# Identification of finger prints, blood and dna

# INTRODUCTION

Forensic science is widely used in the service of the justice system (Jackson). It has helped in solving cases by providing important clues and evidences. The usage of forensics in solving crime cases is inevitable. Forensic sciences is used in various areas like fingerprinting, DNA profiling, blood stain detection and many more.

From the early days of complicated body measurements to today's sophisticated biometric devices, the identification of individuals by their bodies has been a mainstay of government and law enforcement. Computerized databases like AFIS now make it possible to compare thousands, or in the case of the FBI, millions of fingerprints in minutes.

With the advancements in DNA detecting mechanisms, blood stains in the scenes of crimes have also become one of the most important evidences. After a homicide or an assault has been committed, police investigators usually find blood at the scene of the crime. This gives them clues as to what happened during that incident. The blood's texture and shape and how it is distributed around the victim often help investigators determine when and how the crime was committed. A number of techniques have been developed for the identification of fingerprints and blood stains in the crime scene.

# EVOLUTION IN FINGERPRINTING TECHNIQUES:

In the mid-1950s fingerprinting was done using the dangerous mercury-based white powder, a coarse graphite-based black powder and squirrel-hair brushes.

With a burst of innovation concerning fingerprint evidence as part of the crime investigation, ninhydrin test was developed. This method is extremely efficient on paper items, especially if the stock solution is added to fluorisol, which prevents writing on the paper from smudging. Ninhydrin reacts with the amino acids in perspiration, producing red, brown, or purple imprints; this is a most successful method of investigating check fraud.

During the last decade, other techniques for discovering latent imprints have been developed. These include Super Glue, physical developer, small particle reagent, lasers, metal deposition, Sudan black, amido black, thermoplastic fingerprint powders and radioactive sulfur dioxide. Exceptional powders are available with greatly improved fingerprint brushes to help lots in fingerprinting. DFO is a recent improvement on ninhydrin, providing up to 300% more finger and palm imprints.

One other advancement in this area is the use of photoluminescence. Fingerprint luminescence excitation initially used lasers, but filtered lamps are employed as well. This technology helps the forensic scientist to take a picture of the fingerprints immediately at the crime scene.

Computers are now used throughout the world for maintaining and searching files of imprints and fingerprints of offenders found at crime scenes. Computer searches of crime scene imprints provide excellent results. The computer blasts through complete collections at fantastic speed, possibly scanning millions of digits, but there is no promise that the offender who made the imprints is not in the collection if identification is not made. Bio-

metrics especially fingerprints has become one of the main areas of research.

## EVOLUTION IN BLOOD STAIN DETECTION TECHNIQUES:

Blood is one of the most common physical evidences which is present in murder cases, accidents and violent crime investigations. A determination must be made if it really is blood. Eventhough there have been various tests to detect the presence of blood, the widely used tests are Kastle-Meyer test and the Luminol Test.

Luminol is first activated with an oxidant, usually a solution of hydrogen peroxide and a hydroxide salt in water. Then, in the presence of a protein present in blood called hemoglobin, the hydrogen peroxide decomposes to form oxygen and water. Luminol reacts with the hydroxide salt, leading to the formation of a dianion. The oxygen produced from the hydrogen peroxide then reacts with the luminol dianion. This reaction produces an organic peroxide, which is very unstable and hence it immediately decomposes with loss of nitrogen to produce 3-aminophthalic acid (3- APA) in an excited state. As 3-APA relaxes, it releases a visible blue light. Luminol is sensitive to the presence of extremely small amounts of blood. It can detect bloodstains that have been diluted up to 300, 000 times.

The KM Test is a presumptive test which is used to check the presence of hemoglobin using phenolphthalein’s color change in the presence of oxygen.

