



Review

DNA/Nano based advanced genetic detection tools for authentication of species: Strategies, prospects and limitations

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ARTICLE INFO

Keywords:

Biosensors
DNA
Electrochemical
Nanomaterials
Optical
PCR

ABSTRACT

Authentication, detection and quantification of ingredients, and adulterants in food, meat, and meat products are of high importance these days. The conventional techniques for the detection of meat species based on lipid, protein and DNA biomarkers are facing challenges due to the poor selectivity, sensitivity and unsuitability for processed food products or complex food matrices. On the other hand, DNA based molecular techniques and nanoparticle based DNA biosensing strategies are gathering huge attention from the scientific communities, researchers and are considered as one of the best alternatives to the conventional strategies. Though nucleic acid based molecular techniques such as PCR and DNA sequencing are getting greater successes in species detection, they are still facing problems from its point-of-care applications. In this context, nanoparticle based DNA biosensors have gathered successes in some extent but not to a satisfactory stage to mark with. In recent years, many articles have been published in the area of progressive nucleic acid-based technologies, however there are very few review articles on DNA nanobiosensors in food science and technology. In this review, we present the fundamentals of DNA based molecular techniques such as PCR, DNA sequencing and their applications in food science. Moreover, the in-depth discussions of different DNA biosensing strategies or more specifically electrochemical and optical DNA nanobiosensors are presented. In addition, the significance of DNA nanobiosensors over other advanced detection technologies is discussed, focusing on the deficiencies, advantages as well as current challenges to ameliorate with the direction for future development.

1. Introduction

Meat and meat products are generally consumed throughout the world as one of the dietary sources of protein. The consumption of animal based protein contributes to 40% of the total global protein consumption. As a consequence, the overall global meat consumption is rising simultaneously with the rapidly increasing human population in the world [1,2]. To cope with the huge demand of the vast population, especially in developing countries, food manufactures are also facing challenges to support the market demand for both raw and processed meat products [3]. Therefore, with the escalating prices of commercial meat products, globalization of food trade, and processing of meat into value-added products to a large extent; the incidences of species

substitution, adulteration and fraud-labeling of meat products have become a commonplace to generate illegal financial benefits [4]. One of the biggest meat scandals that had shaken the world in the sense of food safety and security, was the detection of horsemeat in many ready-meal food products that were marketed as 100% beef in Europe in 2013 [5]. Another remarkable report which received global media attention and intense public outrage, especially from muslim countries was the presence of pork DNA in Cadbury chocolates in Malaysia in 2014 [6]. As a consequence, food fraud exerts both short term and long term impacts, affecting not only the consumers but also the manufacturers, regulators, industry, local or international trading partners by imposing mistrust in the food supply chain, and consequently leading to market and trade disruptions [7].

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<https://doi.org/10.1016/j.mcp.2021.101758>

Received 2 April 2021; Received in revised form 20 June 2021; Accepted 6 July 2021

Available online 9 July 2021

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