**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 sourcing 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 2.5mg 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**

**Occurrences in food**
- Powdered Milk (Including use in infant formula)
- Wheat Gluten
- Protein Concentrate

**Effects on health**
- 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.

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

**Published Risk Assessments**

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**References**