The Microbial-Vac System:

Advancing Human Identification by Improved Sampling

Written by Jared G. Maughan

BILLIONS OF DOLLARS have been invested over the years on human identification and, as a result, significant advancements have been made. However, nearly all of this investment has been on post-sampling technologies. Therefore, very little improvement has been made in the area of sample collection.

Recently, the Microbial-Vac System (M-Vac)—a device originally developed to collect surface-pathogen samples for the food industry—was identified as a potential step forward in sample-collection technology. The M-Vac System is capable of efficiently collecting samples from substrates common to forensic work.

The M-Vac utilizes wet-vacuum principles to release and capture particles of all sizes, even those that are microscopic. Nuclease- and DNA-free buffer is sprayed directly onto a surface of interest; simultaneously, a vacuum is applied around the spray pattern to collect the buffer and suspended particles in a sample-collection bottle.

Although the M-Vac was originally designed with a primary focus on the collection of bacteria and other microbes, recent third-party testing by Sorenson Forensics has proven the M-Vac is capable of collecting human DNA from small or large surfaces. Although this proof-of-concept testing did not involve high numbers of repetitions, it did involve several different surfaces and stain types.

Testing included spotting outlined surfaces with known amounts of blood or saliva mixtures and allowing stains to dry completely prior to sampling. Samples were then collected using M-Vac, cutting, or dual swab. Sample volumes were reduced using an Amicon filter device and centrifugation. DNA quantities were estimated using qPCR in an Applied Biosystems 7900HT Fast Real-Time PCR System. While the data was limited to one observation per treatment, it did show that in most cases the M-Vac recovered considerably more DNA than either cutting or dual swab. For example, when blood was spotted on white cotton fabric, the M-Vac recovered 51.3 ng of DNA versus 4.2 ng by cutting. This difference between M-Vac and cutting highlights the advantage of being able to sample a large area with the M-Vac instead of being restricted to small areas with cutting. Additionally, when saliva was spotted on polyester, the M-Vac was able to recover 149.16 ng of DNA verses 3.6 ng for dual swab. The results of this testing suggest that the more aggressive wet-vacuum approach to sampling with the M-Vac would enable investigators to recover more DNA from surfaces than dual swabbing, a highly passive approach to sampling.

Following sampling and quantification, additional testing was performed to evaluate the suitability of DNA collected with the M-Vac for producing genetic profiles. Profiles were generated for samples using a common STR multiplex kit (Applied Biosystems Identifiler Kit). In each case, the profiles generated from M-Vac samples were of very high quality.

Several conclusions have been generated from this initial testing. First, traditional sampling methods often did not yield sufficient DNA to obtain profile results of equivalent quality to those obtained from the M-Vac samples. Second, no inhibitors or sample degradation attributable to the M-Vac were detected during qPCR or profile generation. Additional third-party testing has been performed on the M-Vac system to validate this claim. This additional testing confirmed the M-Vac does not introduce any nuclease or inhibitors to samples that would be detrimental to its usefulness. And finally, DNA obtained using the M-Vac was able to produce high-quality profiles.

When a large visual stain is present on evidence, traditional sampling methods are likely sufficient for obtaining

enough DNA to generate a profile. However, there are instances when DNA is not available on evidence in high concentrations, or the DNA is spread over a large area in low concentrations, such as bite marks on a t-shirt, urination stains, or older evidence where much of the DNA has degraded over time. In such instances, the M-Vac can be a critical tool to investigators. Given its high recovery efficiency, it is highly likely the M-Vac could be used to obtain sufficient DNA for a profile by re-sampling evidence previously sampled unsuccessfully with traditional methods. Recovery of so-called "touch DNA" is also an area where the M-Vac may play a useful role to the forensic community.

Continuing research is needed to identify the full forensic value of the M-Vac, but preliminary results suggest that the device could represent a significant advancement in sample collection. The state-of-the-art sampling system produces highly efficient DNA recoveries from a broad spectrum of surfaces and is poised to make significant improvements in the DNA collection abilities of forensic labs around the world.

About the Author

Jared G. Maughan was hired by Microbial-Vac Systems in 2004 to help in the development and production of the M-Vac. He now serves on the Executive Management Team of MSI as Vice President of Laboratories and Operations. Maughan can be reached at this telephone number:

801-523-3962

Or you can send an email to:

jared.maughan@m-vac.com