# ANALYSIS AND INTERPRETATION OF DATA:

# FINGER PRINTING

## THEORY:

Fingerprints often leave residues of oils in the shape of the friction ridges. However, the friction ridge skin does not secrete oils. Some fingerprints will leave a residue of amino acids and other compounds. These principles make ‘ dusting’ techniques to develop fingerprints. (Finger print Powder- Wikipedia the free encyclopedia)

## CLASSIFICATION OF FINGER PRINT PATTERNS:

The following table contains the finger print patterns for the fingers and toes:

Right Hand:

- Thumb: Whorl
- Index Finger: Whorl
- Middle Finger: Loop
- Ring Finger: Whorl
- Small Finger: Whorl

Left Hand:

- Thumb: Arch
- Index Finger: Whorl
- Middle Finger: Loop
- Ring Finger: Loop
- Small Finger: Loop

The toe prints are all arch expect for the ring toe in the right leg which is whorl.

The fingerprints using ink pad for the fingers and toes can be found in Annex C.

## DIFFERENCE IN PATTERNS BETWEEN FINGERS:

The pattern in all the fingers except the left thumb is whorl. This might be the case because the environmental factors within the fetus would have been same for the fingers and hence there is not much change in the pattern between the fingers.

## DIFFERENCE BETWEEN HANDS AND TOES:

The finger prints in the hands are very easy to identify when compared to the toes. This is because the fingers are big enough for us to deposit the prints properly. However, the legs are small and since we don’t use them like fingers it is very difficult to deposit it even while using the ink pad. Since the whole body’s pressure is on the toe, too much of pressure was applied on the paper by it. Hence the prints weren’t clear.

## DIFFERENCE BETWEEN OLD AND NEW PRINTS:

The old prints are not as bright as the new prints. The old print gets exposed to the atmosphere and hence they react with the air. Hence parts of the print vanish. Hence it is not as evident as the new print. However, the old prints is good enough for matching 16 positions on the finger print and thus easy to the catch the criminal.

The old big toe prints deposited wasn’t seen when developed by both the magnetic powder as well as the black powder. This is because the print wasn’t deposited properly. Too much of sweat on the print made the prints

to be smudged when the powders where used to detect their presence. Hence the prints were seen very faintly.

## DIFFERENCE BETWEEN METHODOLOGIES:

The black powder had to be done very carefully since two much of powder made the finger prints to smudge. The magnetic powder was easy in a way because excess magnetic powder could be removed easily. However, the dusting had to be done slowly and such that that the brush wasn't too close to the finger print in order to get the print properly. The ninhydrin test was very easy because we didn't have much to do for it. However, many of my friend's prints were pale. This might have been because they didn't apply enough pressure on their papers when they deposited the prints.

Since I had applied so much moisture, the finger prints smudged badly and the prints weren't clear. Hence I had to repeat the process again. However, the next I exerted too much pressure on the paper which made the fingers to sweat too much leading to smudging. Also the amount of time given to register the finger prints was too less.

Out of the three methodologies used in this lab I find the ninhydrin solution test to be the most efficient one. This is because for because the human influence in this method was very less. Since we were beginners in this lab, we didn't have a proper idea of how much powder had to be used for these methods.

Thus I prefer the ninhydrin solution method for fingerprinting especially for beginners.

### FINGER PRINT LIFTING:

The dusting for finger printing lifting was done using the magnetic powder since excess powder could be easily taken away. However, when I lifted it the first time, a lot of air bubbles where formed which made half of the finger prints to vanish. Also since I had not given enough time for my finger prints to settle the prints weren't clear when dusting.

Hence I tried to avoid these when I lifted the second time. I pressed gently and allowed the prints and gave some time so that the prints to settle. While using the tape I made sure there were no bubbles. Hence I was able to lift a proper print of my right thumb finger using the lifter.

## IDENTIFICATION OF BLOOD STAINS:

### THEORY:

The Kastle-Meyer test is a forensic presumptive test which is used to examine if the dried stains in a violent crime scene is composed of blood. The test is based on the peroxide-mediated oxidation of reduced phenolphthalein. In this reaction the heme molecule acts as a catalyst.

The chemical indicator used in this test is phenolphthalein $C_{20}H_{14}O_4$, a common acid-base indicator which turns pink, in basic solutions with a pH of approximately 8 or higher.. Phenolphthalein, a clear dye, immediately turns pink if oxidized by hemoglobin and hydrogen peroxide.

