Chemical Hazards Datasheet E-book

Essential facts about the 12 most common Chemical Hazards in the food industry.
Table of Contents

Scombrotoxin ................................................................................................................................. 3
Mycotoxins ................................................................................................................................. 5
Acrylamide .................................................................................................................................. 7
PAH .............................................................................................................................................. 11
Antibiotics ................................................................................................................................... 14
BPA .............................................................................................................................................. 17
Dioxins and PCB's ..................................................................................................................... 20
Heavy Metals ............................................................................................................................. 23
Melamine ..................................................................................................................................... 25
Arsenic .......................................................................................................................................... 27
Allergens ..................................................................................................................................... 29
Ciguatera toxin ............................................................................................................................ 31
Scombrotoxin (Histamine) is a foodborne toxin most associated with the consumption of certain fish species, e.g., mackerel and tuna. Histamine is a biogenic amine and can be produced during and/or storage of fish and certain other foods, usually by the action of spoilage bacteria.

Certain bacteria produce the enzyme histidine decarboxylase during growth. This enzyme reacts with histidine, a naturally occurring amino acid that is present in larger quantities in some fish than in others. The result is the formation of scombrotoxin (histamine).

It can cause a mild, though sometimes distressing, form of food-borne intoxication (scombrotoxin poisoning).

Occurrence in Foods: Scombrotoxin is most often associated with scombroid fish, especially tuna, skipjack, bonito and mackerel. Also, other non-scombroid fish such as sardines, herring, pilchards, marlin and mahi-mahi. There have been reports it may also occur in salmon species.

The toxin is not limited to fresh and frozen fish. It may be present in canned and cured fish products at high enough concentrations to cause illness.

Infectious Dose: In most cases histamine levels in fish that have caused illness have been above 200ppm.

Onset period: Can develop between 10 minutes and 2 hours after ingestion of a food containing a toxic histamine level.

Effects on Health: Symptoms of scombrotoxin poisoning include nausea, vomiting, diarrhoea, hives, itching red rash (flushing). It may also cause an oral burning sensation or peppery taste in the mouth. Hypotension including light headedness, dizziness or fainting are also known symptoms.

The symptoms usually resolve themselves within 24 hours.

Control and Preventive Measures:

Chilling (On board vessels)
- One of the key measures to control histamine production in fish is rapid chilling as soon as possible after death especially if the fish had been exposed to warm water. (See recommended temperatures in below table)

Supplier Control
- Purchase from reputable suppliers who store the fish on ice or under refrigeration.
- Receive product at refrigerated temperatures <5°C (41°F).

Good Hygiene Practices
- Careful handling of fish to avoid damage to muscle tissue as puncture wounds in fish can introduce contamination bacteria into deep tissue where large concentrations of histidine are available.
- Good hygiene at processing and preparation stages along the supply chain such as cutting, or packing is important to prevent contamination of fresh fish, or recontamination of frozen and cooked fish.

Chemical Testing
- Testing by chemical methods such as HPLC or ELISA and other immunological techniques can provide some assurance of histamine levels. Variability in histamine levels in a single fish mean that very large numbers of samples must be taken.
Chemical Hazard :: Scombrotoxin (Histamine)

Recommended chilling control on board vessel

- It is recommended that fish exposed to air or water temperature of 28.3°C (82.94°F) or less should be placed in ice, chilled seawater or brine at 4.4°C (40°F) or below as soon as possible but not more than 9 hours after the time of death.

- If fish have been exposed to temperatures above 28.3°C (82.94°F) then they should be chilled to 4.4°C (40°F) or below as soon as possible but no more than 6 hours from the time of death.

- Fish that have been gutted and gilled before chilling should be chilled to 4.4°C (40°F) or below as soon as possible but no more than 12 hours from the time of death.

- Very large fish such as tuna that are eviscerated before chilling also should have the body cavity packed with ice.

Summary Table

<table>
<thead>
<tr>
<th>Occurrences in food</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scombroid fish e.g. Tuna, Skipjack, Bonito, Mackerel</td>
<td></td>
</tr>
<tr>
<td>Non-scombroid fish e.g. Sardines, Herring, Pilchards, Marlin, Mahi-mahi</td>
<td></td>
</tr>
</tbody>
</table>

| Infectious Dose | >200ppm (usually) |
| Onset Period | Between 10 minutes and 2 hours |
| Effects on health | Nausea, Vomiting, Diarrhoea |
| | Hives, Rash |
| | Oral burning sensation |
| | Hypotension |

| Control |
| Rapid Chilling |
| Supply Chain Control |
| Good Hygiene Practice |
| Chemical Testing |

Published Risk Assessments

- FSA :: Review of the risk management practices employed throughout the fish processing chain in relation to controlling histamine formation in at-risk fish species

- NCBI:: Histamine fish poisoning revisited

References

**What are Mycotoxins:** Mycotoxins are a chemically diverse range of secondary metabolites (i.e. have no role in formal metabolism) and are produced by various fungal species. Several hundred different mycotoxins have been identified, but the most commonly observed mycotoxins that present a concern to human health and livestock include aflatoxins, ochratoxin A, patulin, fumonisins and zearalenone.

They are toxic to humans and most are chemically stable and survive prolonged heat processing.

**Occurrence in Foods:**
They commonly enter the food chain through contaminated food and feed crops, mainly cereals.

Other occurrence in foods include nuts, spices, dried fruits, apples and coffee beans, often under warm and humid conditions.

**Outbreaks:** In Kenya in 2004 there was an outbreak which resulted from aflatoxin contamination of maize. 317 cases were reported with 125 deaths.

**Effects on Health:** The toxic effects of mycotoxins can be significant and varied depending on the toxin, dose, host and food matrix involved.

These effects include: Carcinogenicity (cancer causing) especially in the liver, Hepatotoxicity (liver damage), Mutagenicity (changes to DNA), Other toxic effects include kidney disease, immuno-suppression and disturbance to the nervous and hormone systems.

**Control and Preventive Measures:**

**Good Agricultural Practice:**
- Proper preparation of the land, crop rotation, use of fungus and/or pest resistant cultivars, control of insect damage to the growing crop, control of fungal infection, prevention of stress to the growing crop, e.g. drought, weeds, harvesting at the appropriate time, and correct handling and storage after harvesting.

**Monitoring Programs:**
- Inspection and sampling of commodities intended for introduction into the food supply chain. Maximum levels are defined and often legally controlled in specific legislation. Rejection and removal of failed batches is a common control measure

**Pest Control Program:**
- Pest damage may result in heating and moisture generation, leading to fungal growth and mycotoxin production in localised “hot spots”. Therefore, it is important to have adequate pest control programs in place.

**Inactivation of Toxins:**
- This can be achieved through roasting of peanuts, heat and moisture control, chemical control, e.g. acids, H2O2, NH3, hypochlorites.

**Testing**
- Monitoring using analytical methods have been developed based on HPLC, TLC and ELISA. It is important to ensure an adequate sampling plan is used.
### Aflatoxin
Aflatoxins are produced by certain moulds of the genus Aspergillus. They are highly toxic compounds and can cause both acute and chronic toxicity in humans and animals. Liver damage is a common effect and it can also affect kidneys, intestine, blood, reproductive system and the immune system.

They may be present in food commodities such as cereals, oilseeds, spices, and tree nuts.

