



The New Zealand Mycotoxin Surveillance Program 06-14 Report Series

FW10036 Aflatoxins in Nuts and Nut Products

MPI Technical Report – Paper No: 2016/24

Prepared for MPI by Peter Cressey & Shirley Jones (ESR) and
John Reeve (MPI)

ISBN No: 978-1-77665-292-1 (online)
ISSN No: 2253-3923 (online)

May 2010

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Scientific Interpretive Summary

This SIS is prepared by MPI risk assessors to provide context to the following report for MPI risk managers and external readers

The New Zealand Mycotoxin Surveillance Program 06-14 Report Series

FW10036 Aflatoxins in Nuts and Nut Products

These reports are the outputs of MPIs ongoing mycotoxin surveillance programme. The nine reports form a series detailing the research undertaken over the last eight years to characterise and quantify the risk to the New Zealand public through the presence of mycotoxins in the food supply.

The nine reports are:

- Risk Profile: Mycotoxin in Foods 2006
- Aflatoxins in Maize Products 2008
- Aflatoxins and Ochratoxin A in Dried Fruits and Spices 2009
- Aflatoxins in Nuts and Nut Products 2010
- Dietary Exposure to Aflatoxins 2011
- Ochratoxin A in Cereal Products, Wine, Beer and Coffee 2011
- Trichothecene Mycotoxins in Cereal Products 2014
- Dietary Exposure to Ochratoxin A and Trichothecene Mycotoxins 2014
- Risk Profile: Mycotoxin in Foods 2014

Aflatoxins in Nuts and Nut Products 2010

Surveillance activities for Aflatoxins (AF) continued with the consideration of nuts and nut products.

The analytical methodology is well detailed and has sufficient validation to ensure the results presented are accurate for actual occurrence values.

AF levels were detected in 20-41% of the various peanut sources (raw, butter and peanut products) and in 27% of mixed nut products, only a single detect each was reported for Brazil nuts and pistachios and no detects in almonds and cashew.

Prevalence in peanuts was higher than previously reported in New Zealand however this was a factor of a lower detection limit and larger sampling numbers.

Two samples each of raw peanuts and peanut products were in excess of the ML for AF. Levels in all other samples were generally low and in the case of raw peanuts and peanut butter consistent with expected levels.



**MYCOTOXIN SURVEILLANCE
PROGRAMME 2009-2010
AFLATOXINS IN
NUTS AND NUT PRODUCTS**

Prepared for New Zealand Food Safety Authority
under project CFS/09/09, Mycotoxin Surveillance Programme,
as part of overall contract for scientific services

by

Peter Cressey
Shirley Jones

May 2010

Client Report
FW10036

MYCOTOXIN SURVEILLANCE PROGRAMME 2009-2010
AFLATOXINS IN NUTS AND NUT PRODUCTS

Dr Stephen On
Food Safety Programme Leader

Peter Cressey
Project Leader

Dr Richard Vannoort
Peer Reviewer

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ACKNOWLEDGEMENTS

Particular thanks are due to Gaynor Wall of ESR for her efforts in sourcing and obtaining the products analysed in this project.

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SUMMARY

The Mycotoxin Surveillance Programme (MSP) involves investigation of food safety issues associated with mycotoxins in the New Zealand food supply, as identified in a risk profiling exercise carried out in 2005-2006. During 2009-2010, the MSP continued analysis of the presence of aflatoxins in foods by analysis of nuts (groundnuts/peanuts and tree nuts) and nut products.

Aflatoxins were detected in a range of nut and nut products available in New Zealand. The prevalence of aflatoxins in different types of product was generally consistent with or lower than in previous New Zealand and overseas studies. Where estimates of prevalence were greater than previous New Zealand studies (Brazil nuts, peanut butter, peanut products, pistachios), it appears likely that this is largely due to lower limits of detection in the current study, although increased sample numbers will also increase the probability of detecting low prevalence events.

Two samples of peanuts and two peanut products (4/305; 1.3%) were found to be non-compliant with Standard 1.4.1 of the Australia New Zealand Food Standards Code due to the presence of aflatoxins above the maximum limit of 15 µg/kg (or the equivalent proportion of this limit for nut-containing products). It is possible that further peanut products may have been non-compliant, but the proportion of nuts in some products was not declared and the necessary calculations could not be carried out. The low proportion of non-compliant products is consistent with expectations of the import testing protocols that have been in place in New Zealand.

Peanut butter was the most frequently aflatoxin-contaminated product (41% of samples). However, concentrations of aflatoxins in peanut butter were generally low (<3.5 µg/kg). The highest aflatoxin concentrations observed in this survey (20.3 and 26.6 µg/kg) were detected in peanuts.

Aflatoxins were infrequently detected in nut types other than peanuts (2/50; 4%) and were not detected at all in almonds and cashews. Aflatoxins were detected in some mixed nut products that did not declare peanuts, indicating contamination of other nut types.

The distribution of aflatoxin concentrations was examined for peanuts and peanut butter and found to be consistent with expectations, conforming most closely to a lognormal distribution.

Dietary exposure estimates for aflatoxins, considering results from the current study and previous studies of aflatoxins in other food types, would assist in placing the results of the current survey in context with respect to human health risks.

1 INTRODUCTION

The Mycotoxin Surveillance Programme (MSP) involves investigation of food safety issues associated with mycotoxins in the New Zealand food supply.

As with other activities of the New Zealand Food Safety Authority (NZFSA), activities in this area are directed on the basis of risk. The risk profile of mycotoxins in the New Zealand food supply (Cressey and Thomson, 2006) is viewed as a starting point for this process. The risk profile identified a number of issues to be investigated or clarified. With respect to aflatoxins, the risk profile found consistent reports (reported in more than one study) of aflatoxins associated with the following foods:

- Peanuts and peanut products
- Corn/maize
- Dried fruits, particularly figs
- Spices, particularly pepper, chilli and cayenne, ginger, paprika and nutmeg
- Tree nuts

Aflatoxins in maize products were the focus of the MSP in the 2007-2008 year, while aflatoxins in dried fruits and spices were considered in 2008-2009. During 2009-2010, the MSP continued analysis of the presence of aflatoxins in foods through analysis of nuts (groundnuts/peanuts and tree nuts) and nut products.

1.1 Aflatoxins

1.1.1 Hazard identification

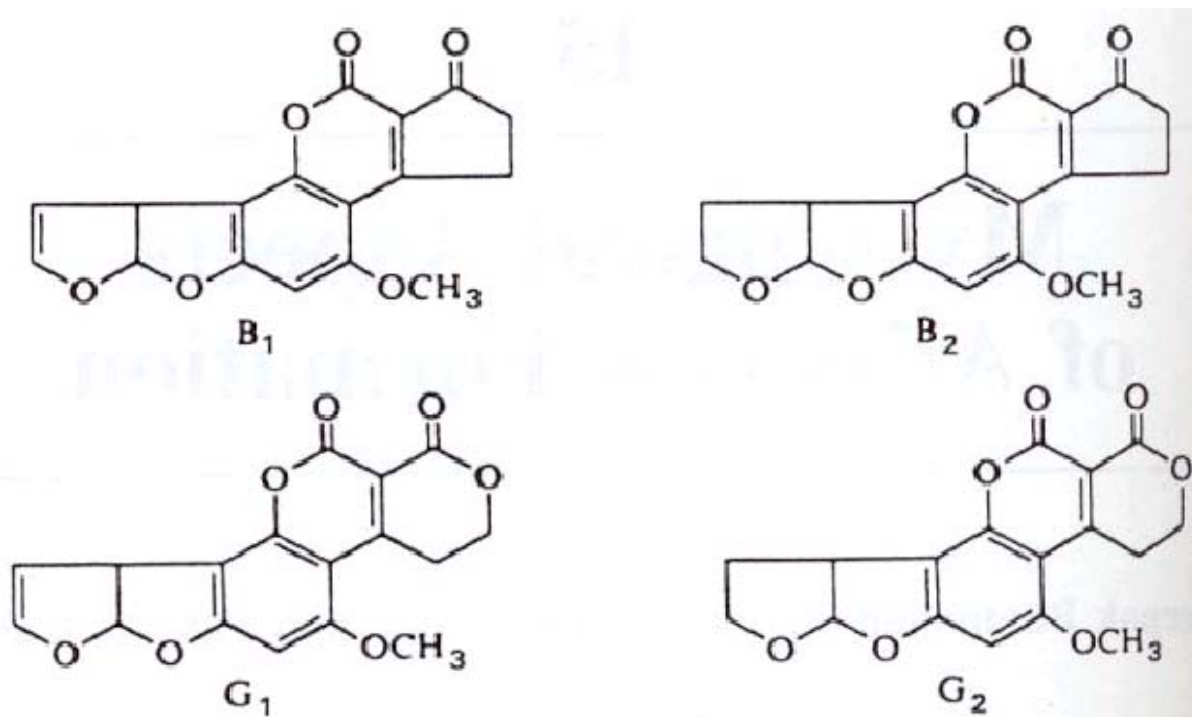
Aflatoxins are secondary metabolites produced by three species of *Aspergillus* mould: *A. flavus*, *A. parasiticus* and *A. nomius* (JECFA, 1998). *A. flavus* occurs in all tropical and subtropical regions and is particularly associated with peanuts and other nuts, maize and other oilseeds. *A. parasiticus* is less widely distributed and is usually only associated with peanuts (Pitt and Tomaska, 2001). *A. nomius* is closely related to *A. flavus*, but little information is available on its host range (Kurtzman *et al.*, 1987).

1.1.1.1 *Structure and nomenclature*

While the aflatoxins comprise a group of about 20 related compounds, the four major naturally-occurring compounds are aflatoxins B₁, B₂, G₁ and G₂. The 'B' and 'G' refer to the blue and green fluorescent colours produced by these compounds under UV light, while the subscripts '1' and '2' refer to major and minor components respectively (Pitt and Tomaska, 2001). The '2' compounds are dihydro derivatives of the major ('1') metabolites. Chemical structures are shown in Figure 1. Aflatoxins M₁ and M₂ are hydroxylated metabolites of the respective 'B' aflatoxins produced when ruminant animals consume aflatoxin-contaminated feed. The 'M' aflatoxins may be excreted in milk (Pitt and Tomaska, 2001). Aflatoxins are fat soluble (lipophilic).

Reference to 'aflatoxins' or 'total aflatoxins' can be taken to refer to the sum of B and G aflatoxins.

Figure 1: Structure of aflatoxins



Reproduced from Eaton and Groopman (Eaton and Groopman, 1994)

1.1.1.2 Occurrence

A. flavus produces only 'B' aflatoxins (AFB₁ and AFB₂), with only about 40% of isolates producing toxins. *A. parasiticus* produces both 'B' (AFB₁ and AFB₂) and 'G' (AFG₁ and AFG₂) aflatoxins, with virtually all isolates producing toxins (Klich and Pitt, 1988). The situation for *A. nomius* appears to be similar to that for *A. parasiticus*.

