A Preliminary Study on the Use of Organic Ink for Fingerprint Recording

Aayush mehta,
Student of Department of Forensic Science
4th semester,
Kalinga University, Raipur,

Abstract

The fingerprint taking methods are the cornerstone of forensic science. This study aimed to find cheap, safe and readily available alternatives to the traditional ink. The creation and application of fingerprint ink derived from natural sources. These environmentally safe Alternatives pigments and compounds created from natural materials highlight their potential adhesive capabilities for fast fingerprint viewing. In this study we used a porous surfaces like plain paper and non-porous surface like glass for the background for taking and visualization of the fingerprint impression. Various types of ink where made with the help of cucumber peel, bottle gourd peel, tealeaf, coffee, cocoa powder, beetroot.

Keywords

Natural based fingerprint ink, fingerprint recording, non –porous surface, tea leaf ink, cucumber peel ink, bottle gourd peel ink, cocoa ink, coffee ink, porous surface.

Chapter – I

Introduction

The influence of friction ridge pores and skin found at the arms of the hand and soles of the toes is precise to each person and is formed in uterus between the 9th and twenty fourth weeks of embryonic improvement. The fetal embryo experiences particular increase and stress resulting in a completely unique pattern of friction ridge skin for every man or woman, along with same twins. Fingerprints are affected by the increased region of the friction ridge skin. For the reason that past due 1800's each ridge of pores and skin has contained a row of pores which in turn bred sweat that is deposited at the pores and skin's surface. The sample of skin ridges and grooves is what offers a fingerprint individuality and stays stable all through a character's lifestyles. The human frame possesses three number one styles of herbal secretion glands. Whilst eccrine sweat touches a floor, and other oily contaminants from sebaceous sweat, there may be an imprint of the ridge detail of the finger. Sebaceous glands secrete sebum, normally which include saturated fats (myristic acid, stearic acid, palmitoleic acid), waxes (triglycerides) and squalene. (Raven and Johnson,1992)

Apocrine glands are simplest placed in the axillae and anogenital areas of people. Because of the invisibility to the naked eye, this turned into stated earlier, the fingerprint is a latent fingerprint. The simplest seen proof of a latent fingerprint is by way of chemical or physical procedures. ninhydrin answer and iodine/benzoabaone spray were the most important techniques of detecting latent fingerprints from porous evidence. these techniques are still performed by using regulation enforcement specialists at the scene of crime. The maximum common method for detecting fingerprints at the scene of against the law is fingerprint powdering. The deciding on of which precise powder became determined by means of several elements, including the character of the floor to be dealt with and the man or woman desire of the forensic officer. Albeit the ongoing techniques for synthetically and in fact developing dormant fingerprints are without a doubt implemented successfully in criminological examinations, there is as yet a requirement for sincere, unique, sensible, and nondestructive widespread strategies for the identification of fingerprints. Amino acids and inorganic salts are

examples of precise components of latent print residue that react with those chemical compounds Amido Black is a non-unique protein stain that reacts to any protein. it is also used to make or decorate bloody impressions on human pores and skin.

To get better prints on apparel in some instances, extra advanced strategies; as an example, vacuum metallic deposition the usage of gold and zinc are coming into desire for the investigator. Powdered latent prints from curved, textured, or difficult surfaces may be lifted the use of a liquid casting cloth. It is a totally thick liquid that fills in the little hiding places of tough or completed surfaces in which every day print lifting tape unearths trouble. as with all unique mark powders, the use of casting materials may diminish an investigator's ability to apply different techniques to get better extra information As a end result, any nondestructive investigations are accomplished preceding to chemical treatment of the evidence. Earlier than being dealt with with ninhydrin, as an instance, a wondered files professional will observe a ransom or maintain-up study because of the reality a few ninhydrin formulations will reason fine inks to run, destroying the writing. The Fingerprint evaluation manner to decide about each print, fingerprint examiners employ the ACE-V (analysis, evaluation, assessment, and verification) method. The manner of evaluating a print to peer if it could be in contrast is called evaluation. The examination is terminated and the print is mentioned as now not appropriate if it isn't appropriate for evaluation due to insufficient characteristic amount or high-quality. The analysis identifies the functions to be in comparison and their tolerances (the quantity of model as a manner to be trendy) if the print is suitable.(Van Koppen and Crumbag 2000)

