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# Rapid and sensitive spectroelectrochemical and electrochemical detection of glyphosate and AMPA with screen-printed electrodes

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## Abstract

*N*-(Phosphonomethyl)glycine (glyphosate), known by the trade name Roundup<sup>®</sup>, is a broad spectrum systemic herbicide used to kill several types of grass weed. The hazard potential of Roundup<sup>®</sup> is unclear, which is a serious issue within the European Union; however, after an intense debate, the EU Commission extended its approval of glyphosate use until the end of 2017.

A persistent need exists for rapid, inexpensive, and sensitive detection of glyphosate and (aminomethyl)phosphonic acid (AMPA), the hydrolysis product of glyphosate. This article presents reliable and easily performed (spectro)electrochemical measurements (e.g., electrogenerated chemiluminescence (ECL) and fast amperometry) for identifying glyphosate and AMPA on the basis of [Ru(bpy)<sub>3</sub>]<sup>2+</sup>. The limit of detection of both methods is also determined in this study. The main feature of the (spectro)electrochemical methods is screen-printed electrodes (SPE) that are made from either gold or multi-walled carbon nanotubes (MWCNTs), optionally decorated with nano-ZnO. Nano-ZnO can significantly enhance the ECL signal to result in a detection limit lower than 1 μmol/L for glyphosate. In addition, these methods are cheaper, faster, and more sensitive than, for example, spectroscopic tests.

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