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Use of a Fluorescent Schiff'S Base as Developing Agent for Latent Finger Prints

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ABSTRACT

During investigations of a crime, the first thing that a forensic team looks for is the finger prints left by the culprits. These finger prints may be visible or latent. Various methods are used for the development of these latent fingerprints on different surfaces. Amongst these methods, powder method is still the most preferred one in forensic investigations due to its simplicity and efficiency. In this paper we report the application of a UV fluorescent schiff's base as an efficient organic compound in various powder formulations for the visualization of latent finger prints on different absorbent and non-absorbent surfaces. The results obtained showed clear ridge details in almost all the cases. The benefit of using this schiff's base in powder formulations over the earlier used powders lies in the fact that it is economical, does not contain any heavy metal and can be used on objects of various colours. Further the visualisation does not require any specific UV lamp or filter to take the photographs.

KEYWORDS: *Forensic Science, Latent fingerprints, Powder method, Schiff's base, UV fluorescent*

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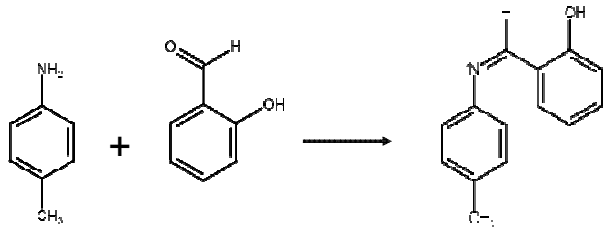
INTRODUCTION

One of the most important categories of physical evidences collected at the crime scene is finger or foot prints. The fingerprints obtained from the crime scene play an important role in solving a case as the individuality of finger marks has been proved and is also accepted by the courts as evidence. The finger prints left by a culprit can be visible which are formed on the blood stains or any paint etc or by the hands stained with blood on other objects. Most of the times finger prints are invisible which are also called latent fingerprints. A latent fingerprint is formed when the sweat pores of the papillary ridges leave a deposit of perspiration on a surface with which the finger has been brought into contact[1]. Human body possesses the following three types of glands - *viz.* eccrine, apocrine and sebaceous, the secretions of which contribute to a fingerprint deposit[2]. Eccrine glands are particularly numerous on palms of hands and soles of feet. Water is the main chemical present in the secretion from these glands. Besides water, eccrine sweat contains up to 1% of other substances, of which inorganic salts constitute one-half. The other half is constituted by organic compounds like amino acids, urea, creatinine, lactic acid, sugars, uric acid and fatty acids[3]. The constituents of sweat may be selectively fixed by different chemical reagents so as to make the latent finger prints visible[4]. The powder technique is the easiest for detecting latent fingerprints and involves the application of a finely divided formulation to the finger mark impression, generally with a glass-fiber or a camel hair brush[5]. The powder gets mechanically adhered to the moisture and oily components of skin ridge deposits. Regular fingerprint powders consist of a resinous polymer for adhesion and a colorant for contrast[6]. The commonly used adhesives are starch, kaolin, rosin and silica gel. The colorant may be an inorganic salt or an organic derivative but we definitely need a powder which is of contrast colour to that of the surface under investigation.

Schiff's bases are a class of organic compounds which are formed by the condensation reaction between carbonyl compounds and primary amines. Such compounds are often yellow in colour, yet these have not been exploited for detection of latent fingerprints. During our recent work on the application of schiff's bases in forensic science as potential mapping agents for iron traces on skin[7], it was observed that the schiff's base, 2-[(4-methylphenylimino)methyl]-phenol (3) shows intense yellow fluorescence in UV light. It is obtained by the reaction between 4-methylaniline (p-toluidine,1) and 2-hydroxybenzaldehyde (salicylaldehyde,2).

In this communication we report the utility of powder fingerprint formulation based on this UV fluorescent schiff's base (**3**). The formulation develops clear and sharp fingerprints on a host of surfaces, absorbent and non-absorbent, colourless and coloured. The fluorescent nature of formulation further assists in detecting weak and faint finger impressions that are often encountered at crime scenes.