Physical characteristics like creases, recurves, deltas, scars, and creases will also be located in the direction of the analysis, providing a place to begin for the comparison. An analyst makes comparisons by the usage of comparing the known and suspect prints thing thru aspect. The examiner thinks approximately info capabilities and areas to decide whether or not they fit. A search of one or extra fingerprint databases, including the FBI's incorporated automatic Fingerprint identification system (IAFIS), or from people of hobby, patients, or others gift at the scene, can yield regarded prints. As of June 2012, IAFIS had extra than seventy million print information from criminals, navy employees, government personnel, and distinctive civilian personnel. it's far the most important fingerprint database inside the worldwide. The examiner can also take a look at whether or not the choices made all through the evaluation segment are suitable. Measurable technological know-how is the research of proof observed at a criminal offense place to assist with settling a wrongdoing. one of the maximum substantial pieces of proof in forensic technology has been fingerprints. For greater than a century,

fingerprint evaluation has been used to identify human beings whose fingerprints have been left at against the law scene. Many crimes have been solved thru fingerprint analysis that is an essential aspect of forensic technological know-how. On this large project, we are able to communicate about the importance of unique finger impact exam in measurable science. The importance of fingerprint evaluation in crook investigations, as well as the techniques used in fingerprint evaluation, could be the subject of our research.(Foote 1997 and Moore 1991)

1.1 The background of Fingerprint evaluation:

Over a century in the past, fingerprint evaluation became used to identify humans. In his eBook "Fingerprints," which came out (Francis Galton 1892) pointed out how fingerprints are specific and the way they can be used to perceive humans. In Argentina, in 1896, fingerprints had been used as evidence within the first criminal case. Given that then, fingerprint evaluation has end up a commonplace device for crook investigations everywhere in the world.

1.2 Fingerprint analysis strategies:

Fingerprint analysis is performed in the use of a selection of strategies. Dusting fingerprints with black powder is the most common method. The powder sticks to the oils and sweat that fingerprints leave at the back of, making them seen. Chemical compounds like ninhydrin and cyanoacrylate are some other method used in fingerprint evaluation to make fingerprints on non-porous surfaces like glass or metallic extra seen. Current era has made it feasible to use digital fingerprint evaluation in addition to these conventional strategies. Utilizing specialized software, digital fingerprint analysis compares and fits fingerprints.

1.3 Fingerprint evaluation's importance in crook Investigations:

In crook investigations, fingerprint analysis is an important factor. It’s far a technique of identifying human beings who have left their fingerprints at a criminal offense scene this is both accurate and dependable. Additionally, suspects who were not gift at the crime scene can be dominated out the use of fingerprint evaluation.

Every body's fingerprints are one-of-a-kind, and no two humans’ percentage the equal set. Due to this, fingerprints make great identification techniques. Numerous crimes, which include homicides, burglaries, and sexual assaults, have been solved through fingerprint analysis.

Fingerprint analysis has additionally been used in civil instances like adoption and immigration, similarly to criminal investigations. a person's identity can be confirmed through

fingerprint evaluation, and applicants for authorities blessings like social security often use it to verify their identity.

1.4 Problems with Fingerprint analysis:

Even though fingerprint analysis is a dependable and accurate method of identification, there are drawbacks. The fine of the fingerprint is one of the finest barriers in fingerprint evaluation. it is able to be tough to perceive the person that left the fingerprint on the crime scene if it is incomplete or smudged.

The possibility of human errors gives some other barrier in fingerprint analysis. Particular mark examination is a manual interaction, and human mistake can manifest throughout the assortment and investigation of fingerprints. It's miles vital to have nicely-educated forensic analysts who adhere to set up protocols and strategies so as to reduce the hazard of human blunders.

The scope for fingerprint recording with organic ink holds crucial capacity in each clinical and security applications. Herbal ink, which is often gotten from ordinary or engineered compounds, offers an alternative in contrast to conventional substance based totally inks utilized in fingerprinting. These inks may be all of the extra innocent to the atmosphere, possibly non-poisonous, and give clean, exceptional prints that are easier to break down. With propels in natural technology, scientists can foster inks that are tremendously delicate to specific surfaces, working on the nature of dormant prints. Also, organic inks may be custom fitted to respond with diverse kinds of surfaces, allowing measurable experts to uncover fingerprints in testing conditions, like on permeable or oily materials. As a ways as security, natural ink can be applied in affirmation frameworks where in fingerprinting is crucial, giving a supportable, reliable technique for person recognizable evidence and forestalling unapproved get admission to. As innovation keeps on enhancing, the utilization of natural inks in particular mark advancement may want to emerge as more some distance and wide, presenting an eco-accommodating and effective way to address criminological technological know-how and biometric security.

