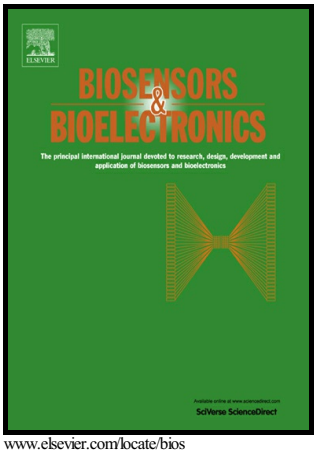
Emerging nano-biosensing with suspended MNP microbial extraction and EANP labeling

Leann Lerie Matta, Evangelyn C. Alocilja



www.elsevier.com/locate/bios

PII: S0956-5663(18)30508-6
DOI: https://doi.org/10.1016/j.bios.2018.07.007
Reference: BIOS10596

To appear in: *Biosensors and Bioelectronic*

Received date: 17 April 2018
Revised date: 2 July 2018
Accepted date: 5 July 2018

Cite this article as: Leann Lerie Matta and Evangelyn C. Alocilja, Emerging nano-biosensing with suspended MNP microbial extraction and EANP labeling, *Biosensors and Bioelectronic,* https://doi.org/10.1016/j.bios.2018.07.007

Emerging nano-biosensing with suspended MNP microbial extraction and EANP labeling

Leann Lerie Matta and Evangelyn C. Alocilja*

Nano-Biosensors Lab, Biosystems and Agricultural Engineering, Michigan State University, East Lansing, MI 48824

*Corresponding author: Tel.: (517)-432-8672; Email: alocilja@msu.edu

Abstract

In ensuring a secure microbe-free food supply, rapid response detection of microbial contamination is of utmost importance. Many biosensor designs have been proposed over the past two decades, covering a broad range of binding ligands, signal amplification, and detection mechanisms. These designs may consist of self-contained test strips developed from the base up with complicated nanoparticle chemistry and intricate ligand immobilization. Other methods use multiple step-wise additions, many based upon ELISA 96-well plate technology with fluorescent detection. In addition, many biosensors use expensive antibody receptors or DNA ligands. But many of these proposed designs are impracticable for most applications or users, since they don't FIRST address the broad goals of any biosensor: Field operability, Inexpensive, with Real-time detection that is both Sensitive and Specific to target, while being as Trouble-free as possible. Described in this review are applications that utilize versatile magnetic nanoparticles (MNP) extraction, electrically active nanoparticles (EANP) labeling, and carbohydrate-based ligand chemistry. MNP provide rapid pathogen extraction from liquid samples. EANP labeling improves signal amplification and expands signaling options to include optical and electrical detection. Carbohydrate ligands are inexpensive, robust structures that are increasingly synthesized for higher selectivity. Used in conjunction with optical or electrical detection of gold nanoparticles (AuNP), carbohydrate-functionalized MNP-cell-AuNP nano-biosensing advances the goal of being the FIRST biosensor of choice in detecting microbial pathogens throughout our food supply chain.

Keywords: Nano-biosensors; Magnetic nanoparticles; Food supply chain security; Rapid detection; User-friendly; Gold nanoparticles; Microbial contamination; Carbohydrate-functionalized MNP-cell-AuNP biosensing

1. Introduction

Worldwide population growth is estimated to reach 9.8 billion people by 2050 (Adegoke, 2017). This growth will further task our food and water supplies. Currently over 28 billion meals are consumed each day around the globe (Beach, 2016). But foodborne disease sickened 600 million people in 2010, causing over 420,000 deaths from foodborne hazards, including those that were bacterial in origin. Unfortunately, children under the age of 5 years represented 40% of these illnesses (WHO, 2015). Higher mortality rates persistently hit under/developing countries in African sub-regions, South-East Asia and the Eastern Mediterranean (Havelaar et al., 2015; WHO, 2015), which have limited economical resources to fight these diseases.