(1) (2) (3)

Method and material

The schiff's base (**3**) was prepared by the general procedure[8], described below. During the present work, using this schiff's base, in all 23 powder formulations have been prepared using six different base materials viz., talc, kaolin, boric acid, calcium carbonate, zinc stearate and silica gel. With each of these base materials, three compositions were prepared having the schiff's base in 2%, 5% and 10% (w/w) ratio. Five more formulations were preparedby mixing silica gel with all other five base materials in the ratio of 1:1 with 5% (w/w) of schiff's base.

Various objects have been used during present study in order to test the applicability of these powders for development of latent fingerprints on different type of surfaces. The observations have been made on various non-absorbent reflective objects viz., aluminium foil , chrome plated spatula, stainless steel spoon and glazed tile; Non absorbent objects viz., glass plate, wood laminate , transparency sheet(plastic sheet) and acrylic sheet; Absorbent objects viz., card board, polished wood, unlaminated paper sheets of different colours and thermocol.

The finger marks were taken on different objects and then allowed to dry for 10 minutes. After that the powder was applied and then these marks were viewed under ordinary UV lamp where yellow fluorescence was observed and these finger prints have been photographed without the use of any filter.

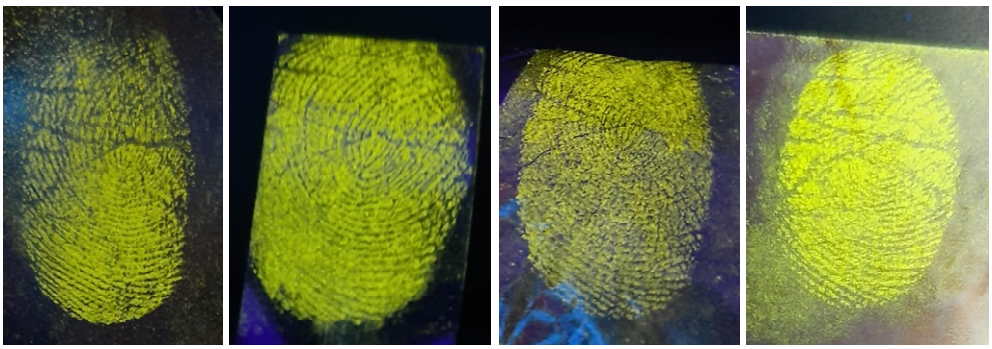
Preparation of 2-[(4-methylphenyl- imino)methyl]phenol (**3**) : 1.07g(0.01 mol) of 4-methylaniline (**1**) was dissolved in 2.5 mL of ethanol, taken in a china dish and then 1.22g (1.05 mL, 0.01 mol) of salicylaldehyde (**2**) was added to it with constant mixing . A yellow solid separated within two minutes. It was further mixed for another five minutes and then crystallized from alcohol to give yellow needle shaped crystals. Melting point of the compound was found to be 100-101°C (Lit.[9] m.p. 100-101 °C).

Preparation of powder formulation containing schiff's base (5% w/w): 0.2 g of 2-[(4-methylphenylimino)-methyl]phenol (**3**) was dissolved in 5.0 mL of acetone in a mortar and then 3.8 g of talc was added. It was thoroughly mixed and grinded with the help of pestle till the whole of acetone evaporated and a fine powder was obtained. It was further kept in air for another 10 minutes and then dried in a vacuum desiccator for 30 minutes. The dried powder, thus obtained, was kept in a stoppered bottle for further use. All other formulations were similarly prepared by taking the appropriate amounts of the schiff's base and the base material.

Preparation of powder formulation containing two base materials and schiff's base (5% w/w) : 0.2 g of 2-[(4-methylphenylimino)methyl]- phenol (**3**) was dissolved in 5.0 mL of acetone in a mortar and then 1.9 g each of talc and silica gel (tlc grade) were added. It was thoroughly mixed and grinded with the help of pestle till the whole of acetone evaporated and a fine powder was obtained. It was further kept in air for another 10 minutes and then dried in a vacuum desiccator for 30 minutes. The powder, thus obtained, was kept in a stoppered bottle.