Aflatoxin B₁ is the most commonly occurring aflatoxin in foods and is also the compound which has been most thoroughly studied in toxicological studies.

A. flavus occurs widely in the environment, but *A. parasiticus* is considerably less common. However, some regional specificities exist and *A. parasiticus* is commonly isolated from peanuts in the United States, South Africa and Australia.

Fungal infection and consequent aflatoxin contamination can occur in field crops prior to harvest or during post-harvest storage if the moisture content of the crop exceeds critical values for fungal growth (JECFA, 1998). Fungal growth and subsequent toxin production are favoured by factors which place the host plant under stress such as high temperature, drought, and high insect activity.

Aflatoxin contamination is most commonly associated with peanuts and peanut products, dried fruit, tree nuts, spices, figs, crude vegetable oils, cocoa beans, maize, rice, cottonseed and copra (JECFA, 1998). Consumption of aflatoxin-contaminated feed by animals can lead

to occurrence of aflatoxins (mainly the hydroxylated metabolite AFM₁) in meat, eggs and milk.

Most of these crops are not grown in New Zealand. Surveillance of fungal infections of New Zealand grown grain found no *Aspergillus* species (Sayer and Lauren, 1991). This is consistent with expert opinion, that aflatoxigenic species of *Aspergillus* are unlikely to occur in New Zealand (Pitt JI, Mycologist, Food Science Australia, personal communication; 1999).

2 MATERIALS AND METHODS

2.1 Foods Sampled

An initial scoping exercise identified nuts and nut products as foods commonly contaminated with aflatoxins. Based on analysis of likely aflatoxin contamination and food consumption patterns, the following sampling programme was agreed with NZFSA:

• Almonds	10
• Brazil nuts	10
• Cashews	10
• Mixed nut products	50
• Peanut butter	75
• Peanut products	75
• Peanuts	50
• Pistachios	20

Sample availability resulted in some slight deviations from these samples numbers, with more samples of mixed nut products (59) and less of peanut products (71) being tested.

2.2 Sampling Plan – Sampling Protocols

The UK Food Standards Agency have updated their advice on the sampling of foodstuffs for mycotoxin analyses (Food Standards Agency, 2007). For sampling of retail packets of food it is recommended that sufficient retail units are purchased to obtain an aggregate sample weight of 1 kg, with all units coming from the same batch. This protocol has been employed in the UK for surveys of mycotoxins in retail products, including nuts and nut products (see http://www.food.gov.uk/multimedia/pdfs/nuts_q_a.pdf for a Q&A, including a discussion of this issue).

A report of the European Commission Working Group on Agricultural Contaminants on Sampling and Analysis of Aflatoxins and Ochratoxins further discussed the issue of sampling retail packaged products, but did not further elaborate strategies for sampling at the retail levels (http://archive.food.gov.uk/pdf_files/ecreport.pdf).

For the current survey it was agreed that analytical samples be made up by blending individual purchase units to a combined weight of approximately one kilogram.

2.3 Analytical Methodology

2.3.1 Aflatoxins

Samples (25 g) were extracted with methanol-water (60:40), filtered and cleaned up using Aflatest immunoaffinity columns (Vicam, Watertown, USA) (Karaca and Nas, 2006). Aflatoxins were eluted from the immunoaffinity column with acetonitrile.

Aflatoxin analyses were based on the method of Takahashi (1977). Extracts were prepared for HPLC by removing acetonitrile under reduced pressure, then adding 100 µL of trifluoroacetic acid and dissolving in 900 µL of water-acetonitrile (9:1).

Aflatoxins (20 µL) were separated by HPLC on a C-18 reversed-phase column with acetonitrile-water (20:80) as the mobile phase at a flow rate of 1.5 ml/minute. Fluorescence detection was carried out with an excitation wavelength of 360 nm and an emission wavelength of 470 nm.

The method allows quantitation of the four principal aflatoxins (B₁, B₂, G₁ and G₂) with a limit of detection of approximately 0.1 µg/kg per aflatoxin.

2.3.2 Analytical quality control

Two quality control materials (FAPAS – Food Analysis Performance Assessment Scheme, operated by the Food and Environment Research Agency, Sand Hutton, York, United Kingdom) were analysed. The materials were:

- T04117 Brazil nut (for Aflatoxins)
- T04121 Peanut (for Aflatoxins)

Results of the analyses are shown in Table 1.

Table 1: Analysis of quality control materials

Analyte	Assigned value (µg/kg)	Satisfactory range (µg/kg)	ESR analytical results (µg/kg)
T04117 Brazil nut			
Aflatoxin B1	4.35	2.44-6.27	4.36, 3.93
Aflatoxin B2	1.38	0.77-1.99	1.34, 1.48
Aflatoxin G1	3.29	1.84-4.73	3.05, 2.86
Aflatoxin G2	0.84	0.47-1.21	0.86, 0.85
Total Aflatoxins	9.94	5.57-14.32	9.61, 9.12
T04121 Peanut			
Aflatoxin B1	15.6	8.8-22.5	12.3, 12.3
Aflatoxin B2	1.92	1.08-2.77	1.64, 1.81
Aflatoxin G1	26.9	15.0-38.7	21.3, 21.9
Aflatoxin G2	2.11	1.18-3.03	1.90, 1.93
Total Aflatoxins	45.2	25.3-65.0	37.1, 37.9

Aflatoxins were spiked into samples of each of the matrices examined. Mean recoveries are reported in Table 2.

Table 2: Spike recoveries for aflatoxins in nuts and nut products

Food (Number)	Percentage spike recovery, Mean (Range)			
	AFB1	AFB2	AFG1	AFG2
Almonds (2)	73 (72-74)	79 (78-80)	81 (79-82)	87 (87-87)
Brazil Nuts (2)	103 (101-104)	108 (106-110)	112 (110-113)	104 (103-104)
Cashews (2)	77 (76-78)	90 (89-90)	87 (85-88)	91 (90-91)
Mixed Nut Products (15)	94 (74-123)	99 (85-115)	94 (82-115)	98 (88-114)
Peanut Butter (19)	78 (70-99)	87 (78-95)	79 (51-112)	83 (66-96)
Peanut Products (14)	86 (71-101)	90 (68-101)	87 (74-99)	88 (70-101)
Peanuts (16)	86 (72-102)	100 (90-109)	85 (69-105)	94 (76-114)
Pistachios (6)	66 (63-72)	74 (67-84)	79 (74-83)	79 (69-88)

The spike recoveries were generally within the range considered to be acceptable (70-120%). While some results were marginally outside this range, they were considered to be acceptable given the analytical challenges associated with these matrices. All analytical results were reported without correction for recovery.

Coefficients of variation (CV) were in the range 3.3-4.4% for the individual aflatoxins. These CVs are very good for trace organic analyses.

Limits of detection and quantitation were calculated as three and ten times the signal to noise (S/N) ratio respectively:

Analyte	LOD (µg/kg)	LOQ (µg/kg)
Aflatoxin B1	0.08	0.25
Aflatoxin B2	0.09	0.28
Aflatoxin G1	0.07	0.23
Aflatoxin G2	0.06	0.22

Results falling between the limit of detection and the limit of quantitation were termed 'indicative'. These appear in this report as quantitative values in brackets.

3 RESULTS AND DISCUSSION

3.1 Summary of Results

Results for the 300 nuts or nut products analysed in the current study are summarised in Table 3. Full details of results are given in Appendix 1.

Table 3: Aflatoxin content of nuts and nut products available on the New Zealand market

Food type	Number of samples	Number positive for aflatoxins (%)	Range of total aflatoxins in positive samples (µg/kg)*	Aflatoxins detected
Almonds	10	0 (0)		
Brazil Nuts	10	1 (10)	5.8	B1
Cashews	10	0 (0)		
Mixed Nut Products	59	16 (27)	(0.1)-9.7	B1, B2, G1, G2
Peanut Butters	75	31 (41)	(0.1)-3.4	B1, B2, G1, G2
Peanut Products	71	14 (20)	(0.2)-10.5	B1, B2, G1, G2
Peanuts	50	10 (20)	(0.1)-26.6	B1, B2, G1, G2
Pistachios	20	1 (5)	0.7	B1, B2

* Concentration figures in brackets are indicative and relate to analytical results that were above the limit of detection, but below the limit of quantitation

3.2 Almonds

Aflatoxins were not detected in any almond samples analysed in the current survey. This is consistent with smaller previous New Zealand studies that did not detect aflatoxins in two (Lake *et al.*, 1991) and three (Stanton, 2000) almond samples.

Almonds are almost exclusively imported into New Zealand from Australia (39% of imports in 2009) and the USA (61% of imports in 2009). Total imports in 2009 were approximately 1,600 tonnes¹.

Results from overseas studies (see Appendix 2) confirm that almonds are infrequently contaminated with aflatoxins.

3.3 Brazil Nuts

The current survey detected aflatoxins in 10% (1/10) of Brazil nut samples examined. Previous New Zealand surveys did not detect aflatoxins in Brazil nuts (Lake *et al.*, 1991; Stanton, 2000). However, the sample numbers in the earlier surveys were much smaller (one and three samples of Brazil nuts, respectively) and the results of the current survey are not inconsistent with the results of the earlier surveys. For example, the 95th percentile binomial confidence interval for the proportion of positives, if no positives are observed in three samples, is 0-71%. The positive result detected in the current study was below the Australia

¹ <http://www.stats.govt.nz/infoshare/TradeVariables.aspx?DataType=TIM>

New Zealand Food Standards Code regulatory limit for aflatoxins in tree nuts (Standard 1.4.1) of 0.015 mg/kg (15 µg/kg).

In 2009, New Zealand imported approximately 300 tonnes of Brazil nuts from three main sources; Bolivia (38%), Brazil (29%) and Peru (30%)¹. The source of the single sample positive for aflatoxins was not declared.

Overseas studies have generally reported a higher prevalence of aflatoxins in Brazil nuts (typically 20-50%, see Appendix 2).

3.4 Cashews

Aflatoxins were not detected in any cashew sample analysed in the current survey. This is consistent with a smaller New Zealand study that did not detect aflatoxins in any of three cashew samples (Stanton, 2000).

New Zealand imported almost 2,000 tonnes of cashews in 2009, with the majority imported from Vietnam (87%), followed by India (12%)¹.

The results of the current survey are consistent with overseas studies (see Appendix 2) in not detecting aflatoxins in cashews.

3.5 Mixed Nut Products

Aflatoxins were detected in 27% (16/59) of mixed nut products. No previous New Zealand surveys included an equivalent category for comparison. Although most of the aflatoxin-containing samples in this category contained a high proportion of peanuts, some did not list peanuts at all. It can be concluded that aflatoxins observed in mixed nut products are coming from a range of nut sources. All aflatoxin levels measured were below the regulatory limit.

