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Knowledge, Attitude and Practice Regarding Road Traffic Safety among Students

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Abstract

Background: Knowledge, attitudes and practice of road traffic regulations and safe driving have an important impact on RTA, few studies of India.

Aims: To study and analyse data of the current status of knowledge, awareness and practice about Road traffic safety among the students of age group between 18-25 years.

Materials and Methods: A cross sectional study was conducted among medical students of, Krishna Institute of medical sciences, Karad for a period of 2 months. 214 subjects were selected from students between the age group of 18-25 years.

Results: All 214 subjects in the study are medical students participated in study in the age group 18 – 25 years. Nearly 80% of the students said that they had adequate knowledge of road traffic regulations and more than one third (36%) mentioned that high speed was the most important cause of RTAs. 39.9 % students are aware of Good Samratian Law. Importance of the use of seat belts, about 90% were strongly convinced of its importance, using seat belts, 38.7% felt convinced of its use. More than half of the students thought that the use of seat belts reduced the disabilities caused by RTAs. 98.1% students know it is compulsory to wear helmet but only 43.9% students actually wear it. 97.6% know it is against the law and safety to use mobile phones while driving but only 51% of students avoid it.

Conclusion: The knowledge and attitude of the members does not necessarily reflect into their practice. Hence, laws should be made more stringent and public should follow them in good faith.

Keyword: Knowledge; Attitudes; Practice; Road Traffic Regulations.

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Introduction

Accident is as an unfortunate incident that happens unexpectedly and unintentionally, resulting in damage or injury. Increased number of vehicles, drink driving, inadequacies of the road, over confidence, distracted driving, ignorance, increased speed of the vehicles and child restraints are the commonest causes for increased road accidents. [1] We have had great success in fighting disease that kill children. We can't now sit and watch people die or disabled due to injuries that can be easily prevented.

The 2030 Agenda for Sustainable Development recognizes that road safety is a prerequisite to ensuring healthy lives, promoting well-being

and making cities inclusive, safe, resilient and sustainable. The Decade of Action for Road Safety 2011–2020, officially proclaimed by the UN General Assembly in March 2010, seeks to save millions of lives by building road safety management capacity; improving the safety of road infrastructure; further developing the safety of vehicles; enhancing the behaviour of road users; and improving post-crash response.[1]

Road traffic accident is a major public health problem in India. Every year the lives of approximately 1.35 million people are cut short as a result of a road traffic crash. Between 20 and 50 million more people suffer non-fatal injuries, with many incurring a disability as a result of their injury.[2]

Road traffic injuries are the leading cause of death for children and young adults aged 5–29 years. From a young age, males are more likely to be involved in road traffic crashes than females. About three quarters (73%) of all road traffic deaths occur among young males under the age of 25 years who are almost 3 times as likely to be killed in a road traffic crash as young females.[2]

In India, more than 70 per cent of fatal road crashes in 2017 involved adults in the 18–45 years age group, according to a report. As many as 1.47 lakh people died on Indian roads in 4.64 lakh accidents reported during 2017, the report by the Ministry of Road Transport and Highways said. Fatal road accident victims largely constitute young people in the productive age groups. Young adults in the age group of 18 – 45 years accounted for 72.1 per cent of victims during 2017. People in working age group of 18– 60 years accounted for a share of 87.2 per cent in the total road accident fatalities.[3]

Indian road deaths wipe out one city every year: To put the death toll due to road accidents in perspective – in the last one decade, the average annual road death crashes stand at 1.3 lakh per year – a figure that surpasses the population of many small Indian cities.[4]

Simple measures like awareness and practice of road safety measures can effectively reduce the impact of RTAs on the lives of people. Road safety deals exclusively with road traffic crashes – how to reduce their number and their consequences. Road safety aims to reduce the harm resulting from crashes of road vehicles and to convey information to road users to enhance their knowledge about road safety issues, influence their behaviour on the road and prepare them for new safety measures.[5] Road safety-educated students will grow to be leaders of communities forming opinions. The chances of road traffic accidents can be averted to a large extent, if these adolescents who are going to be adults of tomorrow are made aware of road safety measures. Adolescence is like a bridge between childhood and adult hood, during which the individual is gaining further physical maturity. The current study is planned to determine the knowledge of medical students regarding road traffic rules, their attitude toward them and their practices adaptedtowards road traffic safety.The study is conducted to assess the knowledge about road traffic rules and make the students conscious about their current awareness and fallacies regarding road safety and rules.

Our aim of study and analyse data of the current status of knowledge, awareness and practice about Road traffic safety among the students of age group between 18–25 years.

Material and Method

A cross sectional study was conducted among medical students of, Krishna Institute of medical sciences, Karad for a period of 2 months. The study subjects were selected from students of Krishna institute of medical sciences deemed to be university Karad, between the age group of 18–25 years.