Review literature

Nia E. Archer (2005) The work in this record turned into focused on obtaining greater understanding of fingerprint chemistry, particularly the chemistry of a latent fingerprint at the time of deposition, in addition to any chemical adjustments within the lipid issue through the years.

Trapecar M (2012b) In this work the author set up a clearer picture of fingerprint improvement techniques on surfaces that had been submerge in water. Donors located fingerprints on glass and burnished (smooth, brilliant) steel surfaces. The situations of the surfaces being tested changed into pre-uncovered to stagnant water for time durations starting from 1 hour to 7 days. This study showed that the time of exposure time of the surfaces to stagnant water and the chosen method of enhancement motivated the exceptional of detected finger marks.

Rohatgi R, Kapoor AK (2016) In this the author used SPR (small particle reagent technique) to detect latent print on wet and moist surface. novel SPR formulation constituting of zinc carbonate based on fuchsin dye where used for the development of latent print.

Trapecar M (2012a) In this investigation the author want to see what if three fingerprint methods may want to get better latent fingerprints on obvious foil immersed in water. Donors have been informed to deliberately place fingerprints on transparent foil surfaces and the foil surfaces have been later tested after being subjected to stagnant water and different time frames. Latent fingerprints were recovered with Swedish soot aggregate powder, small particle reagent (SPR) and cyanoacrylate (CA)

Margherita Pallocci(2022) In this the author reviewed about most commonly reported forensic application of hyperspectral imaging (HSI) according to this paper the most (HSI) technique is used in analysis of blood traces, detection of forged document, identification of (GSR) and visualization of fingerprint

Lukas Nejdl (2022) In this author present the potential analytical application of photochemistry with the combination of fluorescence fingerprinting his approach was to analyze the fluorescence response of sample following ultraviolent light exposure and also he observe in the presence of metal ions and thiol- containing compounds fluorescence behavior changes significantly. The reaction of U.V induced are highly depended on the specific composition of the sample generation unique spectral fingerprint within 230-600 nm range. This method does not require any addition of external reagents of fluorescent probes only appropriate diluent is necessary.

Rachel Robson (2022). Latent fingerprint identification has importance in forensic science, specifically in the examination of evidence at crime scenes. Previously published literature included many references to physical interpretations of latent fingerprint and relatively few referencing chemical analysis. This systematic review evaluated any prospective studies considering the analysis of components of latent fingerprint residues and, therefore included studies that investigated the analysis of basic organic substances contained within latent fingerprints.

Jamila S. Marshall (2021) In this work the author tell the most research on the detection and quantification of amino acids in the latent fingerprint has relied on spectrometric technique. In this the Sakaguchi colorimetric test was adapted to a rotationally driven microfluidic platform for the detection and quantification of arginine in latent fingerprint deposited in latent fingerprint deposited by male and female donors. In this method the presence of arginine was indicated in red color following the reaction.

Mohamed O. Amin (2016) Here, the authors want to confirm that latent fingerprint analysis is an important technique in criminal investigation; the recent fascination toward the biochemical composition of FMs also shows significant promise to be helpful in providing important forensic evidence. This technique is known as vibrational spectroscopy which has also enabled the understanding of the relationship between the chemistry of latent FM; with the ultimate goal of creating improvements in latent FM chemical and physically approached detection methods. This article critically reviews the advances that have been made in the last 10 years on FM analysis with application of a vibrational spectroscopic technique.

Andy Bécue (2019-2022) In this author reviewed about the area of latent fingerprint with many research papers and case studies 630 reference where collected and 500 cited in this. there was a slight growth over the preceding evaluate period which had 599 references, and the research community remains enthusiastic about the area. Roberts et al. produced the equal evidence of excitement.

Wenjing Chen (2022). In this work the author developed the NaLuF4:Mn (sodium lutetium fluoride nanoparticle) exhibiting intense green PerSL (X-ray charged persistent luminescence)And functionalized surface with level 3 detail. With the help of these technique the imaging in latent fingerprint becomes accurate in diverse environmental condition.

