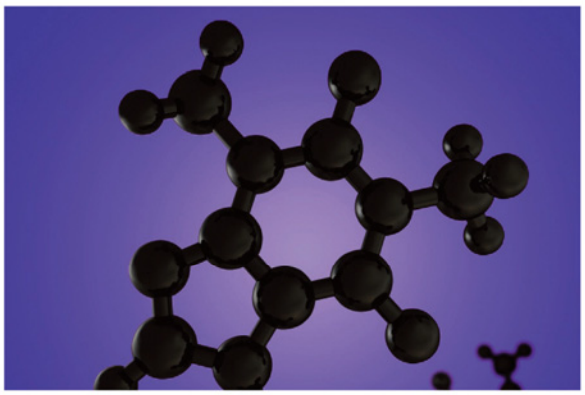
Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments

Food Safety Action Plan

REPORT

2009-2010 Targeted Surveys

Chemistry



Aflatoxin in Dried Figs and Dried Dates

TS-CHEM-09/10-01

Canada

Table of Contents

1. Executive Summary

The Food Safety Action Plan (FSAP) aims to modernize and enhance Canada's food safety system. As part of the FSAP enhanced surveillance initiative, targeted surveys are used to test various foods for specific hazards. The main objective of the aflatoxin survey was to provide baseline surveillance data regarding aflatoxin levels in dried figs and in dried dates.

One hundred (49 dried dates, 51 dried figs) samples were collected and analysed in this targeted survey. The samples originated from 11 different countries. The main import countries targeted included the Turkey, Greece and the USA for figs and USA, Iran and Tunisia for dates. Samples were analysed for aflatoxin residues using a multi-residue method that detects the aflatoxin forms B1, B2, G1 and G2. The levels of both the individual aflatoxin forms and total aflatoxin levels were reported.

All of the 49 (100%) dried date samples and 47 of 51 (92%) dried fig samples did not contain detectable levels of aflatoxin residues. Four dried fig samples contained aflatoxin levels ranging from 7.5 to 78.7 ppb.

The EU has a proposed 4 ppb limit for directly consumed dried fruits and a proposed 10 ppb limit for dried fruit intended for further processing. However, neither Canada nor Codex has established a Maximum Limit (ML) for aflatoxins in dried fruits. In light of this, all positive results were referred to the designated CFIA program for appropriate follow-up actions. These actions may include notification of the producer or importer, follow-up inspections, additional directed sampling, and product recalls.

2. Introduction

2.1. Food Safety Action Plan

The Food Safety Action Plan (FSAP) aims to modernize and enhance Canada's food safety system. The FSAP unites multiple partners in insuring safe foods for Canadians.

Within the FSAP, the Canadian Food Inspection Agency (CFIA) gained increased authority to monitor potential food risks and to prevent unsafe food products from entering the Canadian marketplace. The CFIA fulfills this mandate through an enhanced surveillance initiative which includes targeted surveys. The CFIA works on these initiatives with input from Federal partners (Agriculture and Agri-Food Canada, Health Canada, the Canadian Grain Commission) and from Provincial and Territorial (P/T) representatives.

2.2. Targeted Surveys

Targeted surveys are pilot surveys used to gather information regarding the potential occurrence of chemical residues in defined commodities. The surveys are designed to answer specific questions. Unlike monitoring activities, targeted surveys often focus on obtaining data related to a particular chemical hazard, commodity type and/or geographical area. Due to the vast number of chemical hazards and food commodity combinations, it is not possible, nor should it be necessary, to use targeted surveys to identify and quantify all chemical hazards in all foods.

To identify food-hazard combinations of greatest potential health risk, the CFIA uses a combination of media reports, scientific literature and/or a risk-based model developed by the Food Safety Science Committee (FSSC). At its last meeting, the FSSC ranked the risks posed by a number of natural toxins, including aflatoxins, in a variety of foods. The rankings were based on the 1) human health risks, 2) potential exposure (i.e., How high are the levels? What foods are they found in? Consumed by what population groups? Are these staple foods?), 3) the human health effects of the toxins, 4) whether regulations or industrial controls were in place to reduce the risk, 5) whether consumers could detect the toxins by smell/sight or reduce/destroy the toxin by proper food handling techniques or by cooking, and 6) public perception of the risk.

