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Studying the Activity of Organic and Inorganic Materials for Identifying Fingerprints on Different Surfaces

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Abstract

Organic and inorganic chemical compounds were chosen to play as developer for pattern fingerprint and convert to visible fingerprint. The process was used two chemical compound sodium carbonate Na_2CO_3 as inorganic material and succinic acid $C_7H_6O_2$ as organic material. The methodology was powder method three surface for compare which was iron, aluminum and wood surface. the infra-red spectrum and optic microscopy were used to identified the nature of interaction between the surface under tasting and the powder of organic and inorganic material. The results were shown abilities for organic materials (succinc acid) to make patterns fingerprint for visible fingerprint in two types of surfaces iron and aluminum which failed to make that on wood surface.

Keywords
Organic,
Inorganic,
Iron, Aluminum,
Wood,
IR spectroscopy,
Adhesive.

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Introduction:

The identification and analysis of fingerprints required various techniques used to detect, visualize, and preserve latent (invisible) fingerprints left at a crime scene. The goal of fingerprint development is to obtain clear ridge patterns that can be photographed, lifted, and analyzed for individual identification, making it a critical step in forensic investigations [1].fingerprints are formed by adhesive the sweat on the surface of different materials which consist of the natural oils, and other residues deposited by the friction ridges of the skin. the critical parameter that responsible to chosen the method can be related to the nature of surface Depending on the surface type—porous or nonporous—different methods such as powder dusting [2].

Powder method one of the most common methodology that was depend to identified latent fingerprint and convert from invisible to visible print. The process depend generally in two parameters which is nature of surface and that include porous surface and nonoccurrence surface and that play critical roles towards make strong interactions when succored to make interaction between the sweat and surface[3-4].The other parameter represent by the nature of developer materials which responsible to make real interaction by Van Der Walls forces and adhesive forces with the trace of sweat[5].The other important parameters were the properties, texture, condition, and color of the surface, where the latent fingerprint is left behind. The powder used required take care with critical influence which in the powder method such could be hazardous to the health or may represent source of contamination for pullulate [6].

This work aims to conduct an analytical comparison to detect latent fingerprints using two types of environmentally friendly chemical compounds, namely sodium carbonate and succinic acid, on three selected surfaces: wood, iron, and aluminum. This work is completed for our works in the field of identification of fingerprint by using powder method with many attempts to make many developments for these filed which reported in many work such mentions in this research [7-8].

Experimental:

Materials and instruments: the materials which used in this work were sodium carbonate Na_2CO_3 and succinic acid $C_7H_6O_2$ were purchased from Fluke, and were used without further purification. The Brush was Cyclone Fingerprint brush SKU: A-2488, which used to applied powder method. Three types of surface were used as virtual surfaces which were: the iron, aluminum, and wood, all chosen from local market. The microscope was Deluxe Handheld Digital Microscope (44302-B Old Version).

Powder method: the white powder (succinic acid or sodium carbonate) is dusted over the surface (iron, aluminum, and wood), it adheres to the sweaty part of the latent prints, brush was used to remove extra powder. Then the analysis and comparative study is done based on the results obtained.IR characterization was made by Vector 33 Bruker spectrophotometer with using KBr tablets at 100 scans at a resolution of 3 cm−1 and spectrum was done from 4000 - 400 cm-1.

Results and discussion:

The results of the study show that the latent fingerprint was developed using organic and inorganic powder on three surfaces. two surfaces were nonporous which was iron and aluminum, while wood surface was represent the porous type. the variance in activity by powders give better results on porous surfaces and some on nonporous surfaces. Fingerprint patterns and their ridges could be seen in Figures 1 and 2.

The latent fingerprints invisible fingerprint impressions are identified in three surfaces and proper examination is positively done with the two powders. The ridge line is clearly shown not on the all images and it is clear in some images due to fine

particles of powder adjoining with fatty acid and oily components which is present in the sweat are deposited on the fingerprints and ridges. Figure 1: Development of Latent Fingerprint with the sodium carbonate powder on Porous surface (Fe and Al) and nonporous (wood). Figure 2: Development of Latent Fingerprint with the succinic acid powder on the same surface which mentions before.

The images in figure 1, showed that sodium carbonate was successful in proving the presence of the fingerprint on the surface of iron and aluminum only, but without fine details. While the images in figure 2 reported that succinic acid was succeed to make pasterns of fingerprint visible with shown all the details ridges for iron and aluminium surface but that did not succeed with wood surface.