It is not possible to comment on the origins of the mixed nut products, due to the diversity of nuts involved.

Due to the heterogeneity of this food category, no attempt was made to draw comparisons with overseas studies.

3.6 Peanut Butters

Aflatoxins were detected in 41% (31/75) of peanut butters analysed. While two small New Zealand studies did not detect aflatoxins in peanut butter samples (three and one samples, respectively) (Lake *et al.*, 1991; Stanton, 1977), a larger survey detected aflatoxins in 6/17 (35%) peanut butter samples (Stanton, 1999). The detection limit of this earlier study was significantly higher (1 µg/kg) than the current survey (approximately 0.1 µg/kg) and only about one third of the samples with detectable aflatoxins in the current survey would have been detected in the earlier survey. Similarly, the maximum contamination level reported by Stanton (9 µg/kg) is higher than the maximum level detected in the current survey (3.4 µg/kg).

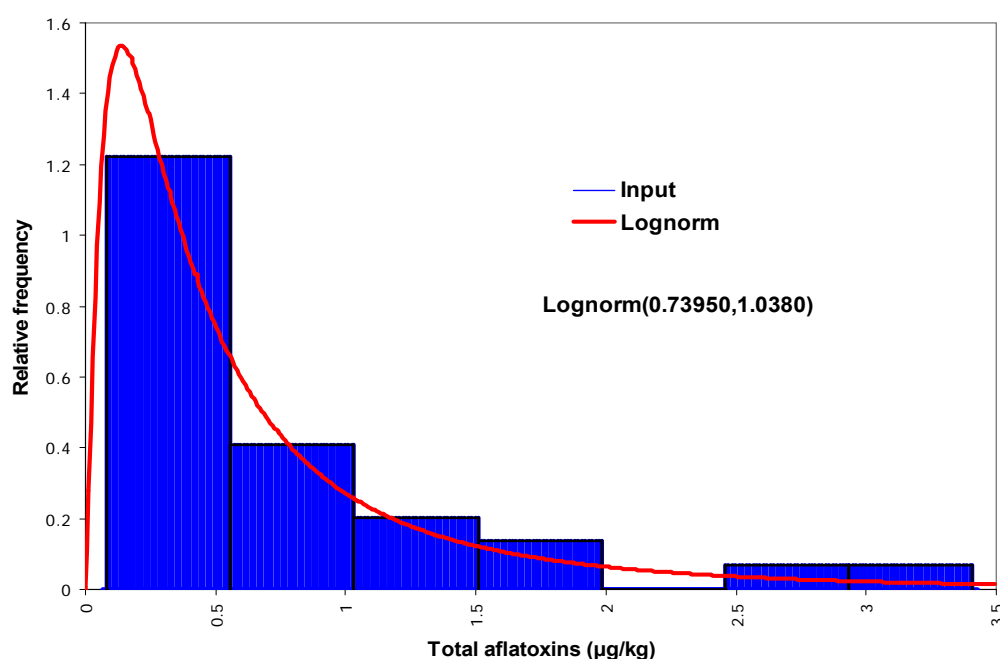
¹ <http://www.stats.govt.nz/infoshare/TradeVariables.aspx?DataType=TIM>

Peanut butters included in the current survey included a mixture of products domestically produced from imported peanuts and products imported as finished peanut butters. In 2009, New Zealand imported approximately 3,100 tonnes of peanut butter, principally from China (66%) and Australia (34%)¹. Of the 75 peanut butters analysed in the current survey, 36 declared China as the country of origin and 27 declared Australia as the country of origin. Of the 31 peanut butters with detectable levels of aflatoxins, 15 were from Australia and 16 were from China.

The results of the current survey are consistent with overseas studies (see Appendix 2). Peanut butters are frequently contaminated with aflatoxins, with the prevalence in overseas studies reported to be in the range 15-100%. This is likely to be due to the homogenisation that occurs during production of peanut butter, when aflatoxin-contaminated peanuts are mixed with non-contaminated nuts to produce a contaminated peanut butter. This process is also consistent with the modest concentrations of aflatoxins observed in peanut butters, compared to intact peanuts.

The distribution of the aflatoxin concentrations in peanut butter samples from the current survey was investigated, using the BestFit function of the Excel add-in @Risk (Palisades Corporation). BestFit uses a Maximum Likelihood Estimation (MLE) algorithm. Goodness-of-fit was assessed by the Anderson-Darling statistic. Aflatoxin concentrations conformed most closely to a lognormal distribution (Figure 2). The lognormal distribution is often considered to be the most appropriate distributional form for the concentration of naturally-occurring contaminants (Baccarelli *et al.*, 2005; Huybrechts *et al.*, 2002; Sioen *et al.*, 2008).

Figure 2: Histogram of aflatoxin concentrations in peanut butter and the associated maximum likelihood lognormal distribution



¹ <http://www.stats.govt.nz/infoshare/TradeVariables.aspx?DataType=TIM>

3.7 Peanut Products

Aflatoxins were detected in 20% (14/71) of peanut products analysed in the current survey. Satay sauces accounted for more than half of the aflatoxin-containing products, with 35% (8/23) of satay sauces found to contain aflatoxins. Stanton analysed 136 samples of peanut confectionery and peanut sauces, both products types included in the present category of peanut products, with 21 (15%) positive for aflatoxins (Stanton, 1999). Given the higher limits of detection in the earlier study, these findings are not inconsistent.

Compliance of nut-containing products with Standard 1.4.1 of the Australia New Zealand Food Standards Code requires calculation of a proportion of the maximum limit (ML) equivalent to the proportion of nut in the product¹. The ML for aflatoxins in peanuts and tree nuts is 15 µg/kg. For a food containing 40% peanut, the associated ML will be 6 µg/kg. Two peanut products were found to marginally exceed the ML, on this basis:

- A nut bar containing 42% peanut (ML = 6.3 µg/kg) contained 7.7 µg/kg total aflatoxins; and
- A satay sauce containing 10% peanut (ML = 1.5 µg/kg) contained 1.7 µg/kg total aflatoxins.

It is possible that other products were non-compliant, but for some products no declaration of peanut content was made, to allow assessment.

The peanut product category was made up of products imported, ready-prepared, and products prepared in New Zealand from imported peanuts.

The proportion of aflatoxin-positive samples in the peanut products category is not high when compared to data from overseas studies (see Appendix 2). For example, the prevalence of aflatoxins in satay sauces has consistently been reported to be 50-60%.

3.8 Peanuts

Aflatoxins were detected in 20% (10/50) of peanut samples analysed in the current survey. Comparison with earlier New Zealand studies is complicated by differences in limits of detection. For example, the first study of aflatoxins in New Zealand foods reported detection limits of 2-4 µg/kg (Stanton, 1977), compared to approximately 0.1 µg/kg in the current survey. Earlier studies reported aflatoxins in 13% (Stanton, 1977), 25% (Lake *et al.*, 1991), 0% (Stanton, 2000) and 50% (Stanton, 1999) of peanut samples.

Of the ten aflatoxin-containing samples in the current survey, two contained levels that exceeded the maximum limit in Standard 1.4.1 of the Australia New Zealand Food Standards Code¹, with total aflatoxin contents of 20.3 and 26.6 µg/kg. The country of origin of the peanuts was not declared for either sample. Schemes for the testing of peanuts for aflatoxins in several countries have been reviewed (Love, 2000). It was concluded that, for a regulatory limit of 15 µg/kg, the probability of accepting a lot of peanuts with a true aflatoxin content of 25 µg/kg could be as high as 40%. The current survey found only 4% of samples exceeded the regulatory limit.

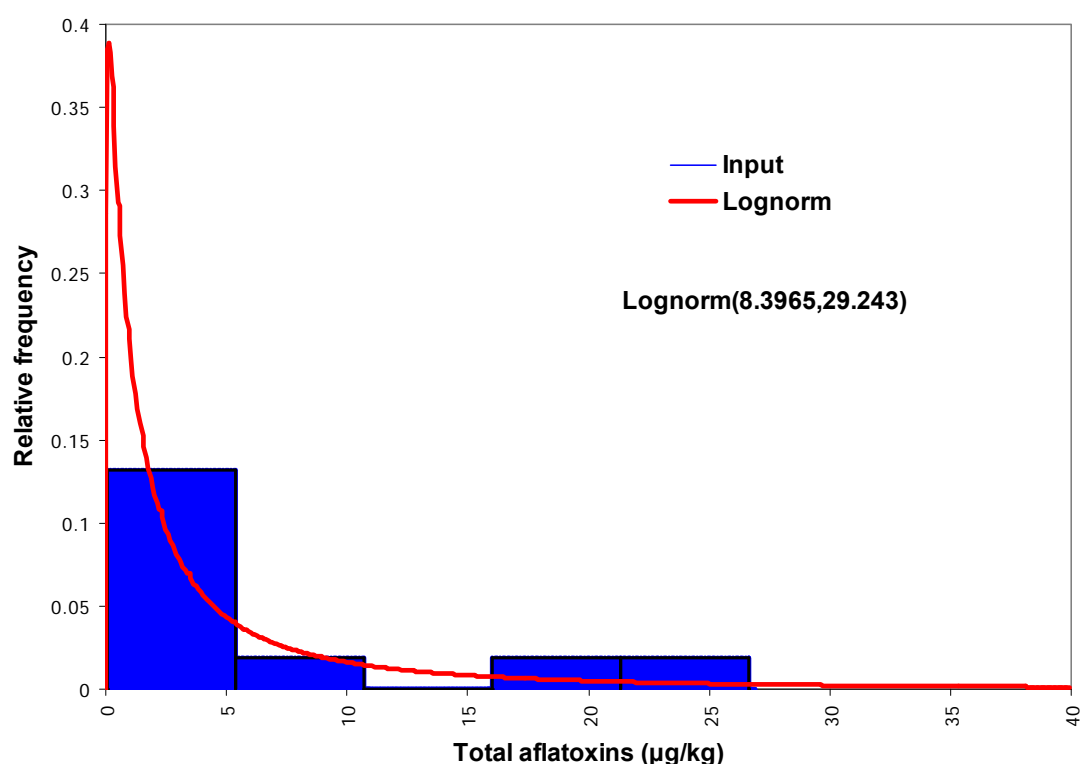
¹ http://www.foodstandards.gov.au/srcfiles/Standard_1_4_1_Contaminants_v113.pdf

In 2009, New Zealand imported approximately 1,700 tonnes of peanuts (shelled and in-shell), principally from Australia (54%) and China (33%)¹.

The results of the current survey are within the range of surveys carried out overseas (see Appendix 2), with prevalence estimates for aflatoxins in peanuts in the range 3-50% being reported.

