CHAPTER I

INTRODUCTION

Fingerprint are impression made by the papillary ridges on the ends of the fingers and thumbs. Fingerprints afford an infallible means of personal identification, because the ridge arrangement on every finger of every human being is unique and does not alter with growth or age. Fingerprints serve to reveal an individual's true identity despite personal denial, assumed names, or changes in personal appearance resulting from age, disease, plastic surgery, or accident. The practice of utilizing fingerprints as a means of identification is referred to as dactyloscopy, is an aid to modern law. Each ridge of the epidermis (outer skin) is dotted with sweat pores for its entire length and is anchored to the dermis (inner skin) by a double row of peglike protuberances, or papillae. Injuries such as superficial burns, abrasions, or cuts do not affect the ridge structure or alter the dermal papillae, and the original pattern is duplicated in any new skin that grows. Any ridged area of the hand or foot may be used as identification. However, finger impressions are preferred to those from other parts of the body because they can be taken with a minimum of time and effort, and the ridges in such impressions form patterns (distinctive outlines or shapes) that can be readily sorted into groups for ease in filing. Fingerprints are classified in a three-way process: by the shapes and contours of individual patterns, by noting the finger positions of the pattern types, and by relative size, determined by counting the ridges in loops and by tracing the ridges in whorls. The information obtained in this way is incorporated in a concise formula, which is known as the individual's fingerprint classification.

Fingerprint classification systems included the Roscher System, the Juan Vucetich System and the Henry Classification System. Henry Classification System developed in India and implemented in most English-speaking countries. In the Henry Classification System there are three basic fingerprint patterns: loop, whorl, and arch, which constitute 60–65 percent, 30–35 percent, and 5 percent of all finger prints respectively .There are also more complex classification systems that break down patterns even further, into plain arches or tented arches, and into loops that may be radial or ulnar, depending on the side of the hand toward which the tail points. Ulnar loops start on the pinky-side of

the finger, the side closer to the ulna, the lower arm bone. Radial loops start on the thumbside of the finger, the side closer to

radius. Whorls may also have sub-group classifications including plain whorls, accidental whorls, double loop whorls, peacock's eye, composite, and central pocket loop whorls. Fingerprints are made of series of ridges and furrows on the surface of a finger; the loops, whorls, and arches formed by those ridges and furrows generally follow a number of distinct patterns. Fingerprints also contain individual characteristics called “minutiae,” such as the number of ridges and their groupings that are not perceptible to the naked eye. The fingerprints left by people on objects that they have touched can be either visible or latent. Visible prints may be left behind by substances that stick to the fingers—such as dirt or blood—or they may take the form of an impression made in a soft substance, such as clay. Latent fingerprints are traces of sweat, oil, or other natural secretions on the skin, and they are not ordinarily visible. Latent fingerprints can be made visible by dusting techniques when the surface is hard and by chemical techniques when the surface is porous.

A number of factors associated with the donor such as sex, age, diet, and type of disease, medication, and the presence of contaminants on the surface of the fingertips affect the chemical composition of latent finger impressions. Chemical composition of the latent residue further changes with the passage of time due to the evaporation of its volatile constituents, action by microorganisms, and exposure to heat, light, moisture, and air. Different kinds of optical, physical, and/or chemical methods are routinely used to visualize latent fingerprints. Optical methods utilize electromagnetic radiation of appropriate wavelengths to visualize latent fingermarks and are nondestructive in nature. The latent finger impressions are developed by physical methods involving physical interaction with deposits of impressions.

Chemical methods can be used to develop the latent fingerprints by converting any particular constituent of sweat into a colored derivative. These methods can be used alone or in combination with others to enhance the visibility of developed prints. In general, there are four classes of fingerprint powders-regular, luminescent, metallic and

thermoplastic. In the past, powder dusting, ninhydrin dipping, iodine fuming and silver nitrate soaking were the most commonly used techniques for latent print development. The selection of the processing method depends on a number of factors and includes

nature (porous, and nonporous), texture (smooth and rough), condition (dry and wet), and color of the surface on which the latent fingermark is impinged. The success of detection method also relies on aging of the deposits.

Different powder methods have been accounted for the development of latent fingerprints on various surfaces in the literature such as lead, titanium oxide, Rhoda mine B dye etc., are used to development of latent fingerprints. In general, there are four classes of fingerprint powders-regular, luminescent, metallic and thermoplastic. In the past, powder dusting, ninhydrin dipping, iodine fuming and silver nitrate soaking were the most commonly used techniques for latent print development.

