Chapter

Introductory Chapter: Mycotoxins and Food Safety

Suna Sabuncuoğlu

1. Introduction

Food-borne illnesses are prevalent in all parts of the world, and the toll in terms of human life and suffering is enormous. Contaminated food contributes to 1.5 billion cases of diarrhea in children each year, resulting in more than 3 million premature deaths, according to the World Health Organization (WHO). Food safety is used as a scientific discipline describing handling, preparation, and storage of food in ways that prevent food-borne illness. The occurrence of two or more cases of a similar illnesses resulting from the ingestion of a common food is known as a food-borne disease outbreak [1, 2].

Food safety issues can have very different political implications. Understanding the potential for the application of Multi-Criteria Decision Analysis processes in countries with challenges on data availability, limited processes for stakeholder input to decision-making, and so on, is an important foundation for the development of FAO guidance for food safety decision-making using best available evidence for transparent decision-making [3].

Recent research has increased the awareness of chemical residues and natural contaminants in food. At the same time, consumer concerns about food safety have also grown. At a national and international level, this has resulted in more stringent imposition of new, legislative limits for a range of mycotoxins which can contaminate food raw materials and enter the food chain [4].

Mycotoxins are naturally occurring toxins produced by microfungi that are capable of causing disease and death in living organisms. The fungi grow on a variety of different foodstuffs including cereals, nuts, spices, dried fruits, apples and coffee beans, often under warm and humid conditions [5, 6]. It is generally known that cereals, peanuts, spices, coffee, and herbal teas can be contaminated with mycotoxins. Various cereal and crops have potential fungal attack either in the field or during storage [6, 7].

The adverse effect of molds and fungi was known already in ancient times. In the Middle Ages, outbreaks of ergotism caused by ergot alkaloids from *Claviceps purpurea* reached epidemic proportions, mutilating and killing many people in Europe. Some mycotoxicoses have disappeared due to more rigorous hygiene measures such as citreoviridin-related malignant acute cardiac beriberi and alimentary toxic aleukia. General interest in mycotoxins increased in 1960 when a feed-related mycotoxicosis called turkey X disease, which was caused by aflatoxins, appeared in farm animals in England. Subsequently, it was found that aflatoxins are hepatocarcinogens in animals and humans, and this stimulated research on mycotoxins.

Mycotoxins have attracted worldwide attention because these have been recognized as a major economic problem due to the significant economic losses associated with their impact on human health, animal productivity, and domestic and international trade [7].

Mycotoxins are produced by fungi such as Aspergillus, Penicillium, Fusarium, or Alternaria. These fungi may produce as secondary, metabolites a diverse group of chemical substances known as mycotoxins. Several hundred different mycotoxins have been identified, but the most commonly observed mycotoxins that present a concern to human health and livestock include aflatoxins, ochratoxin A, patulin, fumonisins, zearalenone, and nivalenol/deoxynivalenol. It is possible to be wide year to year fluctuations in the levels of mycotoxins in foods [8]. This can be dependent on many factors including adverse conditions favoring fungal invasion and growth. Mycotoxicoses, which can occur in both industrialized and developing countries, arise when environmental, social, and economic conditions combine with meteorological conditions (humidity, temperature) which favor the growth of molds. Factors affecting mycotoxin formation are listed below:

- Plant-related factors (type and sensitivity of the plant, other toxic fungal species found in the plant, water content of the plant, plant maturity, mechanical damage to the plant; for example, damage to the plant by insects and/or birds)

- Environmental factors (temperature and humidity of the environment where the plant grows, oxygen source of the environment)

- Conditions during processing, storage conditions after harvest and during storage (relative humidity and temperature of the environment) [6, 9]

Mycotoxins are toxic secondary metabolites that are synthesized by various types of pathogenic fungi. When they are taken into the organism, they can cause latent, acute, or chronic pathological conditions in humans and animals. With developing the modern farming, storage and processing practices, the aim is to reduce obvious contamination, and much of our concern now focuses on chronic effects at low levels of exposure. Thus, several mycotoxins are potent animal carcinogens and have been classified by the International Agency for Research in Cancer (IARC, 1993) as human carcinogens or potential (probable and possible) human carcinogens [2, 7].

Quality procedures and legislation of levels that are toxicologically acceptable are needed to minimize the exposure to mycotoxins; these actions are carried out in the agricultural practice, storage of products, and control of products intended for human or animal consumption [4]. The techniques used for mycotoxin determination are chromatography, including high-performance liquid chromatography (HPLC), thin-layer chromatography (TLC), and gas chromatography–mass spectrometry (GC–MS), and enzyme-linked immunosorbent assay (ELISA) techniques. Considering the limitations of these techniques, the high cost, lack of sensitivity, and need for a skilled technician, there is an urgent need for other accurate, simple, and cost-effective techniques [10].

This book will provide updated information about food-borne mycotoxins, their toxicities, new determination methods, prevention strategies, and regulations in the world.

IntechOpen

Author details

Suna Sabuncuoğlu
Faculty of Pharmacy, Department of Toxicology, Hacettepe University, Sihhiye, Ankara, Turkey

*Address all correspondence to: suna@hacettepe.edu.tr

IntechOpen

References

[1] Kumar P et al. Aflatoxins: A global concern for food safety, human health and their management. Frontiers in Microbiology. 2017;**7**:2170

[2] Toxic effects of mycotoxins in humans. Available from: https://webcache.googleusercontent.com/search?q=cache:4xWocC3OHEEJ:https://www.who.int/bulletin/archives/77(9)754.pdf+&cd=4&hl=tr&ct=clnk&gl=tr&client=firefox-b-d [Last Accessed: 10 June 2020]

[3] The Food and Agriculture Organization, Food safety and quality, Policy Advice. Available from: http://www.fao.org/food/food-safety-quality/capacity-development/policy-advice/en/ [cited 10 June 2020], [Last Accessed: 10 June 2020]

[4] Sanzini E et al. Quality control of plant food supplements. Food & Function. 2011;**2**(12):740-746

[5] Kabak B, Dobson AD. Mycotoxins in spices and herbs—An update. Critical Reviews in Food Science and Nutrition. 2017;**57**(1):18-34

[6] Pitt J et al. Mycotoxins and toxigenic fungi. Medical Mycology. 2000;**38** (Suppl 1):41-46

[7] Marin S et al. Mycotoxins: Occurrence, toxicology, and exposure assessment. Food and Chemical Toxicology. 2013;**60**:218-237

[8] Bennett JW, Klich M. Mycotoxins. Clinical Microbiology Reviews. 2003;**16**(3):497-516

[9] Blesa J et al. Factors affecting the presence of ochratoxin A in wines. Critical Reviews in Food Science and Nutrition. 2006;**46**(6):473-478

[10] Bueno D et al. Determination of mycotoxins in food: A review of bioanalytical to analytical methods. Applied Spectroscopy Reviews. 2015;**50**(9):728-774