As for peanut butter, the distribution of the aflatoxin concentrations in peanut samples from the current survey was investigated, using the BestFit function of the Excel add-in @Risk (Palisades Corporation). Aflatoxin concentrations conformed most closely to a lognormal distribution (Figure 3). The lognormal distribution is often considered to be the most appropriate distributional form for the concentration of naturally-occurring contaminants (Baccarelli *et al.*, 2005; Huybrechts *et al.*, 2002; Sioen *et al.*, 2008).

Figure 3: Histogram of aflatoxin concentrations in peanuts and the associated maximum likelihood lognormal distribution



3.9 Pistachios

Aflatoxins were detected in 5% (1/20) of pistachio samples analysed in the current survey. Aflatoxins were detected in a single sample, at a concentration of 0.7 µg/kg. Only one previous New Zealand survey has examined pistachios for the presence of aflatoxins, with none of six samples positive for aflatoxins at a limit of detection of 1 µg/kg (Stanton, 2000).

¹ <http://www.stats.govt.nz/infoshare/TradeVariables.aspx?DataType=TIM>

Pistachios have been covered by an Imported Food Requirement (IFR) and up to 18% of shipments tested by ESR in any calendar year have been found to contain aflatoxins (Cressey and Thomson, 2006).

The single positive sample detected in the current survey was compliant with the requirements of the Australia New Zealand Food Standards Code.

In 2009, New Zealand imported approximately 120 tonnes of pistachios¹, with a majority imported from the USA (97%).

Overseas studies suggest that the prevalence of aflatoxins in pistachios can be highly variable, with estimates in the range 0-67% being reported (see Appendix 2).

3.10 Regulatory Limits for Aflatoxins

The Joint Australia New Zealand Food Standards Code specifies a maximum limit (ML) for aflatoxins in peanuts or tree nuts of 0.015 mg/kg (15 µg/kg)².

In 2003, worldwide regulations for mycotoxins were reviewed (Van Egmond and Jonker, 2004). While a number of countries reported ‘catch all’ limits for aflatoxins in any food, a limited number of countries reported limits relevant to the foods and mycotoxins included in the current survey. These are summarised in Table 4.

Table 4: International regulatory limits for aflatoxins in nuts and nut products

Countries	Food Description	Limit (µg/kg)
Aflatoxin B1		
China, Hong Kong	Peanuts and peanut products	20
Algeria, Korea	Peanuts, nuts	10
Croatia, Cuba, Egypt, Malawi, Mauritius, Suriname, Zimbabwe	Peanuts	5
Iran, Israel, Russia, Syria, Turkey	Peanuts, nuts	5
Croatia	Almonds, hazelnuts, walnuts	3
EU and candidate EU states	Peanuts, nuts intended for direct human consumption	2
Morocco	Peanuts, nuts	1
Total Aflatoxins		
Guatemala, Hong Kong, Kenya, Mercosur (Argentina, Brazil, Paraguay, Uruguay), Venezuela	Peanuts, peanut butter	20
Belize, Indonesia	Peanuts	20
Australia, New Zealand, Canada, Iran, Israel, Taiwan	Peanuts, tree nuts and their products	15

¹ <http://www.stats.govt.nz/infoshare/TradeVariables.aspx?DataType=TIM>

² http://www.foodstandards.gov.au/srcfiles/Standard_1_4_1_Contaminants_v113.pdf

Countries	Food Description	Limit (µg/kg)
(peanuts only)		
EU and candidate EU states, Codex Alimentarius	Peanuts as raw material	15
Peru	Raw and processed peanuts	15
Turkey	Peanuts, nuts	10
Egypt, Mozambique	Peanuts	10
EU and candidate EU states	Nuts as raw material	10
Singapore	Nuts	5
EU and candidate EU states	Peanuts, nuts intended for direct human consumption	4
Croatia	Tree nuts	3

AFB1 = aflatoxin B1

Total aflatoxins = aflatoxins(B1+B2+G1+G2)

Many countries choose to regulate in terms of aflatoxin B1, as most of the toxicological evidence relates to this aflatoxin and suggests this is the most toxic of the aflatoxins (JECFA, 1998). In this respect, regulation based on total aflatoxins may be viewed as more cautious, in giving equal weight to the four main B and G aflatoxins. Aflatoxin B1 is also produced by both *Aspergillus flavus* and *Aspergillus parasiticus*, while G aflatoxins are not produced by *A. flavus*.

4 CONCLUSIONS

Aflatoxins were detected in a range of nut and nut products available in New Zealand. The prevalence of aflatoxins in different types of product were generally consistent with or lower than in previous New Zealand and overseas studies. Where estimates of prevalence were greater than previous New Zealand studies (Brazil nuts, peanut butter, peanut products, pistachios), it appears likely that this is largely due to lower limits of detection in the current study, although increased sample numbers will also increase the probability of detecting low prevalence events.

Two samples of peanuts and two peanut products (4/305; 1.3%) were found to be non-compliant with Standard 1.4.1 of the Australia New Zealand Food Standards Code due to the presence of aflatoxins above the maximum limit of 15 µg/kg (or the equivalent proportion of this limit for nut-containing products). It is possible that further peanut products may have been non-compliant, but the proportion of nuts in some products was not declared and the necessary calculations could not be carried out. The low proportion of non-compliant products is consistent with expectations of the import testing protocols that have been in place in New Zealand.

Peanut butter was the most frequently aflatoxin-contaminated product (41% of samples). However, concentrations of aflatoxins in peanut butter were generally low (<3.5 µg/kg). The highest aflatoxin concentrations observed in this survey (20.3 and 26.6 µg/kg) were detected in peanuts.

Aflatoxins were infrequently detected in nut types other than peanuts (2/50; 4%) and were not detected at all in almonds and cashews. Aflatoxins were detected in some mixed nut products that did not declare peanuts, indicating contamination of other nut types.

The distribution of aflatoxin concentrations was examined for peanuts and peanut butter and found to be consistent with expectations, conforming most closely to a lognormal distribution.

Dietary exposure estimates for aflatoxins, considering results from the current study and previous studies of aflatoxins in other food types, would assist in placing the results of the current survey in context with respect to human health risks.

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APPENDIX 1 DETAILS OF SAMPLES ANALYSED IN THE CURRENT SURVEY

Details of samples included in the current survey and results of aflatoxin analyses in included in Table 5.

Table 5: Details of samples and aflatoxin concentration of nut and nut products analysed in the Mycotoxin Surveillance Programme 2009-2010

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Almonds	Econo Pack Roasted Almonds, 1 kg	Australia		ND	ND	ND	ND	
Almonds	Value Pack Roasted Unsalted Almonds, 350 g	New Zealand		ND	ND	ND	ND	
Almonds	Home Brand Smoked Almonds, 200 g	Australia		ND	ND	ND	ND	
Almonds	Almonds, 200 g	Not Stated		ND	ND	ND	ND	
Almonds	Tasti Dessert Almonds, 70 g	New Zealand		ND	ND	ND	ND	
Almonds	Mother Earth Almonds, Batch Roasted, 325 g	New Zealand		ND	ND	ND	ND	
Almonds	Alison's Pantry Almonds, loose	Not Stated		ND	ND	ND	ND	
Almonds	Alison's Pantry Sliced Natural Almonds, loose	Not Stated		ND	ND	ND	ND	
Almonds	Pam's Unsalted Almonds Roasted & Crunchy, 150 g	New Zealand		ND	ND	ND	ND	
Almonds	Bulk Foods Almonds Raw, 1 kg	Australia		ND	ND	ND	ND	
Brazil Nuts	Sun Valley Foods Brazil Nuts, 200g	Not Stated		5.8	ND	ND	ND	5.8
Brazil Nuts	Alison's Pantry Brazil Nuts, loose	Not Stated		ND	ND	ND	ND	
Brazil Nuts	Pam's All Natural Brazil Nuts, 70 g	New Zealand		ND	ND	ND	ND	
Brazil Nuts	Liberty Market Organic Brazil Nuts, 1 kg	Brazil		ND	ND	ND	ND	
Brazil Nuts	Summer Harvest Brazil Nuts, loose	Not Stated		ND	ND	ND	ND	
Brazil Nuts	Balars Brazil Nuts, 1 kg	Not stated		ND	ND	ND	ND	
Brazil Nuts	Brazil Nuts Wild, loose	Not Stated		ND	ND	ND	ND	
Brazil Nuts	Organic Brazil Nuts, loose	Not Stated		ND	ND	ND	ND	
Brazil Nuts	Chantal Organics Brazil Nuts, 200 g	Bolivia		ND	ND	ND	ND	
Brazil Nuts	Brazil Nuts raw, 500 g	Not stated		ND	ND	ND	ND	
Cashews	Econo Pack Roasted Salted Cashews, 1 kg	New Zealand		ND	ND	ND	ND	
Cashews	Nelson Dutch Rusk Salted Cashew Nuts, 150 g	New Zealand		ND	ND	ND	ND	

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Cashews	Cashew Nuts, salted, 200 g	Not Stated		ND	ND	ND	ND	
Cashews	Home Brand Salted Cashews, 500 g	Australia		ND	ND	ND	ND	
Cashews	Value Pack Roasted Unsalted Cashews, 500 g	New Zealand		ND	ND	ND	ND	
Cashews	Eta Salted Cashews, 175 g	New Zealand		ND	ND	ND	ND	
Cashews	Pam's Salted Cashews Roasted & Crunchy, 200 g	New Zealand		ND	ND	ND	ND	
Cashews	Mother Earth Batch Roasted Cashews, Unsalted, 325 g	New Zealand		ND	ND	ND	ND	
Cashews	Alison's Pantry Salted Cashews, loose	Not Stated		ND	ND	ND	ND	
Cashews	Bulk Foods Cashews Roasted Unsalted, 1 kg	Australia		ND	ND	ND	ND	
Mixed Nut Product	WallabyBar Macadamia & Cashew, 40 g	Australia	Macadamias (19), cashews (17)	(0.1)	(0.1)	ND	(0.1)	(0.3)
Mixed Nut Product	Mother Earth Grab & Go Snack Packs Booster Pack, 180 g	New Zealand	Not stated	(0.1)	(0.1)	ND	(0.1)	(0.3)
Mixed Nut Product	WeightWatchers Fruit & Nut, 136 g	New Zealand	Cashews (17), peanuts (9)	ND	ND	ND	ND	
Mixed Nut Product	Home Brand Fruit & Nut Milk Chocolate, 300 g	Australia	14	ND	ND	ND	ND	
Mixed Nut Product	Be Natural Trail Bars Nut & Fruit, 192 g	Australia	8	ND	ND	ND	ND	
Mixed Nut Product	Select Nut & Fruit Bars, 160 g	New Zealand	33	ND	ND	ND	ND	
Mixed Nut Product	Nice & Natural Natural Nut Bars Trail Mix, 192 g	New Zealand	Peanuts (39), cashews (5), almonds (5)	ND	ND	ND	ND	
Mixed Nut Product	Pam's Nut Bar Choc Almond & Nut, 210 g	New Zealand	Peanuts (38), almonds (6)	0.4	ND	ND	ND	0.4
Mixed Nut Product	Snapdragon Scroggin, 1 kg	Not Stated	Not Stated	ND	ND	ND	ND	
Mixed Nut Product	Nice & Natural Natural Nut Bars Trail Mix, 192 g	New Zealand	Peanut (39), cashew (5), almond (5)	ND	ND	ND	ND	
Mixed Nut Product	Select Nut & Fruit Bars, 160 g	New Zealand	33 (peanuts, almond, cashews)	ND	ND	ND	ND	
Mixed Nut Product	Tasti Snacking Handful of Nuts, 240 g	New Zealand	Peanuts (45), cashews (21), Brazils (14), almonds (11), macadamias (9)	ND	ND	ND	ND	