The vigilance of finely separated material and sub-sequent clear the extra powder by tapping, blowing and brushing has been regular method of development of latent fingerprint on nonporous surface since early days of latent fingerprint development . The latent fingerprint development technique using powder method relies on mechanical adherence of powder to the moisture and liquid components of the skin ridges. Regular latent fingerprint development powders consist resinous polymer for adhesion and colorant for contrast, the regularly used adhesives are kaolin, rosin, starch and silica gel and colorants are may be organic or inorganic derivatives.

Fingerprints have a great significance in the criminal justice realm. Investigators and analysts can compare unknown prints collected from a crime scene to the known prints of victims, witnesses and potential suspects to assist in criminal cases. Fingerprints can link a perpetrator to other unsolved crimes if investigators have reason to compare them, or if prints from an unsolved crime turns up as a match during a database search. Sometimes these unknown prints linking multiple crimes can help investigators piece together enough information to zero in on the culprit. In the absence of DNA, fingerprints are used by the criminal justice system to verify a convicted offender's identity and track their previous arrests and convictions, criminal tendencies, known associates and other useful information. Officers of the court can also use these records to help make decisions regarding a criminal's sentence, probation, parole or pardon. In addition they are used for providing biometric security (for example, to control access to secure areas or systems).

CHAPTER II

LITERATURE REVIEW

M .Edwin O'Neill(1931-1951) published his article of "Fingerprint in Criminal Investigation" in the "Journal of Criminal law and Criminology. Vol .30.No.6 (Mar-Apr, 1940). It explains about the definition and the types of fingerprints according to Henrys classification. Ridge characteristics are discussed which are essential for individualization. Latent finger prints, the most frequently encountered impressions and their fidelity depends on number of factors: the cleanliness of fingers, amount of secretions, degree of pressure, and nature of the object touched etc. The processes for developing fingerprints are numerous and many different materials are employed to "bring out" invisible impressions. Various finely divided colored powders and certain vapors and liquid reagents are utilized on relatively absorbent materials. Most commonly used powders as developers are black powders like lampblack and charcoal on light surfaces and white powders like aluminum dust on dark surfaces. The processes and procedures which are followed during the development were discussed in detail and the proper methodologies used for collecting the evidence.

Egyptian Journal of Forensic Science on 2011 published an article "A new technique for visualization of latent fingerprints on various surfaces using powder from turmeric; A rhizomatous herbaceous plant(Curcuma longa)" authored by RakeshK.Garg,

Harishkumari, Ramanjitkaur .In this paper a less expensive, simple, and easily available, turmeric powder a common ingredient in Indian food ,has been used to decipher the latent fingerprints on nine different substrates. Ordinary brushing method is avoided as they cause the disadvantages of destruction of the prints some times due to the contact of brush with the surfaces. Standardized grinded fine powder is sprinkled over the surfaces and then the excess powder is removed by simple tapping in order to get a clear print. Later onwards comparatives studies were also conducted on this.

Harish Kumari and Rakesh K.Garg authored their article of "New visualizing agents for latent fingerprints: Synthetic food and festival colors" at Egyptian Journal of Forensic science on September-December 2011.This paper presents new powdering methods (synthetic food and festival color – gulal) for the development of latent fingerprints on

different substrates as preliminary studies. It has been observed that the application of colors to latent finger prints gives clear results particularly on aluminum matrices. It further indicate that latent fingerprints formed from sebum can be developed more easily and clearly on these surfaces (normal paper, aluminum foil, top surface of CD and aluminum sheet) with the help of food colors used in the study i.e. lemon yellow, orange red and green.

On November 2012 Kulvir Singh, Sahil Sharma and Rakesh K. Garg introduced their article on "Visualization of latent fingerprints using Silica Gel: A new technique" and this got published in Egyptian Journal of Forensic Science in 2013. There are various methods are available for the development of latent fingerprints on different substrates .In this study ,a less expensive, simple and easily available ,silica gel G powder (usually used in TLC plate preparation) has been used to develop fingerprints on both porous and non-porous substrates. Silica gel G powder is a form of silicon dioxide with the binder gypsum. At the surface of the silica gel, the silicon atoms are joined to the polar –OH groups, can form hydrogen bonds with Vander Waals dispersion forces and dipole - dipole attractions .The ordinary brushing method is not used in this work. A physical method of enhancement of latent prints and works on the mechanical adherence of the fingerprint particles to the oily components of the skin ridged deposits.

