International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 4 Issue 6, September-October 2020 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Schiff's Bases as Potential Mapping Agents for Iron Traces on Skin

Krishan Kumar Arora, Sarita Passey

Department of Chemistry, Zakir Husain Delhi College (University of Delhi), J L Nehru Marg, New Delhi, India

ABSTRACT

Invisible impression of weapon which are left on holder's palm form an important evidence during investigation of a crime. Identifying the traces of such metals is finding an increasing role of chemists in forensic science. A few reagents like 8-hydroxyquinoline and triazines have been tried for this purpose but their usage entails a number of drawbacks as well. We report here the utility of schiff's bases as potential reagents for mapping the traces of iron left on skin after the suspect held the weapon made up of iron or an alloy of iron.

KEYWORDS: *Trace metal detection, Forensic science, Schiff's bases, mapping agents*

How to cite this paper: Krishan Kumar Arora | Sarita Passey "Schiff's Bases as Potential Mapping Agents for Iron Traces on Skin" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-6, October 2020, pp.1479-1481, URL: www.ijtsrd.com/papers/ijtsrd35710.pdf

IJTSRD35710

INTRODUCTION

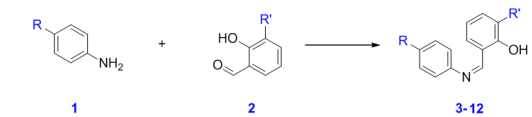
Most often the weapons used in crime, such as a gun, knife, rod or any other article, are generally made up of metal. Whenever a person holds such a weapon in hands, some invisible impressions are left on the holder's palm. It is due to the reaction of sweat with the metal content of weapon. It leaves a trace amount of metal in ionic state adhered to the palm of the holder. Identification of these invisible impressions serves as an important evidence during investigation of a crime. Detection of the traces of such metals on the human skin is a contribution of chemists in forensic science. The main focus is on detection of iron traces because most often the weapons are made up of this metal. Although the concentration of iron traces on skin depends on many factors but the two important factors are time of contact with the iron item and presence of sweat on skin.

A test used for this purpose is referred to as Trace Metal Detection Test (TMDT). One such test was used for the first time during Vietnam war in 1960 to identify people who carried the firearms. For this purpose their hands were sprayed with 8-hydroxyquinoline and then viewed under UV light[1]. Since then many other chemicals have been tried for mapping of these metals specifically iron, present in trace amounts. More recently the use of 3-(2-pyridyl)-5,6-diphenyl-1,2,4-triazine (PDT) and some of its derivatives[2-5] has been studied extensively for this purpose. The main problem in using triazines is that they form coloured complexes with iron in oxidation state (II), whereas iron after getting transferred to skin gets oxidised by air into oxidation state (III). As a result, while using triazine, first a solution of a suitable reducing agent e.g. ascorbic acid[4] or stannous chloride [6]($SnCl_2$) is sprayed so as to convert Fe^{3+} into Fe^{2+}. Moreover, triazines are difficult to prepare and are very expensive.

The main aim of this work is to develop a new reagent which is easy to prepare, cost effective and most importantly forms a coloured complex with Fe^{3+} so as to make the detection relatively easy. We report here the use of various schiff's bases as mapping agents for iron traces on human skin.

Experimental

Ten schiff's bases (3-12) were synthesised by the condensation of various aniline derivatives (1) with two aldehydes viz., salicylaldehyde (2, R′=H) and orthovanillin (2, R′=OCH_3). These compounds were synthesised by the known procedure[7] and their identity was confirmed by comparing their melting points with the literature values.



	R	R'
3	H	H
4	CH_3	H
5	Cl	H
6	NO_2	H
7	OCH_3	H
8	H	OCH_3
9	CH_3	OCH_3
10	Cl	OCH_3
11	NO_2	OCH_3
12	OCH_3	OCH_3

For studying the potential use of these schiff's bases as reagent for detecting the traces of iron, we have used ordinary tissue paper as contact surface. In order to mimic the sweat, a solution of sodium chloride containing a drop of acetic acid was used. This artificial sweat was prepared by dissolving 0.053 g of sodium chloride in 100 ml of distilled water so that it has 100 mM concentration of Cl^- ions and one drop of acetic acid was added to make it slightly acidic[6]. In order to represent a weapon, rings made up of mild steel are used. The traces of iron left by these rings after contact with the tissue paper were tested using 0.5%, 0.2%. 0.1% and 0.05% solutions (w/v) of all these schiff's bases where acetone was used as solvent. First the tissue paper was sprayed with a meagre amount of artificial sweat and iron rings were placed on it for specified time intervals as shown in Fig.1. We have tested the effect of contact of these iron rings for various time intervals viz., 1 min, 2 min, 5 min and 10 min. Thereafter, iron rings were removed and the contact spots were sprayed with the solution of schiff's base. Dark spots get developed at the area of contact due to formation of a coloured complex within a short span of time. The process was repeated with all the schiff's bases at four different concentrations as mentioned above.

