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A Novel Fingerprint Powder Formulation Based on Methyl Orange

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Abstract

A novel fingerprint powder composition based on methyl orange has been formulated. The other ingredients of formulation are boric acid and talcum powder. The formulation develops sharp and clear fingerprints on wide range of dry, smooth, non-porous surfaces such as glass, metallic spoon, plastic folder etc. This formulation is useful in detecting and developing weak and fragmented chance prints from scene of crime. The developed formulation is non-hazardous, non-toxic and cost-effective in nature.

Keywords: Latent fingerprints; Powder method; Methyl orange; Non-porous surfaces.

Introduction

Fingerprints are the most infallible means of identification. It is important physical evidence usually found on various items recovered from the crime scenes. It can be used to ascertain the identity of person and provide a direct link to the suspect. Fingerprints are also useful in establishing the identity of war victims whose bodies are badly mutilated or fragmented. It can be used to identify prisoners of war who escape under disguise. In addition to this, detection of fingerprints on firearms, cartridge cases and explosive devices are useful in linking suspect with the crime.[1,2]

Fingerprints are formed by deposition of sweat from pores on friction ridge skin of fingertips. Since sweat is colorless in nature, the impressions formed there from too are invisible and hence termed as latent fingerprints.[1–3] Three types of glands *viz.* eccrine, apocrine and sebaceous are responsible for natural secretions from fingertips. Eccrine glands are widely distributed throughout the body and are particularly numerous on the palms of hands and the soles of feet. These glands produce sweat that is more than 98% water. Several other inorganic and organic chemicals are secreted by these glands as a result of general metabolism and catabolism. 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.[4–6]

Different kinds of optical, physical and/or chemical methods are routinely used to visualize latent fingerprints. Optical methods are nondestructive in nature and utilize electromagnetic radiation of appropriate wavelengths to render visibility to latent prints. Physical methods involve the physical interaction with sweat deposition of

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latent fingerprints. Chemical methods can be used to develop the latent fingerprints by chemically converting a particular constituent of sweat into a colored derivative. These methods may be used in isolation or in concert with others to enhance the visibility of developed prints. Selection of the method depends on nature (porous, semi-porous, nonporous), color (light, dark, multicolored), texture (smooth and rough), and condition (wet or dry) of surface on which the latent fingermark is impinged.[7-10]

Powder method is one of the oldest, simple, fast and effective techniques to develop latent fingerprints on dry, non-porous surfaces. It is a universal method of detecting latent fingerprints on non-porous surfaces. Powder technique for detecting latent fingerprints involves the application of a finely divided formulation to latent fingermark residues and subsequent removal of excess powder by brushing and blowing.[1,2,11-14] It relies on the mechanical adherence of fingerprint powder to moisture and oily components of latent fingermark residues. Adhering properties of powder formulation depends on the shape and size of particles of formulation. Small, fine particles adhere more effectively than large, coarse ones. No single powder formulation is ideal for detecting latent fingerprints on all kinds of surfaces.[1,2,14]

Latent fingerprints developed with powder method constitute the largest number of fingerprint identifications worldwide. In United Kingdom, approximately 50% of fingerprint identifications per annum arise from fingerprints developed using powder method. It is, therefore, evident that even the small percentage improvements that can be achieved by selection of the optimum powder and brush combination for a particular surface have the potential to provide significant operational benefits, and further studies in this area is required.[1]

Therefore, in the present study, potential utility of a novel methyl orange containing fingerprint composition for detecting and developing latent fingermarks on non-porous surfaces is reported. Clear and sharp fingerprints develop on a broad spectrum of crime scene evidences.

Materials and Methods

Boric acid, talcum powder and methyl orange were procured from Sigma Aldrich, India and were used without further purification. Methyl orange is a pH indicator. The indicator range is from pH 3.1 to 4.4. It is yellow above pH 4.4 while red in solutions below pH 3.1. It is an orange crystalline powder. It is a type of acidic azo dye with a molecular formula of $C_{14}H_{14}N_3NaO_3S$. Its molecular weight is 327.34 g/mol. The characteristic absorption maximum of methyl orange is at 507 nm. It is insoluble in water and diethyl ether.