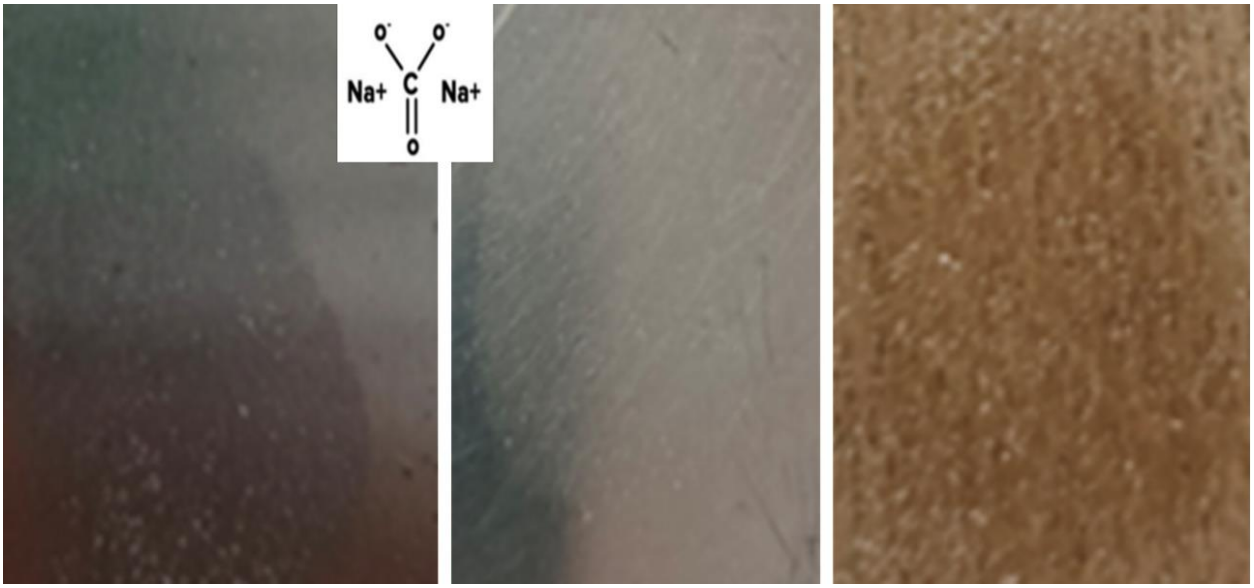


Figure 1: Development of latent fingerprint onto (from the left) iron, aluminum and wood surfaces by sodium carbonate Na_2CO_3.

