STUDENTS' RESEARCH PROJECT IN CHEMISTRY

A Novel Approach for the Development of Latent Finger Print by Iodine-Solvent Method in Crime Science.

By

B.SC STUDENTS (M.P.C,B.Z.C)

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Submitted to

DEPARTMENT OF CHEMISTRY
GOVERNMENT DEGREE COLLEGE, SHADNAGAR

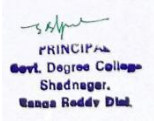
RANGAREDDY

GOVERNMENT DEGREE COLLEGE, SHADNAGAR

RANGAREDDY

DECLARATION

We hereby declare and certify that Students' Study Project titled "**A Novel Approach for the Development of Latent Finger Print by Iodine-Solvent Method in Crime Science.**"submitted to **Department of chemistry** by the students BSc BZC-II Yr, English Medium and Mentor Dr.M.Srilatha, Assistant Professor, Department of Chemistry, Government Degree College, shadnagar Rangareddy is a bonafide record of research work carried out by us during the academic year 2021-22.



Principal

GOVERNMENT DEGREE COLLEGE,SHADNAGAR

Rangareddy , Telangana-509216

CERTIFICATE

This is to certify that Students' Study Project titled "**A Novel Approach for the Development of Latent Finger Print by Iodine-Solvent Method in Crime Science."** submitted to department of chemistry,GDC,Shadnagar,Telangana – 509216 by the students - BSc M.P.C,BZC-II Yr, English Medium and Mentor Dr.M.Srilatha, Assistant professor, Department of Chemistry, Government Degree College, Shadnagar, Rangareddy is a bonafide record of research work carried out by us during the academic year 2021-22.

principal

AKNOWLEDGEMENT

It gives us immense pleasure to submit our research entitled "**A Novel Approach for the Development of Latent Finger Print by Iodine-Solvent Method in Crime Science.**" submitted for the Students' Study Project, which is not an end but a beginning for all those who are keen and enthusiastic to carry out similar studies for developing interest inresearch field.. We are fortunate to have the support and encouragement from the Principal G.Bhanu Prakash sir,and our Mentor Dr M.Srilatha We have no words to express our gratitude towards their humbleness and valuable contributions.Our thanks to all the other Intellectuals, Academicians, Scholars, Professionals, and a large number of Faculty and Students, who came in our contact during the period of research and directly or indirectly made academic or intellectual contributions towards enrichment of our project work.

B.Sc(M.P.C,B.Z.C)

A Novel Approach for the Development of Latent Finger Print by Iodine-Solvent Method in Crime Science

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A Novel Approach for the Development of Latent Finger Print by Iodine-Solvent Method in Crime Science.

Dr.M.Srilatha, BSc M.P.C,BZC-I Yr,

1.0: Introduction of Latent Finger Print:

Fingerprints are one of the most valuable forms of evidence due to their uniqueness. They are found on objects present at a crime scene and are used to identify the suspect or criminal, and link them to the crime scene, weapon, or object. Finger marks are formed by sweat released from pores present on the friction ridge skin of hands. Finger ridges contain a large number of sweat pores. When the finger touches any surface, the sweat from these pores gets deposited in form of contours, which are the mirror image of the ridge patterns. Since sweat is colorless in nature, its deposition on a surface also produces colorless impressions, which are called latent fingerprints.[1]

Latent fingerprint residues consist of secretions of the eccrine (sweat), sebaceous, and apocrine glands present on the palm, head, and nose. Sweat contains water (>98%), minerals (0.5%), and organic compounds (0.5%). Eccrine sweat consists of proteins, urea, amino acids, uric acid, lactic acid, sugars, creatinine, and choline, while sebaceous sweat consists of glycerides, fatty acids, wax esters, squalene, and sterol esters. A number of factors associated with the donor such as sex, age, diet, type of disease, medication, and the presence of contaminants on the surface of the fingertips affect the chemical composition of latent finger impressions.

2.0: Patterns of Finger Print:

Fingerprints are unique patterns, made by friction ridges (raised) and furrows (recessed), which appear on the pads of the fingers and thumbs. Prints from palms, toes and feet are also unique; however, these are used less often for identification, so this guide focuses on prints from the fingers and thumbs. The fingerprint pattern, such as the print left when an inked finger is pressed onto paper, is that of the friction ridges on that particular finger. Friction ridge patterns are

grouped into three distinct types—loops, whorls, and arches—each with unique variations, depending on the shape and relationship of the ridges:

Loops - prints that recurve back on themselves to form a loop shape. Divided into radial loops (pointing toward the radius bone, or thumb) and ulnar loops (pointing toward the ulna bone, or pinky), loops account for approximately 60 percent of pattern types.