Egyptian journal of Forensic Science on April 2013 published an article of "A novel method for the development of latent fingerprints recovered from arson simulation" authored by Jasmine Kaur Dhall,G.S.Sodhi and A.K.Kapoor.A diverse range of physical and chemical methods is available for the development of latent fingerprints. But fingerprints exposed to extreme conditions like fire or arson are generally perceived to have been damaged. Electromagnetic radiations, soot depositions and high temperatures are the forces generated in a fire, which may affect the fingerprint at the scene. This study was conducted to determine if fingerprints could be developed after being subjected to an arson /fire scene simulation. Fingerprints on nonporous surfaces were subjected to high temperatures, soot deposition and subsequently treated with water. A novel fluorescent and a pre-existing small particle reagent was investigated for the same.Zinc carbonate based fluorescent small particle reagent was capable of developing latent fingerprints exposed to a maximum temperature of 8000C.

On December 2015 ,Egyptian Journal of Forensic Science published an article on "Efficacy of RobinR powder blue for latent fingerprint on various surfaces". Latent fingerprints are subject to easy damage and destruction owing to their fragile nature. Powder dusting is the easiest and fastest of the methods used for latent fingerprint development(LEPD).In this study RobinRpowderblue, a common household product (used as a post-wash whitening agent and popularly known in India as 'neel') which is user friendly, less expensive, non-toxic, non-hazardous, environmental friendly, simple and easily available substitute to the commercially available and costlier powders, has been used for LFPD. The powders was tested on twenty four strategically chosen surfaces, keeping in mind the high frequency at which they are commonly encountered on various crime scenes.

On December 2015 Egyptian Journal of Science published an article of "Small particle reagent based on crystal violet dye for developing latent fingerprints on non-porous wet surfaces" authored by Richa Rohatgi and A.K.Kapoor.Small particle reagent (SPR) is a widely used method for developing latent fingerprints on non-porous wet surfaces. SPR based on zinc carbonate hydroxide monohydrate, $ZnCo3{\cdot}2Zn(OH)2{\cdot}H2O$ – also called basic zinc carbonate – has been formulated. The other ingredients of the formulation are crystal violet dye and a commercial liquid detergent. The composition develops clear, sharp and detailed fingerprints on non-porous items, after these were immersed separately in clean and dirty water for variable periods of time. The ability of the present formulation to detect weak and faint chance prints not only enhances its utility, but also its potentiality in forensic case work investigations. The raw materials used to prepare the SPR are cost-effective and non-hazardous.

On December 2016, "New developing reagent for latent fingermark visualization: Fuller's earth (Multani Mitti)"were published at Egyptian Journal of forensic science authored by Pallavi Thakurand Rakesh K.Garg. A number of methods have been reported in the literature for the development of latent fingermarks on different surfaces. This paper reports a new and simple powdering method which is non-toxic and has been employed on different substrates successfully for the development and visualization of latent fingermarks up to the time period of 6 days in varying temperature conditions. In this investigation a less expensive, simple and easily available fuller's earth (Multani

Mitti) powder has been used to decipher the latent fingermarks on different substrates namely black cardboard box, clear glass, coverslip box, steel surface, laminated wooden sheet, clear plastic, colored plastic bag and surface of highlighter pen. It is observed that it gives very clear results on majority of substrates and can be successfully used for the development and visualization of latent fingermarks.

Dinesh Baban Kamble, Shriyapandey, Ankithakumara, Dr. Kavitha sharma published their conference paper at February 2018 on" A New Method for The Development of Latent Fingerprint". Different powder methods have been accounted for the development of latent fingerprints on various surfaces in the literature such as lead, titanium oxide, Rhodamine B dye etc. Which relies on mechanical adherence of powder to the moisture and liquid components of the skin ridges. Some of these powders when exposed to human contact leads to health problems and also these methods are expensive in nature. This study proposes a new powder method which is simple, nontoxic, and cheap and can be utilized for fingerprint development on various surfaces. Different colored soils were used for comparative study on various contrast surfaces. This method will explore on different surfaces with various environmental parameters such as temperature and humidity.