Natural toxins have contaminated foods for centuries and are a global problem. These chemical species are released by micro-organisms such as algae, fungi and moulds. Natural toxins have been detected in domestically produced or imported fish, shellfish, grains, fruits, and vegetables. Some of these natural toxins can be fatal or can have deleterious human health effects (i.e. they can be potent carcinogens). Canada and the international community are dedicated to reducing the levels of these toxins to the lowest possible achievable levels in order to improve people's health and longevity.

Natural toxins, such as mycotoxins, are distinct from other chemical hazards (e.g pesticides or veterinary drugs) as they are neither deliberately added nor absorbed from the environment. They are released by fungi that can grow on various agricultural commodities. The more favourable the climatic, storage or processing conditions are to fungal contamination, the higher will be the levels of the mycotoxins.

Aflatoxin is one of the mycotoxins of interest to which the FSSC committee gave the third highest risk ranking to aflatoxins in dried fruits. This targeted survey will explore the potential exposure of Canadians to aflatoxins through the consumption of dried figs and dried dates.

2.2.1 Aflatoxin

Aflatoxin are naturally occurring secondary metabolites of fungal species belonging to strains of the *Aspergillus* mould *such as A. flavus* and *A. parasiticus*. At least 20 different types of aflatoxin exist. The four most common forms of alflatoxin in plant-based foods, in order of highest to lowest toxicity, are B1, G1, B2 and G2.

Aflatoxin-producing fungi may contaminate fruit intended for drying if grown, stored and/or processed under conditions which favour fungal growth. Hot, humid climates and any pest pressures resulting in bruising or cuts on the fruit will favour the growth of the aflatoxin-producing fungi, either in the field or in storage. Prolonged storage and/or contamination during storage or transport have also been associated with higher aflatoxin levels[1] [2].

Another aspect affecting the levels of aflatoxin on fruits is the drying methods used for processing and preserving fruit. There are numerous variations and/or combinations of drying processes that the food industry may employ, depending on the desired characteristics of the finished product, economic considerations, and the availability of equipment. The typical temperatures in conventional drying processes do not exceed 120 °C. The type of drying process utilised may impact the aflatoxin levels. Fruits can be dried in several different ways, however sun-drying is the most common method[3] [4]. Due to the nature of sun-drying, the fruit is still subject to climatic, weather and pest pressures which may favour fungal growth and hence result in elevated levels of aflatoxins[5] [6].

Aflatoxins are considered the most toxic mycotoxins. The International Agency for Research on Cancer (IARC) considers aflatoxin B1 to be a potent carcinogen, acting mainly on the liver[7]. In addition to its carcinogenic properties, aflatoxins are believed to have mutagenic, teratogenic and immunosuppressive effects on humans and animals[8]. These human and animal health effects have prompted the adoption of Codex Codes of Practice to prevent and to reduce aflatoxin contamination in peanuts[9], dried figs[10] and tree nuts[11].

Aflatoxin is known to infest corn and corn products, nutmeats, dried fruits, grains and spices . The major route of aflatoxin exposure in humans is through the consumption of

contaminated nuts and nut products. The degree of exposure of the Canadian population to other sources of aflatoxin (dried fruits, grains, spices and corn products) is largely unknown.

2.3. Acts and Regulations

The *Canadian Food Inspection Agency Act* stipulates that the CFIA is responsible for enforcing restrictions on the production, sale, composition and content of foods and food products as outlined in the *Food and Drugs Act & Regulations* (FDAR).

Health Canada (HC) determines the legal limits for contaminant residues in food. In the case of aflatoxin, there is a 15 parts-ber-billion (ppb) tolerance for aflatoxins in nutmeats (see section B.01.046 in the FDAR)[12]. There is no tolerance or standard established for aflatoxins in dried fruits.

The U.S. and the Codex Alimentarius Commission do have established regulations for aflatoxin levels in nuts and nut meats (20 ppb for the US, 15 ppb for Codex) but not in other commodities. The European Union has established a maximum limit (ML) for aflatoxins in nuts (2-8 ppb), dried fruits (2-5 ppb if directly consumed, 10 ppb if intended for further processing) and corn (2-5 ppb); cereals (2 ppb); and spices (5 ppb).