Whorls - form circular or spiral patterns, like tiny whirlpools. There are four groups of whorls: plain (concentric circles), central pocket loop (a loop with a whorl at the end), double loop (two loops that create an S-like pattern) and accidental loop (irregular shaped). Whorls make up about 35 percent of pattern types.

Arches - create a wave-like pattern and include plain arches and tented arches. Tented arches rise to a sharper point than plain arches. Arches make up about five percent of all pattern types.

The two underlying premises of fingerprint identification are uniqueness and persistence (permanence). To date, no two people have ever been found to have the same fingerprintsincluding identical twins. In addition, no single person has ever been found to have the same fingerprint on multiple fingers. Persistence, also referred to as permanence, is the principle that a person's fingerprints remain essentially unchanged throughout their lifetime. As new skin cells form, they remain cemented in the existing friction ridge and furrow pattern. In fact, many people have conducted research that confirms this persistency by recording the same fingerprints over decades and observing that the features remain the same. Even attempts to remove or damage one's fingerprints will be thwarted when the new skin grows, unless the damage is extremely deep, in which case, the new arrangement caused by the damage will now persist and is also unique.

The Proof is in the Minutiae

Analysts use the general pattern type (loop, whorl or arch) to make initial comparisons and include or exclude a known fingerprint from further analysis. To match a print, the analyst uses the minutiae, or ridge characteristics, to identify specific points on a suspect fingerprint with the same information in a known fingerprint. For example, an analyst comparing a crime scene print to a print on file would first gather known prints with the same general pattern type, then using a loop, compare the prints side-by-side to identify specific information within the minutiae that match. If enough details correlate, the fingerprints are determined to be from the same person.

Minutiae points:

Minutiae points are the major features of a fingerprint image and are used in the matching of fingerprints. These minutiae points are used to determine the uniqueness of a fingerprint image. A good quality fingerprint image can have 25 to 80 minutiae depending on the fingerprint scanner resolution and the placement of finger on the sensor. Minutiae can be defined as the points where

the ridge lines end or fork. So the minutiae points are the local ridge discontinuities and can be of many types. These types are –

- **Ridge ending** is the point where the ridge ends suddenly.
- **Ridge bifurcation** is the point where a single ridge branches out into two or more ridges.
- **Ridge dots** are very small ridges.
- **Ridge islands** are slightly longer than dots and occupy a middle space between two diverging ridges.
- **Ponds or Lakes** are the empty space between two diverging ridges.
- **Spurs** is a notch protruding from a ridge.
- **Bridges** are the small ridges that join two longer adjacent ridges.
- **Crossovers** are formed when two ridges cross each other.

Ridge endings and ridge bifurcations are the most commonly used minutia types since all other types of minutiae are based on a combination of these two types. Figure below shows some of the common minutiae patterns.

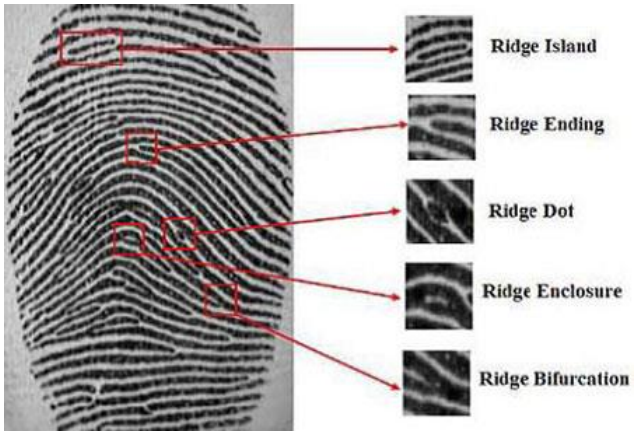


Photo: Some common minutiae patterns\

3.0. When is fingerprint analysis used?

1. To provide biometric security.

2. Used in Aadhar Card

3. Identifying amnesia victims and unknown deceased.

4. Conducting Background Checks (Including applications for government employment, defence security clearance, concealed weapons.

5. In Crime Science investigation

- A killer may leave his finger print on paper or murder weapon.
- A bank robbers fingerprints may be found on a robbery note.
- A burglar may leave fingerprints on a broken window pane.
- A thief's fingerprints may be found on a safe.
- A Fraud Finger prints on bank checks.

