IMPROVING THE FORENSIC ANALYSIS OF TOUCH DNA RECOVERED FROM COPPER

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Touch DNA (tDNA) samples inherently contain small quantities of DNA due to the typically limited transfer of biological material from the contributor's hand to an object or substrate. When the substrate is copper, or a copper alloy such as brass, DNA-degradative and/or PCR-inhibitory effects reportedly play a role in making this analysis much more difficult. Indeed, under defined experimental conditions wherein commercially-available purified TE-buffered genomic DNA was spotted onto copper and two control substrates, glass and aluminum, the DNA swabbed from the copper substrate, then subjected to organic extraction and Microcon filtration (SOP), exhibited a profound reduction in DNA yield and poor STR profiles compared to the DNA similarly collected and purified from either control substrate. In an attempt to overcome these negative results and increase the likelihood that DNA swabbed from copper is forensically informative, we investigated various modifications to the SOP including the addition of chelators to the standard swabbing medium (water) and the use of PCR facilitators. When either bathocuproinedisulfonic acid disodium salt (BCS), a copper-specific chelating agent, or EDTA, a non-specific divalent metal ion chelator, was added to the swabbing medium, no benefit was observed. When the SOP was modified via the addition of BSA to the Quantifiler®Duo and Identifiler® Plus amplification reactions, DNA yields and STR profiles did not improve. However, the addition of Taq polymerase to the Quantifiler®Duo amplification reaction gave upward-trending yields supporting the theory that PCR inhibition may play a role, at least in part, with copper substrates. However, not all results were statistically significant due to high variability. Regardless, the results from this study are promising and warrant further investigation.

Additional experiments revealed that the spotting medium, spotting volume, and different environmental conditions, such as relative humidity, can also affect DNA yield and STR profiles. In contrast to DNA spotted in TE buffer, DNA spotted in water on copper showed yields and STR profiles similar to the control substrates; however, the DNA yields from the control substrates were lower than that following DNA spotted in TE on these substrates. This suggests a greater adherence of the water-spotted DNA to the control substrates and/or an increased difficulty in collecting this DNA, indicating the need for alternative swabbing media towards improving the collection of DNA. In addition, spotting the DNA in either TE or water on the copper substrates in lower volume gave increased yields over spotting DNA in higher volumes using the same spotting medium. Also, drying the spots on the copper substrate in low relative humidity increased DNA yield versus higher relative humidity. Taken together, these results suggest that increased contact of the DNA with the copper substrate in the aqueous state, whether due to higher volume or relative humidity, has a negative effect on DNA recovery. Future experiments will investigate the exact role of these variables on DNA recovery from copper substrates.

Overall, the results of this project suggest the addition of Taq polymerase as a potential PCR amplification modification to increase DNA yield from samples swabbed from copper surfaces. Importantly, the manner in which the DNA is deposited and the environmental conditions in which the copper is exposed appear to greatly affect outcome.