Marco A. Souza (2021) In this work the author explore Raman Spectroscopy and supervised method he wants to determine sex based fingerprints obtain from male and female donors in light and dark condition.

Peisheng Zhang (2022) In this work the author design and synthesis of fluorescent polymer micelles specifically engineered for high contrast imaging of latent fingerprint. This latent prints where prepared through the cross linking reaction between hydrazine (N2H4) and aldehyde groups present in the polymer.

Jun Wang(2022) In this the author present a simple and strong method for preparing multicolor conjugated polymer micelles designed for high resolution visualization of fingerprint.

.

V. Drapel (2009)) In this author analyzed about latent fingerprint residue by sodium-dodecyl sulfate poly acrylamide gel electrophoresis (SDS) and with silver staining which allows the detection of different proteins. From thus two major bands corresponsive to proteins of 56 and 64 KDA molecular weight could be identified.

M. Benton (2010) Hydrophobic silica nano powder has been effective as a possible way for latent fingerprint development agent and subsequently as an enhancement agent within the surface-assisted laser desorption/ionization-time of flight (SALDI-TOF) mass spectrometry for evaluation of latent fingerprint components. The approach become used for the identification of nicotine and cotinine in latent fingerprint of smokers.

3.1 Problem Findings:

The use of natural extracts for fingerprint recording presents a number of challenges and findings. These challenges include possible contamination of the print, increased difficulty in comparison and sensitivity, difficulty in achieving consistent visualization, and possibly damaging the print over the course of processing.

3.2 Aim: This investigation is done to find out how we can record fingerprint with natural inks.

3.3 Scope:

From a security perspective, environmentally friendly inks could be utilized in authentication procedures that relies heavily on fingerprints and provide a sustainable and reliable means of identity verification and minimize the risk of unauthorized access. As technology advances, face-to-face interaction with environmentally friendly inks for recording fingerprint may become the standard, offering an eco-friendly and efficient way to forensic sciences and biometric security.

Materials and methods

The present study has been conducted for my dissertation work for the award of degree of MSc Forensic science. In the present study I have taken 5 types of inks which are cucumber peel ink, bottle gourd ink, tea leaf ink, cocoa powder ink, coffee ink for suggesting new type of organic ink in place of black ink.

Samples	Plain and rolled	observation
Bottle gourd ink	Only plain was taken	Clear ridges was shown in plain and in case of the rolled it was creating smudge.
Cocoa powder ink	Both taken	Clear ridges was show on both plain and rolled fingerprint format.
Tea leaf ink	Both taken	Fingerprint was taken but there was slight smudge in plain print not in rolled fingerprint
Cucumber peel ink	Both taken	Ridges was showing in both format plain and rolled but there was minor smudge.
Coffee ink	Both taken	Clear ridges was shown in plain and rolled fingerprint format.

Fig 1

Fig 1.1

Bottle gourd and cucumber dried peel

METHODS

TEA LEAF INK

Fig 2

Firstly I have taken the certain amount of tea leaf and put it into water and boil them for 1-2 minute then intense yellow color will appear of that water after that filter the whole tea leaf and let the liquid which is prepare should cool down after that ink has been prepared and then I started taking fingerprint with them.

CUCUMBER PEEL INK

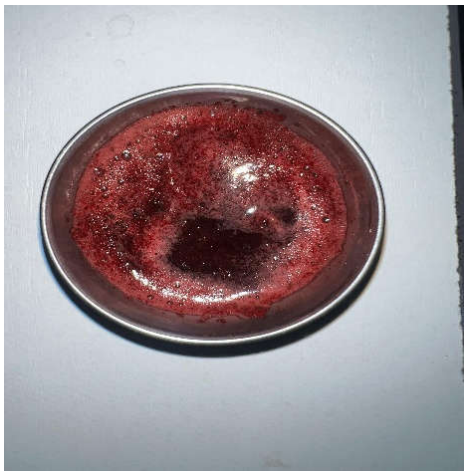

Fig 2.1

For the preparation of cucumber peel ink I have taken peel of raw cucumber and let it dry for 4-7 days after the whole peel become dry then I grind them with the help of mixer and make powder of them and then I add beetroot juice to it and prepared the ink and then ink was made and then I started taking fingerprint.

