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Forensic implication of seized drug imitating methamphetamine with mileage in crime

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Abstract

Background The increase in drug abuse a major global issue. Clandestine laboratories along with illegal drug trafficking and trade increase the menace. Increased confiscation of illicit drugs not only indicates the manifold rise in drug abuse in Delhi and its neighboring region but also signifies an escalation and proliferation in other drug-related criminal activities. Investigating agencies around the world are working hard to combat and eradicate this problem. The samples seized by these agencies are subsequently sent for forensic examination to rule out the presence of any illicit drugs. Few such seized crystalline samples such as "methamphetamine" were submitted for examination with a query for the identification of any scheduled substance. The analysis outline followed was physical, chemical, Fourier transform infrared spectrometer analysis for detection, identification, and confirmation of seized drug samples. The purpose of a detailed investigation regarding the identification of the crystalline sample was also to understand the criminal activities involved in the consistent seizures and the forensics behind it.

Results The comprehensive examination identified the sample as an inorganic salt of sodium thiosulfate with the absence of contraband methamphetamine. The study on salt-imitating methamphetamine underlines its diverse uses as in adulteration, trafficking to camouflage narcotics drug and its involvement in numerous other illegal purposes which on the other hand has a very crucial impact on society and its well-being.

Conclusions The novel findings will update the investigating agencies and other experts regarding the importance of the detection of sodium thiosulfate salt in seized samples and will well establish the foul play behind large seizures to justify the role of forensic science. This unique finding deals with a very sensitive issue that has immense social impact and needs exceptional thoughtfulness.

Keywords Drug abuse, Imitating, Methamphetamine, Fourier transform infrared spectrometer, Sodium thiosulfate

Background

A global increase in the use of controlled and novel psychoactive substances between 1998 and 2017 which alone saw a tenfold increase in global seizures of amphetamine type substances (ATS) (World Drug Report 2019: Pre-release to Member States 2019). The drug cartels that fuel the illegal drug abuse epidemic work hard for trafficking, trade, and distribution unabated. This surge in traffic for ATS reflected a global demand for their use and has caused an increase in the production of synthetic-based psychostimulants which can be produced anywhere (Stoneberg et al. 2018). ATS generated a pervasive problem for Indian authorities, both as trafficked substances and in terms of drug abuse (United Nations Office on Drugs and Crime 2014; Patil and Pandey 2022). India's geographical location has created substantial hurdles in enforcing regulations on precursor chemicals, clandestine fabrications, and trafficking (Goyal et al. 2020a, 2020b, NCB Report 2016). The demand for methamphetamine (MA) available in both crystal and powder form has raised in Indian territory (United Nations Office

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on Drugs and Crime 2022) where, initially, it is popular as a stimulant for recreational purposes and later becomes highly addictive affecting the central nervous system (Ghosh et al., 2022). Unfortunately, the use of the drug does not end only as abuse but leads to other crimes like violence, suicide, and suffering in society (Wright and Klee 2001; Deborah et al. 2013; Jothee et al. 2019). The proliferation of clandestine laboratories with surreptitious methods for processing, extracting, and synthesizing drugs of abuse in demand often requires various pharmaceutical and other chemicals to be added to the drug of abuse as adulterants and diluents. The role of diluents or bulking agents is only limited to increase the quantity and does not have any active pharmacological effect on the abuser whereas the main function of adulterants is to produce a pharmacological effect along with the narcotic substance. Chemically existing as isomers in levo and dextro form of MA wherein dextro isomer is made by the ephedrine-reduction process and is approximately 10 times more physiologically active than its levo isomer. Seizures from drug cartels and clandestine laboratories involved in the illicit manufacture of MA, from ephedrine (EpH), pseudo-ephedrine (PS), and other precursor chemicals, have occurred in recent years by the investigating authorities (UNODC–STNAR 34). For the identification and detection in forensic drug samples, gas chromatography-mass spectrometry (GC-MS) and Fourier transform infrared (FTIR) are used in a routine basis due to ease in sample preparation and accurate repeatable results (Orfanidis et al. 2017; Brettell and Lum 2018). FTIR spectrometer is suitable for the confirmatory identification of unknown samples by selective absorption of infrared radiation (IR). The ability of IR is identify a chemical compound by absorbing a specific wavelength, which is the characteristic of that particular compound due to the molecular bonds present in the sample. Like a fingerprint, no two unique molecular structures produce the same infrared spectrum which makes infrared spectroscopy advantageous in several types of forensic analysis especially powder or crystalline samples (Goyal et al. 2020a, 2020b). Analytical forensic scientists are free to choose a methodological approach toward the chemical identification of compounds in complex cases and aim to achieve positive outcomes to enhance the delivery of justice. The forensic implication is usually masked by the non-detection of a controlled substance, when the culprit walks free from the hands of the law. The purpose of this study is to highlight the various forensic implications of unidentified material imitating MA and understand the reason behind its high demand leading to illegal trading and bulk seizures.

