



BIOLOGY RESEARCH

Effects of Latent Print Technology on PCR DNA Analysis

By Colleen Walls
Howard Community College
Internship with Maryland
State Police Crime Laboratory
March 21, 1997

Introduction:

When one of America's most famous football legends, O.J. Simpson, was tried for the murder of his ex-wife, Nicole Brown Simpson, in a very publicized case, it became apparent how important forensic science is in a criminal investigation. With today's sophisticated technology, it is very evident that crimes are often not resolved by skilled investigators alone, but with the assistance of forensic scientists. Although forensic science employs experts in many different fields of study, such as latent print, toxicology, ballistics, and serology, they must all work together to insure the integrity of their results. For instance, a bloody fingerprint left at a crime scene may need to undergo an examination by a latent print expert. This type of examination often requires the use of specialized chemicals to enhance the detailed ridge patterns that are necessary to make a positive identification. However, this may cause a conflict of interest if the identical blood sample is needed for DNA analysis to determine whether the blood belongs to the suspect or the victim. As a result, blood that is used for DNA analysis can be contaminated with chemicals used to detect latent prints.

In 1993, a study conducted by the Institute of Environmental Health & Forensic Science in Auckland, New Zealand, suggested that certain chemicals used to detect latent fingerprints could compromise test results obtained through RFLP (restriction fragment length polymorphism) DNA analysis. The study indicated that accurate results could not be obtained from some of the samples because the DNA in those samples had been either degraded or destroyed by specific chemicals used to observe latent prints. However, since then the more advanced technique of PCR (polymerase chain reaction) DNA analysis has been developed and is now being utilized to obtain accurate results from a lower quality of DNA. This means that perhaps some of the chemicals that were once thought to compromise DNA

samples for RFLP testing might not have the same effect on samples that are being examined using the PCR technique. For instance, in a recent interview Melissa Lostracco, a forensic chemist at the Maryland State Police Crime Lab in Pikesville, MD, explained that in February, 1996 she received a piece of evidence that contained a bloody shoe print that had already been saturated with amido black, a chemical used to detect latent prints. Lostracco claimed that at the time it was believed that the DNA in the blood had either been destroyed or degraded by the amido black and that accurate results could not be obtained. However, she decided that she would go ahead and try the PCR procedure of DNA analysis. Remarkably, she discovered that the DNA in the samples had not been destroyed or degraded by the amido

black and that she could acquire valuable and accurate results using PCR.

With the new technology of PCR, the ability of many of these chemicals to degrade or destroy DNA in samples is to a large extent unknown. This study investigates whether accurate results can be obtained from PCR DNA analysis using blood samples that are contaminated with chemicals used in latent print technology.

Method & Materials:

This study was performed by using a sample of blood drawn from a known subject. This sample of blood was then used to place 2-3 small bloody fingerprints, about the size of a dime, on several different types of substrates. The remaining blood



Announcing Week-long Training Courses

“Mastering Expert Testimony”
“Crime Scene Processing”
“Advanced Ridgeology Comparison Techniques”

- Other classes being scheduled
- Call for details and registration forms
- Host agency inquiries invited

*Wanted: additional
experienced
instructors.
Call us with your
class details.*



FORENSIC IDENTIFICATION
TRAINING SEMINARS, Ltd.

Forensic Identification Training Seminars, Ltd.

1230 Hoyt Street SE, Salem, Oregon 97302-2121

Tel. 503-363-6962 or 888-235-1230

FAX 503-588-03-98 or 800-588-03-99

e-mail redwop@compuserve.com

was then used as a control sample to ensure that the results obtained from the PCR DNA analysis were accurate enough to make a match with the original sample.

After bloody fingerprints had been placed on all of the substrates each of them were labeled and treated with a particular chemical process used in latent print technology. Each of these procedures were implemented using techniques cited in the "Latent Print Unit Standard Operating Procedure Manual" at the Maryland State Police Crime Lab.