COFFEE INK

Fig 2.2

For the preparation of coffee ink I have taken the coffee which is easily available in the market and I added coffee to water and boil both of them for some time and then made the ink and I let it cool down for some time and after that I take the fingerprint.

BOTTLE GOURD PEEL INK

Fig 2.3

For the preparation of bottle gourd ink I firstly take peel of raw bottle gourd and let them dry for 4-7 days and after that I made powder of them with the help of mixer and then I added small amount of beetroot juice and prepared the ink and after that I take the fingerprint.

COCOA POWDER INK

Fig 2.4

For the preparation of cocoa powder ink firstly I take the cocoa powder which is easily available in the market and then added certain amount of boil water and prepared the ink and I let it cool down for some time and after that ink has been prepared and after that I take the fingerprint.

With the help of organic ink which I have made for recoding the fingerprint on different surface like in plain paper and glass surface. both rolled and pain prints was taken with the help of this inks and the fingerprint shown clear ridges in almost all types of inks.

Outcomes of this study

This study finds a quite successful recording of fingerprint in both plain and rolled format and we can avoid the use of chemical inks because it can do chemical reaction in some person depends people to people and I if we focus on making good organic ink with the help of machine and more refine format then it can replace the use of chemical inks.

Results & Discussions

Different kind of organic ink where taken for recording the fingerprint on non -porous and porous surface fingerprint was taken on both format rolled and plain but in tea leaf ink it was very difficult to take print because it was leaving smudge and ridges was not looking clearly and after so many attempts print was taken and ridges was looking clearly and with other organic powder I don't find so much difficulty fingerprint was take in solid surface and on paper and glass mobile screen.

The further findings of this study are knowledge that are unique mechanism by which these herbal inks interact with fingerprint residue is potentially open up more targeted development of better fingerprint visualization techniques. To design the particle size, attention and alertness systems of those natural inks could possibly provide stronger particle efficacies and more consistent efficacy. In addition, standardizing application techniques could improve the reliability for this method within forensic contexts. the use of natural, potentially environmentally friendly alternatives to traditional fingerprint enhancement methods that may rely on harsher chemicals. This study lays the groundwork for future research into herbal alternatives for taking the fingerprint on porous surfaces and non -porous surface. By knowing the underlying mechanisms and optimizing the techniques these natural powders could become a valuable tool for forensic investigations, especially in resource limited environments.