Targeted surveys may be used to identify emerging food-hazard issues. In such cases, proposed or established maximum limits may be lacking. Thus, results from targeted surveys can provide baseline data which may be used to perform or refine health risk assessments, and subsequently establish ML as needed.

3. Aflatoxin Survey

3.1. Targeted Survey Sample Overview

The 2009-2010 Aflatoxin survey targeted imported dried figs and dried dates. These fruits are not produced domestically; however some may be processed or packaged in Canada. Dried figs and dried dates were sampled at grocery and specialty stores in the Vancouver area. A total of 51 samples of dried figs and 49 samples of dried dates were tested for aflatoxin. The distribution of dried figs and dried dates by country of origin is presented in Figure 3.1.

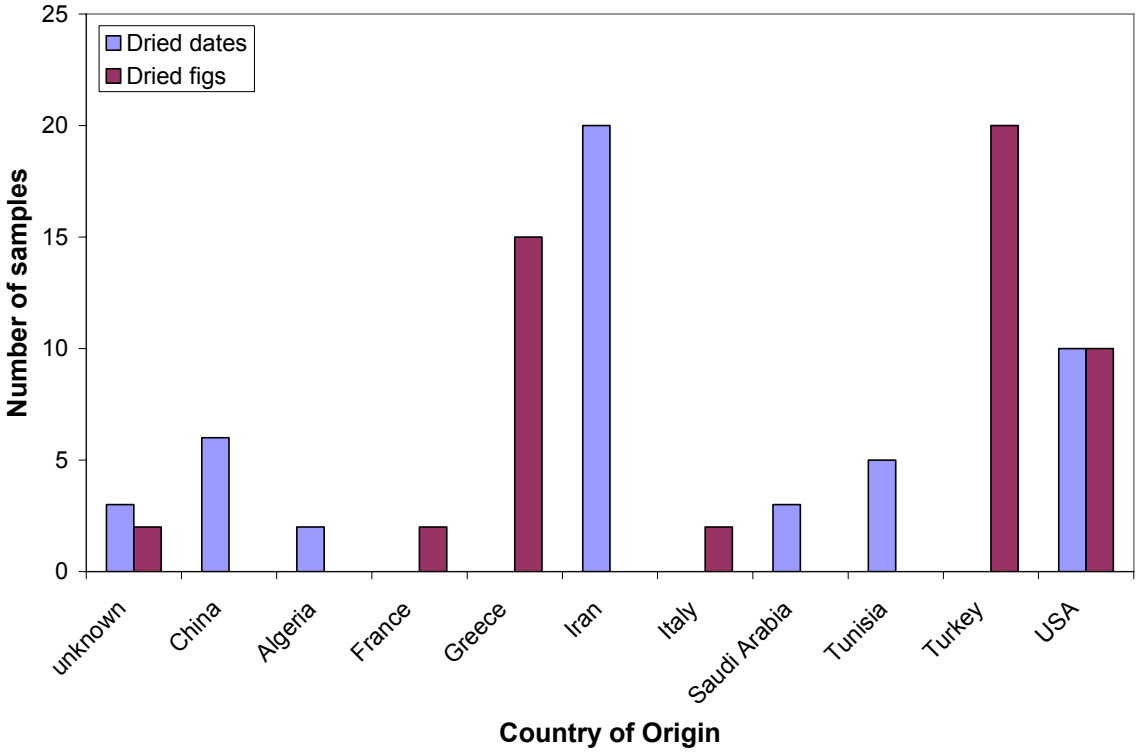


Figure 3.1 Distribution of dried fig and dried date samples per country of origin

3.2. Detailed methods

Samples from the aflatoxin targeted survey were analysed by CFIA's Burnaby laboratory. A multi-residue method (MRM) was used for determination of aflatoxins in dried fruits. This method allows for the simultaneous determination of the major forms of aflatoxin, including B1, B2, G1 and G2. The MRM (BFCL-002 – "Aflatoxins in Food Products - Immunoaffinity Column Method") consists of an immunoaffinity column separation followed by either fluorescence or mass spectrometric detection. Both methods of detection were used for the sample analysis. The reporting limit for each aflatoxin form is 0.3 ppb for HPLC-FLD and 0.5 ppb for HPLC-MS. Both the levels of the individual aflatoxin forms and the total level of aflatoxins are reported. Evaluation of the results was based on the total aflatoxin level.