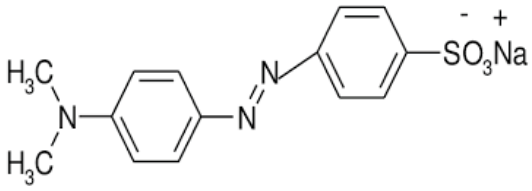

Fig. 1: Chemical structure of Methyl Orange ($C_{14}H_{14}N_3NaO_3S$) (sodium;4-[[4-(dimethylamino)phenyl]diazenyl] benzenesulfonate)

Figure 1 presents the chemical structure of methyl orange.[15] 250 mg of boric acid, 250 mg of talcum powder, and 25 mg of methyl orange were thoroughly mixed and dissolved in 50 ml of distilled water. The contents were stirred for 30 minutes and covered with aluminium foil and then allowed to dry at room temperature for 4–5 days. The dried mass was ground with a mortar and pestle and the fine powder was stored in an air tight container. The dye content in fingerprint composition was 4.76% by weight.

Different surfaces including steel, glass slide, metallic spoon, knife, ceramic tile, wrapping paper, plastic folder, bakelite switch, white board, and reverse surface of mobile phone were used in the present study for deposition of latent fingerprints. These surfaces were selected due to their easy availability and their frequent occurrence as physical evidence at scene of crime. These surfaces were cleaned with acetone moistened swab and dried before depositing latent fingerprints on them.

Samples of fresh latent fingerprints were taken from a single donor in order to maintain the consistency in the sampling. The donor was asked to rub his/her fingers on forehead or hair before impinging on these surfaces. It ensures that a mixture of eccrine and sebaceous sweat residue was transferred on the surface of substrates. The latent fingerprints were then developed with the powder composition using camel hair brush. The excess powder was blown off and prints were then photographed. Gloves were worn throughout the experimental work in order to avoid the contamination and unintentional deposition of latent fingerprints.

Results and Discussion

Powder technique is useful method for detecting latent fingerprints on dry, smooth, non-porous surfaces. The fingerprints developed with methyl orange based formulation is clear, sharp and visible to the naked eye. The orange colored fingerprints were developed with this formulation. The good quality fingerprints were developed on both light and dark background surfaces.

The present methyl orange based formulation produces high quality, sharp fingerprints on these surfaces. Fine ridge details are visible in fingerprints developed on these surfaces. Best results are produce on glass slide, wrapping paper and plastic folder (Figures 2–4).

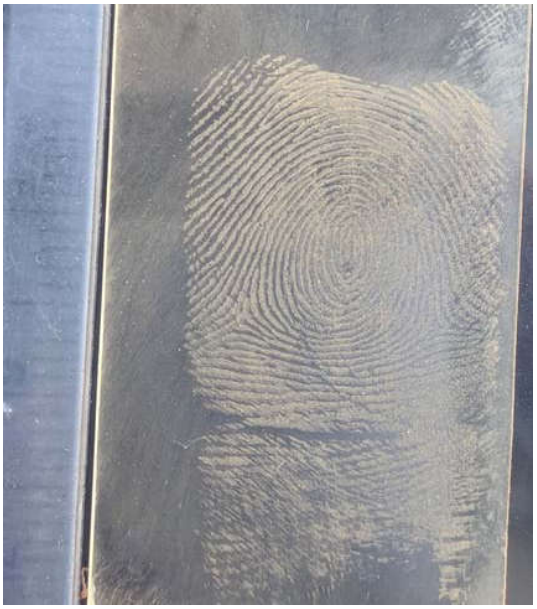

Fig. 2: Fingerprint developed with methyl orange on glass slide

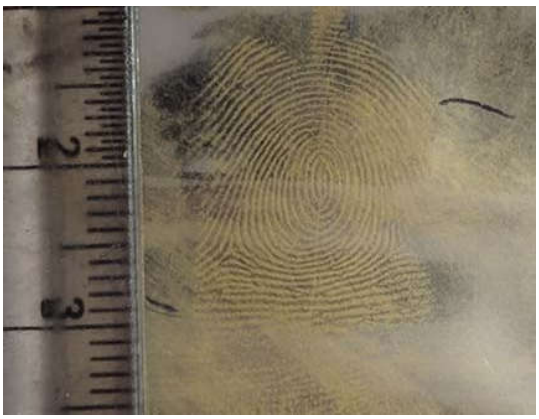

Fig. 3: Fingerprint developed with methyl orange on wrapping paper

Fig. 4: Fingerprint developed with methyl orange on plastic folder

Latent fingerprints can also be developed on variety of commonly used household items. Other surfaces on which suspects are likely to leave his/her fingerprint impressions include steel, metallic spoon, knife, ceramic tile, bakelite switch, and white board. The present formulation produces good prints on these surfaces (Figures 5-10). These prints are identifiable in nature and can be used for comparison and identification purposes.

