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## RESEARCH ARTICLE

# IMPACT OF ADULTERATION OF MILK WITH MELAMINE: A CASE OF PROTEIN REPLACEMENT

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### ABSTRACT

Melamine is an organic base and a trimer of cyanamide, with a 1, 3,5 -triazine skeleton. Like cyanamide, it contains 66% nitrogen by mass and, if mixed with resins, has fire retardant properties due to its release of nitrogen gas when burned or charred, and has several other industrial uses. Melamine is also a metabolite of cyromazine, a pesticide. It is formed in the body of mammals who have ingested cyromazine. It has been reported that cyromazine can also be converted to melamine in plants. Melamine combines with cyanuric acid to form melamine cyanurate, which has been implicated in the Chinese protein export contaminations.

Melamine has been detected at high levels in several foods and feeds in many countries. In most of the cases the adulterated foods or its ingredients have been traced to China, thousands of infants in China being affected due to melamine contamination of baby foods. At least four babies have died and around 1 lakh have become sick after consuming powdered milk baby food laced with melamine. According to the reports the milk used to make the baby food was adulterated with melamine to enhance its apparent protein content. Products of dozens of Chinese companies have been reported to contain high levels of melamine.

Melamine is an organic base and is only slightly soluble in water. It contains 66 % nitrogen by mass. It has a variety of non-food uses. Some such uses are in making the following products:

- Amino resins and plastics
- Melamine foam, a polymeric cleaning product
- Fabrics
- Glues
- Flame retardants
- Nitrogenous fertilizers
- Melamine derivatives of arsenical drugs – Treatment of African sleeping sickness (trypanosomiasis)

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### INTRODUCTION

Melamine is combined with formaldehyde to produce melamine resin, a very durable thermosetting plastic used in Formica, and melamine foam, a polymeric cleaning product. The end products include countertops, dry erase boards, fabrics, glues, housewares and flame retardants. Melamine is one of the major components in Pigment Yellow 150, a colorant in inks and plastics. For making high-resistance concrete. Sulfonated melamine formaldehyde (SMF) is a polymer used as cement admixture to reduce the water content in concrete. The use of melamine as fertilizer for crops had been envisaged during the '50s and '60s because of its high nitrogen content & Melamine derivatives of arsenical drugs are

potentially important in the treatment of African trypanosomiasis.

Melamine is sometimes illegally added to food products in order to increase the apparent protein content. Standard tests such as the Kjeldahl and Dumas tests estimate protein levels by measuring the nitrogen content.

#### Toxicity

Melamine is described as being "Harmful if swallowed, inhaled or absorbed through the skin. Chronic exposure may cause cancer or reproductive damage. Eye, skin and respiratory irritant." However, the toxic dose is on a par with common

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table salt with an LD50 of more than 3 grams per kilogram of bodyweight. FDA scientists explained that when melamine and cyanuric acid are absorbed into the bloodstream, they concentrate and interact in the urine-filled renal microtubules, then crystallize and form large numbers of round, yellow crystals, which in turn block and damage the renal cells that line the tubes, causing the kidneys to malfunction. Ingestion of melamine may lead to reproductive damage, or bladder or kidney stones, which can lead to bladder cancer.

### Synthesis

Melamine was first synthesized by the German chemist Justus von Liebig in 1834. In early production, first calcium cyanamide is converted into dicyandiamide and then heated above its melting temperature to produce melamine. However, today most industrial manufacturers use urea in the following reaction to produce melamine:



It can be understood as two steps.

First, urea decomposes into cyanic acid and ammonia in an endothermic reaction:



Then, cyanic acid polymerizes to form melamine and carbon dioxide:



The second reaction is exothermic but the overall process is endothermic.

The above reaction can be carried out by either of two methods: catalyzed gas-phase production or high pressure liquid-phase production. In one method, molten urea is introduced onto a fluidized bed with catalyst for reaction.

### Contamination of Melamine in Foods

Melamine can enter the food chain through the following possible routes:

- Use of the pesticide cyromazine on crops.
- Use of nitrogenous fertilizers (if containing melamine as a source of nitrogen) for growing food crops.
- Consumption of cyromazine / melamine contaminated crops / crop residues by food producing animals. Cyromazine is metabolized into melamine in the animal's body and, therefore, could be present as contaminant in the animal origin food.
- Leaching of melamine from plastics used in food equipment, containers or packaging materials that come in contact with food, especially acidic foods at high temperatures.

Levels of melamine in foods through these contaminating sources are considered low and not a concern to human health.

### Legal maximum limits accepted for human food

Foods may be adulterated with melamine to make the protein content of the food appear higher for economic gains. It has been claimed that levels below 2.5 ppm melamine in foods is not deemed to indicate adulteration.

Member States of the European Union are required under Commission Decision **2008/757/EC** to ensure that all composite products containing at least 15 % of milk product, originating from China, are systematically tested before import into the Community and that all such products which are shown to contain melamine in excess of 2.5 mg/kg are immediately destroyed.

### Harmful Effects

Laboratory studies have shown calculi (stone) formation, inflammatory reactions and hyperplasia (excessive formation of cells) in the urinary bladder in rats and mice experimentally fed with melamine through diet. The harmful effect of melamine is considered to increase in combination with its analogues, particularly cyanuric acid. The deaths of four infants and sickness of thousands infants in China on consumption of melamine laced baby food have been attributed to formation of kidney stones and acute renal failure.

### Specific Actions to be taken by State Food Authorities

In view of the seriousness of the matter, the State Food Authorities are advised to take special care and actions to ensure that food products containing melamine are not present in the market to protect consumer's health. Following specific actions must be taken with immediate effect:

1. Set up special Inspection Teams of inspectors responsible for monitoring melamine in foods in the market and food manufacturing facilities. Both imported products as well as domestically produced products should be covered in monitoring.
2. Testing food material for presence of
3. Melamine. Samples of milk and dairy products should be collected regularly from the market and manufacturing facilities and tested for presence and levels of melamine. Melamine content of more than 1 ppm in infant formula and more than 2.5 ppm in other foods should be viewed with suspicion of adulteration and such foods should not be allowed to be sold.
4. All Chinese made dairy products should be withdrawn from the market. All other Chinese made food products, or food products containing ingredients imported from China, should be tested for melamine. If tested to contain more than 2.5 ppm of melamine, the food should be withdrawn from the market.
5. Consumers should be advised to avoid consuming Chinese origin dairy foods, or foods containing Chinese origin ingredients.
6. Request consumers to report any instance of sale of Chinese origin milk products in India, immediately to an identified officer. Such products should be removed from the shelf immediately.

## CONCLUSION

A replacement of milk protein through melamine cyanurate. Melamine is described as being harmful if swallowed, inhaled or absorbed through the skin. Chronic exposure may cause cancer or reproductive damage. Eye, skin and respiratory irritant. Melamine is also a metabolite of cyromazine, a pesticide. It is formed in the body of mammals who have ingested cyromazine. It has been reported that cyromazine can also be converted to melamine in plants. Melamine combines with cyanuric acid to form melamine cyanurate it is health hazardous to the human being hence government has ensure that food products containing melamine are not present in the market to protect consumer's health.

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