Sample size: In a study conducted at S.N medical college Karnataka, knowledge regarding RTA in students was 15.9%[5] Sample size was calculated using this as a prevalence, hence according to the formula $4pq/L^2$ (taking allowable error 5) the sample size was calculated to 214 students.

Inclusion criteria

1. Students between 18–25 years.
2. Both sexes.
3. Willing to give consent.

Exclusion criteria: Students who didn't give consent and students who were absent at the time of data collection.

Questionnaire filled by 214 medical students will be analysed. A questionnaire (closed type) is self-prepared regarding the road traffic rules.The questionnaire will be given to the subjects to fill.A pilot study will be conducted after obtaining orally informed and written consent from subjects.

The questionnaire consisted of personal data and background information followed by a knowledge questions, attitude scale and expressed practice

scale. The questionnaire consisted of questions scale categorized as: strongly agree, agree, disagree and strongly disagree. The study was approved by Institutional Ethical Committee and confidentiality of information and anonymity of subjects was maintained. The data was collected after obtaining the verbal consent of the subjects.

Data entry and analysis were carried out using Statistical Package of Social Sciences (SPSS). Student t-test and Chi-square test were used to test for significance when appropriate and (p-value was considered significant if it was less than 0.05).

Statistical Analysis: Data tabulated by using Microsoft office Excel. The data will be collected in pre-structured proforma and will be analysed using statistical package for social sciences (SPSS) version 20 and presented as descriptive statistics.

Result

All 214 subjects in the study are medical students. Most of the subjects are in the age group 18–25 years.

Most of the students are of 22–23 years age with equal male and female ratio, about one half of whom lived in the city (49%); Most of them had vehicle (60%) and 59 % had driving licenses.

More than one half of the students (53%) had been involved in RTAs; 24.7% out of these had been injured, More than 40% of them indicated that speed was the main cause of the RTA (Table 1).

Nearly 80% of the students said that they had adequate knowledge of road traffic regulations and more than one third (36%) mentioned that high speed was the most important cause of RTAs. 39.9% students are aware of Good Sarmatian Law.

When asked about the importance of the use of seat belts, about 90% were strongly convinced of its importance. However, on the reasons for using seat belts, 38.7% felt convinced of its use. More than half of the students thought that the use of seat belts reduced the disabilities caused by RTAs (Table 2).

98.1% students know it is compulsory to wear helmet but only 43.9% students actually wear it. It was found out that 97.6% know it is against the law and safety to use mobile phones while driving but only 51% of students avoid it. Also 91.6% of students are aware about the speed limit but still 52.4% students over speed (Table 3).

Table 1: Socio-demographic characteristics and previous RTA related events of students.

Details	Number of Subjects	Percentage
Age (in years)		
18–19	17	7.94392523
20–21	72	33.6448598
22–23	109	50.9345794
24–25	16	7.47663551
Gender		
Male	105	49.0654206
Female	109	50.9345794
Place of residence they belong to		
Urban	105	49
Rural	75	53
Semi urban	34	15.8878505
Own a vehicle		
Yes	129	60.2803738
No	85	39.7196262
Has a driving license		
Yes	126	59
No	88	41
Exposure to previous RTA		
Yes	114	53
No	100	47
Injured in RTA		
Yes	53	24.7663551
No	161	75.2336449
Reason for RTA		
High speed	21/53	39.6226415
Over taking another car	16/53	30.1886792
More than one reason	11./53	20.754717
Others	5./53	9.43396226
Death in relatives resulting from RTA in Past 10 years		
Yes	51	23.8317757
No	163	76.1682243

Table 2: Knowledge and attitudes of students on road traffic regulations and RTAs.

Knowledge	No. of Students	Percentages
Degree of knowledge about road traffic regulations on law		
High	63	29.4
Moderate	128	59.8
Low	23	10.8
Reason for RTA(what student think)		
Hight speed alone	77	35
Drivers lack of awareness of traffic regulation and law alone	9	4.2
Drivers non compliance with traffic rules and regulations alone	12	5.6
All the above reasons	28	13.1
More than one reason	88	41.1
Good Samaritan Act		
Aware of act	85	39.9
Aware but ignored	20	9.2
Not aware	109	50.9
ATTITUDES		
Convinced about the importance of seat belts		
Very strong	105	49.1
Strong	87	40.6
Weak/very weak	22	10.3
Insistence on passengers use of seat belts		
Always	16	7.5
Sometimes	43	20.1
Usually	37	17.3
Never	112	52.3
No respond	6	2.8
Reasons that make you use seat belt or helmet or safety measures		
I like follow regulations	21	9.8
I am convinced with importance of safety measures	83	38.8
Seat belt/helmet has become compulsory practice	46	21.5
It is civilized phenomenon	8	3.7
More than one reason	39	18.2
No response	17	7.9
Effect of using seat belt or Helmet		
Reduce incidence of RTA	34	15.9
Reduce disabilities caused by RTA	125	58.4
Reduce rate and complications of RTA	8	3.7
Not effect on the rate of disabilities	26	12.1
No Response	21	9.8
Reason for using Seat belt or Helmet		
Drivers are afraid of punishment	139	64.9
Driver are convinced of the importance of importance of using	14	6.5
Positive impact of health education	23	10.7
More than one reason	21	9.8
No response	17	7.9

Table 3: Practice of students concerning road traffic regulations and RTAs.

