Innovative electrochemical detection of genetically modified organisms amplified via LAMP method for agricultural applications

Ana Kuprešanin[1], Zoran Pavlović[1], Ljiljana Šašić Zorić[1], Marija Pavlović[1], Mila Đisalov[1], Teodora Knežić[1], Ljiljana Janjušević[1], Milinko Perić[1], Nikola Kanas[1], Jasmina Anojčić[2], Ivana Gađanski[1]

[1]*University of Novi Sad, BioSense Institute. 21 000 Novi Sad, Serbia*

[2]*University of Novi Sad, Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection, 21000 Novi Sad, Serbia*

The increasing diversity and complexity of genetically modified organisms (GMOs) create obstacles in their detection, impacting food traceability, safety, and monitoring. Current research indicates that GM crop technology may pose risks to human health and the environment. This study focuses on developing a LAMP-based GMO detection device implementing electrochemical methods.

Electrochemical DNA sensor was used to detect LAMP products that are complementary to single-stranded DNA probes using methylene blue as a redox indicator through the hybridization process. The probes were attached to the gold electrodes functionalized by gold nanoparticles, and 2D nanomaterials (such as MoS2 or MXenes). The electrochemical methods, such as alternating current voltammetry, square wave voltammetry, and differential pulse voltammetry were employed in testing the electrochemical detection response.

The experiments show that electrochemical detection methods and setup parameters, as well as the choice of nanomaterial for electrode modification, significantly influence the GMO detection signal. Conformational changes in DNA probes upon binding to the target DNA result in a decrease in signal intensity. This phenomenon is explained by the increased resistance to electron transfer to the electrode materials by methylene blue molecules located at the top of the DNA probes. These results are promising for the development of a device that will enable a specific, sensitive, fast, cost-effective, and precise in-field detection system for the routine detection of GMOs.

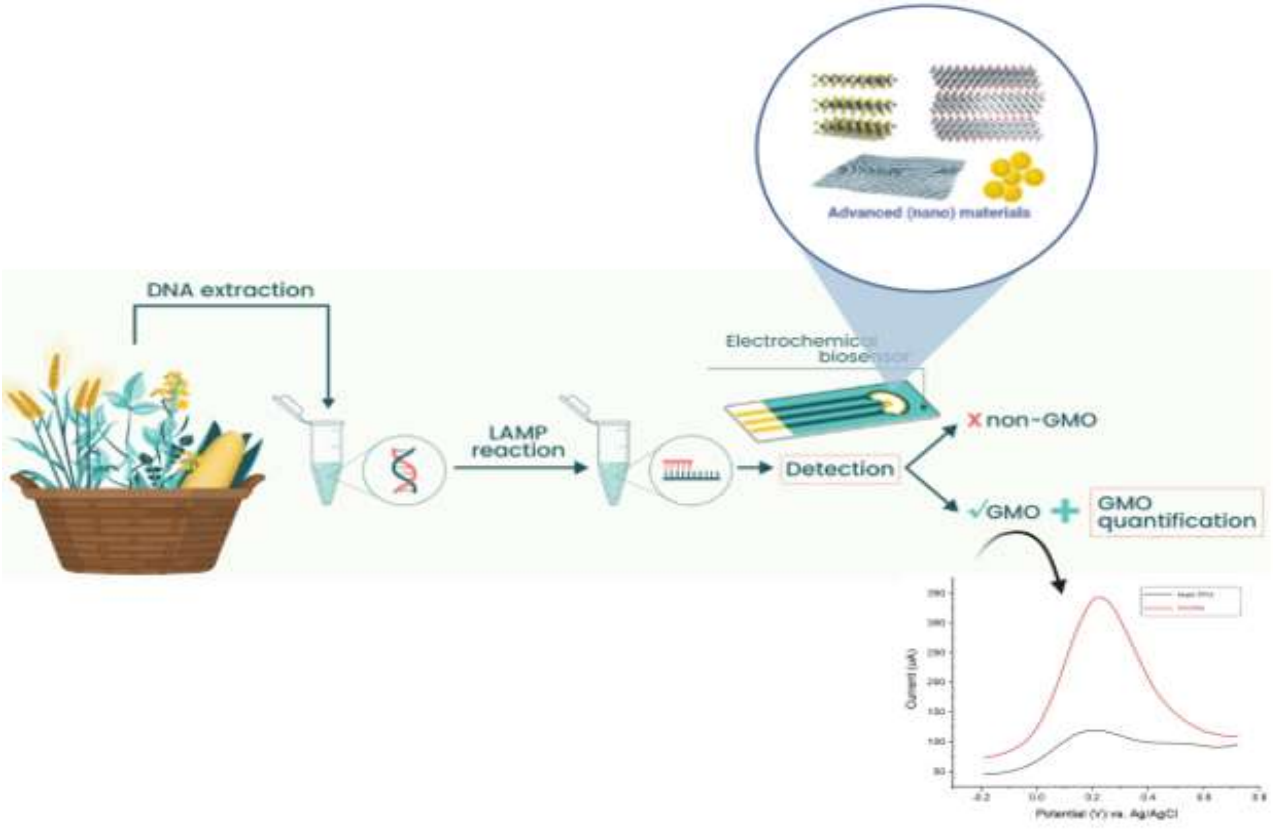

Figure 1. Electrochemical detection of LAMP products

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