OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need: Optimization of DNA extraction for low level samples

Describe the need: Optimizing the yield for DNA extraction has been a research and product development goal for many years. Published research describes a multitude of different assays; some specifically designed for challenging sample types like paraffin embedded tissue or bones (1) and continues to address crime scene samples (2). Faced with increased sample submissions, crime laboratories have embraced automated DNA extraction platforms based on column or magnetic bead silica surface DNA capture and release chemistry, which work well for most sample types (3-5). In addition laboratories may also use membrane filtration devices for further purification and/or concentration and here data have shown that more than 60% of the controlled DNA input can be lost during processing (6,7). Technical improvements include, e.g. the use of carrier RNA (8), but it may be possible to increase yields for low template samples even more. For example, much of the deposited DNA collected on cotton swabs is lost due to irreversible adsorption (2). Improved extraction methods may include alkaline lysis, improved buffers and other alternative methods to reduce cell and DNA surface binding. Research should also address the presence and recovery of cell free DNA (9).

Keyword(s): DNA extraction, optimization, sample types, substrates, DNA recovery

Submitting subcommittee(s): Human Biology **Date Approved:** 05/04/2021

(If SAC review identifies additional subcommittees, add them to the box above.)

Background Information:

1. Does this research need address a gap(s) in a current or planned standard? (ex.: Field identification system for on scene opioid detection and confirmation)

Not Applicable

2. Are you aware of any ongoing research that may address this research need that has not yet been published (e.g., research presented in conference proceedings, studies that you or a colleague have participated in but have yet to be published)?

Yes

3. Key bibliographic references relating to this research need:

1) Butler JM (2011) Advanced Topics in Forensic DNA Typing: Methodology. Elsevier, Amsterdam, New York
2) Adamowicz, M. S., Stasulli, D. M., Sobestanovich, E. M., & Bille, T. W. (2014). Evaluation of methods to improve the extraction and recovery of DNA from cotton swabs for forensic analysis. *PLoS ONE*, *9*(12), 1–19.

3) Phillips, K., Mccallum, N., & Welch, L. (2011). A comparison of methods for forensic DNA extraction: Chelex-100 1 and the QIAGEN DNA Investigator Kit (manual and automated). *Forensic Science International: Genetics*, *6*, 282–285.

4) Stangegaard, M., Hjort, B. B., Hansen, T. N., Hoflund, A., Mogensen, H. S., Hansen, A. J., & Morling, N. (2013). Automated extraction of DNA from biological stains on fabric from crime cases. A comparison of a manual and three automated methods. *Forensic Science International: Genetics*, *7*(3), 384–388.

5) Stangegaard, M., Børsting, C., Ferrero-Miliani, L., Frank-Hansen, R., Poulsen, L., Hansen, A. J., & Morling, N. (2013). Evaluation of four automated protocols for extraction of DNA from FTA cards. *Journal of Laboratory Automation*, *18*(5), 404–10.

6) Garvin AM, Fritsch A (2013) Purifying and Concentrating Genomic DNA from Mock Forensic Samples Using Millipore Amicon Filters. *Journal of Forensic Sciences*, *58*(S1), S173-S175.

7) Verdon, T. J., Mitchell, R. J., & Van Oorschot, R. A. H. (2013). The influence of substrate on DNA transfer and extraction efficiency. *Forensic Science International: Genetics*, *7*(1), 167–175.

8) Kishore R, Hardy WR, Anderson VJ, Sanchez NA, Buoncristiani MR (2006) Optimization of DNA Extraction from Low-Yield and Degraded Samples Using the BioRobots EZ1 and BioRobots M48. *Journal of Forensic Sciences*, *51 (5) 1055*- 1061.

9) Quinones I, Daniel B (2012) Cell free DNA as a component of forensic evidence recovered from touched surfaces. *Forensic Science International: Genetics*, *6*, 26-30.

4. Review the annual operational/research needs published by the National Institute of Justice (NIJ) at https://nij.ojp.gov/topics/articles/forensic-science-research-and-development-technology-working-group-operational#latest? Is your research need identified by NIJ?

Not directly

5. In what ways would the research results improve current laboratory capabilities?

Optimized DNA extraction for a variety of biological material and stain substrates will increase DNA yields and thus improve not only DNA typing success rates but also the quality of the data obtained for low template samples. Less allelic drop out and improved mixture resolution will make profile interpretation less cumbersome and more reproducible.

6. In what ways would the research results improve understanding of the scientific basis for the subcommittee(s)?

Most of the current DNA extraction methods are designed to work for a variety of biological evidence/specimen in an efficient automated fashion. These methods work well for many samples but are known to recover less than 50% of the DNA content in a stain or tissue. Methods could still be improved for difficult or traditionally low level DNA sample types. More information on which methods are most suitable for which category of samples, will allow the subcommittee to work on best practices for this area.

7. In what ways would the research results improve services to the criminal justice system?

Higher success rates on probative items of evidence will increase the number of cases where forensic DNA testing can inform the fact finder and support either the defense or the prosecution theory of a crime. Dissemination of recommendations on DNA extraction methods will help standardize practices

across the US and ensure victims, victims' families and accused individuals will be served equally independent of geographic area.

8. Status assessment (I, II, III, or IV): II

	Major gap in current knowledge	Minor gap in current knowledge
No or limited current research is being conducted	I	III
Existing current research is being conducted	II	IV

This research need has been identified by one or more subcommittees of OSAC and is being provided as an informational resource to the community.