A98 The Effects of Ionizing Irradiation on Liquid, Dried, and Absorbed DNA Extracts With and Without Preservatives

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After attending this presentation, attendees will become familiar with the possible effects of ionizing irradiation on samples of DNA extracts that are shipped or stored in various tube types and absorbed on storage papers.

This presentation will impact the forensic science community by presenting data intended to assist in the decision process of storing DNA extracts at ambient temperatures.

The stability of extracted DNA samples has been and continues to be the subject of much discussion and research. Storage conditions for DNA extracts range from frozen to ambient with ambient storage being the "green" method of choice. In addition to storage methodologies, issues associated with the shipment of extracted DNA samples should be considered. After the events of September 11, 2001, the ways packages are handled during shipping and upon receipt have changed.

This study was designed to examine the effects of various shipping scenarios on extracted DNA samples at two different DNA concentrations: 2ng/µL and 200pg/µL. DNA samples were shipped as: liquid in tubes, dried in tubes, dried with a preservative in tubes, dried stains on FTA paper, and dried stains on 903 paper with or without a preservative used during the drying process. Three different storage tubes were tested: perfluoroalkoxy fluoropolymer (PFA), polypropylene, and medical-grade polypropylene. Control samples of all test materials were held at laboratory ambient temperature (≈ 21°C), and refrigerated at 2°C to 8°C. Sets of shipping test materials were exposed to one of the following scenarios: (1) high dosage X-ray irradiation; (2) commercial carrier from Gaithersburg MD to Quantico VA where they received low dose X-ray irradiation and were then returned by way of a commercial carrier to Gaithersburg MD; and, (3) commercial carrier from Gaithersburg MD to Seattle WA and back. All materials are being evaluated at NIST using qPCR quantitation and Short Tandem Repeat (STR) testing. STRs are first evaluated using commercial 16 loci genotyping kits; if the larger STR loci in these kits fail to yield results, samples are evaluated using a commercial "miniSTR" kit.

In scenario one, DNA packs were added to containers of mail and processed at an industrial facility using an x-ray beam generated with energy of 5 MeV and a beam current of 23 mA. The mail containers were either trays of letters or tubs of magazines. The trays and tubs were filled into large metal totes and passed through the x-ray beam four times to achieve the target dose level. The radiation exposure resulted in the packages experiencing temperatures exceeding 57°C for 20 min to 30 min. In scenarios two and three, packages were shipped at ambient in late April to early May 2011.

The effect on liquid DNA extracts in tubes varied widely, regardless of how they were treated. Even in ambient storage, the samples in medical-grade polypropylene tubes completely evaporated or were greatly reduced in volume. The other tube types were better at maintaining volume but all were completely dried by the high irradiation and/or temperature in scenario one. Because of this volume loss, all "liquid" samples are reconstituted to their original volumes prior to qPCR and genotyping. Full STR profiles were obtained with all ambient stored materials and the scenario two samples.

The results of direct amplification of the samples absorbed on either FTA or 903 papers were variable. Even in ambient storage, no full STR profiles were obtained with either paper at the low DNA concentration. FTA paper yielded partial profiles for the high DNA concentration samples at ambient storage whereas the 903 paper and 903 with preservative generally yielded full profiles.

Quite variable qPCR quantitation STR typing results have been obtained for the highly irradiated samples of scenario one. MiniSTRs yielded degraded profiles for some but not all of these samples, with typing results improving with increasing qPCR-estimated DNA quantity.

Short Tandem Repeats (STRS), DNA, Ionizing Irradiation

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