HelioL.Barros and Valter Stefani(2019) introduced a new article on "Micro structured Fluorescent powders on Detecting Latent Fingerprints on Different Types of Surfaces". Benzazole dyes have shown great potential for application in different fields of science due to their intense and stable photo luminescence properties, associated with high sensitivity .in this study ,a developed and evaluated micro-structured fluorescent powders based on benzazole dyes for fingerprint detection on different types(porous and nonporous) and colors (dark, white and multicolored) of surfaces .The new micro structured powders were obtained by embedding a small amount of benzazole dye into a silica matrix using an aqueous solution or ethanol under ambient conditions. The photophysical properties were characterized by UV-visible absorption and fluorescence emission spectroscopy. To assess the efficiency of these powders ,comparisons were performed with commercially available black, white and fluorescent powders for different types of surfaces.

CHAPTER III

AIM AND OBJECTIVES

Aim:

To develop the latent fingerprints by using organic powders like Arrowroot powder, coconut Husk coir ash, dried leaf ash on different nonporous surfaces.

Objectives:

- To develop latent fingerprints on various surfaces by using naturally made organic powders.
- To assess the efficiency, comparison performed with commercially available powders and organic powders.
- To formulate organic finger print development powder, which is biodegradable, nontoxic, cheap and eco-friendly.

CHAPTER IV

MATERIALS AND METHODOLOGY

Materials Required:

- **Apparatus**
    i. Gloves
    ii. Fingerprint Brushes (camel feather brush and fiber brush)
    iii. Mask
    iv. DSLR Camera
    v. Magnifying lens
- **Powder**
    vi. Arrow root powder
    vii. Coconut Husk coir ash
    viii. Dried leaf ash powder
- **Surfaces**
    ix. Tiles
    x. Granite
    xi. Aluminium surface
    xii. Glass
    xiii. Switch board surface
    xiv. Steel surface
    xv. Top of a helmet
    xvi. Writing surface of CD
    xvii. Wall

(A) (B)

Figure 1 : Fingerprint brushes – Black (A) White (B)

Methodology

Latent fingerprint were collected from different surfaces such as Glass, tiles, granite, aluminium surface, switch board surface, wall, steel surface and writing surface of CD. The method used for the development is powder dusting.it is a physical method of enhancement of latent prints an works on the mechanical adherence of the fingerprint powder particles to the oily components of the skin ridge deposit. A healthy adult subjects (aged 18–28 years), free from any disease, disorder or pathology of the hand were selected. They were informed about the nature, purpose and method of the study. The subjects were asked to wash and dry their hands clean, to eliminate the possibility of contamination by any extraneous substance, dirt or dust. Keeping the palm in closed position (fist) for around 2 min ensured fair amount of sweating. The participants were then asked to hold/touch the given objects surfaces as they would normally do in daily routine, thereby leaving their fingerprints on them. Three types of organic powders were used for the development:

- **Arrow root powder :** It is made from arrowroot ,a starch obtained from the rhizomes of tropical plant Marantaaur andinacea. A few grams of Arrow root is taken and are cut into several pieces and are dried and then further grind in a blender in order to get a very fine powder to the level of talcum powder but no particle size was measured.
- **Coconut Husk Coir Ash powder:** it is made by separating the useless husks from coconut outer shell and are burnt to collect the black ash. These ashes are then grinded and fined into the level of talcum powder.
- **Dried leaf Ash:** Dried guava leaves were collected and they are burnt into ashes. These are then grinded into fine powder.

The powders so prepared were kept in glass tubes and sealed. These were stored at laboratory conditions. The powders when kept in the open formed the masses probably due to the absorption of water from the atmosphere and on again grinding in the blender formed the same type of powder.The experiments were carried out in the months of January /February when the temperature varied from 250C to 300Cand the relative humidity btween 60% and 80%.Powdering method using a suitable (soft feather) brush has been used, wherein, the powder blue was sprinkled over the surface carrying the latent

fingerprints. Excess powder was removed by gentle tapping and by slowly using the brush in order to get clear prints. As a precautionary measure (to be) routinely followed in forensic practice, hand gloves and face masks were used by the operators. For comparing and verifying the result commercially available powder and organic powders were applied simultaneously on various surfaces and photographs were taken.

Figure 2: Finger print development process

CHAPTER V

RESULTS AND CONCLUSION

Results

From this method for the development of latent finger print, it is advised that these organic powders can be successfully employed as a new powder method on the bulk surface except cotton and skin.

(A) (B)

Figure 3 : Comparison between visualization of latent finger prints on the surface of granite using white powder (A) and arrow root powder (B).

(A) (B)

Figure 4 : Comparison between visualization of fingerprints on glass surface using white (A) and arrow root powder (B)

(A) (B)

Figure 5 : Comparison between latent visualization of latent fingerprints powder (A) and arrow root powder (B) on aluminium surface using white

(A) (B)

Figure 6 : Comparison between visualization of latent finger prints on steel surface using white powder (A) and arrow root powder (B).

