Organelle-derived genome electroanalysis applicable to low-resource settings for foodomics support

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Today nutrition's key role in health and wellness is fully accepted. In addition to moving forward to close food/health loop through accurate and personalized nutrition, emerging issues including climate change, access to sustainable land and water, inflation, and war-related food shortages need to be faced. In this sense, the ongoing progress of analytical tools has led to raise more ambitious goals using a wider outlook, triggering the birth of "foodomics" as new discipline, it being based on the study of food/nutrition nexus and its scope, by integrating leading-edge omics technologies to promote food safety and consumer wellness[1][2]. In this field, genomic studies have contributed to nutritional comprehension and follow-up as pathway to prevent and treat modern diseases such as diabetes, allergies, and chronic nutritional disorders. In this context, due to genomic material integrity during food processing, nucleic acid-based methodologies have been postulated as reliable alternative to protein-based assays. Indeed, foodomics aim can be extended to the interrogation of scarcely explored genes found in some abundant organelles as mitochondria and chloroplasts, small size genomes, which are easily handled and provide a more sensitive detection[3].
In this context, we are working on the set-up of amperometric genosensors for the sensitive and selective interrogation of food allergy-relevant genetic targets derived both from animals or plants, implying the selective capture of DNA/RNA heterohybrids onto magnetic microcarriers and their ultrasensitive detection with a specific antibody tagged with n-enzymatic bioconjugates for signal amplification purposes. These bioplatforms have been successfully implemented in the identification of genomic DNA from tomato[4] and mustard[5], and pioneeringly for the interrogation of organelle-derived genomic targets, such as chloroplast and mitochondrial DNA for the detection of peanut or meat adulterations using raw mitochondrial lysates[6], respectively. Currently, in addition to exploiting the isolation of organelles to enhance throughput and simplify gene extraction procedures, the biosensing pathway simplification for the set-up of single step bioelectronics approaches applicable to low resource settings with minimal handling and free of stirring and/or heating devices is being evaluated. The flexibility of the proposed methodology to easily and sensitively detect any type of nucleic acid, regardless of its nature (DNA or RNA), organelle type (nucleus, mitochondria or chloroplast) and origin (plant or animal) make them very promising tools for foodomics support and for advancing genome interactions with improved crop yield, nutritional quality, stress resistance or on-demand recombinant protein production in the desired food host.

References

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