4.0: OBJECTIVES:

Our goal is also to Fixation of develop latent fingerprint by Iodine-Solvent method.

- Understand and implement the scientific method.
- Practice problem-solving skills through forensics.
- Taking a direct fingerprint, Classifying a fingerprint, Identifying fingerprint ridge details, Lifting latent fingerprints.
- Fixation of latent fingerprint by Iodine-solvent method.
- Polar solvents play important role in fingerprint fixation.
- Technique is fast, easy and low cost with good results.

5.0:Literature Survey:

1. Rohatgi and Kapoor [1]used alkaline fuchsine-based small-particle reagent formulation to develop latent fingermarks on wet nonporous surfaces even after 45 days of its deposition.

2. Au et al[2] used titanium dioxide-based wet powder suspension for the development of bloodied marks on dark, smooth, nonporous surfaces.

3. Choi et al[3] used a zinc oxide-based formulation to develop latent fingerprints on a variety of nonporous substrates.

4. Ferguson et al[4] compared different methods (cyanoacrylate fuming, black magnetic powder, ninhydrin, small particle reagent, black powder suspension, and white powder suspension) to develop latent fingerprints on different food items.

5. Jasuja et al5used natural detergent, instead of a synthetic one, in two small-particle formulations (charcoal powder and basic zinc carbonate based) for the development of latent fingerprints on a variety of surfaces.

6. Jasuja et al[6] used Rose bengal and phase transfer catalyst (tetrabutylammonium iodide)-based composition to develop latent fingermarks on the sticky side of adhesive tapes.

7. Sodhi and Kaur[7] used phloxine B (as dye) and tetrabutylammonium iodide (as phase transfer catalyst)-based formulation to develop latent fingermarks on a variety of absorbent and nonabsorbent surfaces.

6.0: Methodology: Results and discussion:

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. Iodine fuming has been used since the turn of the 20th century to develop latent fingerprints on porous surfaces, particularly paper. Iodine fuming is still widely used because it is inexpensive and easy, sensitive, and is non-destructive because the stains it produces are ephemeral. Some forensics studies stated that iodine fuming is used less often nowadays than formerly. That may be true in the limited sense that there

are now many alternatives, but iodine fuming is still used frequently by many forensics labs. It's cheap, fast, effective, and completely reversible.

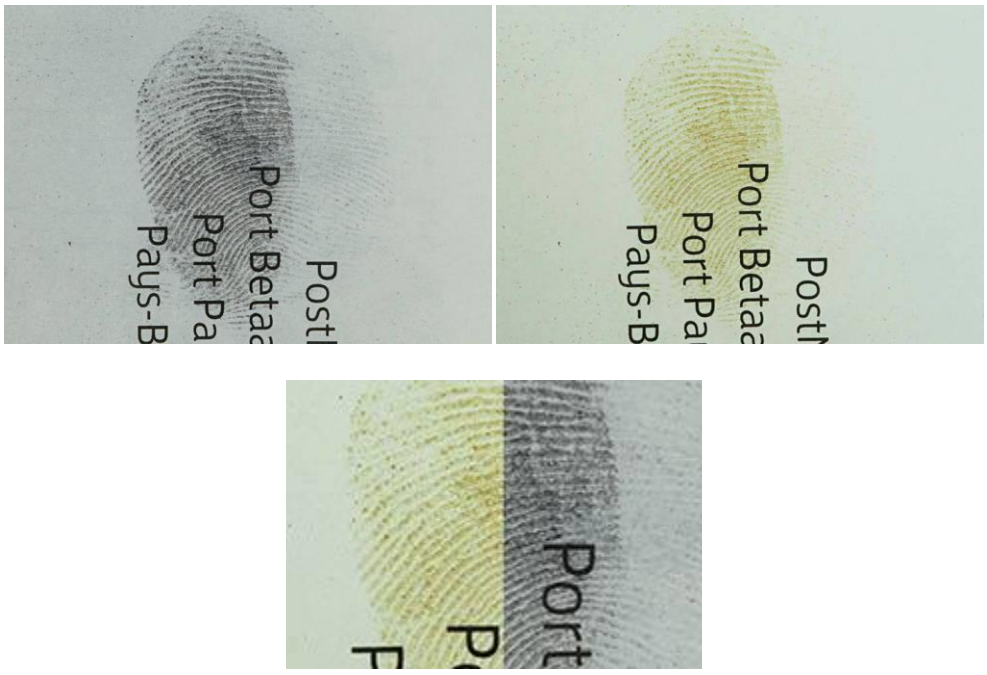
In the lab, iodine fuming is done in a chamber, but the process was adapted to field use quite early. The first iodine fuming wands were simple tubes with a small reservoir for iodine crystals. The operator warmed the tube in his hand and blew gently into one end of the wand. His breath vaporized iodine and expelled iodine vapour from the other end of the tube, which was aimed at the surface to be treated. Modern versions of the iodine fuming wand substitute battery power for body heat and the operator's breathe to avoid the risk of inhaling iodine vapour, but the principle remains the same.

