A138 Comparison of Quantity and Quality of DNA Recovered From Simulated Arson Cases in Which Burn Temperatures and Conditions Were Varied

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After attending this presentation, attendees will learn the results of systematic experiments performed using controlled burns with pig ribs to determine the quantity and quality of DNA recovered from simulated arson cases in which burn temperatures and conditions were varied. An open flame and convection oven were used for varying times for the controlled burns to simulate potential cases resulting from an accidental fire, arson fire, or a mass disaster event. The quality and quantity of DNA were assayed using UV-Vis spectroscopy, agarose gel electrophoresis, and real time PCR. In particular, each one of these conditions results in different burn rates and final temperatures and differentially affected the quality and quantity of DNA recovered.

This research will impact the forensic science community by providing systematic data that can be used in evaluating and collecting samples in cases of accidental fire, arson, and mass disaster. Agarose gel electrophoresis and UV-Vis spectroscopy methods allow an investigator to determine the presence and quality of DNA samples recovered from the crime scene using rapid and non-destructive techniques and real time PCR is a well-respected amplification and quantification technique for a final quality and quantity analysis. The determination of which samples provide quality DNA in terms of amplifying a short autosomal STR fragment in comparison to those that yield no detectable DNA may help the investigator to decide which samples to collect and package for further DNA processing and which are less likely to produce results.

The use of DNA to identify human remains after an accidental fire, arson fire, or even a mass disaster has become a cornerstone in the forensic community. This presentation involves two different ways of burning pig tissue and bone and will demonstrate how each one can have a unique effect on the recovery of DNA. When dealing with arson victims and the need to identify burned remains, it has not been confirmed when autosomal and mitochondrial DNA typing should be used. There is a definitive window of time, dependent upon the heat of the flame and the length of the burn, when autosomal STR analysis of DNA can be used to identify a burn victim. In this research, the goal was to answer at what temperatures and burn times would DNA become unrecoverable and unusable for identification purposes based on quality and quantity determinations.

The research described in this presentation includes both the detailed systematic methods constructed in this study and answers to the questions posed by concluding the results of each controlled burn including both agarose gel (1%) electrophoresis and UV-Vis spectroscopy (260/280 nm ratio) results. Standard DNA extraction techniques (phenol/chloroform) were utilized using food-grade pig muscle as purchased from the supermarket. In order to determine the effect of burn temperatures and conditions on DNA, one large rack of pork ribs was divided evenly, massed, and each approximately 10 gram piece was analyzed individually. The samples were burned using an open flame using a Bunsen burner (average temperature 526ºC for 25 minutes) and a conventional oven (287ºC for 20, 30, 35, and 40 minutes). The temperatures were evaluated using a Traceable Workhorse Thermometer with Type-K probe. Control samples of unburned pig ribs were also assayed; negative controls were reagent blanks. Three replicate samples were collected for each burn temperature and time including material from the the top, middle, next to bone, and bone marrow. Agarose gel electrophoresis results for the open flame burn revealed that all the DNA recovered from the top was degraded and the bone marrow samples had the highest quantity of DNA. The results from the 20 minute oven burn revealed that there was very little to no DNA from the top and small amounts of degraded DNA from the middle, next to bone, and bone marrow samples as assayed by agarose gel electrophoresis. The 30 minute oven burn revealed no DNA except for a faint smear in the gel from the bone marrow sample. The 35 and 40 minute oven burns revealed no visible DNA recovery from agarose gel electrophoresis using SYBR Green dye for any of the samples. The 40 minute oven burn yielded mostly calcined bone that easily cracked and demonstrated full penetration of the burn for the small samples although the flesh was not completely burned off. The quality of the extracted DNA after the burns was degraded as indicated by the further migrating fragments at the longest burn time indicating smaller and more degraded DNA and low UV-Vis quality values. The longest burn times yielded no detectable DNA post-extraction from the UV-Vis spectroscopy and gel electrophoresis techniques. Overall, as expected, the surface DNA was most degraded and had the lowest recovery, although the oven burn by 35 minutes demonstrated full degradation. Since the flesh was removed from the pig muscle, the short burn times were sufficient to fully burn the 10 g meat and bone in the 35 and 40 minute oven burns. Real time PCR is being used to extend these results and determine whether the extracted DNA can be amplified to the length of a 308-bp fragment using pig- specific primers and better quantify the recovered DNA.

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