Control of aflatoxin is best achieved by measures designed to prevent contamination of crops in the field and during storage, or detection and removal of contaminated material from the food supply chain.

### Ochratoxin
Ochratoxin A is produced by several species of Aspergillus and Penicillium and is a common food-contaminating mycotoxin. It is known to cause a number of health effects; the most notable effect is kidney damage and it may also have effects on fetal development and on the immune system.

It has been found in a wide range of raw and processed food commodities including cereals, coffee, dried fruit, wine, beer, cocoa, nuts, beans, peas, bread and rice.

Control is best achieved by measures designed to prevent contamination of foods using HACCP-type techniques. Detection and removal of contaminated material from the food supply chain is important.

### Fusarium fungi
Fusarium fungi are common to the soil and produce a range of different toxins, including trichothecenes such as deoxynivalenol (DON), nivalenol (NIV) and T-2 and HT-2 toxins, as well as zearalenone (ZEN) and fumonisins. Fumonisins are known to cause adverse health effects in humans and animals. E.g. they can cause skin irritations and suppression of the immune system.

They can be found in maize and maize products, rice, and mung beans.

Fumonisin production occurs almost entirely in the field so the most effective controls are applied at the pre-harvest stage, e.g., GAP measures.

### Patulin
Patulin is a toxic fungal metabolite produced by certain moulds of the Penicillium, Aspergillus and Byssochlamys. Exposure to patulin can cause adverse health effects such as gastrointestinal problems in animals however little or no data has showed adverse health effects in humans.

Patulin occurs most often in apples, or in products made from spoiled apples such as apple juice, pies, and conserves. It has also been found in pears and grapes, in vegetables, and in cereals, grains, and cheese.

Controls such as GAP are required during Pre-harvest, Post-Harvest and during Processing.

### SUMMARY TABLE

<table>
<thead>
<tr>
<th>Occurrences in food</th>
<th>Effects on health</th>
<th>Most concerning mycotoxins</th>
<th>Control</th>
<th>Published Risk Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>Immuno-suppression</td>
<td>Fusarium</td>
<td>Inactivation of toxin</td>
<td></td>
</tr>
</tbody>
</table>
References

**DATASHEET**  
Chemical Hazard Series

**What is Acrylamide?** Acrylamide is a chemical that naturally forms in starchy food products during high-temperature cooking, including frying, baking, roasting and also industrial processing, at 120°C (248°F) and above, and at low moisture.

The main chemical process that causes this is known as the Maillard Reaction; it is the same reaction that ‘browns’ food and affects its taste. Acrylamide forms from sugars and amino acids (mainly one called asparagine) that are naturally present in many foods.

Acrylamide was first detected in certain foods in April 2002.

**Occurrence in Foods:** Main sources of acrylamide in the diet includes potato products such as fried potatoes, chips and crisps.

Breakfast cereals, bread, biscuits and pastries. Roasted and ground coffee have all also been found to be sources.

**Effects on Health:** At high levels Acrylamide is a neurotoxin and exposure to these high levels may cause symptoms such as numbness in the hands and feet.

Studies have shown that acrylamide can be carcinogenic in animals. It may also adversely affect the nervous system, pre-and post-natal development and male reproduction.

**Control Measures:**

**Processing**  
Frying, Baking and Roasting at lower temperatures and for shorter times reduce the amount of browning of the product and reduce the amount of acrylamide produced. Some crisp manufacturers have altered frying times and temperature to help with this reduction.

Providing appropriate cooking instructions on frozen French fry packages to guide final preparation by consumers and food service operators may help reduce acrylamide.

**Potato Products**  
Selecting potato varieties that are low in acrylamide precursors, keeping in mind seasonal variation, may help with reduction.

Assessing reducing sugar levels in incoming potatoes, identifying target levels for incoming products, or using treatments to reduce sugar levels may help reduce acrylamide.

**Cereal Based Products**  
Replacing ammonium bicarbonate in cookies and crackers with alternative leavening agents while avoiding overall increases in sodium levels may help to reduce acrylamide levels.

Replacing reducing sugars with nonreducing sugars, using reducing sugars with lower fructose content and only adding sugar coatings to breakfast cereals after toasting steps may also help with reduction.

**Coffee Products**  
Manufacturers should identify the critical roast conditions to ensure minimal acrylamide formation within the target flavour profile.

Control of roast conditions should also be incorporated as part of Good Manufacturing Practice.
### Approximate observed ranges of acrylamide concentration by food group (Taken from FAO/WHO Acrylamide Infonet Analytical Database)

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Acrylamide/ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast Cereals</td>
<td>20-250</td>
</tr>
<tr>
<td>Bread</td>
<td>10-130</td>
</tr>
<tr>
<td>Roast and Ground Coffee</td>
<td>100-400</td>
</tr>
<tr>
<td>Crackers</td>
<td>50-600</td>
</tr>
<tr>
<td>Potato Crisps and Snacks</td>
<td>100-2500</td>
</tr>
<tr>
<td>Chocolate Products</td>
<td>10-100</td>
</tr>
</tbody>
</table>

### Benchmark Levels according to Commission Regulation (EU) 2017/2158

<table>
<thead>
<tr>
<th>Food</th>
<th>Benchmark Level [µg/kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>French Fries (Ready to Eat)</td>
<td>500</td>
</tr>
<tr>
<td>Potato Crisps from fresh potatoes and from potato dough, Potato based crackers and other potato products from potato dough</td>
<td>750</td>
</tr>
<tr>
<td>Soft Bread</td>
<td>50</td>
</tr>
<tr>
<td>• Wheat-based bread</td>
<td></td>
</tr>
<tr>
<td>• Soft bread other than wheat-based bread</td>
<td>100</td>
</tr>
<tr>
<td>Breakfast Cereals (excluding porridge)</td>
<td>300</td>
</tr>
<tr>
<td>• Bran products and whole grain cereals, gun puffed grain</td>
<td></td>
</tr>
<tr>
<td>• Wheat and rye-based products</td>
<td>300</td>
</tr>
<tr>
<td>• Maize, oat, spelt, barley and rice-based products</td>
<td>150</td>
</tr>
<tr>
<td>Biscuits and wafers</td>
<td>350</td>
</tr>
<tr>
<td>Crackers with the exception of potato-based crackers</td>
<td>400</td>
</tr>
<tr>
<td>Crispbread</td>
<td>350</td>
</tr>
<tr>
<td>Ginger Bread</td>
<td>800</td>
</tr>
<tr>
<td>Products similar to the other products in this category</td>
<td>300</td>
</tr>
<tr>
<td>Roast Coffee</td>
<td>400</td>
</tr>
<tr>
<td>Instant Soluble coffee</td>
<td>850</td>
</tr>
<tr>
<td>Coffee Substitutes</td>
<td></td>
</tr>
<tr>
<td>• Coffee substitutes exclusively from cereals</td>
<td>500</td>
</tr>
<tr>
<td>• Coffee substitutes from a mixture of cereals and chicory</td>
<td>(2)</td>
</tr>
<tr>
<td>• Coffee substitutes exclusively from chicory</td>
<td>4000</td>
</tr>
<tr>
<td>Baby foods, processed cereal based foods for infants and young children excluding biscuits and rusk</td>
<td>40</td>
</tr>
<tr>
<td>Biscuits and rusks for infants and young children</td>
<td>150</td>
</tr>
</tbody>
</table>

### USA :: FDA

FDA provides guidance on acrylamide which is intended to suggest a range of possible approaches to reducing acrylamide levels and not to identify specific recommended approaches. This guidance also does not identify any specific maximum recommended level or action level for acrylamide.
SUMMARY TABLE

Sources
- Cereal products – Bread, biscuits, pastries
- Potato products – Chips, crisps, fried potato products
- Roasted and Ground Coffee

Effects to Health
- Neurotoxin effects
- Possible carcinogenic effects

Control Measures
- Product Formulation
- Process at lower temperature for shorter times
- Provide correct cooking instructions for consumers

Published Risk Assessments
- Oxford Academic :: Risk Assessment of Acrylamide in Foods [https://academic.oup.com/toxsci/article/75/1/7/1696221](https://academic.oup.com/toxsci/article/75/1/7/1696221)

References
What are Polycyclic Aromatic Hydrocarbons?
Polycyclic Aromatic Hydrocarbons (PAHs) are a large group of stable, lipophilic organic chemical contaminants containing two or more fused aromatic rings.