Methods

Samples seized by investigating agency suspected as MA was submitted for chemical identification for the presence of any scheduled drug as shown in Fig. 1.

Materials required

The materials required are water, ethanol, diethyl ether, chloroform, formaldehyde, conc. sulfuric acid, sodium carbonate, sodium nitroprusside, acetaldehyde, zinc uranyl acetate, iodine solution, and silver nitrate.

Fig. 1 Crystalline seized samples

Physical and chemical examination

Physical examination was undertaken for color, odor, solubility, pH, and melting point. The chemical tests conducted are listed in Table 1.

ATR-FTIR parameters

ATR-FTIR spectrometer model No. Alpha II (Bruker, Germany) was used for the analysis of samples. Spectral measurements were acquired in continuous scan mode for 64 scans over the range of 600 to 4000 cm^{-1} at 4 cm^{-1} resolutions. Samples are placed directly on the diamond crystal plate, and images are obtained through infrared focal plane array (FPA) detector. Spectra were processed using the OPUS (from Bruker) software for performing data analysis operations. Background measurements were carried out before each sample.

Results

The physical and chemical examinations of crystals showed distinct differences pointing toward the presence of inorganic compound sodium thiosulfate (STS) rather than organic MA as illustrated in Table 1. The melting point of the samples was analyzed by the melting point apparatus of make STUART model SMP 30. Instrument GC-MS examination of the sample was conducted to rule out the presence of MA (ATS) in the suspected samples. As the sample was insoluble in any solvent and was water soluble, it could not be identified by GC-MS; therefore, ATR-FTIR were explored for sample analysis.

The ATR-FTIR spectra of the suspected crystalline substance indicated wavenumbers 3397, 1653, 1161, 1112, 993, and 654 cm^{-1} which were tallied with standard STS in the library provided with the instrument. However, wavenumbers 1603, 1487, 1454, 1386, 1355, 1191, 1081, 1059, 748, and 699 cm^{-1} specific for MA could not be observed in seized crystalline exhibits (Riyanto and Nas 2016).

Discussion

Drugs and crime are inevitably co-related as a global contributor to major social problems. Goldstein's work on psycho-social opportunities for drug abusers to commit crime identified the involvement of major illegal drugs like cocaine, MA, and heroin in various criminal activities including theft, burglary, robbery, and rape and in many unpredictable crimes (Goldstein 1985). Thus, the distinct significance of detection and identification of drugs in any drug-related crime by forensic scientists exists. The mentioned case was received for identification of a sample suspected as MA; however, inorganic salt was detected after various physical and chemical examinations according to a laboratory protocol. The different wavenumbers in identified compounds signify the different compounds as shown in Fig. 2a, b. The MA-FTIR data goes in correlation with the findings of

Table 1 The chemical and physical tests conducted

Physical examination				
S. no	***Physical properties***	***Observation of seized substance***	***Standard MA. hydrochloride***	***Ref***
1	**State**	**Crystalline**	**Crystalline**	**(Methamphetamine-National Medical Library n.d.)**
2	**Color**	**White**	**White**	
3	**Odor**	**Odorless**	**Odorless**	
4	**Nature**	**Hygroscopic**	**Hygroscopic**	
5	**Melting point**	**48.3 °C**	**170 °C**	
6	**Solubility**	**Water**	**Water, ethanol, diethyl ether, and chloroform**	
7	**pH**	**Acidic**	**Alkaline**	
Chemical examination				
S. no	***Chemical tests***	***Observation and inference of seized substance***	***Standard MA. hydrochloride***	***Ref***
1	**Marquis test**	**No reaction—MA not detected**	**Orange, slowly turning to brown**	**(unodc stnar 34)**
2	**Simon's test**	**No reaction—MA not detected**	**Deep blue color**	
3	**Flame test for sodium ions**	**Yellow-colored flame—positive**	**No reaction**	**(Svehla 1979)**
4	**Zinc uranyl acetate test for sodium ions**	**Yellow precipitate—positive**	**No reaction**	
5	**Iodine solution test for thiosulphate ions**	**Color of iodine disappears gradually—positive**	**No reaction**	
6	**Test with silver nitrate for thiosulphate ions**	**White ppt which changes to black on standing—positive**	**No reaction**	

