STABILITY ANALYSIS OF CHEMICALS IN FOOD MATRICES

The Department of Homeland Security (DHS) Science and Technology Directorate's (S&T) Chemical Security Analysis Center (CSAC) Chemical Security Lab (CSL) is measuring chemical and physical properties for compounds that are in the S&T Risk Assessments. This data is being used in a study designed to understand the effect of the pasteurization process on hazardous chemicals. Milk (2%) and apple juice are spiked with chemicals and heated at 80 °C for 30 minutes to simulate pasteurization and determine which chemicals could survive the pasteurization process. This information indicates if contamination of a food matrix before or after pasteurization will affect the human health consequences that are calculated by the model.

MATERIALS

The chemicals 4-aminopyrdiine, aniline, caffeine, and 2,4-dinitrophenol (sourced from Sigma-Aldrich) were spiked in milk and/or apple juice (sourced from the local grocery store), extracted from their matrices, then analyzed using the Agilent gas chromatography-mass spectrometry (GC-MS) instrument.

METHODOLOGY

The test matrices, 2% milk and apple juice, were spiked with a pre-determined concentration of the chemical. Immediately after spiking and mixing, a small sample was set aside for extraction. At 80 °C, the samples were heated and removed at the time points of 15 and 30 seconds, 1, 2, 5, 10, 20, and 30 minutes. Upon removal from the heat, the samples were immediately chilled, and the specific extraction initiated. The extracted chemical was then dried, dissolved in 1mL of preferred solvent, and injected onto the GC-MS for analysis.

RESULTS

Table 1. Stability of Chemicals after Treatment at 80 °C for 30 Minutes

Chemical	Matrix	% Loss in 30 min*
4-Aminopyridine	Milk	8.3%
4-Aminopyridine	Apple Juice	4.6%
Aniline	Milk	18%
Caffeine	Milk	2.0%
2,4-Dinitrophenol	Milk	85%

NOTE: *Repetitions are planned to formulate statistics.

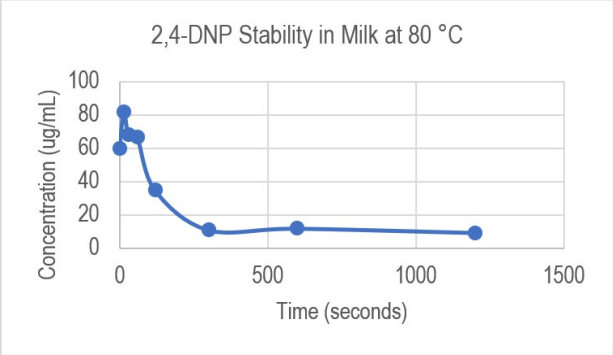

Figure 1. Plot of Concentration vs Time for 2,4-Dinitrophenol (DNP) in 2% Milk at 80 °C

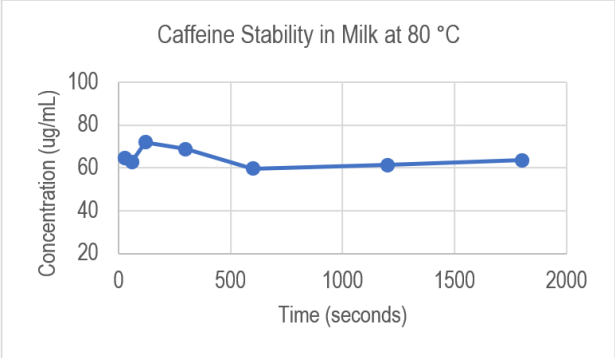

Figure 2. Plot of Concentration vs Time for Caffeine in 2% Milk at 80 °C

Caffeine results demonstrate a stable compound with minimal loss.

After the simulated pasteurization in milk at 80 °C for 30 minutes, the concentration of 2,4-dinitrolphenol dropped 85%; it was the only chemical that showed a substantial percent loss. Aniline, 4-aminopyridine, and caffeine did not have a sizable loss through the pasteurization process.

4-Aminopyridine was tested in both apple juice and milk and showed a larger percent loss in milk than it did in apple juice.

DISCUSSION

When the chemical is unreactive in the matrix, the toxicity of the chemical is pertinent to the risk models. When the chemical is lost over time, products are formed, and the toxicity of those products needs to be elucidated to properly calculate human health consequences using the risk models. Future plans include repeating the experiments with statistical analysis and including apple juice pasteurization for the current chemical methods.