They can be produced during the partial combustion or pyrolysis of organic material and are common by-products of a number of industrial processes, including the processing and preparation of food.

PAHs are potentially carcinogenic and their presence in food, even at low levels, is therefore undesirable.

Sources and Occurrence in Foods:
The main sources for PAHs in foods are air, soil or water-borne environmental contamination and food which has been processed at high temperatures. Sources in the diet include smoked meat and fish, smoke flavourings and vegetable oils including olive pomace oil.

During processing of meat, pyrolysis occurs when fat drips onto a heat source and PAHs may be produced and deposited onto the food itself. Meat that is also heated to temperatures above 200°C (392°F) may also undergo pyrolysis which may produce PAHs on the surface.

PAHs are usually present in oils as a consequence of direct seed drying methods where the product comes into contact with combustion gases.

PAHs in dried products is most likely to occur from exposure to partially burnt combustion gases in direct flame dryers.

Other potential sources include bivalve shellfish which accumulate PAHs from seawater and sediment. Vegetables are also vulnerable to environmental PAH contamination, particularly when grown in areas where industrial pollution levels are high.

Effects on Health: There is not a lot of data on health effects due to PAH exposure.

It is said to be unlikely that any acute toxicity would occur through consumption of contaminated food and it is the effect of low doses over a long time that would be of most concern from a food safety aspect.

A number of PAHs including benzo[a]pyrene BaP has been shown to be both carcinogenic and genotoxic in experimental animals and are therefore potential human carcinogens.

Control Measures:
The control of PAHs in foods focuses on limiting their production during processing.

Replace traditional direct smoking processes with indirect smoking or use smoke flavouring.

Reduce cooking temperatures and do not brown food excessively.

Avoid direct contact of oil seeds and cereals with combustion gases during drying.

Avoid fat coming into contact with heat e.g. fat should not drip down onto an open flame, creating smoke that may coat the product with PAHs.

Safe advice for consumers on safer barbecuing and grilling of meat and fish in the domestic environment may also help with reduction of PAHs in their diet.
## Maximum levels in Regulation 835/2011 for Polycyclic Aromatic Hydrocarbons (PAHs) in certain foodstuffs

<table>
<thead>
<tr>
<th>Foodstuff</th>
<th>Benzo(a)pyrene</th>
<th>Sum of benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene and chrysene</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1.1 - Oils and fats (excluding cocoa butter and coconut oil) intended for direct human consumption or use as an ingredient in foods</td>
<td>2,0</td>
<td>10,0</td>
</tr>
<tr>
<td>6.1.2 - Cocoa beans and derived products</td>
<td>5,0 µg/kg fat</td>
<td>30,0 µg/kg fat</td>
</tr>
<tr>
<td>6.1.3 - Coconut oil intended for direct human consumption or use as an ingredient in food</td>
<td>2,0</td>
<td>20,0</td>
</tr>
<tr>
<td>6.1.4 - Smoked meat and smoked meat products</td>
<td>2,0</td>
<td>12,0</td>
</tr>
<tr>
<td>6.1.5 - Muscle meat of smoked fish and smoked fishery products, excluding fishery products listed in points 6.1.6 and 6.1.7. The maximum level for smoked crustaceans applies to muscle meat from appendages and abdomen. In case of smoked crabs and crab-like crustaceans (Brachyura and Anomura) it applies to muscle meat from appendages</td>
<td>2,0</td>
<td>12,0</td>
</tr>
<tr>
<td>6.1.6 - Smoked sprats and canned smoked sprats (Sprattus sprattus); Smoked Baltic herring ≤ 14 cm length and canned smoked Baltic herring ≤ 14 cm length (Clupea harengus membras); Katsuobushi (dried bonito, Katsuwonous pelamis); bivalve molluscs (fresh, chilled or frozen); heat treated meat and heat treated meat products sold to the final consumer</td>
<td>5,0</td>
<td>30,0</td>
</tr>
<tr>
<td>6.1.7 - Bivalve molluscs (smoked)</td>
<td>6,0</td>
<td>35,0</td>
</tr>
<tr>
<td>6.1.8 - Processed cereal-based foods and baby foods for infants and young children</td>
<td>1,0</td>
<td>1,0</td>
</tr>
<tr>
<td>6.1.9 - Infant formulae and follow-on formulae, including infant milk and follow-on milk</td>
<td>1,0</td>
<td>1,0</td>
</tr>
<tr>
<td>6.1.10 - Dietary foods for special medical purposes intended specifically for infants</td>
<td>1,0</td>
<td>1,0</td>
</tr>
</tbody>
</table>

### USA/FDA Regulations

The U.S. Food and Drug Administration has not established standards governing the PAH content of foodstuffs.

### SUMMARY TABLE

**Occurrences in food**
- Smoked Fish
- Smoked Meat
- Oils and Fats

**Effects on health**
- Potential carcinogenic and genotoxic effects

**Control**
- Control of smoking of foods during processing
- Reduce cooking temperatures and do not brown food excessively
- Avoid direct contact of oil seeds and cereals with combustion gases during drying

**Published Risk Assessments**
References


**What are antibiotics?** Antibiotics are a broad range of chemical compounds that destroy or limit the growth of microorganisms. They are used widely as veterinary drugs in food animals by the farming industry. Antibiotics are administered to food animals as therapeutic agents to treat clinical infections or may be administered at low, sub-therapeutic doses as “growth promoters”. Some antibiotics and their metabolites may be toxic to humans in sensitive individuals (e.g. penicillin).

The use of antibiotic growth promoters in intensive livestock farming has been shown to be an effective means of increasing the growth rate of food animals and improving the quality of meat by raising protein content.

**Occurrence in Foods:**
Antibiotic residues are most likely to be found in foods of animal origin such as meat, poultry, fish, eggs and honey.

There is little evidence to support suggestions that some antibiotics can be produced naturally by microbial action in the soil.

**Effects on Health:**
One of the more major concerns is Antimicrobial resistant bacteria. Some bacteria are naturally resistant whilst other bacteria become resistant following selection after prolonged antibiotic use. This can lead to Antimicrobial resistance (AMR).

Reservoirs of resistant bacteria may develop in the gastrointestinal (GI) tracts of food-producing animals following mis-use of antibiotics. These resistant bacteria can be transmitted from food-producing animals such as cattle, pigs, poultry and the environment to humans via the food chain.

