



CALIFORNIA STATE SCIENCE FAIR 2015 PROJECT SUMMARY

Name(s) Ashton C. Authement	Project Number J2002
Project Title Beware of the Cookware	
<div>Objectives/Goals<p>My objective was to test different types of metal cooking pots to determine which one would leach the most amounts of metals when boiled in a 25% citric acid solution for 30 minutes. My goal was to support my research and hypothesis that softer porous metals (like cast iron and aluminum) would release the most metal into the citric acid solution.</p></div> <div>Abstract<p>I tested and analyzed the metal content released by six different metal cooking pots: (1) aluminum; (2) grades of stainless steel; (1) copper; (1) cast Iron; and (1) non-stick. The test was performed by dissolving citric acid crystals in water to make a 25% citric acid solution. 200ml of the solution was then boiled in each pot for 30 minutes. The solution left in each pot was collected and observed by a spectrophotometer for eight metal indicators (copper, chromium, iron, nickel, aluminum, zinc, cobalt, and cadmium). The concentration and intensity levels of each of the eight metal indicators were analyzed for each pot.</p></div> <div>Methods/Materials<p>I tested and analyzed the metal content released by six different metal cooking pots: (1) aluminum; (2) grades of stainless steel; (1) copper; (1) cast Iron; and (1) non-stick. The test was performed by dissolving citric acid crystals in water to make a 25% citric acid solution. 200ml of the solution was then boiled in each pot for 30 minutes. The solution left in each pot was collected and observed by a spectrophotometer for eight metal indicators (copper, chromium, iron, nickel, aluminum, zinc, cobalt, and cadmium). The concentration and intensity levels of each of the eight metal indicators were analyzed for each pot.</p></div> <div>Results<p>All six metal cooking pots tested leached different types and concentrations of metals during the heating process. The cast iron leached the highest amount of metal (iron, chromium, and surprisingly cadmium). Cadmium is very toxic and harmful to the human body. The aluminum pot leached the second highest amounts of metals with large concentrations of aluminum, which can be toxic in high quantities. It also leached small amounts of copper, chromium, iron, zinc, and cobalt. The non-stick pot (third) leached a good amount of metals (copper, chromium, iron, zinc, and cobalt). The ordinary stainless steel pot (fourth) leached copper, chromium, iron, nickel, and cobalt; followed by the higher quality 18/10 stainless steel that leached copper, chromium, iron, zinc, and cobalt. Finally, the copper pot leached the least but surprisingly showed more iron than copper. The results showed the pot used in the experiment was likely an alloy.</p></div> <div>Conclusions/Discussion<p>Through the use of metal indicators and a spectrophotometer I was able to analyze my test results to support my research and hypothesis that the cast iron pot boiled in 25% citric acid solution would leach the most metal. All pots tested had varying traces of metal. This creates a challenge for pot designers who are trying to find the perfect metal combination to solve a major problem in cooking: designing a 'healthy' pot that leaches the least amount of metal into food.</p></div>	
Summary Statement <p>I tested different types of metal cooking pots to determine concentrations of metals which could be leaching into our foods while cooking.</p>	
Help Received <p>I used an Inductively Coupled Plasma - Optical Emission Spectrophotometer from the University of California, Riverside to test metal content of samples under the supervision of Kenneth Flack (Chemistry Dept., Graduate Student). My parents helped me proof read my report and attach items to my board.</p>	