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Mixed Nut Product	Mother Earth Deluxe Mix, Batch Roasted, Lightly Salted, 150 g	New Zealand	Cashews, almonds, Brazils, pecans, macadamias	0.7	ND	ND	ND	0.7
Mixed Nut Product	Pam's Deluxe Nut Mix Roasted & Salted, 150 g	New Zealand	Cashews, almonds, hazelnuts, Brazil, macadamias	0.3	ND	ND	ND	0.3
Mixed Nut Product	Alison's Pantry Honey Roasted Mixed Nuts, loose	Not Stated	Peanuts, Brazils, cashews, almonds	9.0	0.7	ND	ND	9.7
Mixed Nut Product	Alison's Pantry Deluxe Raw Mixed Nuts, loose	Not Stated	Almonds, Brazils, cashews, walnuts, pecans, hazelnuts	ND	ND	ND	ND	
Mixed Nut Product	Alison's Pantry Supreme Roast Mixed Nuts, loose	Not Stated	Cashews, almonds, Brazils, pecans, macadamias, hazelnuts	1.0	ND	ND	ND	1.0
Mixed Nut Product	Bulk Foods Premium Mixed Nuts Roasted & Salted, 600 g	Australia	Cashews, almonds, Brazils, hazelnuts, pecans, macadamia	0.6	ND	ND	ND	0.6
Mixed Nut Product	Select Deluxe Nut Trio Cashews, Macadamias & Blanched Almonds, 200 g	Australia, Vietnam (Cashews)	Cashews, macadamias, almonds	ND	ND	ND	ND	
Mixed Nut Product	Deluxe Raw Mix, loose	Not Stated	Brazils, almonds, hazelnuts, cashews, pecans, walnuts	1.0	ND	ND	ND	1.0
Mixed Nut Product	Nuts Roasted Mix, loose	Not Stated	Peanuts, cashews, almonds, hazelnuts, Brazils	0.9	ND	ND	ND	0.9

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Mixed Nut Product	Alison's Pantry Energy Booster, loose	Not Stated	Peanuts, pecans, chocolate peanuts, almonds, cashews, apricot, papaya, pineapple, pumpkin seed, raisins, sunflower seeds, peaches, pears, apple	ND	ND	ND	ND	
Mixed Nut Product	CeresOrganics Trail Mix Original, 150 g	New Zealand	Almonds, cashews	ND	ND	ND	ND	
Mixed Nut Product	Summer Harvest Raw Mixed Nuts, loose	Not Stated	Pecans, walnuts, Brazils, hazelnuts, almonds	1.9	ND	ND	ND	1.9
Mixed Nut Product	Naytura Natural Nut Mix, 250 g	Australia	Almonds, cashews, pecans, peanuts, hazelnuts, Brazils, walnuts	0.4	ND	ND	ND	0.4
Mixed Nut Product	Naytura Nibbles Mix, 250 g	Australia	35 (Almonds, cashews, hazelnuts, Brazils)	(0.1)	ND	ND	ND	(0.1)
Mixed Nut Product	Value Pack Scrummy Mix, 400 g	New Zealand	Peanuts, almonds, cashews, hazelnuts, pecans	ND	ND	ND	ND	
Mixed Nut Product	Summer Harvest Raw Mixed Nuts, loose	Not Stated	Cashews, peanuts, Brazils, hazelnuts, almonds	2.4	(0.1)	ND	ND	2.5
Mixed Nut Product	Alison's Pantry Mixed Raw Nuts with Peanuts, loose	Not Stated	Peanuts, almonds, Brazils, cashews, pecans	ND	ND	ND	ND	
Mixed Nut Product	Alison's Pantry Goji Mix, loose	Not Stated	Cashews, cranberries, pecans, goji berries, pistachios	ND	ND	ND	ND	
Mixed Nut Product	Alison's Pantry Brazilian Delight, loose	Not Stated	Almonds, cashews, coconut chips, papaya, pineapple, raisins	ND	ND	ND	ND	

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Mixed Nut Product	Alison's Pantry Maggies Mix, loose	Not Stated	Almonds, macadamias, pecans, pineapple, raisins, peanuts, pumpkin seeds, banana chips	ND	ND	ND	ND	
Mixed Nut Product	Alison's Pantry Nuts, Raisins & Cashews, loose	Not Stated	Not Stated	ND	ND	ND	ND	
Mixed Nut Product	Mo'jpleez All in One, 160 g	India	Not Stated	ND	ND	ND	ND	
Mixed Nut Product	Mixed Raw Nuts, loose	Not Stated	Hazelnuts almonds, Brazils, walnuts, macadamias	ND	ND	ND	ND	
Mixed Nut Product	Honey Roast Mixed Nuts, loose	Not Stated	Peanuts, macadamias, almonds, cashews, Brazils	ND	ND	ND	ND	
Mixed Nut Product	Roast Mixed Nuts, loose	Not Stated	Peanuts, macadamias, hazelnuts, almonds, cashews, Brazils	0.4	0.5	0.3	0.5	1.7
Mixed Nut Product	Snapdragon Mixed Nuts, 1 kg	Not Stated	Peanuts, almonds, cashews, Brazils, hazelnuts	ND	ND	ND	ND	
Mixed Nut Product	Snapdragon Supreme Mix, 1 kg	Not Stated	Almonds, cashews, Brazils, hazelnuts, pecans	ND	ND	ND	ND	
Mixed Nut Product	Snapdragon Raw Supreme Mix, 1 kg	Not Stated	Almonds, cashews, Brazils, hazelnuts, pecans, macadamias	ND	ND	ND	ND	
Mixed Nut Product	Snapdragon Roasted Salted Mixed Nuts, 1kg	Not Stated	Peanuts, almonds, cashews, Brazils	ND	ND	ND	ND	
Mixed Nut Product	Alison's Pantry Honey Roasted Mixed Nuts, loose	Not Stated	Peanuts, Brazils, cashews, almonds	ND	ND	ND	ND	
Mixed Nut Product	Alison's Pantry Deluxe Raw Mixed Nuts, loose	Not Stated	Almonds, Brazils, cashews, walnuts, pecans, hazelnuts	ND	ND	ND	ND	

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Mixed Nut Product	Alison's Pantry Supreme Roast Mixed Nuts, loose	Not Stated	Cashews, almonds, Brazils, pecans, macadamias, hazelnuts	ND	ND	ND	ND	
Mixed Nut Product	Alison's Pantry Fruit & Nut Mix, loose	Not Stated	Raisins, cinnamon raisins, almonds, cashews, papaya	ND	ND	ND	ND	
Mixed Nut Product	Tasti Snacking Handful of Nuts, 240 g	New Zealand	Peanuts (45), cashews (21), Brazils (14), almonds (11), macadamias (9)	ND	ND	ND	ND	
Mixed Nut Product	Tasti Snacking Scroggin, 240 g	New Zealand	Peanuts (24), cashews (8), almonds (6)	ND	ND	ND	ND	
Mixed Nut Product	Ocean Spray Craisins Trail Mix, 170 g	USA	Peanuts (25), cashews (10)	(0.1)	(0.2)	(0.1)	0.2	(0.7)
Mixed Nut Product	Mother Earth Deluxe Mix, Batch Roasted, Lightly Salted, 150 g	New Zealand	Cashew, almonds, Brazils, pecans, hazelnuts, macadamias	ND	ND	ND	ND	
Mixed Nut Product	Mother Earth Deluxe Mix, Natural, 150 g	New Zealand	Cashews, almonds, Brazils, pecans, hazelnuts, macadamias	ND	ND	ND	ND	
Mixed Nut Product	Signature Range Mixed Nuts, Roasted & Salted, 250 g	New Zealand	Peanuts, almonds, Brazils, cashews, hazelnuts	ND	ND	ND	ND	
Mixed Nut Product	Value Pack Scrummy Mix, 400 g	New Zealand	Peanuts, almonds, cashews, pecans, hazelnuts	ND	ND	ND	ND	
Mixed Nut Product	Value Pack Deluxe Roasted Nuts, 350 g	New Zealand	Cashew, almonds, Brazils, pecans, hazelnuts, macadamia	ND	ND	ND	ND	

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Mixed Nut Product	Sun Valley Foods Granny Treats, loose	New Zealand	Chocolate raisins, almonds, coconut chips, raisins, peaches, pears, apples, apricot, raw peanuts, blanched peanuts, pumpkin and sunflower seeds	ND	ND	ND	ND	
Mixed Nut Product	Sun Valley Foods Healthy Lunch Mix, loose	New Zealand	Almonds, peanuts, apricots, banana chips, raisins, pumpkin seed	ND	ND	ND	ND	
Mixed Nut Product	Sun Valley Foods Hikers Energy Mix, loose	New Zealand	Cashews, almonds, pecans, pineapple, papaya, peanuts, pumpkin seeds	ND	ND	ND	ND	
Mixed Nut Product	Sun Valley Foods Premium Mixed Nuts, Roasted, loose	New Zealand	Pecans, cashews, almonds, Brazils, hazelnuts	ND	ND	ND	ND	
Mixed Nut Product	Select Deluxe Nut Trio Cashews, Macadamias & Blanched Almonds, 200 g	Australia, Vietnam (Cashews)	Cashews, macadamias, almonds	ND	ND	ND	ND	
Mixed Nut Product	Cadbury Brunch Bar Fruit & Nut, 210 g	Australia	Cashews (3), almonds (2)	ND	ND	ND	ND	
Peanut Butter	Home Brand Peanut Butter Smooth, 1 kg	China	88	0.9	(0.1)	ND	ND	1.0
Peanut Butter	Home Brand Peanut Butter Crunchy, 1 kg	China	89	0.6	0.3	ND	ND	0.9
Peanut Butter	Eta Seriously Smooth Peanut Butter, 1 kg	China	Not Stated	0.3	ND	ND	ND	0.3
Peanut Butter	CeresOrganics Peanut Butter Smooth, 300 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Butter	Sanitarium Original Crunchy Peanut Butter No Added Salt, 500 g	Australia	94	0.3	ND	(0.1)	ND	0.3
Peanut Butter	Sanitarium Original Smooth Peanut Butter No Added Salt, 500 g	Australia	94	(0.2)	ND	ND	ND	(0.2)
Peanut Butter	Sanitarium Original Smooth Peanut Butter, 500 g	Australia	92	0.4	ND	ND	ND	0.4
Peanut Butter	Sanitarium Original Crunchy Peanut Butter, 500 g	Australia	92	0.4	ND	ND	ND	0.4

