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http://dx.doi.org/10.5339/qfarc.2016.HBPP2333

Development of Novel Reagents for Visualizing Latent Fingerprints

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Chemical composition of fingerprints includes the presence of salts, ions, fatty acids, lipids, amino acids, nucleobases, nucleotides, and nucleic acids. Many methods used to detect latent fingerprints on porous surfaces such as paper exploit the reactivity of amino acids with a number of different reagents, including ninhydrin and lawsone (2-hydroxy-1,4-naphthoquinone; HNQ). HNQ, also known as hennotannic acid, is a natural yellow-orange dye present in the leaves of henna plant (Lawsonia inermis) as well as in the flower of water hyacinth (Eichhornia crassipes). It is used as natural dye to color hair and skin. HNQ has been shown to react with amino acids, accordingly used to detect fingerprints on paper. HNQ has also been shown to be a sensor for the detection of anions (changes its color from yellow to orange-red in the presence of anions such as OH-, CN-, etc.). The presence of nucleobases, nucleotides and/or nucleic acids that are also part of the chemical composition of fingerprints, has not been exploited to detect latent fingerprints. In this study we propose utilize the reactivity of HNQ, nucleobases and nucleotides to detect and enhance the detection of latent fingerprints. HNQ reacts with amines and form Schiff-bases that are expected to be strongly colored, whose colors can be further enhanced upon exposure to a base (NH3) or anions (OH- and/or CN). In this regard, we have synthesized a series of HNQ-amine derivatives using microwave green synthetic methods (reactants dissolved in methanol and the reaction carried out at 150°C for 5 min). The compounds formed in the above reactions are strongly colored as judged visually and by spectrophotometry. Under similar conditions, adenine and guanine bases or adenosine and guanosine nucleosides (with amine substituents) also react with aromatic aldehydes to form Schiff-bases. The aromatic aldehyde derivatives of these purine nucleobases or nucleosides are expected to be highly fluorescent. Again, we have synthesized a series of aromatic imine derivatives of adenine, guanine, adenosine and guanosine as above. As judged visually and by spectrophotometry, these compounds exhibit strong fluorescence. The spectroscopic characterization of the compounds described above is on-going. Further, we have used these compounds to detect and enhance detection of latent fingerprints. The latter involved (a) application of powdered HNQ, adenine, guanine, adenosine or guanosine on latent fingerprints or cyanoacrylate coated latent fingerprints, (b) powder deposition aromatic amines or aldehydes, (c) followed by microwave synthesis

Cite this article as: Sreerama L, Hijji YM, Al-Gunid NM, Gawadi AE. (2016). Development of Novel Reagents for Visualizing Latent Fingerprints. Qatar Foundation Annual Research Conference Proceedings 2016: HBPP2333 http://dx.doi.org/10.5339/qfarc.2016.HBPP2333.

of Schiff-base derivatives directly on the surface of the fingerprints using a commercially available domestic microwave oven (medium power for 3–10 min). The resulting fingerprints developed as above with HNQ and aromatic amines are strongly colored. Further exposure of thus formed colored fingerprints to NH3 strongly enhanced their color. The fingerprints developed as above using purine nucleobases or nucleosides with aromatic aldehydes were strongly fluorescent. Through this study, we have successfully synthesized Schiff-base derivatives of HNQ and aromatic amines as well as purine nucleobases or nucleosides and aromatic aldehydes. Further, we also suggest a novel method for the detection of latent fingerprints and its successful application on nonporous surfaces using the newly synthesized compounds.