3.3. Limitations

The aflatoxin survey in dried figs and dried dates was designed to provide a snapshot of the industry. In comparison to the total number of dried fig and dried date products available to Canadian consumers, a sample size of 100 is small. Therefore, care should be taken in the interpretation of the results. Lastly, this survey does not examine seasonality, year-to-year trends, impact of product shelf-life, or cost of the commodity on the open market.

4. Results and Discussion

4.1. Dried Figs

In total, 51 samples of dried figs were tested for aflatoxin; 47 samples had no detectable levels. Total levels of aflatoxin ranged from 7.5 to 78.7 ppb in the remaining four positive samples. Table 4.1 presents a sample description, the country of origin as well as the type and level of aflatoxin found in each positive sample.

In three of four positive samples, aflatoxin B1, the most toxic form of aflatoxin, was predominant. These same samples also had detectable levels of aflatoxin B2 but no detectable levels G1 or G2. In the remaining positive sample, G1 was the predominant aflatoxin type detected. Positives samples originated from the USA (1 of 10), Turkey (2 of 20) and Greece (1 of 15).

Table 4.1 Description of Positive Samples

Sample Description	Country of Origin	Total Aflatoxin Level (ppb)	Aflatoxin Type and Level (ppb)
Figs, calimyrna	USA	7.46	B1 (5.18) B2 (2.28) G1 (ND) G2 (ND)
Figs, dried	Turkey	71.53	B1 (57.87) B2 (13.67) G1 (ND) G2 (ND)
Figs, dried	Turkey	72.33	B1 (65.7) B2 (6.63) G1 (ND) G2 (ND)
Figs, string	Greece	78.66	B1 (22.0) B2 (1.64) G1 (53.83) G2 (1.19)

ND = < 0.3 ppb or < 0.5 ppb, depending on the detection method

These results were similar to previous studies in the literature. A study on aflatoxin levels in dried figs imported from Iran and Turkey was carried out in Brazil in 2002-2003. The results indicated that 58% (11 of 19 samples) were contaminated with aflatoxins. The levels of aflatoxin ranged from 0.3 to 1500 ppb. The 1500 ppb level was observed in only one sample of dried figs, the remaining ten positives had aflatoxin levels below 200

ppb[13]. A study of aflatoxin levels in dried figs was carried out in Turkey in 2003-2004. The aflatoxin levels ranged from 0.1 to 35.1 ppb[14].

All four positive samples were referred to the appropriate program for follow-up. The ensuing actions were dependent on the health risk associated with the test results as well as the status of production and distribution. As a result of the high aflatoxin levels, three Class II recalls to retail were initiated.

4.2. Dried Dates

There were 49 samples of dates tested for aflatoxin. None of the samples had detectable levels of aflatoxin. This result is similar to the results of previous studies of aflatoxin contamination of dried dates. A previous study indicated that mechanically injured dates could support the proliferation of *A. parasiticus*[15]. A French study in 1992 reported on the aflatoxin levels in dried fruits, including dried dates, at the retail level[16]. Two of 28 samples of dates were positive for aflatoxin and the average level of aflatoxin was 0.09 ppb (which is below the limit of detection of our study). Another study in 1999 examined aflatoxin levels in a variety of fruits grown and dried in Egypt. Two of 24 samples of dried dates contained detectable levels of aflatoxin (300 and 390 ppb)[17].

5. Conclusions

The 2009-2010 aflatoxins in dried figs and dried dates targeted survey indicates that the majority of the samples analysed (96 of 100 samples) contained no detectable aflatoxin levels. The four positive results for dried figs were referred to the appropriate program. As a result, three production recalls of dried figs were carried out.

6. Future Considerations

The aim of this targeted survey was to provide a snapshot of aflatoxin levels in dried figs and dried dates available to Canadian consumers.

A future aflatoxin survey will help address the following concerns:

- Identify trends based on seasonality as aflatoxin levels are extremely dependent on climatic conditions
- Increase the number of commodities to encompass other foods (e.g. corn, raisins, nutmeats) which are known to contain aflatoxins and for which baseline data is lacking
- Focus on countries with increased incidence of aflatoxin residues**.**

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