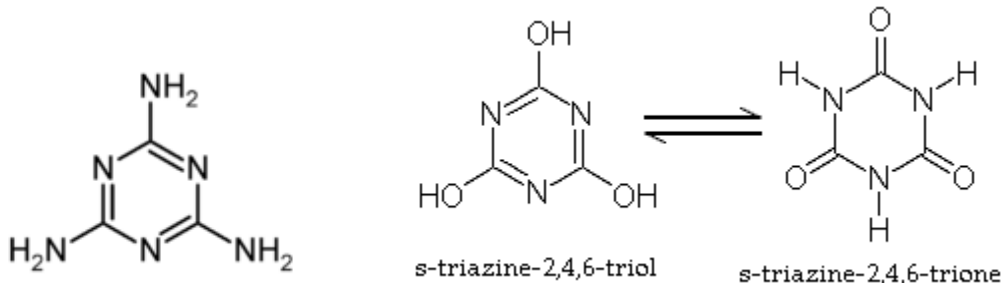


7.10 Protein enhancers and the pet food scare

In April 2007 an increase in pet deaths due to kidney failure was noticed and traced back to food imported from a plant in China. Initial reports suggested that the toxic ingredient was gluten, which is a major non-toxic protein constituent in wheat which helps make bread dough rise. Further investigation revealed that the ground wheat being added to the pet food was spiked with melamine, cyanuric acid and other chemicals. Their structures are shown below

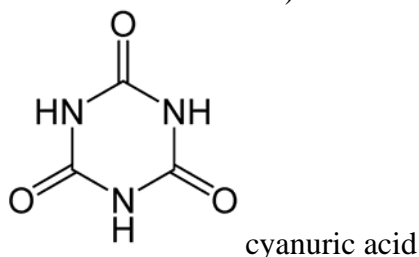


Melamine

Cyanuric acid

The primary use of melamine is for making plastics (such as whiteboards) by polymerizing it with formaldehyde. So what was it doing in cat and dog food? Although the Chinese aren't talking, the following *plausible* (but unproven) scenario has been suggested. The Chinese have several huge plants making melamine (from coal) for the plastic industry. An overcapacity of melamine production has resulted in more melamine production than is needed for making plastics. It has been known since the 1950's that ruminant animals (e.g. cows) fed melamine can convert melamine into amino acids with the help of bacteria in their rumens and the amino acids can then be converted into proteins such as muscle (i.e. meat!). Non-herbivores like cats and dogs cannot do this however, so melamine has no nutritional value to cats and dogs. On the other hand, toxicity tests on rats and cows did not find any evidence for toxicity either.

Small quantities of other chemicals besides melamine were found in the contaminated pet food suggesting that it was actually "melamine scrap", waste products from melamine synthesis. One of the other products in the food beside melamine was cyanuric acid. (structure shown above).



Analysis of the pet food showed that the "gluten" protein was in fact just wheat flour, which is mostly carbohydrate (only about 10% protein), and hence not as digestible by

cats and dogs. The melamine was added to increase the *apparent* N content of the mislabeled wheat gluten to make it more closely resemble protein. Of the three primary nutrients (fat, carbohydrates, and proteins) only proteins contain N, so a chemical test measuring the amount of N in a food sample can be done to determine the % protein in the food. However if melamine is added to food, it will test much higher for N than the actual amount due to protein and that was the reason for adding the melamine. The wheat flour has much less protein than pure wheat gluten and would test low for protein and potentially be rejected. By adding melamine to the wheat flour the factory was able to use cheaper wheat flour combined with excess melamine and melamine waste products and meet the nitrogen content expected of protein.

Still, the available data suggests that both melamine and cyanuric acid *individually* have very low toxicity which led investigators to look at other products in the melamine waste. Crystals isolated from the kidneys of dead animals were found to contain both melamine and cyanuric acid and one possible explanation is that the melamine reacted with cyanuric acid by hydrogen bonding as shown below to form insoluble crystals that caused damage to the kidney nephrons.