Those individuals who are at higher risk include those going through cancer chemotherapy, have had complex surgery, rheumatoid arthritis, those on dialysis and transplant recipients. This is because they are more vulnerable to infections and depend on antibiotics to help fight these infections.

**Control Measures:**

- **Regulated Supply Chain**
  - It is important that companies maintain a regulated supply chain to ensure quality of the product. This may include sampling and testing of raw materials for any antibiotic residues (Maximum Residue Limit :: MRL).

- **Health improvement and maintenance of animals**
  - Improve health status of animals and maintain this to try and prevent use of antibiotics.

- **Surveillance**
  - Intensify AMR surveillance in the animal population, across the food chain and in the human population.

- **Withdrawal Period**
  - A withdrawal period is the length of time that must lapse between administration and the point the animal can be slaughtered to enter the food chain.
## Pharmacologically active substances and their classification regarding maximum residue limits (MRL) (EC 37/2010)

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Animal Species</th>
<th>MRL</th>
<th>Target Tissues</th>
<th>Other Provisions (according to Article 14 (7) of Regulation (EC) no 470/2009)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>All food producing species</td>
<td>50 μg/kg 50 μg/kg 50 μg/kg 10 μg/kg</td>
<td>Muscle Fat Liver Kidney Milk</td>
<td>For fin fish the muscle MRL relates to ‘muscle and skin in natural proportions’. MRLs for fat, liver and kidney do not apply to fin fish. For porcine and poultry species the fat MRL relates to ‘skin and fat in natural proportions’. Not for use in animals from which eggs are produced for human consumption</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>All food producing species</td>
<td>50 μg/kg 50 μg/kg 50 μg/kg 10 μg/kg</td>
<td>Muscle Fat Liver Kidney Milk</td>
<td>For fin fish the muscle MRL relates to ‘muscle and skin in natural proportions’. MRLs for fat, liver and kidney do not apply to fin fish. For porcine and poultry species the fat MRL relates to ‘skin and fat in natural proportions’. Not for use in animals from which eggs are produced for human consumption</td>
</tr>
<tr>
<td>Benzylpenicillin</td>
<td>All food producing species</td>
<td>50 μg/kg 50 μg/kg 50 μg/kg 100 μg/kg 200 μg/kg 600 μg/kg</td>
<td>Muscle Fat Liver Kidney Milk</td>
<td>For fin fish the muscle MRL relates to ‘muscle and skin in natural proportions’. MRLs for fat, liver and kidney do not apply to fin fish. For porcine and poultry species the fat MRL relates to ‘skin and fat in natural proportions’. Not for use in animals from which eggs are produced for human consumption</td>
</tr>
<tr>
<td>Cefapirin</td>
<td>Bovine</td>
<td>50 μg/kg 50 μg/kg 100 μg/kg 60 μg/kg</td>
<td>Muscle Fat Kidney Milk</td>
<td>NO ENTRY</td>
</tr>
<tr>
<td>Chlortetracycline</td>
<td>All food producing species</td>
<td>100 μg/kg 300 μg/kg 600 μg/kg 100 μg/kg 200 μg/kg 600 μg/kg</td>
<td>Muscle Liver Kidney Milk Eggs</td>
<td>For fin fish the muscle MRL relates to ‘muscle and skin in natural proportions’. MRLs for liver and kidney do not apply to fin fish.</td>
</tr>
<tr>
<td>Oxytetracycline</td>
<td>All food producing species</td>
<td>100 μg/kg 300 μg/kg 600 μg/kg 100 μg/kg 200 μg/kg 600 μg/kg</td>
<td>Muscle Liver Kidney Milk Eggs</td>
<td>For fin fish the muscle MRL relates to ‘muscle and skin in natural proportions’. MRLs for liver and kidney do not apply to fin fish.</td>
</tr>
<tr>
<td>Antibiotic</td>
<td>Animal/Food Type</td>
<td>Tolerance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------------------------------------</td>
<td>----------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>Milk and Un cooked edible tissues of cattle.</td>
<td>0.01 ppm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>Uncooked edible tissues of swine and cattle and in milk.</td>
<td>0.01 p/m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlortetracycline</td>
<td>Tissues of beef cattle, nonlactating dairy cows, calves, swine, sheep, chickens, turkeys and ducks.</td>
<td>2ppm in muscle 6ppm in liver 12ppm fat and kidney</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxytetracycline</td>
<td>Beef cattle, dairy cattle, calves, swine, sheep, chickens, turkeys, finnish and lobster.</td>
<td>2ppm in muscle 6ppm in liver 12ppm in fat and kidney 0.3ppm in milk</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Withdrawal periods of antibiotics (Withdrawal period set by the veterinary surgeon should not be less than the below according to Veterinary Medicines Directorate UK)

<table>
<thead>
<tr>
<th>Type</th>
<th>Withdrawal period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat from poultry and mammals including fat and offal</td>
<td>28 Days</td>
</tr>
<tr>
<td>Milk</td>
<td>7 days</td>
</tr>
<tr>
<td>Eggs</td>
<td>7 days</td>
</tr>
<tr>
<td>Fish Meat</td>
<td>500 degree days</td>
</tr>
</tbody>
</table>

FDA do not maintain a database of withdrawal times

### SUMMARY TABLE

<table>
<thead>
<tr>
<th>Occurrences in food</th>
<th>Effects on health</th>
<th>Published Risk Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administered to animals for therapeutic reasons or growth promoters therefore common food sources include meat, poultry, milk and eggs</td>
<td>AMR :: Antimicrobial Resistance</td>
<td>US National Library of Medicine National Institutes of Health: Antibiotics in agriculture and the risk to human health. How worried should we be? <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4380918/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4380918/</a></td>
</tr>
<tr>
<td>MRL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Withdrawal periods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintain health of animals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surveillance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### References

32. BMCAntibioticsWithoutAntibiotics [Accessed 03 July 2018]
33. The Pigsite.com [Accessed 03 July 2018]
34. CDC [Accessed 03 July 2018]
35. European Commission [Accessed 03 July 2018]
37. EC-EUropa [Accessed 03 July 2018]
What is Bisphenol A: Bisphenol A (BPA) is a chemical that is mainly used in combination with other chemicals to manufacture plastics and resins. It is a major component of rigid polycarbonate plastics and epoxy-resin coatings. Polycarbonate is commonly used in the food industry for water and soft drink bottles and can also be used to manufacture infant feeding bottles. Epoxy resins are used as protective linings for metal food cans, wine storage vats and other liquid containers.

BPA has been used in packaging for food and beverages for many years and some scientific studies have shown that under certain conditions BPA can migrate into food products.

Why is BPA used for food contact materials: BPA based polycarbonate and epoxy resins are durable and lightweight. They offer high impact resistance, can sustain numerous sanitation methods and are heat resistant.

Occurrence in Foods: BPA can be present in foods as a result of migration from epoxy-resin coatings used to line metallic food cans and on metal closures for glass jars and bottles.

The other main source is polycarbonate plastic bottles and containers used to package a wide range of products such as water, soft drinks and milk.

It has been reported in various canned food and drink products including canned fruit, vegetables, coffee, tea, infant formula concentrate and sake.