Results and discussion:

It has been observed that better results showing less smudging and clear ridge details are obtained when formulations with calcium carbonate , silica gel and talc are used. Formulations containing 5% (w/w) schiff's base showed better results than those containing 2% (w/w), whereas the formulations with 10% (w/w) showed no extra benefit .Best results were obtained with a formulation obtained by mixing silica gel and talc in 1:1 ratio with schiff's base in 5% (w/w) ratio. The results are evident from the following figures. Fig.1 and Fig.2. show the results on non-absorbing objects whereas Fig.3 shows the observations on some absorbing objects. The results were not very encouraging on those objects which themselves contain some fluorescent dye e.g. white paper used for printing. The Schiff's base used for preparing these formulations, is cost-effective and non-toxic in comparison to the other fluorescent dyes in use. The compositions, thus prepared, can be used to develop fingerprints on a wide spectrum of surfaces, albeit to a varying degree. Their ability to detect weak latent fingerprints by virtue of fluorescent property enhances their utility in casework investigations at the crime scene.



Stainless steel spoon | Chrome plated spatula | Aluminium foil | Glazed tile

Fig.1 Finger prints on non-absorbing reflective objects

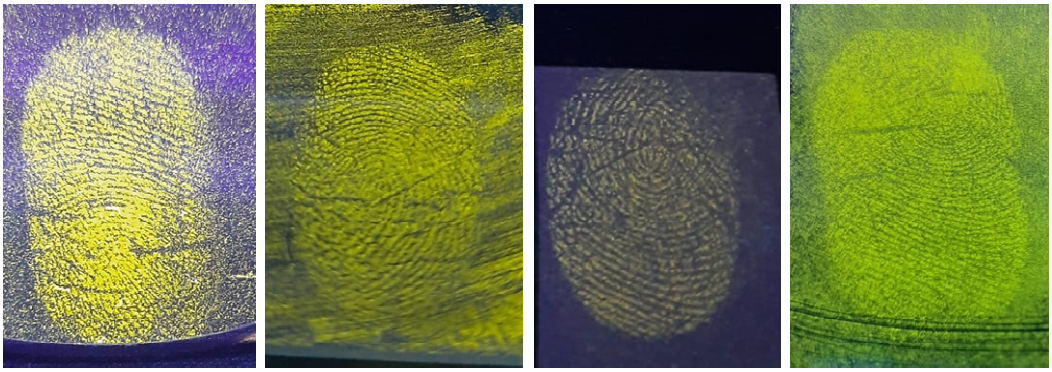


Fig.2 Finger prints on non-absorbing objects

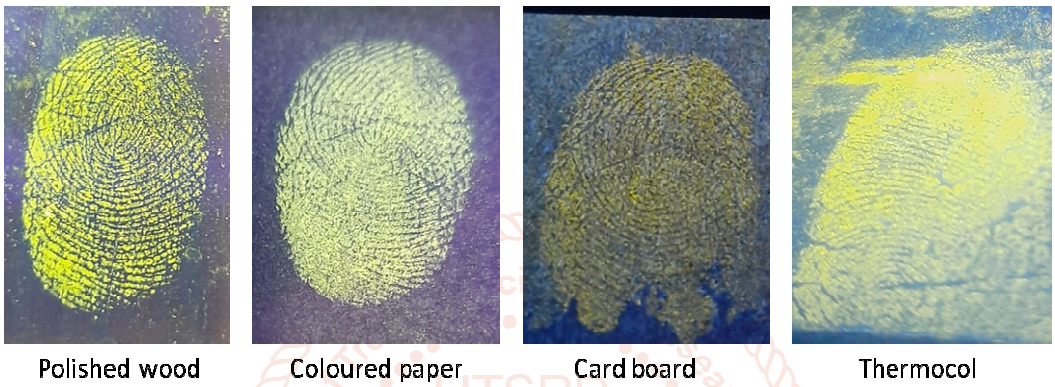


Fig.3 Finger prints on absorbing objects

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