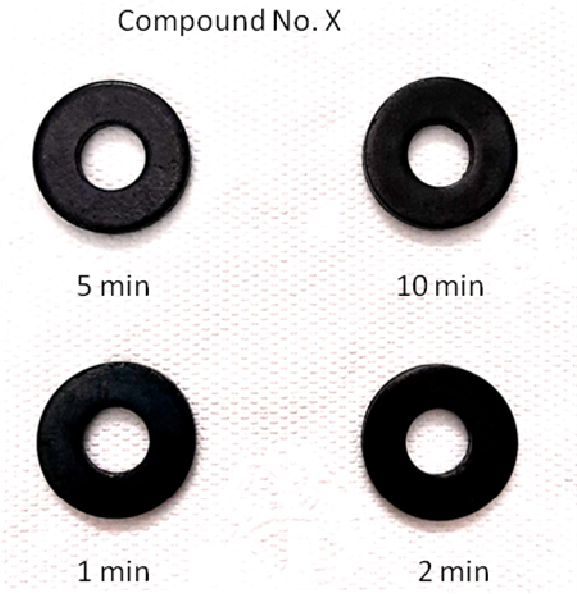


Fig.1 Placement of iron rings on tissue paper

Results and Discussion

It has been observed that although all the 10 schiff's bases being reported here (compounds 3-12) form the coloured complexes at the area where iron rings were in contact with the tissue paper but best results were obtained with the compounds No. 3, 4, 5 and 8. Better results were obtained when 0.2% (Fig.2) and 0.1% (Fig.3) solutions of these compounds were used as spraying reagents. The colour of the complexes formed was masked by the colour of the schiff's base itself when 0.5% solution was used while the colours developed with 0.05% solutions were very faint. It is also evident that the contact spots could be detected even when the time of contact was as low as 1 min. On the basis of above observations we propose the use of schiff's bases as mapping agents for iron traces.

The benefit of these reagents vis a vis triazines is that the additional step for reduction of Fe^{3+} to Fe^{2+} is not required. Further these reagents are quite easy to prepare as well as cost effective. We also propose that the use of these substances may be further explored for identifying weapon holders as the similar colour reaction may be observed on the suspects' hands.