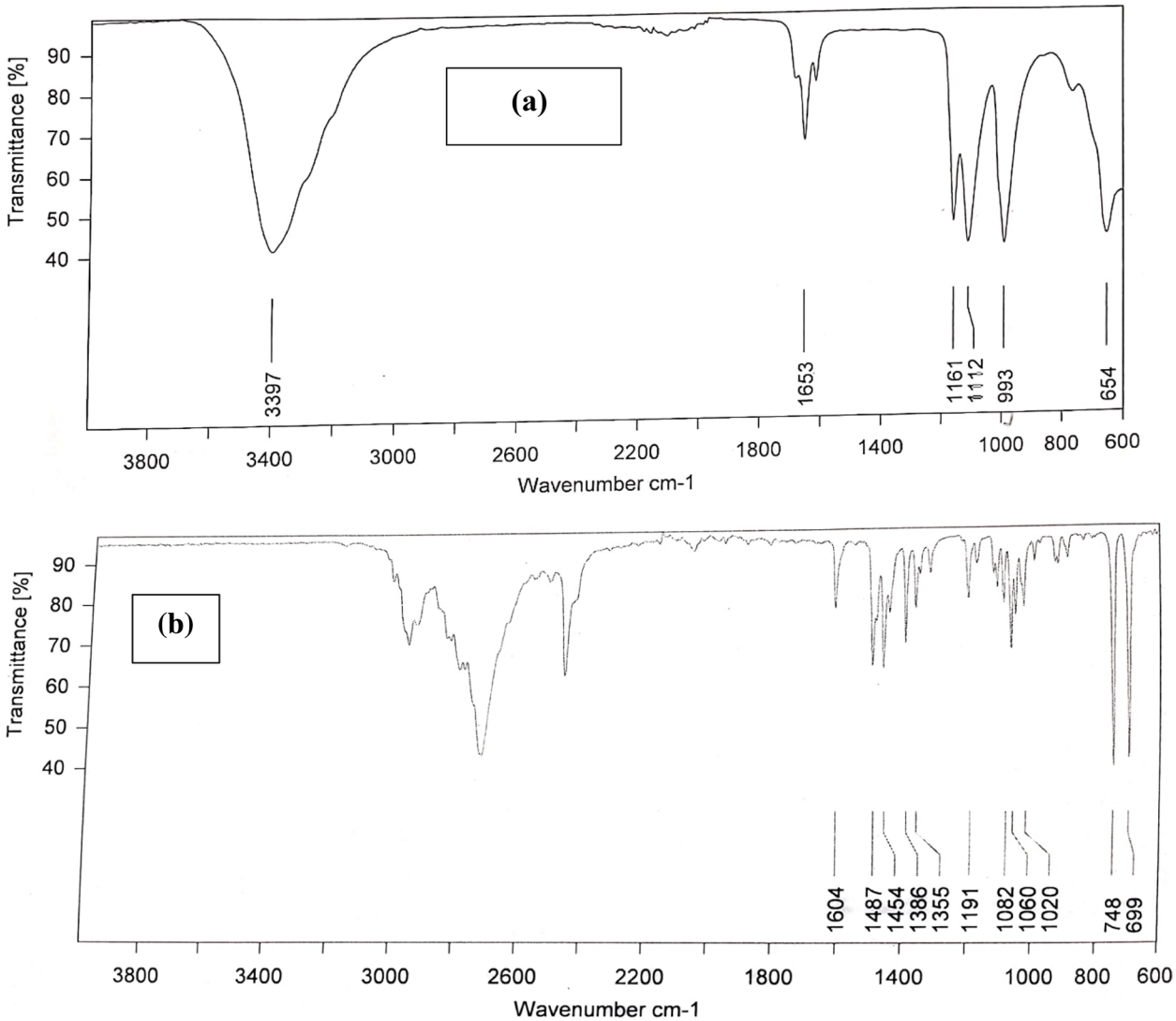

Fig. 2 FTIR spectra represent a wavenumber of samples having sodium thiosulfate (**a**) and represent wavenumber of drug methamphetamine (**b**)