Effects on Health:

Based on animal studies, high doses of BPA (hundreds of times above the TDI) are likely to cause adverse effects in the kidney and liver. BPA is also likely to have effects on the mammary glands of rodents. How these effects are caused (the ‘mechanism of action’) is not clear.

Possible effects of BPA on the reproductive, nervous, immune, metabolic and cardiovascular systems, as well as in the development of cancer are not considered likely at present but they could not be excluded. They add to the overall uncertainty about BPA-related hazards.

How to reduce BPA in processing:

Manufacturers can source cans and containers that contain lower levels of BPA or are BPA free.

Manufacturers of food containers should provide instructions to the consumer for the intended use of the product including temperature specifications and restrictions on use.

It is important to note that for canned food products, alternatives should not permit bacterial or metallic contamination of the contents and should not give rise to other safety concerns. The use of alternatives may also reduce the final shelf-life of a canned product, if the resistance of the alternative is lower than that of an epoxy-resin-based lining.
### Chemical Hazard :: Bisphenol A

#### Regulation (EU) 2018/213 (Regulate BPA in certain food contact materials)

<table>
<thead>
<tr>
<th>Item</th>
<th>Specific Migration Level (SML) mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food contact plastics</td>
<td>0.05</td>
</tr>
<tr>
<td>Food contact varnished or coated products</td>
<td>0.05</td>
</tr>
<tr>
<td>Food contact varnished or coated materials and articles for young children for food categories under Regulation (EU) 609/2013</td>
<td>Prohibited</td>
</tr>
<tr>
<td>Polycarbonate drinking cups or bottles for infants and young children</td>
<td>Prohibited</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>The use of BPA-based polycarbonate resins in baby bottles and sippy cups</td>
<td>Prohibited</td>
</tr>
<tr>
<td>The use of BPA-based epoxy resins as coatings in packaging for infant formula</td>
<td>Prohibited</td>
</tr>
</tbody>
</table>

#### SUMMARY TABLE

| Occurrences in food                          | · Canned fruit, vegetables, coffee, tea and infant formula |
| Effects on health                           | · Stated that BPA poses no serious health risk due to current exposure levels |
|                                           | · In animal studies if exposed to high levels it has been said it could affect kidney and liver function and other systems |
| Control                                    | · Source packaging materials with lower levels of BPA or BPA free materials |
|                                           | · Manufacturers of food containers should provide instructions for the intended use of the product including temperature specifications and restrictions on use |
| Published Risk Assessments                  | · FDA :: 2014 Updated safety assessment of Bisphenol A (BPA) for use in food contact applications [https://www.fda.gov/downloads/NewsEvents/PublicHealthFocus/UCM424266.pdf](https://www.fda.gov/downloads/NewsEvents/PublicHealthFocus/UCM424266.pdf) |
|                                           | · EFSA’s Panel on Food Contact Materials, Enzymes and Processing Aids (CEP) will re-assess the potential hazards of BPA in food and review the temporary safe level set in EFSA’s previous full risk assessment from 2015. This new assessment should be ready by 2020. |
References


47. Bisphenol A (BPA) and Food Contact Materials. 2018. Bisphenol A (BPA) and Food Contact Materials. [ONLINE] Available at: https://www.fda.gov/newsevents/publichealthfocus/ucm064417.htm [Accessed 08 August 2018]


What are Dioxins and PCB’s:
Dioxins are colourless, odourless organic compounds containing carbon, hydrogen, oxygen and chlorine. Dioxins are ubiquitous environmental contaminants that have been found in soil, surface water, sediment, plants and animal tissue worldwide. They are highly persistent in the environment.

PCB’s or Polychlorinated biphenyls, are chlorinated aromatic hydrocarbons and are produced by the direct chlorination of biphenyls. Like dioxins PCB’s are widespread environmental contaminants and are very persistent in soil and sediments.

Dioxins and PCB’s have a broad range of toxic and biochemical effects and some are classified as human carcinogens.

Occurrence in Foods:
Dioxins and PCB’s enter the food chain through a variety of routes. Grazing animals and growing vegetables may be exposed directly or indirectly to these contaminants in the soil.

Leafy vegetables, pasture and roughage can also become contaminated through airborne transport of dioxins and PCB’s.

A significant percentage of paper food packaging materials also contain PCB’s which have the potential to migrate to the packaged food.

Extensive stores of PCB-based waste industrial oils, many with high levels of PCDFs, exist throughout the world. Long-term storage and improper disposal of this material may result in dioxin release into the environment and the contamination of human and animal food supplies.

Effects on Health:
Humans accumulate dioxins in fatty tissue mostly by eating dioxin-contaminated foods. The toxicity of dioxins is related to the amount accumulated in the body during the lifetime.

Short-term exposure of humans to high levels may result in skin lesions, such as chloracne and patchy darkening of the skin and altered liver function.

Long-term exposure is linked to impairment of the immune system and the developing nervous system, the endocrine and reproductive functions.

The developing foetus is the most sensitive to dioxin exposure. New-born with rapidly developing organ systems may also be more vulnerable to certain effects.

Control and Preventive Measures:
Most of human exposure to dioxins is through the food supply, mainly meat, dairy products, fish and shellfish. Protecting the supply chain is one of the most important factors.

Food and feed contamination monitoring systems must be in place to ensure that tolerance levels are not exceeded.

Avoid those areas with increased dioxin contamination due to local emission, accidents or illegal disposal of contaminated materials that are used for grazing or for the production of feed crops. If possible, contaminated soil should be treated and detoxified or removed and stored under environmentally sound conditions.

Monitor compliance with nationally-established guideline levels or maximum levels, if available, and minimize or decontaminate non-complying feed.
### Limits for dioxins and PCBs set out in EC regulation No. 1881/2006

<table>
<thead>
<tr>
<th>Foodstuff</th>
<th>Maximum levels (sum of dioxins)</th>
<th>Maximum levels (sum of dioxins and dioxin like PCBs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat from Bovine animals and Sheep (excluding edible offal)</td>
<td>3.0 pg per g of fat</td>
<td>4.5 pg per g of fat</td>
</tr>
<tr>
<td>Meat from Poultry (excluding edible offal)</td>
<td>2.0 pg per g of fat</td>
<td>4.0 pg per g of fat</td>
</tr>
<tr>
<td>Meat from Pigs (excluding edible offal)</td>
<td>1.0 pg per g of fat</td>
<td>1.5 pg per g of fat</td>
</tr>
<tr>
<td>Muscle meat of fish and fishery products (excluding eel)</td>
<td>4.0 pg per g wet weight</td>
<td>8.0 pg per g wet weight</td>
</tr>
<tr>
<td>Hen Eggs and Egg products</td>
<td>3.0 pg per g of fat</td>
<td>6.0 pg per g of fat</td>
</tr>
<tr>
<td>Vegetable oils and fats</td>
<td>0.75 pg per g of fat</td>
<td>1.5 pg per g of fat</td>
</tr>
</tbody>
</table>

### USA :: FDA

There are no tolerances or other administrative levels for dioxins in food or feed in the USA and the FDA considers all detectable levels to be of concern. Action levels have been set for PCBs in red meat and fish. Temporary tolerances have been set for animal feeds and paper packaging as per below.

