Comparison of aflatoxin content of Brazil nut kernels with that of the shell

Area of research interest: Chemical hazards in food and feed
Study duration: 2010-11-01
Project code: FS241008 (C03068)
Conducted by: FERA
Back to top

Background

The UK is a high consumer of Brazil nuts in-shell, compared to the rest of Europe. Brazil nut crops are susceptible to contamination from aflatoxins. Maximum legal levels set by the European Commission to control aflatoxin levels in food commodities, including Brazil nuts have recently been revised.

Currently, it is assumed that all the contamination within in-shell nuts occurs in the kernel. In-shell nuts are homogenised and analysed for aflatoxins without shelling and legal levels for aflatoxins apply to the whole nut and not just to the edible kernel. The current EU legislation notes the uncertainty about whether the contamination occurs in the kernel or the shell in the case of Brazil nuts.

Understanding of the distribution of contamination between the kernel and the shell will help inform sampling and analysis protocols to appropriately address the level of risk to consumers.

Back to top

Research Approach

This project aimed to establish the relationship between the concentration of aflatoxins in whole nuts, the concentration usually measured, and in the kernel, the concentration of interest. Understanding the distribution of contamination between the kernel and the shell will help to inform sampling and analysis protocols to appropriately address the level of risk to consumers.

The project was split into two stages:

- The aim of the first stage was to collect and collate existing data and to use this data to develop a statistical model or conversion factor to describe the relationship between aflatoxin contamination of Brazil nut kernels and the corresponding shells.
- The aim of the second stage was to test this conversion factor by analysing whole in-shell nut samples, separated into kernel only samples and shell only samples. During this part of the project, eleven lots each consisting of 2kg of unsorted in-shell nuts were shelled and tested.

Back to top

Results

Data produced in this project support the conclusion that initially aflatoxin contamination occurs on the shell, or more particularly on the surface of the kernel at the interface with the shell, with little contamination on the kernel. However, as the infection increases, the amount of aflatoxin on the kernel increases dramatically and the aflatoxin on the shell remains at a relatively low level.

Data from stage 1 showed that the proportion of aflatoxin in kernels was, on average, lower in sorted samples (rotten nuts removed) than in unsorted samples. There was no clear correlation between the observed concentration of aflatoxins in whole nuts and the proportion of aflatoxins in the kernel in 30kg unsorted samples taken from the lots. A mean (across-lot) conversion factor of 1.05 was estimated, which means that the aflatoxin concentration is on average the same in the kernel as in the shell.

The analytical measurement and the conversion factor each have an associated uncertainty. Where a measurement is used to estimate the concentration of aflatoxins in the kernels of nuts in a particular lot the analytical uncertainty is estimated to be ± 44%. The results suggest the uncertainty associated with the estimated concentration of aflatoxins in the kernel of a lot based on a whole nut (in-shell) measurement, converted to a kernel concentration using a factor of 1, is ± 80%. The main source of additional uncertainty is the variations between samples in the proportion of aflatoxins in the kernel and on the shell.

Differences in sample mass and the fact that all of the nuts were visibly rotten, and so were not generally representative of typical batches of edible nuts, meant that the value of the conversion factor calculated in stage 1, could not be validated or refuted by results generated by the analysis of these independently sourced Brazil nuts.

The results indicate that the total aflatoxin concentration measured in whole in-shell Brazil nuts may only partly contribute to consumer exposure, as some aflatoxin occurs in the shell, which is not eaten.

Further work is required to fully validate the conversion factor for use with smaller samples in the range 2 to 12kg (as currently specified in Commission Regulation (EU) No. 178/2010). For aflatoxin concentrations of greater than 100?g/kg the conversion factor becomes irrelevant as the nuts are clearly non-compliant with the limits of 10?g/kg for direct human consumption and 15?g/kg for product to be subjected to further processing.

Back to top

Published Papers

A paper is in preparation for this project

Research report

England, Northern Ireland and Wales

PDF
View Study to Compare the Aflatoxin Content of Brazil Nut Kernels with that of the Shell as PDF(Open in a new window) (3 MB)