Riyato (Riyanto and Nas 2016). The manifestations associated with the alleged role of STS should be imperative in the minds of investigating authorities while seizure. Investigating agency in a large part of northeastern India was confounded after they received information regarding "black paper turning into cash magic" where individuals were inclined to become from "rags to riches" effortlessly duped of their currency involving simple chemistry with chemical STS and duplicate currency notes (Times of India 2022; Bussiness Standard 2016; Express news service 2009). Forensic scientists were intrigued to understand the different roles played by STS which was leading to its large share of illegal trading. An immense connection is observed between drugs and crime signaling a rise in demand and supply. According to Taylor, imported and clandestine drugs like MA cause high levels of criminal activity (Taylor et al. 2011). This study deals with an important problem of current forensic interest having a high impact on society. Since STS is not covered under the controlled substance act, the drug peddlers walk free even if investigating agencies suspect them of carrying a scheduled drug as its crystals are look-alike MA. Oftentimes, drug traffickers use adulterants, diluents, etc. to increase the bulk quantity of drugs in order to maximize profit (Jennifer et al). STS is easily mistaken for MA due to its similarity in physical appearance and can be effortlessly used as camouflage because of its colorless, odorless, and stable nature

of crystals (Material Hazzard sheets 2007), for not compromising on profit and availability. As drug abusers are mostly addicts and have developed a tolerance capacity toward drugs, they fail to understand the trick behind and increase consumption to have enhanced effects which may lead toward intoxication not only by the drug but also by the other ingredients present in it. Symptoms including nausea, vomiting, decreased hemoglobin, hypocalcemia, hyponatremia, hypokalemia, hypophosphatemia, pyrexia, stomatitis, stomach cramps, metabolic acidosis, and also gastrointestinal discomfort may occur in large doses of STS (drug and disease), although its legitimate use lies as an antidote medicine where calculated doses are given for treatment purposes (Meillier and Heller 2015). Also, as far as our knowledge goes, no case has been reported as suicidal or homicidal poisoning from sodium thiosulfate. The common mode of administration for abusive drugs is mainly through snorting, oral, and injections whereas when STS is mixed with MA, the effect from snorting and injections will be delayed and the abuser will move for ingestion for quick action. The biochemical effects on the body will come into play as soon as STS reacts with HCL found in the stomach causing additional acidity (Dinegar et al. 1951). Also, evidence suggests that thiosulfate inhibits cytochrome c oxidase of the electron transport chain in yeast mitochondria and eukaryotes (Chen et al. 2021). Enzyme cytochrome c oxidase is necessary for the respiratory process, and its inhibition causes breathing trouble or dyspnea mainly acute hypoxic respiratory failure secondary to pulmonary edema worsened by anion gap (Corwin et al. 2020). Asymptomatic acidosis is expected during treatment, but when out of proportion, this can have life-threatening effects due to a large anion gap. Although the pathophysiology of this condition is poorly understood, it appears to be related to a derangement in calcium-phosphate metabolism as STS is acidic in nature (Hunt and Ryder 2018; Selk and Rodby 2011). Keeping in view of this mechanism of action on body which will not be paid attention in case of drug abuse death as the forensic scientist will be busy trying to detect MA during forensic analysis which is available only in traces or metabolized whereas the primary action was due to STS added in trafficked drug and its overdose. The salt imitating methamphetamine has diverse uses as in adulteration, trafficking to camouflage narcotics drug, and involvement in numerous other illegal purposes which has a crucial impact on society and its well-being. Therefore, the identification of drug is of greatest concern for law enforcement agencies, scientists, citizens, policymakers, and physicians.

Conclusions

The purpose of this study was to identify the unknown crystals imitating MA and underline the logical reason behind its high demand which is leading to illegal trading. Clandestine laboratories use STS for manufacturing MA and drug peddlers often dupe consumers by camouflaging the bulk of drug causing equal harm to health as the drug itself. ATR-FTIR techniques enabled forensic scientists to examine the sample even in minute quantities and reach accurate inferences. The identification of STS crystals would allow the criminal justice system to check on drug-related crimes. The study highlights the forensic challenges faced when not detecting any contraband in the suspicious drug and its other attributions in crime which confuse the investigators and let the guilt walk free. This study should put into consideration the need for in-depth screening of suspicious cases where the presence of contraband could not be established. The study highlights vigilant chemical identification by forensic scientists to strengthen the judiciary and investigating agencies.

Abbreviations

STS	Sodium thiosulfate
NDPS	Narcotic drugs and psychotropic substances
ATS	Amphetamine type substances
MA	Methamphetamine
FTIR	Fourier transform infrared spectrometer
UNODC	United Nations Office on Drugs and Crime
EpH	Ephedrine
PS	Pseudo-ephedrine

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Authors' contributions

SD—case examination and chemical and instrumental analysis. NV—case examination and chemical and instrumental analysis. SS—study conception and design and presentation and critical review of the draft. AK—interpretation and presentation of the data. KG—interpretation, presentation, and critical review of the draft. The authors read and approved the final manuscript.

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Competing interests

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