CURRENT ANALYTICAL METHODS FOR MYCOTOXIN DETECTION IN FOODS AND FEEDS: A COMPARATIVE REVIEW

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INTRODUCTION

Mycotoxins are potent toxins that accumulate in the food chain and pose a great risk for acute and chronic health complications. Therefore, there are various methods developed and in use for their qualitative and quantitative analysis. Current approaches for mycotoxin detection consist of three phases. The first is sampling. It is a crucial step because the contamination of natural products is often non-homogenous. Therefore, the use of standardized protocols is important to avoid false negative results. The next phase is sample preparation, which includes grinding, extraction and purification. The most commonly used extraction methods are solid–liquid extraction, solid-phase extraction and QuEChERS. The final phase is detection with analytical methods such as chromatography techniques and antibody-based immunoassays.

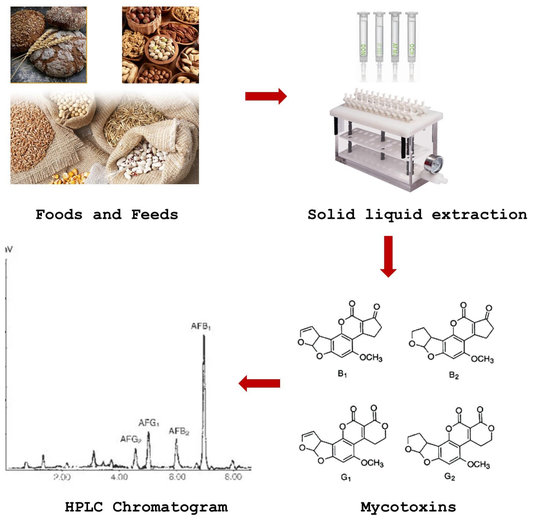

Figure 1. Workflow for mycotoxin detection

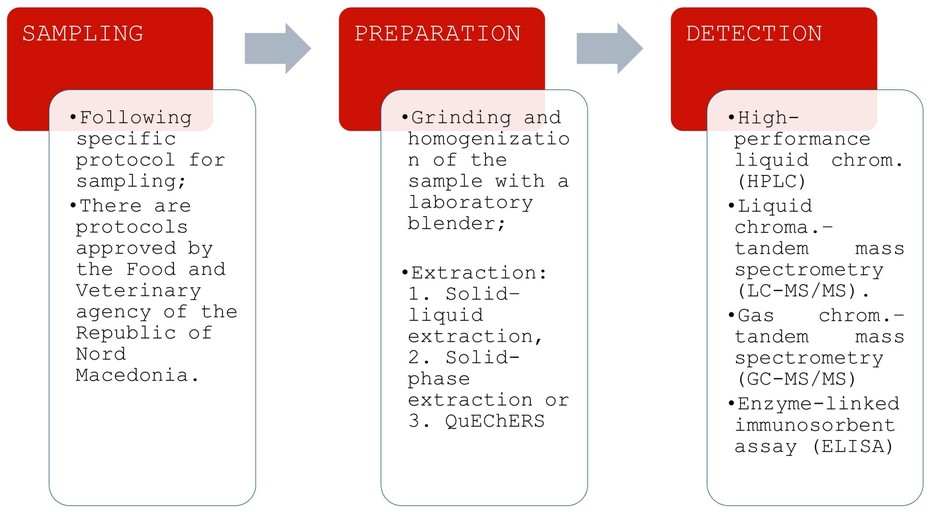

Chart 1. The three phases in mycotoxin detection. Sampling as a vital step that must result in withdrawing representative samples. Preparation of the samples that starts in the laboratory. List of various detection methods that are in use.

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2. Gayathree T. Perveen A. Bilal J. Baljit S. Hugh J. B. and Furong T. Recent Advancements in Lateral Flow Assays for Food Mycotoxin Detection: A Review of Nanoparticle-Based Methods and Innovations, Toxins, 2025.