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Peanut Butter	Pam's Extra Crunchy Peanut Butter, 1 kg	China	97	ND	ND	ND	ND	
Peanut Butter	Pam's Crunchy Peanut Butter, 1 kg	China	97	(0.1)	ND	ND	ND	(0.1)
Peanut Butter	Pam's Smooth Peanut Butter, 1 kg	China	97	ND	ND	ND	ND	
Peanut Butter	Eta Awesomely Crunchy Peanut Butter, 1 kg	China	96	(0.2)	(0.1)	0.3	(0.1)	0.7
Peanut Butter	Kraft Nuts Peanut Spread Light Crunchy, 375 g	Australia	63	0.3	0.4	(0.2)	0.2	1.1
Peanut Butter	Kraft Nuts Peanut Spread Light Smooth, 375 g	Australia	63	ND	ND	ND	ND	
Peanut Butter	Kraft Nuts Peanut Butter Crunchy, 375 g	Australia	85	0.3	ND	ND	ND	0.3
Peanut Butter	Select Light Smooth Peanut Spread, 500 g	Australia	63	ND	ND	ND	ND	
Peanut Butter	Select Light Crunchy Peanut Spread, 500 g	Australia	64	ND	ND	ND	ND	
Peanut Butter	Select Super Crunchy Peanut Butter, 500 g	Australia	89	ND	ND	ND	ND	
Peanut Butter	CeresOrganics Peanut Butter Crunchy, 300 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Butter	Kaiora Organic Peanut Butter Crunchy, 400 g	China	99.4	ND	ND	ND	ND	
Peanut Butter	Kaiora Organic Peanut Butter Smooth, 400 g	China	99.4	ND	ND	ND	ND	
Peanut Butter	Chantal Organics Classic Crunchy, 700g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Butter	PIC's Really Good Peanut Butter, 1 kg	Australia	Not Stated	ND	ND	ND	ND	
Peanut Butter	Reilly Organic Peanut Butter, 400 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Butter	CeresOrganics Peanut Butter Smooth, 300 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Butter	Chantal Organics Classic Peanut Butter Smooth, 700 g	China	99.4	ND	ND	ND	ND	
Peanut Butter	Huckleberry Farms Organic Peanut Butter Smooth Salted, 300 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Butter	Huckleberry Farms Organic Peanut Butter Smooth Unsalted, 300 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Butter	Piko Wholefoods Peanut Butter Blanch Smooth, 1 kg	China	Not Stated	ND	ND	ND	ND	
Peanut Butter	Piko Wholefoods Peanut Butter Blanch Crunch, 1 kg	China	Not Stated	ND	ND	ND	ND	
Peanut Butter	Piko Wholefoods Peanut Butter Skin Crunch, 1 kg	China	Not Stated	ND	ND	ND	ND	
Peanut Butter	Kraft Nuts Peanut Butter Smooth, 375 g	Australia	85	ND	ND	ND	ND	
Peanut Butter	Chantal Organics Classic Peanut Butter Crunchy, 400 g	China	99.4	ND	ND	ND	ND	
Peanut Butter	Kraft Nuts Peanut Spread Light Smooth, 375 g	Australia	63	(0.1)	ND	ND	ND	(0.1)
Peanut Butter	Kraft Nuts Peanut Spread Light Crunchy, 375 g	Australia	63	0.7	0.6	(0.2)	0.3	1.8

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Peanut Butter	Kraft Nuts Peanut Butter Crunchy, 375 g	Australia	85	(0.1)	ND	ND	ND	(0.1)
Peanut Butter	Kraft Nuts Peanut Butter Smooth, 375 g	Australia	85	(0.1)	ND	ND	ND	(0.1)
Peanut Butter	Pam's Smooth Peanut Butter, 1 kg	China	97	(0.2)	ND	ND	ND	(0.2)
Peanut Butter	Pam's Extra Crunchy Peanut Butter, 1 kg	China	97	0.9	(0.2)	ND	ND	1.1
Peanut Butter	Pam's Crunchy Peanut Butter, 1 kg	China	97	0.8	(0.2)	ND	ND	1.0
Peanut Butter	Eta Seriously Smooth Peanut Butter, 1 kg	China	Not Stated	2.1	0.6	ND	ND	2.7
Peanut Butter	Eta Awesomely Crunchy Peanut Butter, 1 kg	China	97	0.4	ND	ND	ND	0.4
Peanut Butter	Sanitarium Original Crunchy Peanut Butter, 500 g	Australia	92	0.3	ND	ND	ND	0.3
Peanut Butter	Sanitarium Original Smooth Peanut Butter, 500 g	Australia	92	0.9	ND	(0.1)	ND	1.0
Peanut Butter	Sanitarium Original Crunchy Peanut Butter No Added Salt, 500 g	Australia	94	ND	ND	ND	ND	
Peanut Butter	Sanitarium Original Smooth Peanut Butter No Added Salt, 500 g	Australia	94	ND	ND	ND	ND	
Peanut Butter	PIC's Really Good Peanut Butter, 360 g	Australia	Not Stated	ND	ND	ND	ND	
Peanut Butter	Select Light Smooth Peanut Spread, 500 g	Australia	63	ND	ND	ND	ND	
Peanut Butter	Select Crunchy Peanut Butter, 500 g	Australia	89	ND	ND	ND	ND	
Peanut Butter	Select Super Crunchy Peanut Butter, 500 g	Australia	89	0.6	ND	0.4	(0.1)	1.1
Peanut Butter	Select Light Crunchy Peanut Spread, 500 g	Australia	64	ND	ND	ND	ND	
Peanut Butter	Home Brand Peanut Butter Crunchy, 1 kg	China	89	1.3	(0.2)	1.5	0.3	3.4
Peanut Butter	Home Brand Peanut Butter Smooth, 1 kg	China	88	ND	ND	ND	ND	
Peanut Butter	CeresOrganics Peanut Butter Crunchy, 300 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Butter	CeresOrganics Peanut Butter Smooth, 700 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Butter	Kaiora Organic Peanut Butter Crunchy, 700 g	China	99.4	ND	ND	ND	ND	
Peanut Butter	Kaiora Organic Peanut Butter Smooth, 700 g	China	99.4	ND	ND	ND	ND	
Peanut Butter	Chantal Organics Classic Peanut Butter Crunchy, 700 g	China	99.4	ND	ND	ND	ND	
Peanut Butter	Home Brand Peanut Butter Crunchy 1kg	China	89	0.3	ND	(0.1)	ND	0.4
Peanut Butter	Chantal Organics Classic Peanut Butter Smooth, 700 g	China	99.4	ND	ND	ND	ND	
Peanut Butter	Piko Wholefoods Peanut Butter Blanch Smooth, small	China	Not Stated	ND	ND	ND	ND	
Peanut Butter	Piko Wholefoods Peanut Butter Blanch Crunch, small	China	Not Stated	ND	ND	ND	ND	

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Peanut Butter	Piko Peanut Butter Skin Crunch 1kg	China	Not Stated	ND	ND	ND	ND	
Peanut Butter	Piko Wholefoods Peanut Butter Skin Smooth, 1 kg	China	Not Stated	ND	ND	ND	ND	
Peanut Butter	Kaiora Organic Peanut Butter Smooth, 400 g	China	99.4	ND	ND	ND	ND	
Peanut Butter	Eta Seriously Smooth Peanut Butter No Added Salt, 375 g	China	Not Stated	0.9	(0.2)	0.3	(0.1)	1.5
Peanut Butter	Eta Awesomely Crunchy Peanut Butter, 375 g	China	96	0.8	(0.1)	ND	ND	0.9
Peanut Butter	Pam's Smooth Peanut Butter No Added Salt, 375 g	China	98	(0.2)	ND	ND	ND	(0.2)
Peanut Butter	Pam's Crunchy Peanut Butter No Added Salt, 375 g	China	98	(0.1)	ND	ND	ND	(0.1)
Peanut Butter	Pam's Smooth Peanut Butter, 375 g	China	97	ND	ND	ND	ND	
Peanut Butter	Kraft Nuts Peanut Butter Crunchy, 375 g	Australia	85	(0.1)	ND	ND	ND	(0.1)
Peanut Butter	Kraft Nuts Peanut Butter Smooth, 375 g	Australia	85	(0.1)	ND	ND	ND	(0.1)
Peanut Butter	Huckleberry Farms Organic Peanut Butter Smooth Unsalted, 300 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Butter	Huckleberry Farms Organic Peanut Butter Crunch Salted, 300 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Butter	Huckleberry Farms Organic Peanut Butter Crunchy Unsalted, 300 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Product	Home Brand Scorched Peanuts Milk Chocolate, 300g	Australia	33	ND	ND	ND	ND	
Peanut Product	Cadbury Brunch Bar Nut Peanut, 210 g	Australia	31	ND	ND	ND	ND	
Peanut Product	Nice & Natural Natural Nut Bars Dark Chocolate Apricot, 192 g	New Zealand	47	ND	ND	ND	ND	
Peanut Product	Tasti Nut Bar Choc & Peanut, 225 g	New Zealand	42	ND	ND	ND	ND	
Peanut Product	Tasti Nut Bar Fruit & Nut, 225 g	New Zealand	28	ND	ND	ND	ND	
Peanut Product	Nice & Natural Natural Nut Bars Yoghurt, 192 g	New Zealand	49	ND	ND	ND	ND	
Peanut Product	Nice & Natural Natural Nut Xtreme Bars Peanut, 180g	New Zealand	44	ND	ND	ND	ND	
Peanut Product	Alison's Pantry Milk Chocolate Peanuts, loose	Not Stated	Not Stated	ND	ND	ND	ND	
Peanut Product	Mars Peanut M&M's, 200 g	Australia	23	ND	ND	ND	ND	
Peanut Product	Eta Chocolate Peanuts, 100 g	New Zealand	33	(0.1)	(0.2)	(0.1)	(0.1)	(0.5)
Peanut Product	Pam's Nut Bar Fruit & Nut, 210 g	New Zealand	55	ND	ND	ND	ND	
Peanut Product	Mars Snickers Bar, 216 g	Australia	22	ND	ND	ND	ND	

