A Graphene Oxide-Based Aptasensor for the Multiplexed Detection of Neonicotinoids in Food Samples

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Neonicotinoids are a group of neurotoxic insecticides that are chemical analogues of nicotine [1]. They possess significant threats not only to the environment, but also to human health [2]. This underlines the importance of developing cost-effective detection tools for these insecticides. Graphene oxide is a popular choice of material in the development of such sensors due to the unique properties it presents like the presence of oxygenated functional groups, its high conductivity, and the simple preparation [3]. Nonetheless, no aptasensor was reported for the multiplexed detection of neonicotinoids. Recent years have seen a surge of interest in integrating aptamers with graphene in electrochemical biosensors, thanks to the remarkable properties of both materials. Herein, an electrochemical biosensor was fabricated by integrating three aptamers on a reduced graphene oxide screen printed electrodes for the detection of imidacloprid, thiamethoxam, and clothianidin. While the latter two were directly retrieved from the literature, the imidacloprid-specific aptamer underwent a truncation, which showed strong affinity with K_d = 20 nM when studied with cyclic voltammetry (CV) and differential pulse voltammetry (DPV). The biosensor displayed good sensitivity and a linear range from 0.01ng/mL to 100 ng/mL for imidacloprid, thiamethoxam, and clothianidin. It also demonstrated good selectivity to the three analytes against dinotefuran and one another. Spiked extracts of tomatoes and rice samples were tested for all three neonicotinoids and the recovery was in the range of 99.0% - 100.8%. This study highlights the potential for using reduced graphene oxide in developing electrochemical biosensors, which could be further extended to detect emerging organic contaminants.

References

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Figures

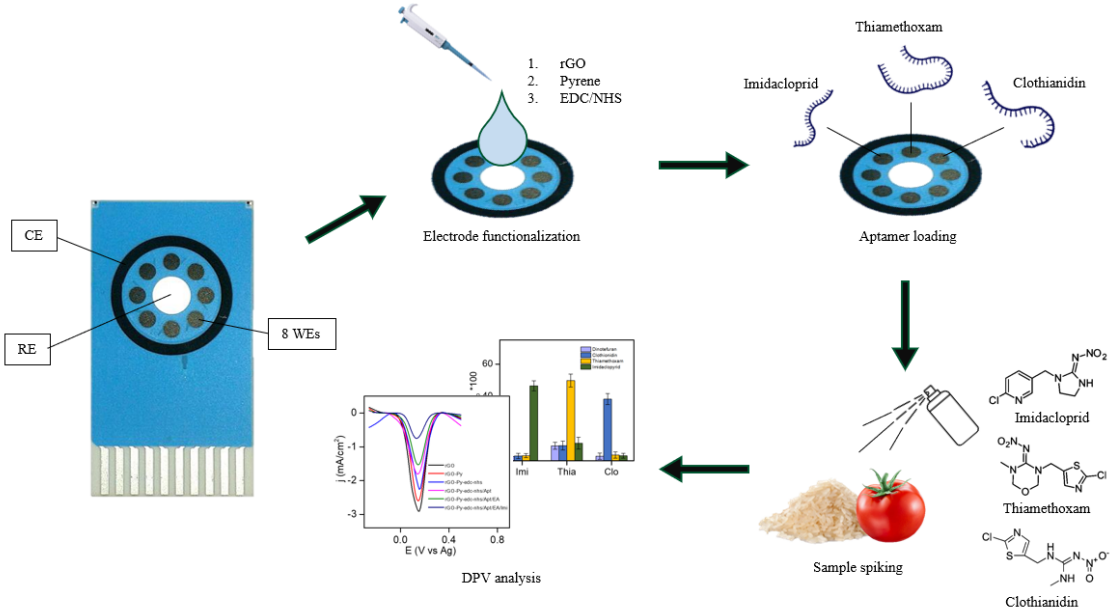

Figure 1: Schematic overview of the developed aptasensor