Fig 3.finger print recorded with tea leaf ink on plain paper

Fig 3.1 rolled fingerprint recorded with tea leaf ink on plain paper

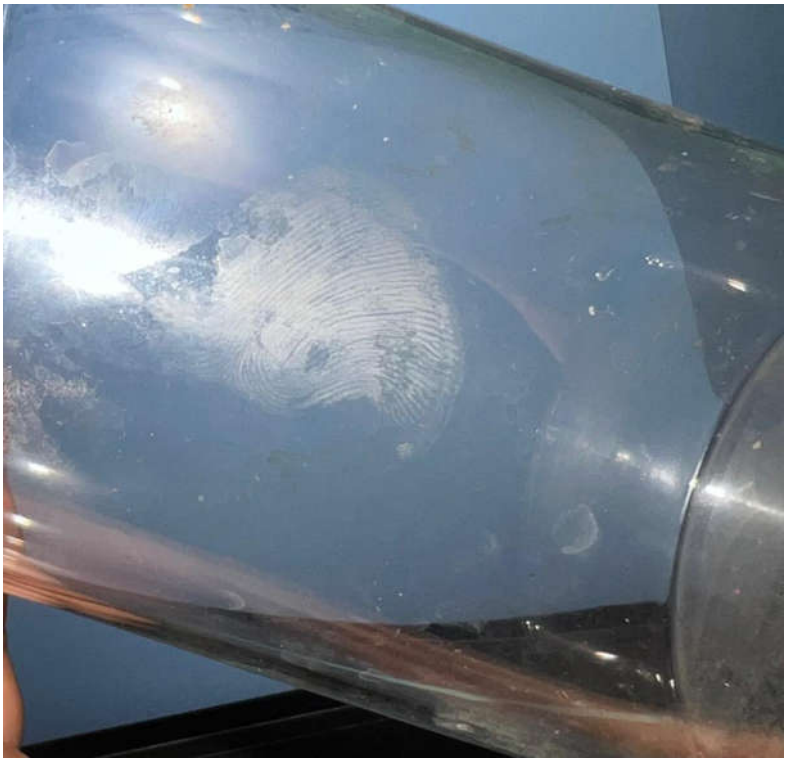

Fig 3.2 fingerprint recorded on glass with tea leaf ink

Fig 4 fingerprint recorded with bottle gourd ink on plain paper

Fig 4.1 finger print recorded in glass with bottle gourd ink

Fig 5.rolled fingerprint recorded with cucumber ink

Fig 5.1 plain fingerprint recorded with cucumber ink

Fig 6 Pain fingerprint recorded with cocoa ink

Fig 6.1 rolled fingerprint recorded with cocoa ink

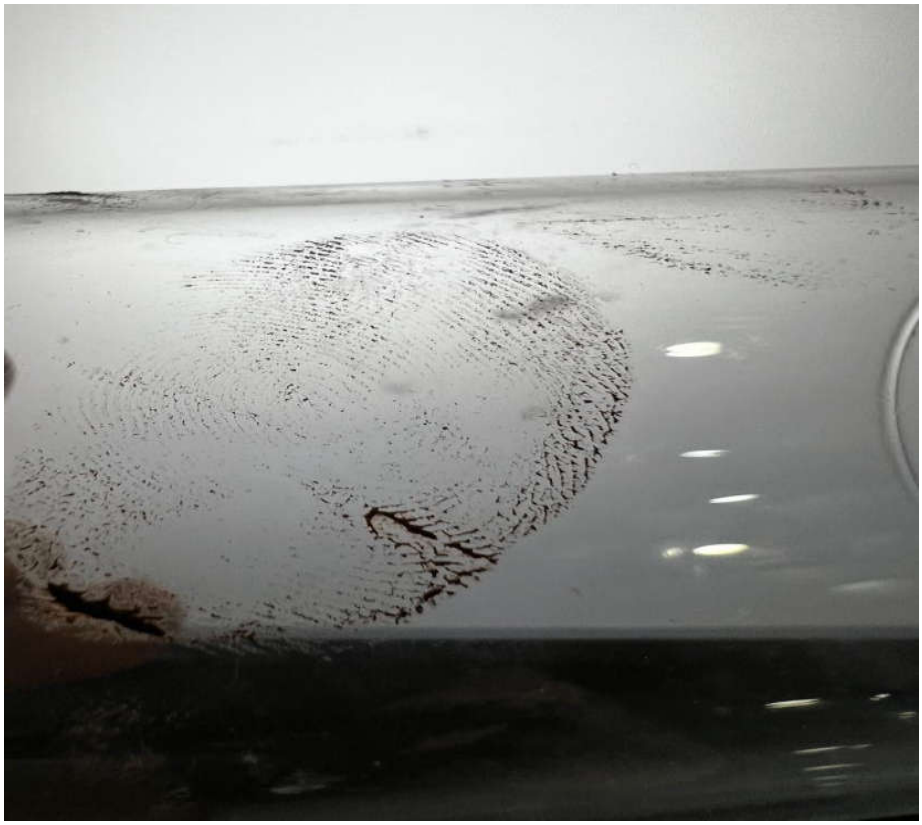

Fig 6.2 fingerprint recorded in glass with cocoa ink

Fig 7, plain fingerprint recorded with coffee ink

Fig 7.1 rolled fingerprint recorded with coffee ink.

Fig 7.2 finger print recorded in glass with coffee in

CONCLUSION

With the outcomes of this research, the distinct varieties of natural sources used, the materials noted here are the household items that are basically those home -made, non-toxic kitchen and easy to use materials were good for recording fingerprints on porous surfaces. This natural source fingerprinting inks, unlike chemical inks maybe, and when low on supplies, it may also be able to be used for recording fingerprint and worldwide publication of Forensic Medicine visualization. The specific aim of this research is to investigate using naturally available materials to record fingerprint with inks when forensic supplies available are not appropriate, there lies in the beauty of this method, it is easy and does not require anything specialized, from benefitting the criminal justice system, the perspective is this method if it is reliable provides the ability to identify fingerprints with resources that may be limited, and possibly help solve crimes that way. The results of this research are beetroot, tea leaf, cucumber peel, bottle gourd peel, coffee, cocoa powder achieve fingerprints on smooth surfaces, natural materials are in fabric selection, better formulations, new application techniques, and always ensure surface compatibility. This research suggests evaluated the usefulness of common (readily available obviously) materials on various surface types is necessary. The opportunity to further target the fingerprint inks using natural materials in regard to appropriate fabric types, formulations, new application techniques, surface compatibility