The fugitive nature of iodine-developed prints is a two-edged sword. On the one hand, it's nice that iodine fuming is **easily reversible.** After Development of finger print, if we take photograph, the appearance is blurred and not clear. To overcome this problem, New method has introduced that is iodine- solvent method. Iodine and solvent combine to form a black complex, which persists for days-weeks, depending on storage conditions.

Present Work:

In the present work we have introduced new method to develop latent fingerprint that is Iodine –solvent method. In this methodology, we have used different polar and non-Polar solvent. We know that "like dissolve like principle" related on the formation of solutions on intermolecular forces and ΔH_{mixing}, be sure to emphasize the three types of interactions involved in the formation of solutions: solvent-solvent, solute-solute-solute, and solute-solvent. Non-polar solutes such as I_2 do not dissolve in polar solvents like water because the I_2, having just London dispersion forces, are unable to compete with the strong attraction that the polar solvent molecules have for each other. Thus neither hexane nor iodine dissolves in water. Iodine is a non-polar molecule because

the iodine-iodine bond is a pure covalent bond. The difference in electronegativity between the two Iodine atoms is zero. In solid I_2, I_2 molecules are attracted to other I_2 molecules by developing temporary partial positive and partial negative areas around the molecule and are attracted to the temporary partial positive and partial negative areas around other I_2 molecules, i.e. London dispersion forces. Hexane is non-polar because the electronegativity difference between the hydrogen and carbon atoms is very small, $\Delta EN = 0.4$ and ΔEN between the carbon and carbon atoms is zero. Liquid hexane molecules are held together by London dispersion forces. Therefore iodine and hexane both are non polar interact with each other and form complex with sweat present in fingerprint but iodine vapor smear which leads to decreasing in clarity. We know that sweat is a mixture of water, salt ions (including sodium, magnesium and potassium) and many other biological chemicals in **small** amounts. When we use iodine-polar solvent spray technique method which is more effective in producing the photograph clarity of latent finger print.



Latent fingerprint detection using Iodine fuming method and Iodine-Solvent Method.

In this lab session, we'll use iodine fuming to develop latent prints on paper. We'll then treat those developed prints with non-polar and polar solvents to fix them, at least temporarily.

Required Equipment and Supplies:

- goggles, gloves, and protective clothing
- iodine fuming chamber (see Substitutions and Modifications)
- camera (optional)
- small sprayer bottle
- iodine crystals (a few crystals per run)
- Hexane, Water, ethyl acetate.
- specimens of paper with latent fingerprints

Results and Discussions:

Nonpolar solvents as hexane is sprayed on the surface of Iodine fumed latent finger prints present on the surface of paper. However, fragile paper items, such as paper napkins, tear apart on dipping and therefore spraying procedure is followed. Swabbing action tends to smear the ink and is therefore avoided on scripted documents. Less conventional methods include exposure to Iodine fumes, spraying them with polar and non polar solvents over the fingerprint impression. This may take a few minutes with good clarity results, using non polar solvents smear the iodine and decreasing its clarity, whereas polar solvents like ethylacetate are less interacting with iodine, increasing the clarity and time period. According to experiment, Iodine-ethyl acetate solvent combination plays an important role in fixation of develops latent finger print. We can use Iodine-Steam method for fingerprint fixation. This method is future technique for the development of latent finger print.

Step-1 Our Student Taking finger print on A4-size paper

Step-2: Inserting paper in Iodine crystal containing Chamber

Step-3: <u>Keeping Iodine containing bottle in hot water bath.</u>

Step: 4 <u>Removing paper from iodine chamber and spraying solvents for fixation of latent finger print.</u>

Data Analysis: Method 1: Iodine-Hexane solvent Method

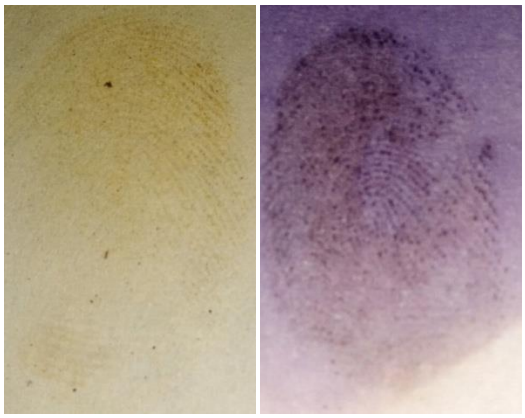


Figure 1: Development using Iodinefumine-hexane spray method

Method 2: Iodine-ethyl acetate

Figure 2: Development Using Iodine fuming-ethyl acetate method on A4 size paper.