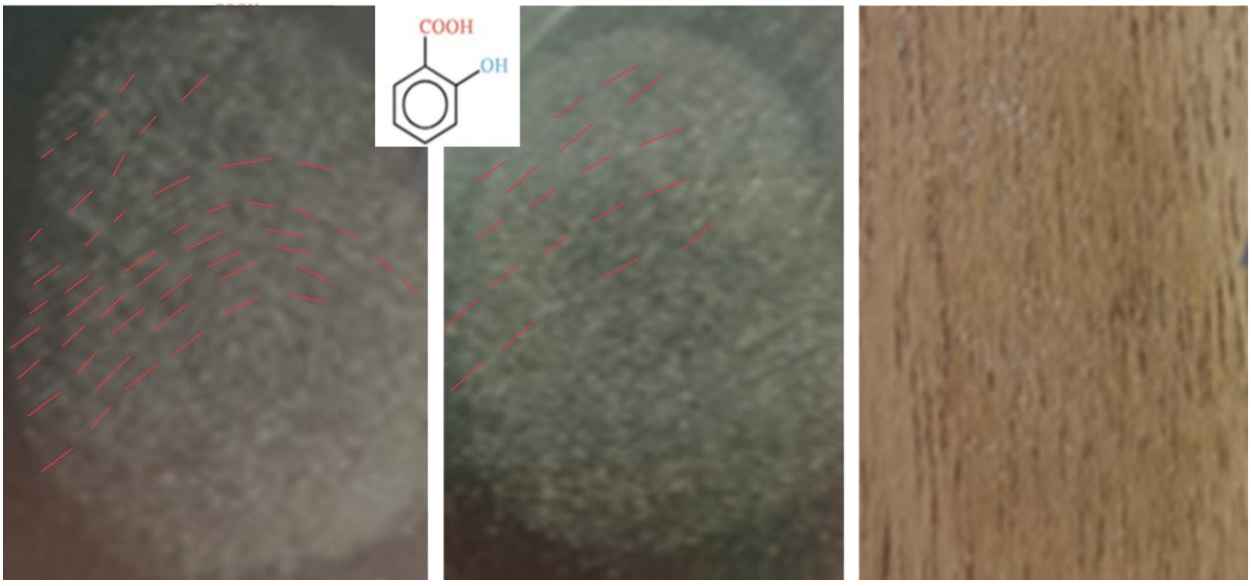


Figure 2: Development of latent fingerprint onto (from the left) iron, aluminum and wood surfaces by Succinic acid.

The variance in activities for the three surfaces by two chemical compounds with variance in physical and chemical properties can be related to the nature of two compound which responsible to physical properties [9-10].

Figure 3 reported the IR- spectrum for Na_2CO_3 were reported that less active side towards interactions with the trace of sweat Figure 4, shown, the IR spectrum for succinc acid, with characteristic vibrational peaks at wavenumber 3233 cm-1 for OH and 2999- 2831 cm-1 FOR C-H stretching, The other bonding refrs to C=O (COO-) asymmetric and symmetric stretching were assigned to IR peaks observed at 1652-1670 cm-1 and 1386 cm-1, respectively. Further, IR peaks appeared at 1558-1610 cm-1 were attributed to C=C (phenolic) multiple peaks [11].

These five peaks were responsible to the adhesive behaviour of solid succinc acid in different three surfaces which did not shown with inorganic compound Na_2CO_3.

The other critical reasons for the variance in activities between two compounds was Succinic acid identified with heavily on inter-molecular hydrogen bonding and Van der Waals forces for its solid-state structure, while Sodium carbonate is an ionic compound held by strong electrostatic forces, which loosen the behaviour of molecular interactions [12].