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Peanut Product	Whittaker's Original Peanut Block, 250 g	New Zealand	25	ND	ND	ND	ND	
Peanut Product	Chengdu Jiuxiang Foods Peanut Sugar, 180 g	China	Not Stated	2.1	(0.1)	ND	ND	2.3
Peanut Product	Chengdu Jiuxiang Foods Peanut Crisp, 180 g	China	Not Stated	0.7	ND	ND	ND	0.7
Peanut Product	LBB Peanut Crisps, 136 g (x5)	China	Not stated	ND	ND	ND	ND	
Peanut Product	Vinawang Peanut Candy, 100 g	Vietnam	42	ND	ND	ND	ND	
Peanut Product	Brahim's Satay Sauce, 180 g	Malaysia	20	2.1	0.4	ND	ND	2.5
Peanut Product	Lee Kum Kee Satay Sauce, 220 g	China	25	(0.1)	ND	(0.1)	(0.1)	(0.3)
Peanut Product	Wattie's Bit on the Side Java Satay, 300 g	New Zealand	14	ND	ND	ND	ND	
Peanut Product	Pam's Spicy Satay Sauce, 300 g	New Zealand	18	ND	ND	ND	ND	
Peanut Product	Kan Tong Peanut Satay, 570 g		9	ND	ND	ND	ND	
Peanut Product	Kan Tong Inspirations Malaysian Satay, 160 g	Australia	12	(0.2)	(0.1)	(0.2)	(0.1)	(0.6)
Peanut Product	Wattie's Wok Creations Malaysian Peanut Satay, 125 g	New Zealand	21	ND	ND	ND	ND	
Peanut Product	MasterFoods Satay Marinade, 375 g	Australia	8	(0.2)	ND	ND	ND	(0.2)
Peanut Product	Whittakers Raisin Peanut Slab, 150 g	New Zealand	16	ND	ND	ND	ND	
Peanut Product	Whittakers Peanut Slab, 150 g	New Zealand	35	ND	ND	ND	ND	
Peanut Product	Vogel's Scroggin Clusters Apricot & Nut, 240 g	New Zealand	4	ND	ND	ND	ND	
Peanut Product	Tasti Nut Bar Choc & Peanut, 225 g	Australia	42	ND	ND	ND	ND	
Peanut Product	Fleming's Chewy Nut Bar Macaroon, 225 g	New Zealand	42	ND	ND	ND	ND	
Peanut Product	Fleming's Chewy Muesli Raisin Nut, 180 g	New Zealand	9	ND	ND	ND	ND	
Peanut Product	Tasti Nut Bar Yoghurt Fruit & Nut, 225 g	Australia	25	ND	ND	ND	ND	
Peanut Product	Fleming's Chewy Nut Bar Country Caramel, 225 g	New Zealand	42	ND	ND	ND	ND	
Peanut Product	Fleming's Chewy Nut Bar Classic Rocky Road, 225 g	New Zealand	42	4.8	0.7	1.9	0.3	7.7
Peanut Product	Fleming's Chewy Nut Bar Berry Scroggin, 225 g	New Zealand	35	ND	ND	ND	ND	
Peanut Product	Yeo's Satay Sauce, 270 g	Malaysia	13	ND	ND	ND	ND	
Peanut Product	Healtheries Simple Peanut Crunch, 40 g	Australia	48	ND	ND	ND	ND	
Peanut Product	Peanut Chews, 56 g	USA	27.7	ND	ND	ND	ND	
Peanut Product	Signature Range Chocolate Nut & Cereal Bars, 210 g	New Zealand	20	ND	ND	ND	ND	
Peanut Product	Signature Range Yoghurt Nut & Cereal Bars, 210 g	New Zealand	21	ND	ND	ND	ND	
Peanut Product	Patrick Donovan's Fruit & Nut Fudge, 280 g	New Zealand	9	ND	ND	ND	ND	

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Peanut Product	Vault Chocolate Mini Bars, 264 g	Germany	24	ND	ND	ND	ND	
Peanut Product	Ayam Thai Satay Sauce, 340 g	Malaysia	20	ND	ND	ND	ND	
Peanut Product	Ayam Indonesian Satay Sauce, 340 g	Malaysia	20	ND	ND	ND	ND	
Peanut Product	Select Singapore Satay, 375 g	Malaysia	10	0.4	0.7	0.3	0.3	1.7
Peanut Product	Wattie's Creamy Satay Stir Fry Sauce, canned, 425 g	New Zealand	12	ND	ND	ND	ND	
Peanut Product	Mo'pleez Chana Nuts, 350 g	India	Not Stated	0.3	ND	ND	ND	0.3
Peanut Product	Udorn Thai Peanut Sauce Spicy, 850 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Product	D&P Satay Sauce, 340 g	Malaysia	14	(0.2)	ND	ND	ND	(0.2)
Peanut Product	Shantou Han River Satay Sauce, 218 g	China	Not Stated	4.6	1.3	ND	ND	5.9
Peanut Product	Mo'jpleez All in One, 160 g	India		ND	ND	ND	ND	
Peanut Product	Oliviero Peanut Bars	Italy	55	ND	ND	ND	ND	
Peanut Product	Spiral Foods Satay Sauce, 296 g	USA	Not Stated	ND	ND	ND	ND	
Peanut Product	Zhongshan Camil Satay Sauce, 280 g	China	Not Stated	ND	ND	ND	ND	
Peanut Product	Cadbury Dairy Milk Rocky Road, 200 g	Australia	4	ND	ND	ND	ND	
Peanut Product	CHNG Kee's Satay Sauce, 250 g	Singapore	Not Stated	8.3	2.2	ND	ND	10.5
Peanut Product	Ayam Satay Sauce Mild, 250 ml	Malaysia	21	ND	ND	ND	ND	
Peanut Product	Tasti Snak Logs Carob Coated Fruit & Nut	New Zealand	13	ND	ND	ND	ND	
Peanut Product	Tasti Snak Logs Carob Coated Apricot, 240 g	New Zealand	Not Stated	ND	ND	ND	ND	
Peanut Product	Exotic Food Spicy Hot Satay Sauce, 200 g	Thailand	8.1	ND	ND	ND	ND	
Peanut Product	Exotic Food Satay Curry, 400 ml	Thailand	Not Stated	ND	ND	ND	ND	
Peanut Product	Cadbury Picnic, 46 g	Australia	23	ND	ND	ND	ND	
Peanut Product	Haldiram's Hara Chiwda, 200 g	India	10	ND	ND	ND	ND	
Peanut Product	Haldiram's Nut Cracker, 200 g	India	69	0.3	ND	ND	(0.1)	0.3
Peanut Product	Wattie's Bit on the Side Java Satay, 300 g	New Zealand	14	ND	ND	ND	ND	
Peanut Product	Ayam Thai Satay Sauce, 340 g	Malaysia	20	ND	ND	ND	ND	
Peanut Product	Koh-Kae Peanuts Thai Tom Yum Spicy flavour, 240 g	Thailand	50	ND	ND	ND	ND	
Peanut Product	Koh-Kae Peanuts Bar-B-Q flavour, 240 g	Thailand	50	ND	ND	ND	ND	
Peanut Product	Koh-Kae Peanuts Shrimp flavour, 240 g	Thailand	50	ND	ND	ND	ND	
Peanut Product	Koh-Kae Peanuts Chicken flavour, 240 g	Thailand	50	ND	ND	ND	ND	

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Peanut Product	Koh-Kae Peanuts Coconut Cream flavour, 240 g	Thailand	50	ND	ND	ND	ND	
Peanuts	Roasted Peanuts, 500 g	Not Stated		ND	ND	ND	ND	
Peanuts	Dutch Rusk Salted Peanuts, 400 g	Not Stated		ND	ND	ND	ND	
Peanuts	Home Brand Unsalted Peanuts Roasted, 250 g	China		ND	ND	ND	ND	
Peanuts	Home Brand Salted Beer Nuts Roasted, 350 g	China		ND	ND	ND	ND	
Peanuts	Eta Salted Peanuts, 200 g	New Zealand		ND	ND	ND	ND	
Peanuts	Sun Valley Foods Peanuts Roasted/Salted, 400 g	Not Stated		ND	ND	ND	ND	
Peanuts	Alison's Pantry Unsalted Peanuts, loose	Not Stated		ND	ND	ND	ND	
Peanuts	Pam's Honey Roasted Peanuts, 325 g	New Zealand		ND	ND	ND	ND	
Peanuts	Pam's Sweet & Salty Roasted Peanuts, 200 g	New Zealand		18.0	2.4	ND	ND	20.3
Peanuts	Budget Natural Peanuts, 500 g	New Zealand		ND	ND	ND	ND	
Peanuts	Budget Blanched Peanuts, 500 g	New Zealand		ND	ND	ND	ND	
Peanuts	Mother Earth Peanuts, Oven Roasted, Lightly Salted, 325 g	New Zealand		ND	ND	ND	ND	
Peanuts	Eta Honey Roasted Peanuts, 200 g	USA		ND	ND	ND	ND	
Peanuts	Bulk Foods Peanuts Roasted & Salted, 1 kg	China		ND	ND	ND	ND	
Peanuts	Eta Dry Roasted Peanuts, 200 g	New Zealand		ND	ND	ND	ND	
Peanuts	Signature Range Honey Roasted Peanuts, 250 g	New Zealand		ND	ND	ND	ND	
Peanuts	Select Chilli Peanuts, 200 g	China		0.5	0.7	0.5	0.7	2.5
Peanuts	Value Pack Roasted Salted Peanuts, 400 g	New Zealand		(0.1)	ND	ND	ND	(0.1)
Peanuts	Alison's Pantry Roasted Salted Peanuts, loose	Not Stated		2.6	0.5	ND	ND	3.2
Peanuts	Organic Red Skin Peanuts, loose	Not Stated		ND	ND	ND	ND	
Peanuts	Liberty Market Organic Raw Peanuts, 350g	China		ND	ND	ND	ND	
Peanuts	Summer Harvest Roasted in Shell Peanuts, 340 g	Not Stated		ND	ND	ND	ND	
Peanuts	Summer Harvest Salted Peanuts, loose	Not Stated		ND	ND	ND	ND	
Peanuts	Chengdu Jiuxiang Foods Spicy Peanuts, 180 g	China		0.7	ND	ND	ND	0.7
Peanuts	Blanched Peanuts, 500 g	China		ND	ND	ND	ND	
Peanuts	Raw Peanuts, 500 g	China		ND	ND	ND	ND	
Peanuts	Peanuts in shell, 500 g	China		ND	ND	ND	ND	
Peanuts	Signature Range Salted Peanuts, 250 g	New Zealand		22.7	3.9	ND	ND	26.6

