B90 Combined Genetic and Micro-Chemical Analysis of Household Dust as a Definitive Trace Identifier of a Room and Its Occupants

Katherine Farash, BS, University of Central Florida, Forensic Science Graduate Prog, Biochemistry Track, PO Box 162366, Orlando, FL 32826; Hayley O'Brien, BS, National Center for Forensic Science, PO Box 162367, Orlando, FL 32826; Erin K. Hanson, PhD, PO Box 162367, Orlando, FL 32816; Nicholas Petraco, MS, 73 Ireland Place, Amityville, NY 11701; and John Ballantyne, PhD, University of Central Florida, Dept of Chemistry, 4000 Central Florida Boulevard, Orlando, FL 32816-2366*

After attending this presentation, attendees will learn how household dust (i.e., dust bunnies) is analyzed for the presence of human DNA. The quantity and quality of human DNA in dust bunnies will be presented. Attendees will also learn enhanced micro-volume strategies for the analysis of human bio-particles identified in dust bunnies.

This presentation will impact the forensic science community by demonstrating the probative value of an underused form of physical evidence — household dust or dust bunnies.

The ultimate goal of trace forensic evidence in a criminal investigation is to identify the people, places, and things involved in the commission of the crime. A commonly found trace material that does not appear to be widely analyzed in operational crime labs at this time is household dust. This is unfortunate since the potential for identification, rather than merely association, with this type of evidence is a realistic possibility. Macroscopic dust bunnies appear to be a unique entangled conglomeration of fibers containing a variety of inorganic and organic particulates from the immediate environment. Dust bunnies are formed over a period of time due to air flow and they accumulate inside rooms (inside homes or the workplace), vehicles (e.g., in the trunk), and even in some outdoor locations. They can be transferred onto, for example, the clothing of a body that has been dragged across the floor prior to the body being taken away and deposited elsewhere. Thus, in principle, if one or more dust bunnies are found associated with a crime it should be possible to positively identify the room from which the dust bunnies originated; however, the probative value of the dust bunny would be enhanced not only if the room could be identified but also the habitual occupier of the room. This might be accomplished by sensitive DNA typing of the cellular material that is trapped inside the dust bunny (likely originating from the habitual occupier of the room).

In this study, dust bunny samples were genetically profiled using two approaches: (1) organic DNA extraction of whole dust bunny samples with standard and increased cycle number Short Tandem Repeat (STR) profiling; and, (2) "smart" analysis with the individual isolation of bio-particles present in the dust bunny samples using micro-manipulation and enhanced micro-volume direct-Polymerase Chain Reaction (PCR) STR profiling. Detectable amounts of human DNA were obtained in 73% (29/40) of the whole dust bunny samples evaluated. DNA profiles (from one to >30 alleles) were obtained in 55% (standard cycle number) to 98% (increased cycle number) of the 40 dust bunnies examined. While admixed DNA profiles were observed in numerous whole dust bunny samples (particularly with increased cycle numbers), highly probative single-source DNA profiles (random match probabilities $>10^6$) were recovered in ~25% of the samples.

The use of enhanced micro-manipulation collection techniques and direct micro-volume DNA profiling from individually isolated bio-particles recovered from within the dust bunnies was evaluated (11 samples tested). DNA profiles were successfully recovered from all dust bunnies examined, with profiles ranging in quality and number of alleles. From the more than 600 bio-particle samples evaluated, DNA profiles (from one to >30 alleles) were obtained in ~30% of the bio-particles tested. This enhanced analysis also resulted in the recovery of mainly single-source DNA profiles (97% of the samples tested) with multiple donors identified in some specimens.

The results of these studies demonstrate that human DNA of sufficient quantity and quality can be recovered from household dust (i.e., dust bunnies). The use of DNA profiles in combination with micro-chemical analysis of the non-biological material in dust bunnies should permit an identification of the room from which it originated as well as the occupier(s) of the room.

Household Dust, Dust Bunny, STR Analysis