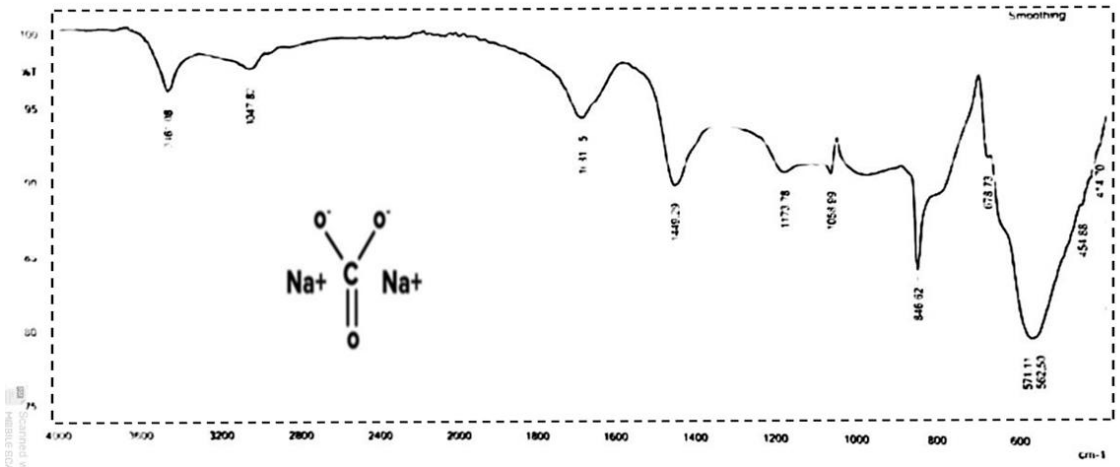


Figure 3: Skim for IR- spectrum of sodium carbonate

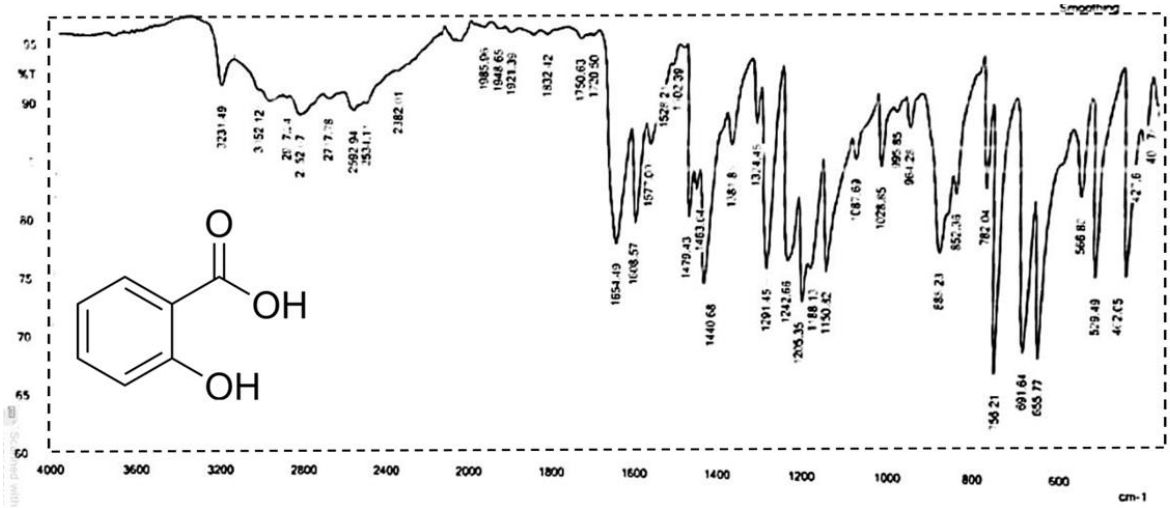


Figure 4: Skim for IR-spectrum of succinc acid

Figure 5 shows the distribution of the powder, as the image has been magnified 200 times. According to figure 5 the observed the size of the clump's characteristic of sodium carbonate, which are large compared to succinic acid. It can also be observed that the acid powder spreads in a way that allows for a more effective interaction and van der Waals forces to bond with the sweat residues present on the surface, noting that the development success was only achieved on non-porous surfaces [13].

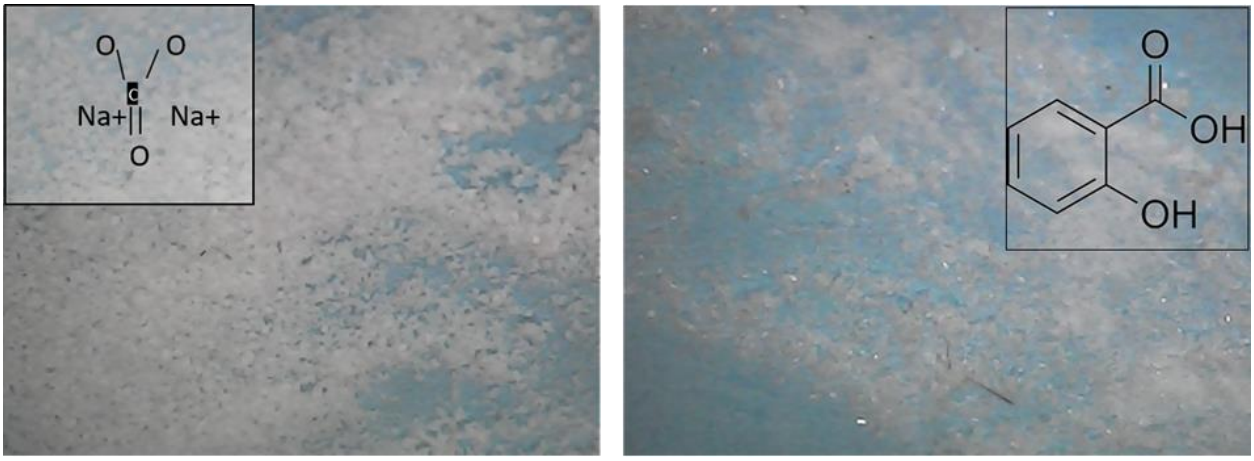


Figure 5: Skim of images for sodium carbonate powder and succinc acid powder (200x)

Conclusion:

Powder method was shown good agreement to develop the fingerprint onto iron and aluminum surface when used succenic acid due to the function groups and particle size which identified by IR- spectrum and optic microscope. The function groups were succeeded to create many and new interaction site on the surface as a result for abilities to make that under the activities of adhesive behavior. The powder method used in the current research confirms that the greatest effectiveness is a physical property that is adhesion, without the need for a chemical reaction. Therefore, the different effectiveness of the two components used in this work, organic and non-organic, could have given different results if they had the ability to adhere to the fingerprint remnants.

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