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Peanuts	Signature Range Dry Roasted Peanuts, 250 g	New Zealand		ND	ND	ND	ND	
Peanuts	CeresOrganics Organic Peanuts Roasted & Salted, 300 g	New Zealand		ND	ND	ND	ND	
Peanuts	Peanuts in Shell, 500 g	Not Stated		ND	ND	ND	ND	
Peanuts	Blanched Peanuts, 500 g	Not Stated		ND	ND	ND	ND	
Peanuts	Raw Peanuts, 500 g	Not Stated		ND	ND	ND	ND	
Peanuts	Balars Peanuts Roasted Salted, 1 kg	Not Stated		ND	ND	ND	ND	
Peanuts	Balars Peanuts Natural Raw (With Skin), 1 kg	Not Stated		ND	ND	ND	ND	
Peanuts	Balars Peanuts Blanched Raw (Skin off), 1 kg	Not Stated		ND	ND	ND	ND	
Peanuts	Family Choice Roasted & Salted Peanuts, canned, 150 g	China		ND	ND	ND	ND	
Peanuts	Raw Red Skin Peanuts, loose	Not Stated		ND	ND	ND	ND	
Peanuts	Honey Peanuts, 150 g	Not Stated		ND	ND	ND	ND	
Peanuts	Raw Blanched Peanuts, loose	Not Stated		0.4	0.5	0.3	0.4	1.7
Peanuts	Red Raw Peanuts, loose	Not Stated		5.8	0.7	ND	0.0	6.5
Peanuts	Honey Roast Peanuts, loose	Not Stated		ND	ND	ND	ND	
Peanuts	Americana Roasted & Salted Peanuts, canned, 150 g	China		1.3	(0.2)	1.0	(0.1)	2.6
Peanuts	Sun Valley Foods Blanched Peanuts, 500 g	New Zealand		ND	ND	ND	ND	
Peanuts	Peanut Roasted and Chopped, 500 g	Not Stated		(0.2)	ND	0.3	(0.1)	0.6
Peanuts	Blanched Peanuts, 1 kg	Not Stated		ND	ND	ND	ND	
Peanuts	Home Brand Salted Peanuts Roasted, 500 g	China		ND	ND	ND	ND	
Peanuts	Bulk Foods Australian Peanuts Roasted in Shell, 350 g	Australia		ND	ND	ND	ND	
Peanuts	Bulk Foods Peanuts Savoury Honey, 400 g	Australia		ND	ND	ND	ND	
Peanuts	Bulk Foods Peanuts Roasted & Salted, 1 kg	China		ND	ND	ND	ND	
Pistachios	Econo Pack Roasted Salted Pistachios, 750 g	USA		0.6	(0.1)	ND	ND	0.7
Pistachios	Value Pack Roasted Pistachios, 400 g	USA		ND	ND	ND	ND	
Pistachios	Sun Valley Foods Pistachios Roasted in Shell, 200 g	Not Stated		ND	ND	ND	ND	
Pistachios	Alison's Pantry Pistachios, loose	Not Stated		ND	ND	ND	ND	
Pistachios	Bulk Foods Pistachios Roasted & Salted, 500 g	USA		ND	ND	ND	ND	
Pistachios	Signature Range Pistachios Salted, 90 g	New Zealand		ND	ND	ND	ND	

Product type	Product	County of Origin ¹	% Nut/peanut or Components of nut mix ²	Aflatoxin concentration (µg/kg)				
				B1	B2	G1	G2	Total ³
Pistachios	Pistachios, Roasted & Salted, loose	Not Stated		ND	ND	ND	ND	
Pistachios	Alison's Pantry Roasted Salted Pistachios, loose	Not Stated		ND	ND	ND	ND	
Pistachios	Tasti Raw Pistachios, 70 g	New Zealand		ND	ND	ND	ND	
Pistachios	Summer Harvest Raw Pistachios, loose	Not Stated		ND	ND	ND	ND	
Pistachios	CeresOrganics Roasted and Salted, 100 g	Not Stated		ND	ND	ND	ND	
Pistachios	Balars Pistachios in Shell, Roasted and Salted	India		ND	ND	ND	ND	
Pistachios	Pistachio Nuts organic, 250 g	USA		ND	ND	ND	ND	
Pistachios	Pistachios in Shell, 1 kg	Not Stated		ND	ND	ND	ND	
Pistachios	Pistachios Shelled Whole, 200 g	Not Stated		ND	ND	ND	ND	
Pistachios	Pistachios Shelled Split, 200 g	Not Stated		ND	ND	ND	ND	
Pistachios	Snapdragon Dry Roasted Pistachios, 500 g	Not Stated		ND	ND	ND	ND	
Pistachios	Alison's Pantry Roast Pistachios, loose	Not Stated		ND	ND	ND	ND	
Pistachios	Econo Pack Roasted Salted Pistachios, 750 g	Not Stated		ND	ND	ND	ND	
Pistachios	Bulk Foods Pistachios Roasted & Salted, 500 g	USA		ND	ND	ND	ND	

Concentration figures in brackets are indicative only and relate to analytical results which lie between the limit of detection and the limit of quantitation of the analytical method.

B1 = aflatoxin B1, B2 = aflatoxin B2, G1 = aflatoxin G1, G2 = aflatoxin G2

ND = Not detected, at a limit of detection of approximately 0.1 µg/kg (see section 2.3.2 for exact limits)

¹ Where New Zealand is listed as the country of origin this will generally mean that the product was packed in New Zealand, manufactured in New Zealand from imported materials, or manufactured in New Zealand from a mixture of domestic and imported materials

² Percentage nut content figures are not given for whole nut products (i.e. almonds, cashews, Brazil nuts, peanuts and pistachios). These products are assumed to be 100% or very close to 100% nuts

³ For some samples the figure for total aflatoxins will differ from the sum of the individual aflatoxins as presented in this table. This is due to cumulative roundings.

APPENDIX 2 INTERNATIONAL CONTEXT

Results of some overseas studies of aflatoxins in food comparable to those analysed in the current study are summarised in Tables 6.

Table 6: Overseas studies on the aflatoxin content of nuts and nut products

Country	Year	Food(s)	Number of samples (positive/total)	Range of positive results (µg/kg)*	Reference
Australia (West)	1995-2000	Peanut butter Satay sauces	14/75 33/66	1.4-23 1-80	(Western Australia Department of Health, 2004)
Bahrain	NS	Pistachios Peanut butter	2/3 7/7	Mean (SD) 27.3 (47.1) 2.4 (4.5)	(Musaiger <i>et al.</i> , 2008)
China	NS	Peanut butter	41/50	Maximum = 68.5	(Li <i>et al.</i> , 2009)
Cyprus	1992-1996	Peanut butter Desiccated coconut Almonds Walnuts Chestnuts Cashews Brazil nuts Hazelnuts Pistachios Peanuts Nut products	21/74 0/71 0/615 6/560 10/118 0/310 10/51 0/182 53/856 179/1860 0/12	AFB1 1.2-73 <LOQ-0.2 <LOQ 8.3-20 1.4-206 <LOQ-700	(Ioannou-Kakouri <i>et al.</i> , 1999)
Iran	2002-2003	Pistachios	3699/10068	AFB1 Mean (SD) 5.9 (41.7)	(Cheraghali <i>et al.</i> , 2007)
Italy	NS	Hazelnuts	6/35	<LOQ-1.0	(Bacaloni <i>et al.</i> , 2008)
Japan	1986-1990	Peanuts Cashews Almonds Pistachios Brazil nuts Walnuts Macadamia nuts Mixed nuts	11/149 0/56 0/43 5/165 1/4 0/25 0/13 0/15	AFB1 0.4-21.7 11.5-1382 10.2	(Tabata <i>et al.</i> , 1993)
Japan	1988-1992	Peanuts Peanut butter Almonds Cashews Macadamia nuts Pistachios Walnuts Nuts, other	1/34 3/4 0/19 0/17 0/2 0/24 0/3 0/3	0.1 0.7-2.0	(Taguchi <i>et al.</i> , 1995)

Country	Year	Food(s)	Number of samples (positive/total)	Range of positive results (µg/kg)*	Reference
Malaysia	NS	Peanuts, raw, shelled Peanuts, roasted, in shell Peanuts, roasted, shelled Walnuts Coated nut products Peanut butter Pound peanut Peanut cake Peanut slice Bakery product Confectionery	6/14 2/10 3/20 1/3 4/20 7/12 3/8 2/3 1/2 1/31 2/16	17.8-711 29.7-179 40.1-46.0 17.2 113-514 16.6-67.3 22.0-69.6 61.9-84.0 95.6 23.9 17.0-21.4	(Leong <i>et al.</i> , 2010)
Morocco	2006	Peanuts Pistachios Walnuts	1/20 9/20 6/20	Mean (Maximum) 0.3 163 (1450) 730 (4320)	(Juan <i>et al.</i> , 2008)
South Korea	2004	Peanut, raw Peanut, roasted Pistachios Peanut butter Walnuts	1/4 4/8 1/4 2/2 0/12	0.2 2.0-28.2 3.4 7.0-7.7	(Chun <i>et al.</i> , 2007)
South Korea	2004-2005	Peanuts Peanut butter Walnuts Almonds Pistachios Pine nuts	8/27 5/19 0/19 3/15 3/15 0/12	0.1-18.0 1.3-6.4 0.1-0.6 3.4-38.7	(Ok <i>et al.</i> , 2007)
Spain	2007	Pistachios, pre-packed Pistachios, bulk	3/16 8/16	0.12-0.30 0.13-0.41	(Ariño <i>et al.</i> , 2009)
Turkey	NS	Hazelnuts Pistachios Peanuts	4/72 8/72 12/73	AFB1 1.2-1.8 0.5-36.8 0.2-33.4	(Basaran and Ozcan, 2009)
Turkey	NS	Hazelnuts Pistachios Peanuts	2/80 16/28 5/10	5.5-6.5 2.3-63.1 0.8-26.4	(Bircan <i>et al.</i> , 2008)
UK	2000-2001	Almonds Brazil nuts Cashews Chestnuts Hazelnuts Peanuts Peanut butter Other nut butters Pecans Pine nuts Pistachios Walnuts	0/4 4/12 0/6 0/1 0/2 8/19 20/29 1/6 0/2 0/3 9/23 0/3	0.3-0.9 0.3-70.9 0.3-11.2 4.2 0.3-47.5	(Food Standards Agency, 2002)

Country	Year	Food(s)	Number of samples (positive/total)	Range of positive results (µg/kg)*	Reference
USA	1986	Domestic		Mean (Maximum)	(Wood, 1989)
		Peanuts	6/64	68 (329)	
		Peanut butter	17/104	14 (27)	
		Almonds	1/26	6	
		Cashews	0/3		
		Hazelnuts	0/1		
		Macadamia nuts	0/1		
		Pecans	0/35		
		Pistachios	7/22	58 (252)	
		Walnuts	2/27	35 (41)	
		Imported			
		Almonds	1/5	10	
		Brazil nuts	6/12	20 (42)	
		Peanuts	2/10	139 (273)	
		Peanut candy	10/18	10 (20)	
		Pecans	3/17	135 (334)	
		Pistachios	10/21	41 (133)	
		Walnuts	2/4	4 (8)	
		Mixed nuts	1/3	7	
		Other nuts	0/24		

* Total aflatoxins unless otherwise stated

AFB1 = Aflatoxin B₁ Total = total aflatoxins (B₁ + B₂ + G₁ + G₂)