(A) (B)

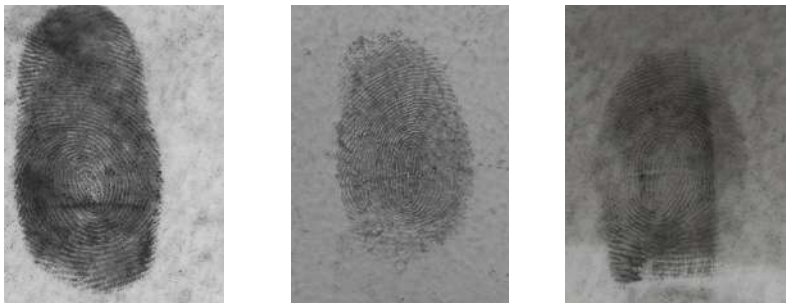
Figure 7 : Comparison between visualization of latent fingerprints on top of a helmet using white powder (A) and arrow root powder (B)

(A) (B) (C)

Figure 8: Comparison between visualization of latent finger prints on a plastic surface (Switch Board) using black powder (A), coconut husk coir ash (B) and dried leaves ash (C).

(A) (B) (C)

Figure 9: Comparison between visualization of latent finger prints on a paper using black powder (A), coconut husk coir ash (B) and dried leaves ash (C).

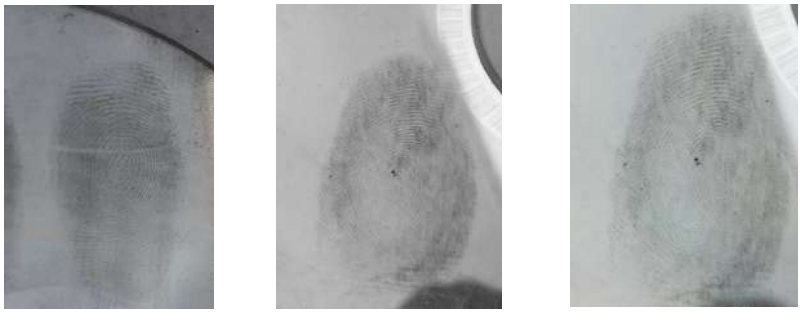


(A) (B) (C)

Figure 10: Comparison between visualization of latent finger prints on a piece of tile using black powder (A), coconut husk coir ash (B) and dried leaves ash (c).

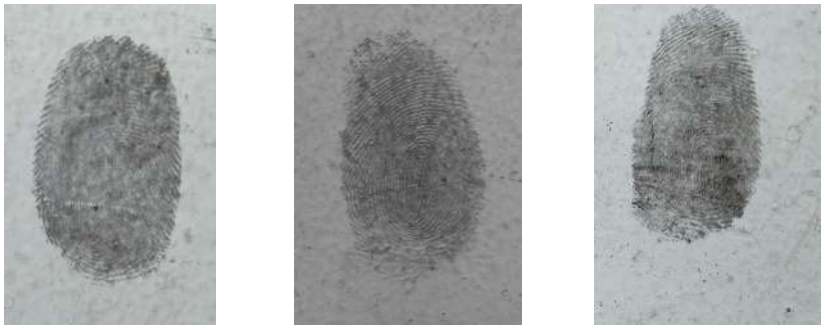
(A) (B) (C)

Figure 11: Comparison between visualization of latent finger prints on a steel surface using black powder (A), coconut husk coir ash (B) and dried leaves ash (C).



(A) (B) (C)

Figure 12: Comparison between visualization of latent finger prints on the writing surface of a CD using black powder (A), coconut husk coir ash (B) and dried leaves ash (C).



(A) (B) (C)

Figure 13: Comparison between visualization of latent finger prints on a wall using black powder (A), coconut husk coir ash (B) and dried leaves ash (C).

Conclusion

Our current study is basically a preliminary observation aimed to bring forth the efficacy of organic powders like Arrow root powder, Coconut husk coir Ash, Dried leaf ash powder for the development of latent fingerprints on various surfaces. It can be concluded from the present study that this commonly available; less expensive; non-toxic powder can be successfully used for the decipherment of latent finger prints. Thorough comparison between commercial powders and organic powders shows some similar exhibitions. It effectively and successfully proves its usefulness in forensic latent fingerprint development.

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