B50 MicroFLOQ®: Swabs and Direct Amplification of Trace DNA Samples

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Learning Overview: After attending this presentation, attendees will understand the utility of Copan's microFLOQ® swabs coupled with direct amplification for the recovery of DNA from challenging forensic samples.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing an alternative method for recovering DNA from challenging surfaces, such as copper, by using direct amplification from microFLOQ® swabs, thereby increasing the potential yield of DNA from swabs.

Recent literature has evaluated the use of different types of swabs in terms of DNA recovery efficiency.[1] In comparison to traditional cotton swabs commonly used to collect biological samples from crime scenes, the use of nylon flocked swabs can increase the overall strength of a profile.[1] While traditional cotton swabs have fibers that circle inward towards the swab stick, nylon flocked swabs have fibers that protrude away from the swab stick.[2] This design allows for DNA to remain near the surface of the swab. With the DNA on the outer surface of the swab, the recovery of DNA from the swab is increased.[2] This makes nylon flocked swabs ideal for direct amplification, as tested by Templeton et al. microFLOQ™ swabs (Copan, Brescia, Italy) are miniature versions of nylon flocked swabs with a ~1.2mm swab head designed to easily break into polymerase chain reaction (PCR) tubes for direct amplification. Because of the demonstrated use of nylon flocked swabs for efficient DNA recovery, the goal of this study was to determine the suitability of microFLOQ™ swabs for the recovery and preservation of DNA from copper substrates.

Copper surfaces, or copper alloy surfaces such as brass used for cartridge cases, prove to be a challenge to DNA recovery because of the presence of touch DNA coupled to the degradation effects of copper on DNA.[3] This combination of low-level, degraded DNA often results in partial profiles, if a profile is even obtained, and indistinguishable mixtures. With the potential for loss of DNA at the extraction and quantitation steps in the DNA processing workflow, direct amplification offers a solution for unnecessary DNA loss.

MicroFLOQ™ swabs were used to swab a variety of surfaces to compare the yield of DNA from different substrates. Sterile Falcon tubes were used for a plastic control substrate; metal substrates used included cleaned, unfired bullets and cartridge casings made of aluminum, nickel, brass, and copper, in addition to cleaned copper pipes. All samples were rolled between the hands of individuals to deposit DNA. Dry-swabbing and wet-swabbing were both tested as methods to recover the DNA from samples. For wet-swabbing, bovine serum albumin (BSA) (at concentrations of 1mg/mL and 50mg/mL), sterile water, and low TE buffer were added to the microFLOQ™ swabs prior to swabbing. The swabs were processed for direct PCR amplification followed by capillary electrophoresis separation using the Identifiler® Plus amplification kit (ThermoFisher Scientific, Waltham, MA). Analysis of the profiles was followed by determining the number of alleles present in the profile compared to the expected number of alleles and the average peak height (in relative fluorescent units) per dye channel.

The results of this study indicate microFLOQ™ swabs coupled to direct amplification for short tandem repeat (STR) analysis provides a simplified approach to the recovery of DNA from metal surfaces, including copper. Partial DNA profiles were obtained from copper substrates using microFLOQ™ swabs, although the profiles recovered from copper substrates were considerably weaker compared to the profiles obtained from plastic substrates.

Additional testing was performed to determine if the degradation effects of copper can be transferred to other substrates. This was simulated by having individuals handle copper pipes immediately prior to handling plastic Falcon tubes. For comparison, a plastic tube was handled prior to handling a second plastic Falcon tube. The difference in number of alleles obtained between the subsequently handled plastic tubes were compared. While the number alleles obtained between the copper and the first-handled control plastic were significantly different, the number of alleles obtained between the second-handled plastic tubes were comparable, indicating that the degradation effects of copper are not transferred to secondary surfaces.

These results support the use of microFLOQ™ swabs coupled to direct amplification as a viable option for minimal sample handling to obtain DNA profiles from copper surfaces.

Reference(s):

1. Templeton, J., Ottens, R., Paradiso, V., Handt, O., Taylor, D., and Linacre, A. Genetic profiling from challenging samples: Direct PCR for touch DNA. *Forensic Science International: Genetics Supplement Series.* (2013) 4:e224-e225.
2. Copan 4N6 FLOQSwabs Forensic Collection brochure, http://www.copanusa.com/products/forensic-genetic/4n6-floqswabs-genetics/.
3. Horsman-Hall, K.M., Orihuela, Y., Karczynski, S.L., Davis, A.L., Ban, J.D., Greenspoon, and S.A. Development of STR profiles from firearms and fired cartridge cases. *Forensic Science International: Genetics.* (2009) 3:242-250.

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