COPPER INDUCED DNA DAMAGE ON UNFIRED BRASS CARTRIDGE CASINGS

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The antimicrobial properties of copper have been known for centuries. The Egyptians used copper to sterilize drinking water and to clean wounds, Hippocrates used it to treat wounds and skin irritations, and in Roman literature there are reports of medicinal uses of copper. Experimental data has shown that on copper surfaces cells die rapidly upon contact compared to stainless steel surfaces where bacteria can survive for weeks and months if not cleaned. Hospital trials, evaluating the use of copper touch surfaces, have shown dramatic reduction in bacterial infections. Copper alloys with high percentages of copper have similar 'contact killing' effects and the higher the copper content in an alloy, the faster 'contact killing' occurs. In fact many hospitals are now considering replacing all metal and plastic touch surfaces with copper or copper alloys. Although the exact mechanism is still currently being elucidated, the proposed idea involves redox cycling and the production of reactive oxygen species (ROS) groups that cause lethal damage to cell membranes and oxidative damage to DNA. Brass is a common copper alloy with a high percentage of copper and is used for manufacturing the majority of the commercially available cartridge casings.
Firearms can be recovered from a crime scene and theoretically touch DNA could be recovered from cartridge casings of unfired bullets given that the process of loading a cartridge into a firearm will deposit trace amounts of epithelial cells (and possibly free DNA) onto the cartridge of the bullet. There have been attempts to recover DNA from fired cartridges with inconsistent results, yet to the best of our knowledge, none of them considered the possibility of there being no DNA to be recovered due to the degrading/damaging effect of copper.

To evaluate the antimicrobial effects of copper on DNA recovery from unfired cartridge casings, aliquots of suspended cells were spotted onto different surfaces and allowed to dry for various times. The surfaces tested included a brass pipe and cartridge casings made of brass, nickel, steel, and aluminum. The spotted substrates, after the appropriate times, were swabbed followed by DNA extraction and quantitation with Qiagen QIAmp® Investigator kit and Quantifiler® Human respectively. As positive controls, and to evaluate DNA loss from the spotting and swabbing process, identical aliquots of cell suspension were spotted directly on a swab and in a microcentrifuge tube.

Results show that significantly lower amounts of DNA are recovered minutes after spotting cells on copper piping and brass casings while from nickel, aluminum and steel casings effective recovery occurs several weeks after cells are spotted on the surface. Furthermore the recovered DNA appears degraded when subjected to STR analysis. This demonstrates that regardless of whether the cartridges are fired or unfired effective DNA recovery may be compromised by copper induced damage to nucleic acids.