Non-toxic levels of melamine detected in Sharples dinnerware

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SWARTHMORE

Introduction

Sharples Dining Hall uses melamine resin dinnerware. Melamine resins are produced through polymerization of melamine monomers (1). Melamine (**Figure 1**) is an organic compound that, alone, is non-toxic (LD_{50} = 3296 mg/kg) (2). In combination with cyanuric acid, a byproduct of industrial melamine synthesis, or triazine, melamine co-crystallizes (2). In animals, these crystals can form in the kidneys, causing renal failure (2). There are also links between melamine and bladder tumors (2).

There is no cyanuric acid in melamine plastics, and so risk of co-crystallization is extremely low. However, there are regulated limits to melamine exposure. The FDA has established a tolerable daily intake (TDI) for melamine of 0.63 mg/kg (2). In addition, the FDA prohibits the use of melamine as a food additive and sets the limit of melamine to 50 ppb in food products (2).

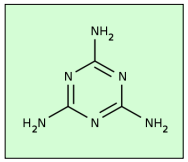

Figure 1. Molecular structure of melamine

Sample Preparation

A solvent of water or 4% acetic acid at varying temperatures was added to the melamine dinnerware and stored at 25º or 60º C for 30 minutes. Resorcinol was added as an internal standard (3).

Solution was removed from container and boiled down to a volume of 2 mL (**Figure 2**).

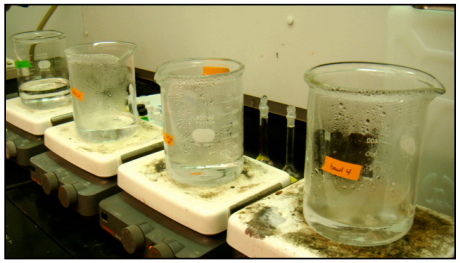

Figure 2. Boiling excess solvent from sample.

Methods

Reversed-phase High Performance Liquid Chromatography (HPLC) was used to separate and detect melamine and resorcinol. A Varian Polaris C18A (150x4.6 mm) column with 5µm beads was used. A mobile phase of 0.1 M phosphate buffer, pH 3, was used at a flow rate of 1.5 mL/min (1). Sample injection was 25 µL. A photodiode array was used for detection and confirmation of species. Analytes were quantified using chromatographs at 235 nm.

Results

In the following chromatograph (**Figure 3**), melamine retention time is 1.7 min., and resorcinol retention time is 10.9 min. The UV spectrum of each analyte is shown on right.

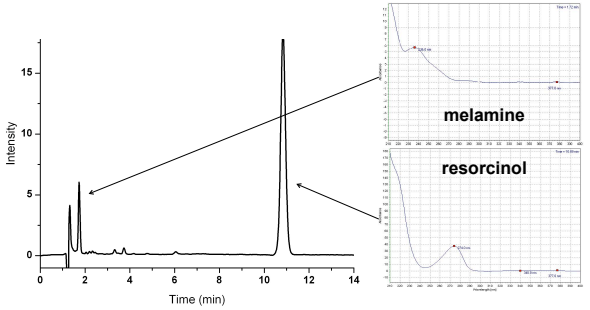

Figure 3. Representative chromatograph and corresponding UV spectrum of melamine and resorcinol.

A calibration curve between 0 and 50 ppm of melamine was constructed using resorcinol as an internal standard (**Figure 4**).

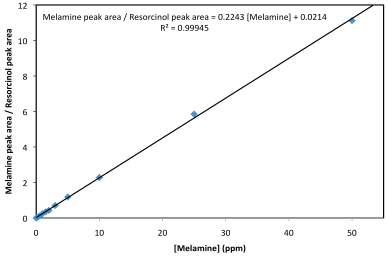

Figure 4. Calibration curve of melamine with resorcinol used as an internal standard.

Results

No melamine was found in white Sharples mugs using 100 ºC water or 60 or 100 ºC 4% acetic acid as solvent.

Using 60 ºC acetic acid, and incubating at 60 ºC for 30 minutes, 30±4 ppb melamine was detected from yellow Sharples plates.

From the black Sharples bowls, the following results were obtained:

Table 1. Melamine detected in Black Sharples bowls

Solvent	water	water	water	AA*	AA	AA
Liquid Temp. (C)	RT**	60	100	RT	60	60
Incubation Temp. (C)	RT	60	RT	RT	60	RT
[melamine] (ppb)	**1.3±0.7**	**16.9±0.7**	**29.1±0.7**	**2.0±0.7**	**90±20**	**26.7±0.7**

*AA = 4% acetic acid ; **RT = room temperature

Conclusion/Future Directions

Overall, melamine is found at non-toxic levels. The black bowls showed the highest levels. Using 4% acetic acid increases melamine leeching. Higher temperature of liquid or incubation increases leeching as well.

In the worst case (4% AA, liquid T = 60 ºC, incubation T = 60 ºC), an average person (80.5 kg would need to consume 564 liters of 60 ºC liquid from a black bowl to reach the TDI of 0.63 mg/kg.

In future studies, we would try using extraction solutions that more accurately mimic food products served in Sharples. We would also try to detect cyanuric acid in Sharples dinnerware.

Acknowledgements

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References

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