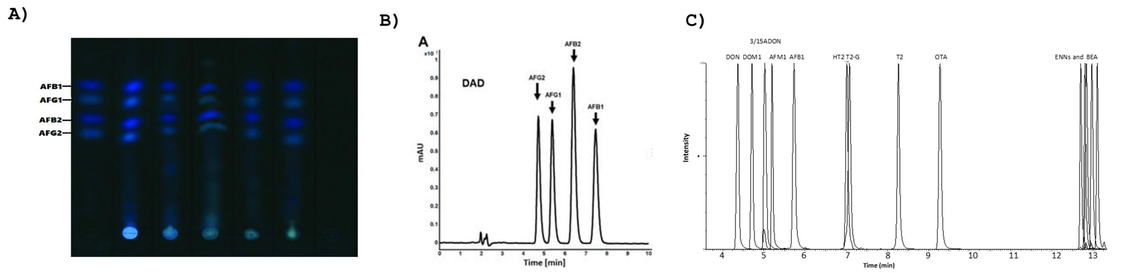

Figure 2. A)TLC plate of aflatoxin separation. Adopted by Salisu, B.U. et.al. *Journal of Advanced Veterinary and Animal Research*, 2021. B) HPLC chromatogram of aflatoxins. Adopted by Alshannaq, A.F. et. al. *Toxins* 2020. C) LS MS/MS chromatogram showing the separation of multiple mycotoxins. Adopted by Lauwers, M.et.al. *Toxins* 2019.

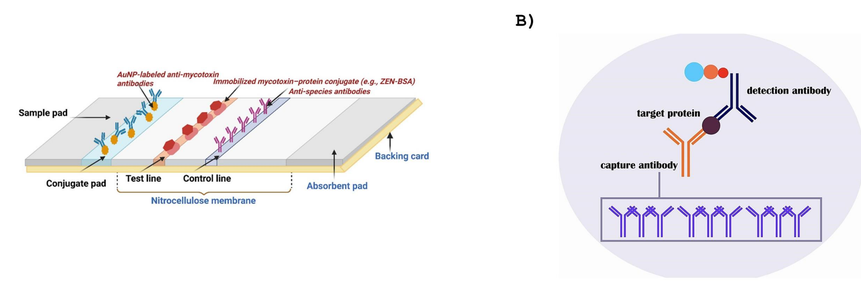

Figure 3. A)Lateral flow immunoassay. Thenuwara, G. et. al. *Toxins* 2025. B) Representation of ELISA test. Adopted by Nwachukwu, S. et. al. *Journal of Food Measurement and Characterization* 2024.

DISCUSSION

The thin-layer chromatography (TLC) is one of the earliest analytical methods and is still in use due to its low cost. A more specific, sensitive, and automated technique than TLC is liquid chromatography–tandem mass spectrometry (LC-MS/MS). It advantage the identification of multiple mycotoxins in a single run, regardless of their chemical composition. Gas chromatography–tandem mass spectrometry (GC-MS/MS) is also used. However, since the mobile phase is a gas, it is not the method of choice for mycotoxin analysis. High-performance liquid chromatography (HPLC) is considered a gold standard for the analysis of mycotoxin contamination in various foods. It is often combined with UV visible or fluorescence detector to increase efficiency and sensitivity. It offers advantages in terms of availability and reliability. On the other side, the antibody-based immunoassays with their promptness and ability for screening of many samples of mycotoxins are worth noting. The most often used are enzyme-linked immunosorbent assay (ELISA) and lateral flow immunoassay (LFA).

CONCLUSION

The above discussed methods hold their own advantages and drawbacks. In general, the automatic and more relevant methods require expensive apparatus and trained personnel. Until recent, the HPLC was considered a gold standard for mycotoxin detection. However, in present the LS MS/MS multimethod have gained a growing relevance because it allow rapid quantification on multiple mycotoxins. There is a need for rapid, accurate and cost-effective methods for detection and quantification of mycotoxins.