There are three reagents involved in this test. To increase the sensitivity of the test the reagent, Methyl or Ethyl alcohol is used. It does this by " cleaning up" the area in and around the bloodstain to better expose the hemoglobin. Phenolphthalein, the second reagent acts as a color indicator.

This solution when oxidized (exposed to oxygen), turns pink. Hydrogen Peroxide is the 3% form typically found in drugstores. Hydrogen peroxide is essentially water with an extra oxygen atom attached to it. These chemical reactions are further stated using the following equations:

This test is nondestructive to the sample. Hence the sample can be kept and used in further tests at the lab. This test has the same reaction with human blood and animal blood. So, further investigation is required to determine whether it is human or animal blood.

## ANALYSIS:

The blood stain turned pink instantly after adding all the three reagents stating the presence of blood.

When the reagents where added to copper powder, it turned pink even before the addition of the hydrogen peroxide showing giving a false result . Thus it is vitally important to add the reagent first, then wait a few seconds, then add the hydrogen peroxide.

Ketchup didn’t change at all showing the absence of hemoglobin. Whereas, cabbage solution turned yellow.

Beetroot and ribena solutions turned colourless due to their neutral nature with very very slight pink tinge occurring due to their natural colour.

Hence except for copper there weren’t any false positive tests in the samples which were recognized.

**LIMITATIONS:**

Eventough Kastle-Meyer test can detect blood upto dilutions of 1: 107, there are many limitations for this test. In the presence of vegetable peroxidases, like in horseradish, broccoli, cauliflower, etc. the test gives a false positive result. Oxidizing species present in the sample also causes this test to fail. (Kastle-Meyer test: Limitations)

For example when this test was performed for copper powder the Kastle-Meyer reagent turned pink even before hydrogen peroxide was added to it. Thus it is very much important that we wait for a few seconds after the reagent is added and then only we need to add hydrogen peroxide.

The Kastle-Meyer test gives positive results to both human blood as well as animal blood. In general, it gives a positive result to all hemoglobin containing blood.. In order to ensure that the blood is really from a human species, a confirmatory test such as the Ouchterlony Test is performed. (Kastle-Meyer test: Limitations)

In short, color catalytic tests are very sensitive in nature. The negative results from these tests show that these samples do not hemoglobin and so it is not blood. However, the positive results need not be correct in all cases. It is noteworthy to mention here that false positive tests occur due to the presence of a reducing agents, animal blood, peroxidases and many more. (Kastle-Meyer test: Limitations)

# FINGER PRINT PATTERNS IN IDENTICAL TWINS:

When a fertilized egg splits into two, it leads to a development of two embryos. This leads to the development of Identical twins. Since the twins are formed from the same egg, their DNA is identical.

The interactions between the environment in the fetus and the genes, plays an important role in the fingerprints and the appearance of a person. The environmental factors include blood pressure, nutrition, etc. (Twins Fingerprints: Identical Twins and fingerprints) The genes thus play an important role in depicting the fingerprint patterns in humans. The skin of the finger is in contact with various parts of the fetus and anionic fluids in the uterus. The interactions between the fingers and these parts changes due to the movement of the fetus and the mother. Thus this microenvironment plays an important role in the details of the fingerprint patterns. (Why Identical Twins have Di)

Though there are only minimal changes in the environment, the differentiating cells make the differences in the fingerprint pattern to be seen evidently. All these reasons make fingerprint patterns in the twins to be different. This also makes fingerprints between the finger and the toes from being the same. (Why Identical Twins have Di)

Eventhough after birth, identical twins just look the same they also have a few physical differences for e. g. moles which help in distinguishing one from the other. These physical differences amplify day by day and become greatly evident.

# CONCLUSION:

Fingerprinting by dusting and ninhydrin solutions help in lifting them properly. It makes sure that none of the fingerprints in the crime scene is unnoticed. However, it is important to note that these techniques should be done only by people who are very experienced.

Kastle-Meyer test helps in identification of blood stains but it also gives false positive tests. Hence the samples should be analyzed once again to check the presence of blood in it.

The lab was very enriching and gave a true picture of what is done by forensic scientists at the crime scene.