OSAC RESEARCH NEEDS ASSESSMENT FORM

Title of research need: Optimization of collection, isolation and amplification for trace biological samples

Describe the need:

Subcategory: Collection and analysis of nucleic acids

Trace biological samples are routinely encountered in forensic casework. Although optimization of DNA isolation and amplification of trace biological samples have been the subject of countless research and development projects within and outside of forensic science, there remains a need to further increase the efficiency and yield of these techniques. Published and peer reviewed research has addressed many issues relating to the collection and DNA isolation of trace samples such as the removal of inhibitors, using different substrates or methods to increase the amount of cells or DNA collected from an object and subsequently released for testing, concentration techniques, and automated methods including rapid DNA processing. Similarly, research and development has been robust for DNA amplification of trace samples including the development of new kit chemistries, the use of modified reactions, direct to amplification methods as well as non-PCR based methods that may increase the sensitivity and resolution of DNA amplicons. Technical improvements in DNA isolation is needed, including: improving sample collection and release efficiency, methods that increase the yield of DNA (or RNA), development of new manual and automated methods that increase yield and decrease co-extracted contaminants, the use of enzymatic repair mechanisms to improve low quality/quantity analyses and methods to further understand the impact of and assess the quantity of the presence and recovery of cell free DNA.

Keyword(s): DNA extraction/isolation, PCR amplification, purification, DNA repair, sample concentration

Submitting subcommittee(s): Human Biology **Date Approved:** 05/16/2025

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)

No

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: (ex.: Toll, L., Standifer, K. M., Massotte, D., eds. (2019). Current Topics in Opioid Research. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88963-180-3)

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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?

Indirectly: "Alternative ways to enrich or target genomic areas of forensic DNA interest, especially in challenging samples (e.g. rootless hair, burned bone), as opposed to a traditional PCR-based approach." ; "Research that documents the various impacts of methods, reagents, and materials on the recovery, repair, and/or preservation of low-quantity and/or low-quality DNA from various cell types"; "Improved DNA collection devices or methods for recovery and release of human DNA (e.g., from metallic items)".

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

Optimized sample collection, DNA isolation and purification, and PCR amplification that increases the purity, quality, and overall yield of the DNA sample will result in greater resolution of the resulting DNA profile. Improvements could include decreased allelic dropout, and improved resolution through the presence of more alleles making the profile interpretation more statistically appropriate and possibly meaningful in the context of the case .

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

Development and optimization of techniques that focus on the isolation, purification and amplification of trace samples lies at the foundation of molecular biology and nucleic acid research; therefore this aids the committee in better understanding the foundational elements of techniques used in molecular biology and as it applies to forensic DNA testing and data interpretation and comparison.

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

Increasing the success rates in obtaining interpretable DNA profiles from probative items of evidence will increase the number of cases where forensic DNA testing can better inform the fact finder.

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

	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.