The substrates and latent print procedures that were examined in the study included:

SUBSTRATE: Paper
CHEMICALS: Ninhydrin, Magnetic Powder, DFO

SUBSTRATE: Glass
CHEMICALS: Black Powder, Amido Black, Cyanoacrylate

SUBSTRATE: Hard Plastic Cap
CHEMICALS: MBD, Gentian Violet, Fluorescent Powder, Cyanoacrylate

SUBSTRATE: Wood
CHEMICALS: Amido Black, Gentian Violet, Ninhydrin

SUBSTRATE: Clear Plastic Bag
CHEMICALS: Cyanoacrylate, Black Powder

SUBSTRATE: Paper Currency
CHEMICAL: Physical Developer

SUBSTRATE: Metal Soda Can
CHEMICALS: Amido Black, Cyanoacrylate, Black Powder

After all of the substrates had been processed for latent prints, they were submitted to the serology lab at the Maryland State Police Crime Lab in Pikesville. Once the samples were submitted, Cathy Braunstein, a forensic chemist, performed PCR DNA analysis on all of the samples. During this procedure both organic extractions and chelex extractions of DNA were implemented on all of the samples.

Results & Discussion:

As expected, results obtained from this study suggest that reliable results from PCR DNA analysis, using organic extractions, can be obtained from blood samples that are exposed to the chemicals used in this experiment. In addition, the results from this study also signify that, when using chelex extractions of DNA, that most of the chemicals used in this experiment did not compromise the results of the PCR DNA analysis. These results were anticipated because the newer technique of PCR DNA analysis does not require the DNA in the samples to be of a high quality in order

to acquire accurate results. However, contrary to expectation, this study did indicate that blood samples treated with physical developer may compromise the integrity of results obtained from PCR DNA analysis when using chelex extractions of DNA. This finding was very unexpected due to the fact that accurate results were obtained from the same sample using an organic extraction of DNA. When examining both the slot blot and the product gel of this sample, it appears that the DNA in the sample did not successfully amplify. These factors indicate that a component in the chelex extraction caused a problem in the amplification process of the DNA. A possible reason why the DNA successfully amplified when using an organic extraction and not when using a chelex extraction may be due to the way the chemicals in the physical developer reacted with the chemicals in the chelex beads. These beads work by removing all metal ions that act as

cofactor for enzymes that degrade DNA. The chemicals involved with physical developer may have reacted with the chelex beads and deactivated them. If this occurred, then there is a possibility that enzymes degraded the DNA beyond the point in which it could be successfully amplified. A way to further examine this possibility would be to perform another chelex extraction on a duplicate sample, using increased amounts of chelex.

Although the forensic scientists of the many different fields of study must still work together to ensure the integrity of their results, this research will undoubtedly assist them in cases when evidence must undergo both DNA analysis and a latent print examination. In any case, this study clearly illustrates the advantage that PCR DNA analysis offers over RFLP DNA analysis when samples have been contaminated with particular chemicals used in latent print technology. ■

DNA EXTRACTION AND PM/HLA-DQA1 AMPLIFICATION OF CHEMICALLY TREATED BLOODY FINGERPRINTS

Substrate	Chemical	Chelex Extraction	PM/HLA-DQA1 Amplification	Organic Extraction	PM/HLA-DQA1 Amplification
<i>paper</i>	ninhydrin	✓	☺	✓	☺
	magnetic powder	✓	☺	✓	☺
	DFO	✓	☺	✓	☺
<i>glass</i>	superglue	✓	☺	✓	☺
	black powder	✓	☺	✓	☺
	amido black	✓	☺	✓	☺
<i>plastic bag</i>	superglue	✓	☺	✓	☺
	black powder	✓	☺	✓	☺
<i>wood</i>	amido black	✓	☺	✓	☺
	gentian violet	✓	☺	✓	☺
	ninhydrin	✓	☺	✓	☺
<i>money</i>	physical developer	✓	☹	✓	☺
<i>hard plastic</i>	MBD	✓	☺	✓	☺
	superglue	✓	☺	✓	☺
	fluorescent powder	✓	☺	✓	☺
	gentian violet	✓	☺	✓	☺
<i>metal can</i>	amido black	✓	☺	✓	☺
	superglue	✓	☺	✓	☺
	black powder	✓	☺	✓	☺