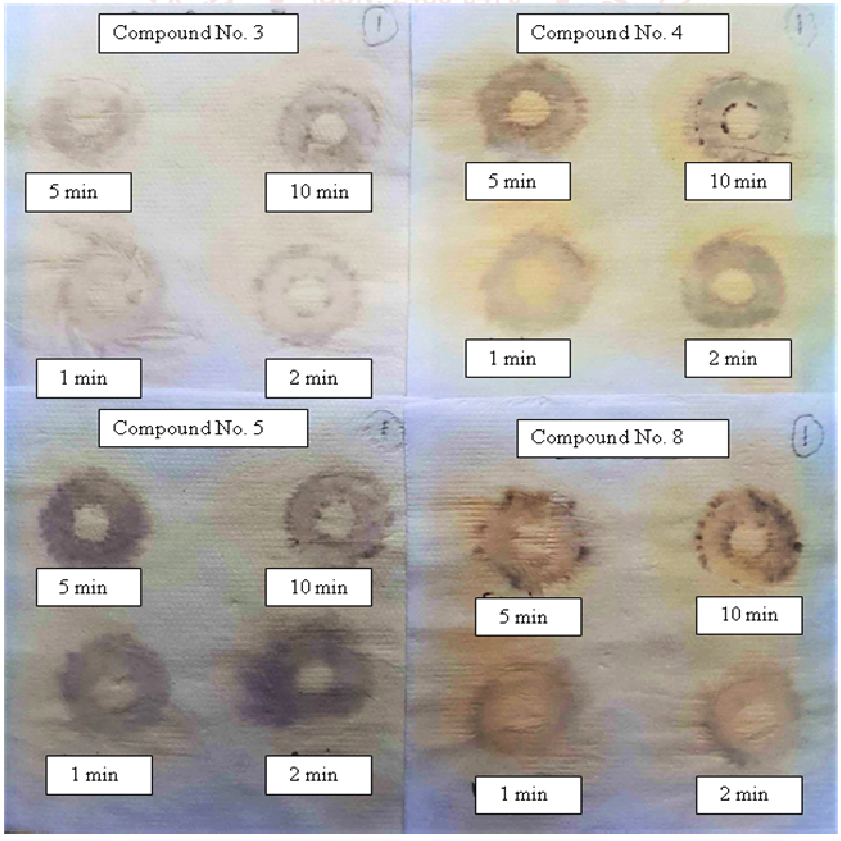


Fig.2 concentration of spraying reagent 0.2% (w/v)

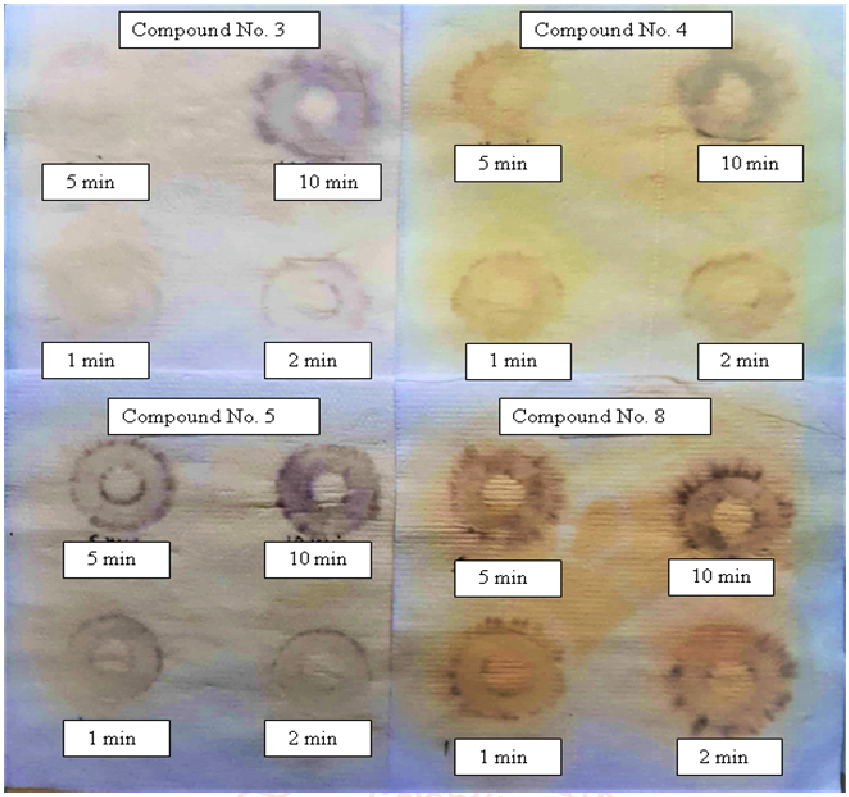


Fig.3 concentration of spraying reagent 0.1% (w/v)

References

[1] J M Stevens, H Messler, "the trace metal detection technique (TMDT)", J Forensic Sci. Vol.19 (3), 496-503, 1974.

[2] G L Goldman, J I Thornton, "A new trace ferrous metal detection reagent", J Forensic Sci. Vol. 21(3), 625-628, 1976.

[3] J Almog, A Hirshfeld, B Glattstein, J Sterling, Z Goren, Analytica Chimica Acta, Vol.322 (3), 203-208, 1996.

[4] J Almog and B Glattstein, "Detection of firearm imprints on hands of suspects: Study of the PDT-based field test", J Forensic Sci. Vol. 42(6), 993-996, 1997.

[5] Y Avissar, A E Sagiv, D Mandler and J. Almog, "Identification of Firearm holders by the $[Fe(PDT)_3]^{2+}$ complex", J Forensic Sci.Vol. 49(6), 1-5, 2004.

[6] J Szumera, M Welniak, A Olejniczak and J P Lukaszwicz, "Transfer of triazine –iron (II) chromic complexes left by iron items on textile background and human skin", J Forensic Sci, Vol.55 (4), 944-952, 2010.

[7] F G Mann and B C Saunders, Practical Organic Chemistry, Longman Inc, New York, Fourth Edition, pp 230,1978.