Questions	Number of Students	Practice %
Driving License	106	49.5
Driving Training	54	25.4
Seat Belt	114	53.2
Helmet	94	43.9
Helping RTA Victim	125	58.7
Speed Limit	102	47.6
Rear View Mirror	155	72.6
Triple Riding	118	55.1
Traffic Intersection	190	88.8
Wrong Lane Driving	101	47.3
Earphones	162	76
Indicator	143	67.1
Overtaking From The Left Side	80	37.5
Passing Too Close Other Vehicles While Driving	174	81.4
Servicing (Vehicles)	180	84.2
Giving Way To An Ambulance In Emergency	184	86.1
Using Mobile Phone While Driving	109	51
Signal Jumping	102	47.7
Hazard Lights	105	49.5
Railway Crossing	150	70.4

Discussion

Road traffic accidents are, to a great extent, preventable. The most effective way to reduce fatalities and injuries would be through an integrated approach involving close collaboration of many sectors. Progress is being made in many parts of the world where multisectoral strategic plans are leading to incremental reductions in the number of road accidental fatalities and injuries (Evans, 2003).[7] Such strategies focus on four key factors that contribute to the risk of occurrence of a road accident – exposure, behavioural factors, road environment, and vehicle factors.

Road traffic awareness among school going adolescents is one of the most important aspect towards safety concerning traffic rules. The students in adolescence may derive a thrill out of taking risks on road not realizing the consequences such risks may have. This age group is rapidly emerging as a major population of vehicle owners and also constitutes major number of accidents, making it very important to sensitize this population about road traffic rules, as they are future of the nation.

In our study most of the students are of 22–23 years age. This finding is similar to the study done by Mahawar et al in Indore among school going teenagers and Kulkarni et al in south Indian states.[8,9]

In present study equal number of males and females take part in which about one half of whom lived in the city (49%) coincides with study of Al-Khaldi YM showing 47% of students lived in city.[10]

Most of them had vehicle (60%) and 59 % had driving licenses and study done by Al-Khaldi YM showing more than two thirds had cars (70.6%) and 72% had driving licenses.[10]

More than one half of the students (53%) had been involved in RTAs; 24.7% out of these had been injured, More than 40% of them indicated that speed was the main cause of the RTA.

Studies show 54% had been involved in RTAs and 22% out of these had been injured and 13% had been admitted into hospital for 9.3 days and 50% indicated that speed as a cause of the RTA. where as in study conducted at Raichur College of Medical Sciences 55.4% students have an idea about the speed limit.[11]

These findings were similar to those reported by many other investigators.[12,13] About 23.8% of the students mentioned that they had lost at least one relative in a RTA in the previous ten years. This means that as reported by Ansari et al, the Saudi society has a major problem with RTAs.[12] Nearly 80% of the students said that they had adequate knowledge of road traffic regulations and more than one third (36%) mentioned that high speed was the most important cause of RTAs.

When asked about the importance of the use of seat belts, about 90% were strongly convinced of its importance. However, on the reasons for using seat belts, 38.7% felt convinced of its use. More than half of the students thought that the use of seat belts reduced the disabilities caused by RTAs.

A study from another medical college from India has shown 74% participants wearing the seat belts.[14] Wearing a seat belt reduces the risk of a fatality among front seat passengers by 40–50% and fatalities of rear seat occupants by 25–75%.[15,16] Mandatory seat belt laws, their enforcement and appropriate public awareness campaigning have been shown to be very effective in increasing rate of wearing seat belts 67% of study participants never use mobile phone while driving. Similar findings have been reported by Jogand S et al.[17]

In study done by Din Prakash Ranjan[18] on adolescent students of a selected Pre-University college in Raichur city, 97.8% and 99.4% participants knew that it is compulsory to put on the seat belt while in a moving car and wear helmet while travelling in two wheelers respectively. 55.4% respondents had correct knowledge on the correct speed limit for driving in the city, much higher than the studies by Swamy et aland Mahawar et al.[6,8] Only 33.8% participants had correct knowledge of traffic lights. This finding was similar to the study done by Mahawar et al among school going teenagers in Indore.[8] The inability to correctly identify the traffic lights need to be addressed immediately as road traffic accidents can be reduced drastically if the knowledge towards traffic lights improves.

