Species authentication methods in foods and feeds: the present, past, and future of halal forensics.

Abstract

We extensively reviewed the existing as well as the potentials of the molecular biology and nanotechnology methods for the identification of animal-derived materials in foods and feeds. The verification of animal-derived materials in foods and feeds is mandatory by several religious as well as regional and state laws. It is also essential to limit the transmission of food-borne pathogens and allergens. Verification of declared components further helps prevent unfair trades and protect consumers' trusts, religious faiths, and hard-earned fortunes. In this review, special emphasis is given to the molecular markers and their tracing tools in biology and nanotechnology. Among the four types of biomolecules, known as proteins, lipids, carbohydrates, and nucleic acids, DNA has been reported as the most appropriate biomarker to identify the source of animal-derived materials. While PCR has got enormous attention as the most effective molecular identification tool, PCR-based methods are not suitable for the unambiguous identification of very short DNA targets (15–30 bp) which can survive even in the harsh conditions of food and feed processing. Nanotechnology-based approaches using nanogap electrodes, quantum dots (QDs), and SERS-active nanoparticle shells are highly sensitive and can detect very short oligo targets almost at single-molecule sensitivity. However, nanogap fabrication has remained a challenging task and also involves complicated surface modification and immobilization chemistries. QD and SERS-based techniques also demand surface modifications and immobilization chemistries. On the other hand, gold nanoparticle (GNP)-based hybridization detection is label-free, sensitive, and does not involve any modification chemistry and expensive instrumentations. GNP-based biosensors offer a low-cost platform to detect and quantify short-length DNA markers in mixed biological and processed commercial foods.