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Application of Raman Technique in the Detection of Aflatoxins

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Aflatoxin is one of the most important topics of research in food contamination (mohamadigol r *et al.*, 2015). Aflatoxin, a member of the Mycotoxin family, is a secondary metabolite of molds such as *Aspergillus Flavus* and *Aspergillus Parasiticus* (Herrman *et al.*, 2020). These fungi also pollute the crops during production and storage (Aristil, 2019). In the case of the products' contamination with spores in the desired temperature and humidity conditions, the hogs grow, fungus is produced, and poison is created (Dana *et al.*, 2019). One of the most deadly toxins is Aflatoxin (Smith and Dent, 2019), which is known as Mycotoxin due to its considerable abundance in the nature, toxicity, and carcinogenicity (Kachapulula *et al.*, 2017). Several types of Aflatoxin, i.e., G1, G2, B2, B1 were identified, among which B1 Aflatoxins (AFB1) are most important (Arrus *et al.*, 2005). AFB1 is the most toxic compound in this group. The highest concentration of AFB1 is observed in food and animal feed (Eaton and Groopman, 2013). The concentration range of AFB1 varies in different food products; for example, in pistachios. According to the European Union, the acceptable AFB1 is 12 ppb (Parts per billion), but this amount may vary in different countries from 2 to 20 ppb (Meneely *et al.*, 2018). Among the 400 known Mycotoxins, AFB1 is considered as the most dangerous one to human health due to its severe effects of toxicity, carcinogenicity, fetal defects, and mutagenesis (Haruna *et al.*, O'Riordan and Wilkinson, 2008).

Among the most commonly used to detect this toxin high-performance liquid chromatography (HPLC) and immunohistochemistry columns are widely used for detection of Aflatoxin and other agricultural products in research and commercial areas (Dragacci *et al.*, 2001).

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The stages of isolation and extraction of Aflatoxin are complicated, are time consuming, and require a lot of experimental experience in HPLC (Sinha, 1999). However, spatial costing method introduced by Raman is one of the simplest and least expensive spectroscopy techniques that allows the molecular detection of materials and applications in a variety of research fields. Today, Raman's technique is widespread and has a variety of uses in basic sciences (Smith and Dent, 2019).

When an electromagnetic radiation passes through a transparent environment, the existing species will scatter part of the beam in all directions. In 1928, Raman discovered that the wavelength was related to a small fraction of radiation emitted by specific molecules different from the initial wavelength (i. e., non-elastic or inelastic scattering). The difference between these wavelengths depends on the molecular structure of the compounds. Raman spectroscopy is based on the analysis of these differences to determine the molecular structure of different compounds (Vandenabeele, 2013).

In recent years, extensive research has been carried out in various fields of medicine and pharmacy over the use of Raman spectroscopy, and over the Raman Signal Upgrade Technique in particular (Hwang and Chang, 2011). The main focus of this research is on early detection and diagnosis of cancer tissue, bacteria, fungi, and pharmaceutical chemicals.

Considering the advances made in the field of optical technology and nanotechnology, development of the remarkable Raman spectrometer increased the global demand for using rapid and accurate detection of food contamination.

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Authors' contributions

Shirdeli M was involved in designing and supervising the study. Marzban A and Shirani M were involved in designing the study, data collecting. Yaghoubi F and Shahidi MS participated in writing the manuscript. All authors critically reviewed the manuscript and approved the final version submitted for publication.

Conflict of interest

The authors stated no conflict of interest.

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