally toxic organic solvents. Additionally, the products of the chemiluminescent reaction are carbon dioxide and either 2,4,6-trichlorophenol or 2,4-dinitrophenol, both of which are aquatic and terrestrial toxins. To avoid these toxic pollution sources, new chemiluminescent reactions have been described in the literature, employing not only oxalates synthesized from naturally occurring molecules but also non-toxic and biodegradable solvents (triacetin and ethyl acetate). These environmentally benign and commercially available analogs are derived from vanillin and methyl salicylate. As the use of these new compounds for the peroxyoxalate reaction might open up its future analytical and bioanalytical application, including in bioimaging studies, we describe here our results of a kinetic study on the peroxyoxalate reaction using the previous mentioned "environmentally friendly" oxalate esters and solvents, as well as adequate bases and activators.

Keywords: peroxyoxalate reaction, green oxalic esters, biodegradable solvents

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