- 0.2ppm in finished animal feed for food producing animals (except the following finished animal feeds: feed concentrates, feed supplements and feed premixes.
- 2 ppm in animal feed components of animal origin, including fishmeal and other by-products of marine origin and in finished animal feed concentrates, supplements and premixes intended for food producing animals.
- 10ppm in paper food packaging material intended for or used with finished animal feed and any components intended for animal feed. The tolerance shall not apply to paper food-packaging material separated from the food therein by a functional barrier which is impermeable to migration of PCB's.

### Contamination Incidents

<table>
<thead>
<tr>
<th>YEAR</th>
<th>LOCATION</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>USA</td>
<td>FDA found contamination of animal feeds with dioxin which resulted in elevated levels of dioxin in chicken, eggs and catfish.</td>
</tr>
<tr>
<td>1999</td>
<td>Belgium</td>
<td>High levels of dioxins were found in poultry and eggs. The cause was traced back to animal feed contaminated with illegally disposed PCP-based waste industrial oil.</td>
</tr>
<tr>
<td>2008</td>
<td>Ireland</td>
<td>Recall of many tons of pork meat and pork products when up to 200 times the safe limit of dioxins were detected in samples of pork. Contamination was traced back to contaminated feed.</td>
</tr>
</tbody>
</table>

### SUMMARY TABLE

**Occurrences in food**
- Grazing animals and growing vegetables
- Leafy vegetables, pasture and roughage
- Fish

**Effects on health**
- Short-term:: Skin lesions
- Long-term:: Impairment of immune system
- Long-term:: Impairment of the developing nervous system

**Control**
- Protect and monitor supply chain
- Monitor compliance with applicable legislation
- Avoid growing in areas where there is increased dioxin contamination

**Published Risk Assessments**


**DATASHEET**
Chemical Hazard Series

**What are Heavy Metals?** Heavy metals refer to any relatively high-density metallic element that is toxic or poisonous even at low concentrations. Heavy metals are natural components of the Earth’s crust and cannot be destroyed.

Metals such as lead, cadmium, mercury and others are found in certain foods. Eliminating them entirely from our food supply is not always possible because these metals are found in the air, water and soil and then taken up by plants as they grow.

The toxicity of these metals is in part due to the fact that they accumulate in biological tissues, a process known as bioaccumulation. This process of bioaccumulation of metals occurs in all living organisms as a result of exposure to metals in food and the environment, including food animals such as fish and cattle as well as humans.

**Effects on Health:**

*Lead:* It can be very damaging to health particularly infants, children and the developing foetus. Adverse effects include disruption of haemoglobin synthesis, kidney damage, increased blood pressure, miscarriage, nervous system disruption, reduced fertility. Lead can cross the placenta any may damage the nervous system and brain of the developing foetus.

*Mercury:* Can cause toxin disruption of the nervous system, brain damage, damage to DNA and chromosomes, allergenic reactions and adverse reproductive effects.

*Tin:* Long term exposure to tin can lead to nervous system disorders. Can cause gastrointestinal irritation and upset.

*Cadmium:* Long term exposure may lead to kidney damage as cadmium tends to accumulate in the kidneys. Other adverse health effects include diarrhoea, stomach pains, sickness, bone defects, immune system damage, possible infertility, possible DNA damage and carcinogenic effects.

**Control Measures:**

Regulations for Maximum Levels (MLs) have been established for some heavy metals and it is important that food manufacturers comply with these levels as laid down in Commission Regulation (EC) No 1881/2006.

Control of heavy metal levels in food relies largely on avoiding those commodities that are likely to have been exposed to large concentrations of metal contaminants in the primary production environment.

Manufacturers must ensure that all equipment is constructed from food grade materials that meet the required standard.

It is important to source only raw materials from approved suppliers and that all processing water is sourced from potable suppliers that are not contaminated with heavy metals.
# Chemical Hazard :: Heavy Metals

## Occurrences in food
- **Lead**: Water, Meat, Fish
- **Mercury**: Fish, Shellfish, Fruit and Vegetables
- **Cadmium**: Cereals, Fruit and Vegetables
- **Tin (Inorganic)**: Canned Foods

## Vulnerable Groups
- Infants and children
- Elderly
- People with chronic health conditions

## Effects on health
- Gastrointestinal problems
- Nervous system disruption
- Kidney damage
- Effect development of fetus

## Control
- Approved Suppliers
- Potable Water Source
- Only use food grade equipment

## Published Risk Assessments
- NCBI Heavy metals health risk assessment for population via consumption of food crops and fruits in Owerri, South Eastern, Nigeria [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3567425/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3567425/)

### Heavy Metal | Foodstuff | Maximum Acceptable Level (mg/kg) Regulation (EC) No 1881/2006
--- | --- | ---
Lead | Raw Milk and Heat-Treated Milk, Infant formula and follow on formula | 0.02
 | Meat (excluding offal) of bovine animals, sheep, pigs & poultry | 0.10
 | Crustaceans | 0.50
 | Fruit and Vegetables (Excluding berries) | 0.10
Mercury | Fish Products and muscle meat of fish (Excluding species such as brown meat of crab and head/thorax meat of lobsters and similar large crustaceans) | 0.50
 | Muscle meat of fish (Examples) anglerfish, Atlantic catfish, bonito, grenadier, halibut, marlin, megrim, mullet, pike, seabream, swordfish tuna | 1.0
Cadmium | Cereals | 0.10
 | Fruit and Vegetables | 0.05
 | Crustaceans (Excluding brown meat of crab and excluding head and thorax of lobster and similar large crustaceans) | 0.50
Tin (Inorganic) | Canned food other than beverages | 200
 | Canned beverages including fruit and vegetable juices | 100
 | Canned baby foods, infant formula and foods for special medical purposes | 50

### SUMMARY TABLE

**Occurrences in food**
- Lead :: Water, Meat, Fish
- Mercury :: Fish, Shellfish, Fruit and Vegetables
- Cadmium :: Cereals, Fruit and Vegetables
- Tin (Inorganic) :: Canned Foods

**Vulnerable Groups**
- Infants and children
- Elderly
- People with chronic health conditions

**Effects on health**
- Gastrointestinal problems
- Nervous system disruption
- Kidney damage
- Effect development of fetus

**Control**
- Approved Suppliers
- Potable Water Source
- Only use food grade equipment

**Published Risk Assessments**
- EFSA provides risk assessment on mercury in fish: precautionary advice given to vulnerable group
- NCBI Heavy metals health risk assessment for population via consumption of food crops and fruits in Owerri, South Eastern, Nigeria

### References
What is Melamine? Melamine is a synthetic triazine compound and an organic base with the chemical name 2,4,6-triamino-1,3,5-triazine and is high in nitrogen (C3N6H6).

Melamine is widely used in plastics, adhesives, countertops, dishware and whiteboards.

Sources and Occurrence in Foods: Melamine contamination in food first became a food safety issue when the chemical was detected in pet foods. An investigation showed that melamine was found in wheat gluten and protein concentrate exported from China and was used as a thickening and binding agent within the pet food.

It has also been found in animal feed samples, orange juice and coffee. In 2008 it was also found in dairy products from China, an example being powdered milk to make infant formula.

Media reports suggest that melamine was added to certain food ingredients and to milk because of its very high nitrogen content. This would give a falsely high result in tests designed to determine protein content and cause the material to be assigned a higher quality rating and commercial value. It has been estimated that the addition of 1g of melamine to 1 litre of milk would raise the apparent protein content by approximately 0.4%.

