TOX TOPIC

*Documents like this created after 2014 are dubbed Express Statements.

Melamine Contamination of Infant Formulas: Lessons Learned

Reviewed by the SOT Occupational and Public Health Specialty Section leadership in April 2015

Background

As a result of a series of contaminations over the past four years, the public and the scientific community are beginning to consider Melamine a poison. In March 2007, the largest pet food recall in the U.S. history occurred as a result of melamine contamination in pet food. Thousands of pets were affected and hundreds of animals died. In September 2008, Chinese officials acknowledged that illegal use of melamine, a fraudulent protein substitute, had contaminated powdered infant formula that was sold throughout the country and beyond. It is reported that in the Peoples Republic of China alone at least 294,000 infants were affected, of whom 6 died. It has emerged that melamine and compounds of similar chemical structure cause kidney failure in children and in pets. These are industrial compounds that should not be present in food. Little is known about the mechanisms of toxicity of these compounds in people and in animals. There are still gaps in knowledge that need to be filled in order to help regulators to develop informed guidelines to protect the public and our pets, and to treat patients should similar contaminations occur in the future.

Research

Melamine is an industrial nitrogen-rich chemical that is used industrially in the manufacture of plastics, glues, adhesives, and as a fertilizer among other uses. It has been intentionally used to adulterate human and animal food, mainly to cheat on protein content in food in China. In March of 2007, melamine pet food contamination sickened thousands of pets and killed hundreds. The cause of death was renal failure. It was later discovered that the pet food also contained cyanuric acid, ammeline, and ammelide and that the toxicity was a result of melamine and cyanuric acid crystallizing together within the kidneys of pets with subsequent renal failure. Hundreds of news stories were published by the media about that episode. The first human melamine poisoning contamination occurred in China in 2008 and involved intentional contamination of infant formula products with this compound. That episode triggered a recall of human foods in the U.S. as well. In December of 2009 and in January of 2010, new reports of melamine contamination in human foods in China emerged in the media, although no human illness was reported this time.

Gaps in Knowledge

There is agreement that in the pet food contamination of 2007 acute renal failure was a result of interaction between melamine and cyanuric acid, causing deposition of melamine-cyanurate crystals in kidney tubules. Definitive mechanisms are not yet clear, but tubular blockage is a contributing factor. In the case of Chinese infant formula outbreak, the urine stones/crystals contained melamine, or melamine with uric acid. Uric acid is a normal human excretory protein breakdown product. Renal failure was a result of blockage of the urinary tract by these urinary stones. It is interesting that melamine can actually interact with a normal human excretory product to cause kidney failure. Yet, there is little understanding of the mechanisms of renal failure, the interaction of melamine with cyanuric acid, ammeline, and ammelide, the background levels of melamine in food arising from environmental uses of melamine and from leakage from packaging materials, the long-term effects in poisoned children and pets, and if there are *in utero* toxic effects in pregnant women, among others. A great deal of research is desired on this subject.