Figure 3: Development Using Iodine fuming-ethyl acetate method on scripted paper.

Method 3: Iodine-steam method

Figure 4: Development of latent finger print on News paper

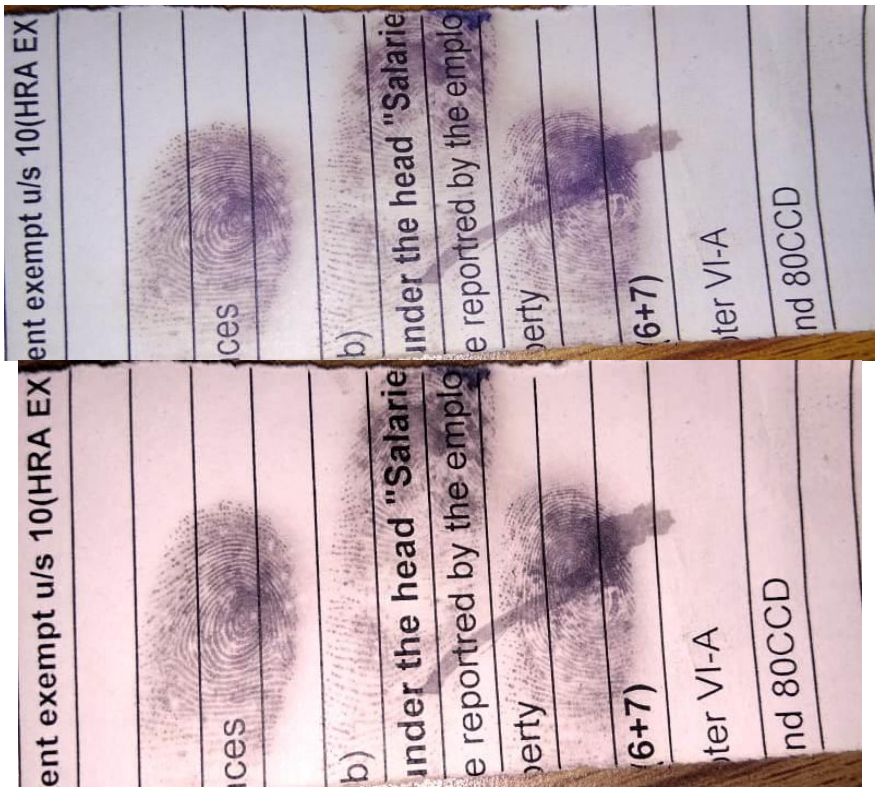


Figure 5: Development of latent finger print on scripted paper.

Figure 6: Development of latent finger print on paper

Figure 7: Development of latent finger print on Chart paper.

7.0: Conclusions:

The aim of the study was to develop latent finger prints from porous surface materials like paper, bank cheque paper , scripted paper, chart paper etc. The Study demonstrated that it is possible to fix the developed latent finger prints using Iodine Fuming method followed by spraying polar solvent like ethyl acetate, water etc. The impression of latent finger print will be remained for days to week. This method is very effective technique in crime investigation.

8.0: References:

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STUDENTS ATTENDED FOR PROJECT WORK :TITLE- A Novel Approach for the Development of Latent Finger Print by Iodine-Solvent Method in Crime Science.

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4	2021	B. Yamini	21033067 445 1004
5	2021	B. Manisha	21033067 445 1005
6	2021	B. Sreevani	21033067 445 1006
7	2021	B. Girija	21033067 445 1007
8	2021	B. Anitha	21033067 445 1008
9	2021	C. Lingam	21033067 445 1009
10	2021	D. Swapna	21033067 445 1010
11	2021	G. Sruthi	21033067 445 1011
12	2021	J. Naveen Prakash	21033067 445 1012
13	2021	J. Sanjay	21033067 445 1013
14	2021	K.Anusha	21033067 445 1014
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30	2021	V. Arjun	21033067 445 1030
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