It may also come from other sources especially plastic packaging or processing equipment but usually only at levels not harmful to health.

Effects on Health: While there are no direct human studies on the effect of melamine, data from animal studies can be used to predict adverse health effects. Melamine alone causes bladder stones in animal tests. When combined with cyanuric acid, which may also be present in melamine powder, melamine can form crystals that can give rise to kidney stones.

These small crystals can also block the small tubes in the kidney potentially stopping the production of urine, causing kidney failure and, in some cases, death. Melamine has also been shown to have carcinogenic effects in animals in certain circumstances, but there is insufficient evidence to make a judgement on carcinogenic risk in humans.

Symptoms and signs of melamine poisoning include irritability, blood in urine, little or no urine, signs of kidney infection and high blood pressure.

Control Measures:

Sourcing

Food manufacturers should exercise caution when souring ingredients. Traceability to the point of origin is essential. Materials such as milk powder, dried egg powder and high-protein ingredients should be purchased only from known low-risk sources.

Testing

The only practical control for Melamine in foods at present, other than careful sourcing, is testing analysis of all ingredients that carry a risk of contamination.
EXAMPLE OUTBREAKS

<table>
<thead>
<tr>
<th>YEAR</th>
<th>LOCATION</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>China</td>
<td>Melamine found in wheat gluten and rice protein concentrate used to produce pet food. This caused the death of a large number of dogs and cats due to kidney failure.</td>
</tr>
<tr>
<td>2008</td>
<td>China</td>
<td>Contaminated infant formula is reported to have affected at least 294,000 children. Some 51,900 of these required hospital treatment and at least six deaths have been associated with the contamination.</td>
</tr>
</tbody>
</table>

Legislation

In the EU Melamine can be used as a component in plastics and has been assigned a specific migration limit of 30 mg per kg of food for materials in direct contact with foodstuffs. It is not permitted as an additive or ingredient in food. However, following the incident in China both the EC and FDA have applied maximum acceptable limits of 2.5 mg kg$^{-1}$ for melamine in imported foods, particularly foods containing powdered milk from China, and 1 mg kg$^{-1}$ in infant formula. The legislation position could change as more information becomes available.

SUMMARY TABLE

<table>
<thead>
<tr>
<th>Occurrences in food</th>
<th>Effects on health</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powdered Milk (Including use in infant formula)</td>
<td>Although there are no results from studies on humans, studies on animals have demonstrated and can predict adverse health effects such as bladder stones and kidney failure.</td>
<td>Source ingredients carefully</td>
</tr>
<tr>
<td>Wheat Gluten</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein Concentrate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Control

- Source ingredients carefully
- Carry out testing on those materials that carry a risk of contamination

Published Risk Assessments


References

**What is Arsenic?** Arsenic is a naturally occurring element in the environment that can enter the food supply through soil, water or air. It has also been known to be used by farmers as a pesticide and a fertilizer. Arsenic is a widely found contaminant which occurs both naturally and as a result of human activity. Arsenic is a metalloid that occurs in different inorganic and organic – i.e. containing carbon – forms. These are found in the environment both from natural occurrence and from anthropogenic activity. The inorganic forms of arsenic are more toxic as compared to the organic arsenic.

**Sources and Occurrence in Foods:** Food, particularly grain-based processed products such as wheat bread, rice, milk, dairy products and drinking water are the main sources. Fish, shellfish, meat and poultry can also be dietary sources of arsenic, although exposure from these foods is generally much lower compared to exposure through contaminated groundwater. In seafood, arsenic is mainly found in its less toxic organic form.

**Effects on Health:**

**Acute effects:** The immediate symptoms of acute arsenic poisoning include vomiting, abdominal pain and diarrhoea. These are followed by numbness and tingling of the extremities, muscle cramping and death, in extreme cases.

**Long-term effects:** The main adverse effects reported to be associated with long term ingestion of inorganic arsenic in humans are: skin lesions, cancer, developmental toxicity, neurotoxicity, cardiovascular diseases, abnormal glucose metabolism and diabetes.

Inorganic arsenic exposure in utero and in the very young is associated with impaired intellectual development, such as decreased performance on certain developmental tests that measure learning. For this reason, the FDA prioritizes monitoring and regulating products that are more likely to be consumed by very young children.

**Control Measures:**

**Water Supply**

- Using treated and safe sources of water.

**Reducing contamination from soil**

- Washing product thoroughly.

**The use of pesticides**

- If using pesticides use those that do not contain arsenic.
### Legislation :: (EC) No 1881/2006 (Inorganic Arsenic)

<table>
<thead>
<tr>
<th>Foodstuff</th>
<th>mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-parboiled milled rice (polished or white rice)</td>
<td>0.20</td>
</tr>
<tr>
<td>Parboiled rice and husked rice</td>
<td>0.25</td>
</tr>
<tr>
<td>Rice waffles, rice wafers, rice crackers and rice cakes</td>
<td>0.30</td>
</tr>
<tr>
<td>Rice destined for the production of food for infants and young children</td>
<td>0.10</td>
</tr>
</tbody>
</table>

### Regulations :: FDA (Inorganic Arsenic)

<table>
<thead>
<tr>
<th>Foodstuff</th>
<th>ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottled Water</td>
<td>10</td>
</tr>
<tr>
<td>Infant Rice Cereal</td>
<td>100</td>
</tr>
<tr>
<td>Apple Juice</td>
<td>10</td>
</tr>
</tbody>
</table>

### SUMMARY TABLE

#### Occurrences in food
- Rice
- Cereals
- Drinking Water
- Dairy Products
- Meat, Fish and Poultry

#### Effects on health
- Acute :: Vomiting, abdominal pain & diarrhea, numbness & tingling of the extremities and muscle cramping
- Long-term :: Skin lesions, cancer, developmental toxicity, neurotoxicity, cardiovascular diseases, abnormal glucose metabolism and diabetes
- Impaired development in the very young

#### Control
- Use only treated water
- Don’t use pesticides containing arsenic
- Wash produce

#### Published Risk Assessments
- NCBI: Risk Assessment of Arsenic in Rice Cereal and Other Dietary Sources for Infants and Toddlers in the U.S. [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4847023/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4847023/)

### References
What is an allergen? An allergen is any normally harmless substance that causes an immediate allergic reaction in a susceptible person. Food allergens are almost always proteins although other food constituents, such as certain additives, are known to have allergenic (allergy-causing) properties.

What is an allergy/allergic reaction? A food allergy can be defined as an adverse, immune-mediated reaction to food. It involves the production of a specific kind of antibody which reacts to a particular food component and, in doing so, causes an allergic reaction.

What are the symptoms of an allergic reaction? From the Gastrointestinal system there may be nausea, vomiting, abdominal cramping and diarrhoea. Respiratory system effects include wheezing, asthma and rhinitis. Cutaneous include itching, hives, eczema and rash. Other symptoms include hypertension, increased heart rate, tongue swelling, anaphylactic shock, oral allergy syndrome and laryngeal oedema.

When do symptoms occur? Symptoms can typically appear from within a few minutes to 2 hours after a person has eaten the food.

Dose-Response? The amount of allergen required to elicit an allergic response varies between individuals and between allergens.