Fig. 5: Fingerprint developed with methyl orange on steel

Fig. 6: Fingerprint developed with methyl orange on metallic spoon

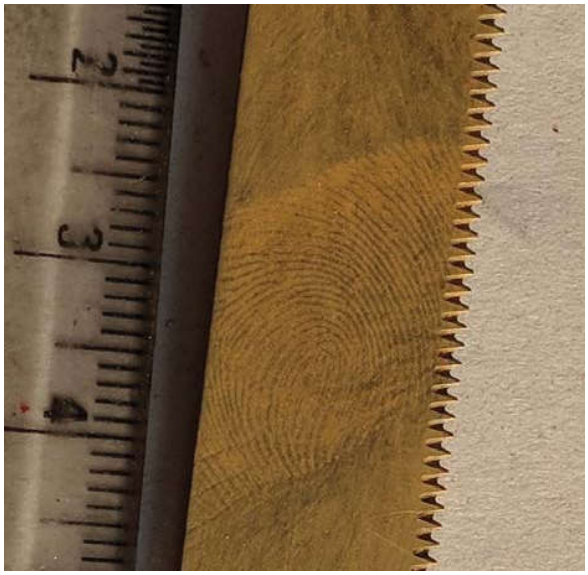

Fig. 7: Fingerprint developed with methyl orange on knife

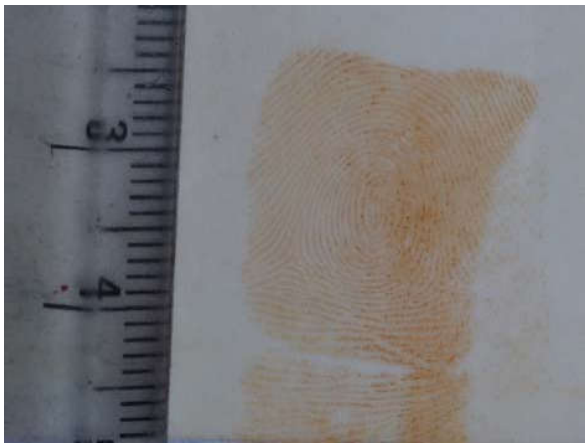

Fig. 8: Fingerprint developed with methyl orange on ceramic tile

Fig. 9: Fingerprint developed with methyl orange on bakelite switch

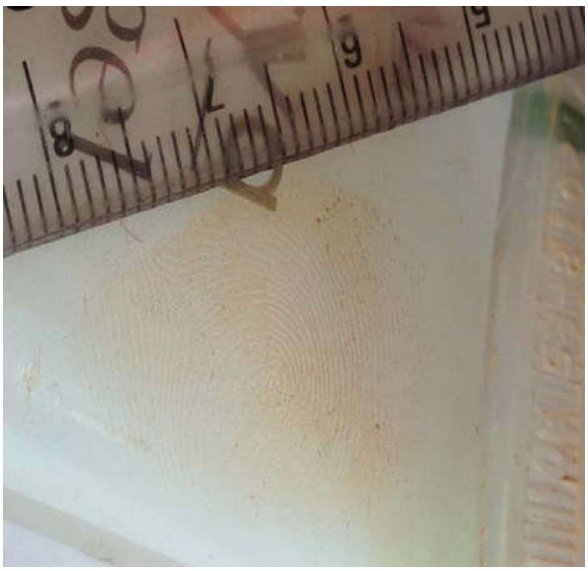

Fig. 10: Fingerprint developed with methyl orange on white board

In addition, fingerprints can also be developed on smooth surface of mobile phone. Fingerprints developed on reverse surface of mobile phone are shown in figure 11. Thus, the present method may be extended for obtaining fingerprints from touch screen of mobile phones and pen drives. The use of acridine orange, phloxine B and rhodamine B are also suggested to develop latent fingerprints on laminated sheets, postal stamps, polythene bags, glassware, bakelite switches and polished furniture.[16–18]

Fig. 11: Fingerprint developed with methyl orange on reverse surface of mobile phone

Methyl orange is a readily available, cost-effective and non-toxic organic dye. It is used as an indicator in acid base titrations. Conventional dusting formulations contain costly polymeric adhesives like starch, silica gel or rosin. However, boric acid and talcum are used in present formulation. These ingredients are non-toxic and cheaper than conventional polymeric adhesives. The use of such cost-effective ingredients also reduces the cost of formulation. The formulation had a shelf life of 4 weeks under ambient normal conditions.

Conclusion

The proposed method is a simple and fast for developing latent fingerprints on wide range of dry, smooth, non-porous surfaces. It may be used both at the scene of crime or in the laboratory. This formulation is nonhazardous, non-toxic, cost-effective, and remains stable for 4 weeks. This powder formulation offers convenient, easy and effective methodology to detect fresh latent fingermarks on wide range of dark and light coloured surfaces. It detects weak, chance prints and is deemed suitable for case-work investigations.

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