

# Enhanced Detection with Prussian Blue-based Nanocubes: A Novel Electrochemical Biosensor for Bovine Serum Albumin Analysis

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## Abstract:

Early diagnosis of relevant biomarkers is nowadays crucial for optimizing therapeutic approaches and elevating survival rates. Therefore, the development of straightforward, cost-effective, and user-friendly diagnostic assays holds significant value for use in Point-of-Care (PoC) testing. In this context, employing a nanomaterial-redox probe approach in electrochemical biosensing devices not only enhances sensitivity and accelerates response times but also ensures stability, thereby enabling reliable detection of target analytes.

The monitorization of Bovine Serum Albumin (BSA) can serve as valuable indicators of both liver and kidney function (Belinskaia *et al.*, 2021; Cheng *et al.*, 2023). Liver dysfunction, such as in liver cirrhosis or hepatitis, may lead to decreased BSA levels (hypoalbuminemia), while kidney dysfunction, as in chronic kidney disease or acute kidney injury, can result in elevated BSA levels (hyperalbuminemia). Thus, tracking BSA levels offers valuable insights into the function and dynamics of these organs, aiding clinicians in assessing the severity of liver and kidney diseases and guiding appropriate treatment strategies for affected individuals.

Herein, an innovative electrochemical biosensor was developed using a platinum screen-printed electrode (Pt-SPE) decorated with Manganese-based Prussian Blue Nanocubes ( $K_2Mn[Fe(CN)_6] \cdot 2H_2O$ , Mn/PBNCs) for selective and sensitive determination of BSA protein. The biorecognition layer, constituted by a molecularly imprinted polymer (MIP), was fabricated on the surface of Mn/PBNCs-Pt/SPE by electropolymerization of phenol, in the presence of the target protein (BSA) by means of cyclic voltammetry (CV). Subsequently, the template was removed from the polymer matrix using proteinase K and a mixture of methanol and acetic acid. In parallel, a non-imprinted material (NIP) was constructed in the absence of the target protein. Both MIP and NIP resulted in a nonconducting and electrically inactive film on the modified electrode surface. Along the optimization, both electrochemical impedance spectroscopy (EIS) and square wave voltammetry (SWV) were employed to characterize the electrochemical performance of the MIP sensor.

Overall, the incorporation of the nanomaterials onto the electrode surface resulted in an electrochemical biosensor exhibiting enhanced responsiveness to BSA detection, enabling the detection of this biomarker down to the nanoMolar level.

## References:

Belinskaia, D.A. *et al.* (2021) ‘Serum albumin in health and disease: Esterase, antioxidant, transporting and signaling properties’, *International Journal of Molecular Sciences*, 22.

Cheng, T. *et al.* (2023) ‘The level of serum albumin is associated with renal prognosis and renal function decline in patients with chronic kidney disease’, *BMC Nephrology*, 24(1).

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