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A Review of Fabrication Techniques and Optimizatic

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Abstract

Challenges of stability and specificity associated with early generation sensors necessitate the fabrication and optimization of microbial biosensors. More so, the global biosensors market size currently valued at USD25.5 billion in 2021 is expected to grow at a compound annual growth rate (CAGR) of 7.5% to USD36.7 billion in 2026. Microbial biosensors are bioanalytical systems that integrate microorganisms with a physical transducer to generate signals, thus, aiding the identification of analytes. The biosensors are fabricated through a series of steps comprising microbe selection, immobilization onto a matrix, microfabrication, calibration, and validation. The transducers integrated microorganisms generate quantifiable signals, enabling real-time monitoring of a diversity of analytes within food samples. The optimization strategies are scrutinized, with a particular focus on the integration of sundry nanoparticles, such as magnetic, gold, and quantum-dot nanoparticles, which enhance sensor performance. Distinct advantages offered by microbial biosensors promise to revolutionize food quality assessment via cost-effectiveness, rapid sample testing, and the ability to provide access to real-time data. Literature have highlighted certain limitations including interference from complex matrices, instability of microorganisms, and microbial lifespan. In assessing their economic importance, a comparative analysis is presented against conventional food analytical methods like ELISA, PCR, and HPLC; thus, highlighting the unique strengths of microbial biosensors. The future perspectives focus on the potential of the technology in addressing the need for continuous monitoring challenges, and research for further improvements in the biocompatibility of fabrication processes and long-term reusability.

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