Food Chemistry 215 (2017) 425–437

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Review

# Challenges and issues concerning mycotoxins contamination in oil seeds and their edible oils: Updates from last decade

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ARTICLE INFO

*Article history:*
Received 9 May 2016
Received in revised form 13 July 2016
Accepted 28 July 2016
Available online 29 July 2016

*Keywords:*
Oil seeds
Edible oil
Fungi
Mycotoxins
Safety
Management

ABSTRACT

Safety concerns pertaining towards fungal occurrence and mycotoxins contamination in agri-food commodities has been an issue of high apprehension. With the increase in evidence based research knowledge on health effects posed by ingestion of mycotoxins-contaminated food and feed by humans and livestock, concerns have been raised towards providing more insights on screening of agri-food commodities to benefit consumers. Available reports indicate majority of edible oil-yielding seeds to be contaminated by various fungi, capable of producing mycotoxins. These mycotoxins can enter human food chain via use of edible oils or via animals fed with contaminated oil cake residues. In this review, we have decisively evaluated available data (from the past decade) pertaining towards fungal occurrence and level of mycotoxins in various oil seeds and their edible oils. This review can be of practical use to justify the prevailing gaps, especially relevant to the research on presence of mycotoxins in edible plant based oils.


**Contents**



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http://dx.doi.org/10.1016/j.foodchem.2016.07.161
0308-8146/

## 1. Introduction

Contamination of agri-food commodities by mycotoxins-producing fungi (molds) and their mycotoxins is a recurring food safety problems world over. In recent years, serious concerns are being raised by consumers as well as by health professionals for the presence of various toxigenic fungi or their secondary metabolites (as mycotoxins) in food and feed. This concern is mainly due to increased evidence based research knowledge, and the available monographs related to the health effects caused by ingestion of food or feed contaminated by toxigenic fungi in humans and livestock.

Majority of the mycotoxins reported till date are potentially carcinogenic, teratogenic, tremorogenic, nephrotoxic, immunotoxic or hemorrhagic. In addition, most of the mycotoxins are capable of causing dermatitis in both humans and livestock. Some of the common mycotoxins identified in human food and animal feeds include aflatoxins, ochratoxins, trichothecenes (deoxynivalenol, nivalenol), zearalenone, fumonisins, patulin, citrinin, cyclopiazonic acid, sporidesmins, slaframine, stachybotryotoxin, and phomopsin (Bhat, Rai, & Karim, 2010). Contamination of human food and livestock feed by fungi and their respective toxins presents a serious food safety issue globally, leading to incredible yield and economic losses. As per the International Agency for Research on Cancer (IARC), aflatoxins are considered group 1, and ochratoxin A (OTA) and fumonisins (B1 and B2) as group 2B possible human carcinogens, while zearalenone is a group 3 carcinogen. Zinedine and Mañes (2009) have opined that mycotoxins, being heat-stable, represent an impending risk for human and animal health. In majority of the cases, mycotoxin-producing fungi is reported to belong to genera of *Aspergillus*, *Fusarium*, and *Penicillium* (Bhat et al., 2010; Kumar, Basu, & Rajendran, 2008).

Today, with widely available reports and updated database on fungal occurrence and mycotoxins contamination in marketed commodities, health protection bodies have imposed stringent regulations, especially for imported commodities (Bhat et al., 2010). Fungal contamination in a seed generally occurs either during pre-harvest or during postharvest conditions. In majority of the instances, fungi might be present as an endophyte and invisible to the naked eye. Improper storage conditions and other eco-physiological factors, especially prevailing in the tropics and sub-tropics (wherein high temperature and humidity prevail) contribute immensely for the rapid growth of molds. These fungi can thrive even at low moisture and water activity levels and produce mycotoxins.

In recent years, edible oils (fat) extracted from plant seeds have gained immense popularity over animal-based fats, mainly due to their potential therapeutic/health-promoting potential. Several reports are available on fungal contamination of various oil-yielding seeds, as well as on the presence of mycotoxins in the extracted oil. Contamination of oil seeds by toxigenic molds is a menace, as the seeds and the oil extracted from the infected seeds tend to become unfit for consumption. Accordingly, some of the world's health-governing bodies [such as the Food and Agriculture Organization (FAO), Codex Alimentarius Commission (CODEX), EU Commission and the World Health Organization (WHO)] have put forth stringent laws/regulations for the maximum tolerable levels (limits) of mycotoxins contamination in oilseeds, some of which are depicted in Table 1.

To our knowledge, no review is available wherein various data and reports are compiled to provide comprehensive information on the presence of toxigenic fungi or the mycotoxin level in oil yielding seeds and their edible oil. In this review, we have attempted to disseminate details on the presence of various

**Table 1**
Global regulation of mycotoxins contamination in oilseeds.

| Country | Mycotoxins | Seeds/tolerable levels (μg/kg) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Groundnut (peanuts) | Maize (corn) | Oats | Mustard | Rape seed | Soy bean | Sun flower |
| Australia | Total AF | 15 | – | – | – | – | – | – |
| Brazil | Total AF | 30 | 30 | 50 (f) | – | – | 50 (f) | 50 (f) |
| Bulgaria | Total AF | 15 | 4 | – | – | – | – | – |
| Canada | Total AF | 15 | – | – | – | – | 20 (f) | 20 (f) |
| China | AFB1 | 20 | 20 | – | – | – | 5 | – |
| Egypt | Total AF | 10 | 10 | – | – | – | 20 (f) | 20 (f) |
| France | FB1 | – | 1000 | – | – | – | – | – |
| | ZEA | – | 50 | | | | | |
| Hungary | Total AF/OTA | 15 | 4 | – | – | – | – | – |
| | | | 5 | | | | | |
| India | Total AF | 30 | 30 | – | – | – | – | – |
| Iran | Total AF | 15 | 30 | – | – | – | 20 (f) | 20 (f) |
| | OTA | – | 50 | – | – | – | – | – |
| | DON | – | 1000 | – | – | – | – | – |
| | ZEN | – | 200 | – | – | – | – | – |
| | Fumonisins | – | 1000 | – | – | – | – | – |
| Israel | Total AF/OTA | 15 | – | – | – | – | – | – |
| | | – | 50 | – | – | – | – | – |
| Japan | AFB1 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Kenya | Total AF | 20 | – | – | – | – | – | – |
| Korea | AFB1 | 10 | 10 | – | – | – | 10 | – |
| Malaysia | Total AF | 35 | 35 | 35 | – | 35 | 35 | 35 |
| Mexico | Total AF | – | 20 | – | – | – | – | – |
| Morocco | AFB1 | 1 | – | – | – | – | – | – |
| Nigeria | AFB1 | 20 | 20 | – | – | – | – | – |
| Russia | AFB1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Taiwan | Total AF | 15 | 15 | – | – | – | – | – |
| Turkey | AFB1 | 5 | 2 | – | – | – | – | – |
| USA | Total AF | 20 | 20 | – | – | – | – | – |

AF: Aflatoxins; FB1: Fumonisin B1; ZEA: Zearalenone; OTA: Ochratoxin A; DON: Deoxynivalenol; f: Feed; (Compiled from: Bhat et al., 2010; FAO, 2004; van Egmond, Schothorst, & Jonker, 2007; Reddy et al., 2010).