Scope for further use

The usage of organic inks for recording fingerprint holds enormous scope, and enhancing the performance of fingerprint. These inks offer a greener, greater sustainable, and doubtlessly greater effective alternative to conventional chemical-based techniques. in addition they provide advantages in terms of comparison, clarity, and sensitivity for fingerprint visualization.

REFERENCE

(1)Amin, M. O. (2016). Trends in vibrational spectroscopy of fingermarks for forensic purposes. Retrieved from sciencedirect: https://www.sciencedirect.com/science/article/abs/pii/S0165993621001643

(2) Archer, N. E. (2005). Changes in the lipid composition of latent fingerprint residue with time after deposition on a surface. Retrieved from sciencedirect: https://www.sciencedirect.com/science/article/abs/pii/S0379073804006607

(3) B´ecue, A. (2023). Interpol review of fingermarks and other body impressions (2019 – 2022). Retrieved from researchgate: https://www.researchgate.net/publication/366653190_Interpol_review_of_fingermarks_and_other_body_impressions_2019_-_2022

(4) Benton, M. (2010). Environmental nicotine contamination in latent fingermarks from smoker contacts and passive smoking. Retrieved from national library of medicine: https://pubmed.ncbi.nlm.nih.gov/20395083/

(5) Chen, W. (2022). national library of medicine. Retrieved from pubmed: https://pubmed.ncbi.nlm.nih.gov/35687348/

(6) Marshall, J. S. (2021). Microfluidic Device for the Identification of Biological Sex by Analysis of Latent Fingermark Deposits. Retrieved from national library of medicine: https://pubmed.ncbi.nlm.nih.gov/33921163/

(7) Nejdl, L. (2022). UV-Induced fingerprint spectroscopy. Retrieved from sciencedirect: https://www.sciencedirect.com/science/article/abs/pii/S0308814621015053

(8)Pallocci, M. (2022). Forensic applications of hyperspectral imaging technique: narrative review. Retrieved from pubmed: https://pubmed.ncbi.nlm.nih.gov/36121069/

(9) Richa Rohatgi, K. A. (2016). Development of latent fingerprints on wet non-porous surfaces with SPR based on basic fuchsin dye. Retrieved from science direct: https://www.sciencedirect.com/science/article/pii/S2090536X15000489

(10) Robson, R. (2022). Analysis of fingermark constituents: a systematic review of quantitative studies. Retrieved from springernature link:

(11) Souza, M. A. (2021). Raman spectroscopy of fingerprints and chemometric analysis for forensic sex determination in humans. Retrieved from researchgate: https://www.researchgate.net/publication/357359510_Raman_spectroscopy_of_fingerprints_and_chemometric_analysis_for_forensic_sex_determination_in_humans

(12) Trapecar, M. (2012a). Fingerprint recovery from wet transparent foil. Retrieved from sciencedirect: https://www.sciencedirect.com/science/article/pii/S2090536X12000469

(13) Trapecar, M. (2012b). Finger marks on glass and metal surfaces recovered from stagnant water. Retrieved from sciencedirect: https://www.sciencedirect.com/science/article/pii/S2090536X12000238

(14) V. Drapel. (2009). Identification of promising antigenic components in latent fingermark residues. Retrieved from SONAR: https://folia.unifr.ch/global/documents/125814

(15) Wang, J. (2022). Preparation of fluorescent conjugated polymer micelles with multi-color emission for latent fingerprint imaging. Retrieved from researchgate: https://www.researchgate.net/publication/348731700_Preparation_of_fluorescent_conjugated_polymer_micelles_with_multicolor_emission_for_latent_fingerprint_imaging

(16) Zhang, P. (2022). Cross-Linking Induced Emission of Polymer Micelles for High-Contrast Visualization Level 3 Details of Latent Fingerprints. Retrieved from acspublication: https://pubs.acs.org/doi/abs/10.1021/acsami.2c02563