How to manage food allergens:

Labelling
- It is important to follow labelling laws:
  EU law requires every inclusion of allergens if it is mentioned more than once it needs to be named and highlighted each time. In the US however, it only has to be mentioned one time even though it may appear in the product multiple times.

Handwashing
- Posters/Signage encouraging staff to wash their hands after working with allergenic materials should be placed in areas where allergenic products are manufactured.

Clothing Requirements
- To ensure that cross-contamination does not occur staff working in the area manufacturing allergenic ingredients must wear the correct uniform.

Cleaning Procedures
- Thorough cleaning that is effective in reducing the risks of allergen cross-contamination should be used. It is also good to validate cleaning for removal of allergens.

Dedicated Equipment
- Choosing to dedicate a production line or equipment to products that are free from particular allergens may help minimize cross contamination risk.
### Foods that must be declared as allergens:

<table>
<thead>
<tr>
<th>EU (14 in total)</th>
<th>Food Allergen Labeling and Consumer Protection Act enforced by the FDA (8 in total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals containing gluten</td>
<td>Milk</td>
</tr>
<tr>
<td>Crustaceans</td>
<td>Eggs</td>
</tr>
<tr>
<td>Eggs</td>
<td>Fish</td>
</tr>
<tr>
<td>Fish</td>
<td>Crustacean Shellfish</td>
</tr>
<tr>
<td>Peanuts and products thereof</td>
<td>Tree Nuts</td>
</tr>
<tr>
<td>Soya beans</td>
<td>Peanuts</td>
</tr>
<tr>
<td>Milk</td>
<td>Wheat</td>
</tr>
</tbody>
</table>

Nuts, namely: almonds (Amygdalus communis L.), hazelnuts (Corylus avellana), walnuts (Juglans regia), cashews (Anacardium occidentale), pecan nuts (Carya illinoinsensis (Wangenh.) K. Koch), Brazil nuts (Bertholletia excelsa), pistachio nuts (Pistacia vera), macadamia or Queensland nuts (Macadamia ternifolia), and products thereof, except for nuts used for making alcoholic distillates including ethyl alcohol of agricultural origin.

- Celery
- Mustard
- Sesame Seeds
- Sulphur dioxide and sulphites
- Lupin
- Molluscs

### SUMMARY TABLE

<table>
<thead>
<tr>
<th>Onset period of reaction</th>
<th>• Can range from a couple of minutes to a couple of hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose Response</td>
<td>• Can vary between the allergen and the individual</td>
</tr>
<tr>
<td>Symptoms</td>
<td>• Can range from gastrointestinal issues such as vomiting, diarrhea, to respiratory such as wheezing or asthma, then cutaneous such as itching, hives or rash</td>
</tr>
<tr>
<td>Published Risk Assessments</td>
<td>• NCBI: Allergen and allergy risk assessment, allergen management, and gaps in the European Food Information Regulation (FIR) <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4792368/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4792368/</a></td>
</tr>
</tbody>
</table>

### References

72. Allergen Info. 2019. Allergen Info. [ONLINE] Available at: [https://Food-bvsi.org/meals/Pages/Allergen-info.aspx](https://Food-bvsi.org/meals/Pages/Allergen-info.aspx) [Accessed 31 May 2019]
76. Food Standards Agency - In the factory - Staff. 2019. Food Standards Agency - In the factory - Staff. [ONLINE] Available at: [https://librarytraining.food.gov.uk/english/in-the-factory/staff.aspx](https://librarytraining.food.gov.uk/english/in-the-factory/staff.aspx) [Accessed 31 May 2019]
Chemical Hazard :: Ciguatera Toxin

**DATASHEET**

*Chemical Hazard Series*

**Pathogen Name:** Ciguatera Toxin

**Characteristics:** Ciguatera toxin is a heat-stable lipid soluble compound, produced by dinoflagellates and concentrated in fish organs, it is odourless and tasteless.

Ciguatera toxin tends to accumulate in large predator fish (weight over 2 Kg or about 4.5 lbs), such as the barracuda and other carnivorous reef fish, because they eat other fish that consume toxin-producing alga, which live in coral reef waters. The toxin has highest concentrations in fish visceral and sex organs.

The areas of concern for Ciguatera toxin include the Caribbean Sea, Hawaii and coastal Central America.

**Pathogenicity:** Eating ciguatera-contaminated tropical or subtropical fish is the main way that humans are exposed to the toxin.

**Limits in food:** In the EU, legislation covering fishery products states that “fishery products containing biotoxins such as ciguatera toxins” cannot be placed on the market, but no methods of analysis are given. In the USA no action limits have so far been established. However, the FDA has proposed guidance levels of $<0.1 \mu g \ kg^{-1} C-CTX-1$ equivalents and $<0.01 \mu g \ kg^{-1} P-CTX-1$ equivalents.

**Sources (Including High Risk food groups):** This toxin is found in fish most commonly, barracuda, grouper, red snapper, eel, amberjack, sea bass and Spanish mackerel.

**Onset Period:** Symptoms generally begin 6 to 8 hours after eating the contaminated fish but can occur as early as 2 or as late as 24 hours after ingestion.

**Illness, Symptoms and Complications:** Symptoms include nausea, vomiting, diarrhoea, muscle pain, numbness, tingling, abdominal pain, dizziness and vertigo. Teeth may feel loose and itching may be intense.

Severe cases of ciguatera poisoning may result in shortness of breath, salivation, tearing, chills, rashes, itching, and paralysis. Bradycardia, coma and hypotension can occur.

Death due to heart or respiratory failure occurs in rare cases.

**Controls to reduce the risk:**

For food manufacturers it can be difficult to control or prevent ciguatera toxin within fish products as it is odourless, tasteless and toxic fish cannot be identified by appearance or behaviour. It is also heat stable so cooking, boiling or any other heat treatment will not destroy it.

However, one potential way to control is to try and reduce the use of those fish that are reported to have a greater likelihood of the toxin.

It has been recommended that primary seafood processors who purchase fish directly from fishermen obtain information about harvest locations to determine the potential for ciguatoxic fish based on the regions where ciguatera occurs.
### EXAMPLE OUTBREAKS

<table>
<thead>
<tr>
<th>YEAR</th>
<th>LOCATION</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>Hamburg</td>
<td>Crew of a container ship consumed fish caught in the Caribbean and all sailors bar one who had not eaten the fish suffered from Ciguatera poisoning.</td>
</tr>
<tr>
<td>2012</td>
<td>North Germany</td>
<td>20 people effected through consumption of fresh fish imported from South Indian Fishing grounds.</td>
</tr>
<tr>
<td>2014</td>
<td>USA</td>
<td>5 people from the same family became ill after eating black grouper fish purchased from a grocery store. Around the same time, 1 other person who ate black grouper fillet at a restaurant also became ill.</td>
</tr>
</tbody>
</table>

### SUMMARY TABLE

<table>
<thead>
<tr>
<th>Source</th>
<th>Illness, Symptoms, Complications</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish: Most Commonly found in Spanish Mackerel, Barracuda, Red Snapper</td>
<td>Vomiting, Diarrhoea, Muscle Pain, Numbness, Tingling, Severe cases: Paralysis, Bradycardia, Hypotension, Death due to heart or respiratory failure occurs in rare cases.</td>
<td>Select fish that are less likely to be contaminated by the toxin</td>
</tr>
</tbody>
</table>

### Published Risk Assessments


### References
