Identificación del proyecto

Nombre del proyecto

Next generation serology: Immune profiling via graphene-enhanced DNA scaffold sensors (SerDNA)

Expediente numero

CPP2023-010774

MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

Cofinanciado por la Unión Europea

AGENCIA ESTATAL DE INVESTIGACIÓN

Descripción del proyecto

The SerDNA project aims to develop a novel rapid diagnostic test to effectively measure the presence of clinically-relevant antibodies at the point of care. Specifically, we will employ electrochemical DNA scaffold sensors as sensing mechanisms. This involves using a DNA scaffold attached at one end to the electrode surface and the other end modified with a redox reporter and a specific epitope. In the absence of the antibody target, the DNA scaffold is free to move, and its redox reporter can effectively exchange electrons with the electrode surface. In the presence of the antibody target and its binding to the epitope on the DNA scaffold, this induces steric hindrance that diminishes the interactions between the redox reporter and the electrode surface. This generates a decrease in the electrochemical signal that can be used to measure the specific antibodies. Overall, the sensor allows for a single-step measurement of antibodies at the point of care. In the SerDNA project, we aim to combine this sensing mechanism with nanomaterials that can improve its performance while minimizing the production cost and the environmental impact. Specifically, we will employ our patented fabrication method to fabricate electrodes using graphene-based aqueous solution inks. We will also develop metal nanoparticles specifically tailored to maximize the electrode functionalization and the electrochemical signal.

As a test bed for our technological innovation, we will address the management of vaccine-preventable diseases, especially in international travellers. Specifically, we will measure at the point of care antibodies specific for the most immunogenic antigens of measles, hepatitis A, and dengue. Measles is highly transmissible, posing a significant threat of outbreaks, especially in susceptible populations, highlighting the need for national vaccination initiatives to maintain herd immunity, complemented by individual immune status assessments for effective prevention. Hepatitis A (HAV) presents risks for travellers from low-prevalence to high-risk regions, with its foodborne transmission and severity increasing with age, emphasizing the importance of serostatus-guided vaccination strategies for enhanced protection. Dengue, increasingly common, introduces a new vaccine for travellers to prevent severe cases, underscoring the need for serostatus assessment and the variability in rapid test performance, pointing towards the benefits of point-of-care testing. During the SerDNA project, healthcare professionals will be engaged throughout the entire duration of the project to receive feedback during the test development phase, to be trained on the use of the final prototype, and to conduct a usability assessment, which will also include the patient experience.

The project is divided into six work packages, with each partner leading at least one WP to carry out parallel and sequential tasks. The work packages cover the biobank and serological characterization (WP1), the DNA scaffold sensor development (WP2), the nanoparticle synthesis and functionalization (WP3), the graphene electrode fabrication (WP4), the implementation and clinical validation (WP5), and the project management (WP0). Carrying out these tasks is our multidisciplinary team that involves a clinical partner (ISGlobal), whose members also act as stakeholders, a private company with a patented fabrication method to make environmentally sustainable and low-cost graphene-based electrodes (GraphenicaLab), and two public institutions, the Interfibio research group of the University Rovira Virgili, which is expert in the development of biosensing technologies including the E-DNA scaffold sensors, and the group led by Prof. Puntes at the Vall d'Hebron Research Institute, which is expert in the synthesis and functionalization of nanoparticles. Thanks to this group composition, we cover all the aspects required to move our prototype to the pre-commercialization phase.

Overall, the SerDNA project expects to have a significant impact on the scientific and technological advancement of nanomaterial-based point-of-care serology, the social and economic benefits of personalized and optimized vaccination strategies, and the environmental sustainability of biosensor production.

Financiación

Entidad financiadora

MICIU/AEI/10.13039/501100011033 y por FEDER, UE

Importe

120.625,00