Out of 214 students, only 39.9% of students know about Good Samaritan Act. The time has come to strictly enforce the implementation of speed limits both on highways and city roads. Lately, the fines imposed on violation of traffic rules have been greatly increased so as to curb road accidents and increase safety measure. In mix traffic environment, restriction on vehicle speed would also help in reducing casualties to pedestrians, cyclists, and other vulnerable road users.

In this study 51% reported using mobile phones while driving compared to 22.2% in the study conducted at S N Medical College and similar to Christopher et al of 21.7% but Kulkarni et al[9] 44% participants and Reang 8.2% used mobile phones.[14]

Regarding earphones in our study 76% practised listening music as compared to 61.2% male and 38.8% female found in Agaratala Government Medical College.[14]

In our study 47.6% students practiced about the speed limit while driving where as in study conducted at Raichur College of Medical Sciences 55.4% students have an idea about the speed limit.[11]

In our study 53.2% students practice that it is compulsory to put on seatbelt while driving similar that is 98.1% in study conducted by Stanley Medical College, Chennai.[19]

Indicator usage was always followed by 67.1% of students in our study compared to 78.7% in a study conducted at AIIMS College, Rishikesh.[20]

About the fact that overtaking from left side is wrong only 37.5% practiced and 32.8% of Chennai Higher Secondary School and Raichur Institute of Medical sciences had the correct knowledge. Also is was found that 72.4% male and 27.6% female of Agartala Government Medical College overtook from left side as a habit.[14]

Behaviour of road users, the way people drive, cycle, or walk on the road, are the most common source of road injuries and fatalities. Factors such as age and experience of driver, alcohol and drug use, fatigue, acute psychological stress, and enforcement of traffic laws are the key determinants of accident and fatality risk.

Our study showed that 47.7% students obey all traffic signals compared to 66.7% found in a study conducted at AIIMS College of nursing, Rishikesh, Uttarakhand.[20]

There is still a lack of acceptance among drivers that their choice of speed may increase accident risk not only for themselves but also for other road users. To reduce accident risk, there is a need to focus on changing the drivers' perception of speed risk.

The level of enforcement of traffic law and the severity of penalties for infringement also influence the behaviour of road users. Low levels of enforcement often negate the efforts made to improve road safety through legislation. Simply legislating is rarely effective without enforcement, education, and publicity campaigns to raise public awareness of the purpose of the legislation.

Therefore, a systems approach to road injury prevention, that is, using the legislation and law enforcement with the support of education, information, and publicity campaigns, needs to be adopted by the government to influence the behaviour of road users and consequently to reduce the rate of road accidents and related fatalities and injuries.

Most of the traffic accidents are caused by human errors. In 2013, drivers' fault accounted for 78% of total accidents, 76.5% of total injuries, and 73.7% of total fatalities in India. For this reason, road safety initiatives traditionally focus on 'fixing' the driver in order to prevent accidents. There is no doubt that the approaches involving road-safety education and enforcement such as wear your seat belts, always wear helmet while driving, say no to drunken driving, and general adherence to traffic rules are essential in curtailing traffic accidents, however, it is equally important to realize that people will always make mistakes. Therefore, there is a need to focus on mediating the outcome of accidents by designing safer vehicles and safer roads. It is indeed possible to protect the road user in the event of an accident by designing vehicles and roads to work together to ensure crash energies do not overwhelm the human. For vulnerable road users such as pedestrians, bicyclists, motorcyclists, and those using informal public transport, road design must ensure that they are not exposed to high speed traffic (Singh, 2009).[21] Therefore, roads should be designed in such a way so that it is not only self-explaining but also forgiving.

Conclusion

As per the above study conducted in Krishna Institute of Medical Sciences, Karad, majority of the students had good knowledge and appropriate attitude about Road Traffic Safety. However, good practice was seen only among more than 50% of participants.

The knowledge and attitude of the members does not necessarily reflect into their practice, which is unfortunate. Hence, laws should be made more stringent and public should follow them in good faith.

References

1. WHO- Decade of action for Road Safety 2011–2020 seeks to save millions of lives at: https://www.who.int/roadsafety/decade_of_action/en/
2. WHO – Road traffic injuries. Available at: https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries
3. http://www.indiaenvironmentportal.org.in/content/459084/road-accidents-in-india-2017
4. https://timesofindia.indiatimes.com/india/india-way-off-road-safety-targets-for-2020-road accidents-still-kill-over-a-lakh-a-year/articleshow/65765549.cms
5. Ministry of Road Transport and Highways. Government of India. Road accidents in India 2010. Available from: URL: http://morth.nic.in/writereaddata/mainlinkFile/File761.pdf
6. Swami HM, Puri S, Bhatia V. Road safety awareness and practices among schoolchildren of Chandigarh: Indian Community Med. 2006;31:199.
7. Evans, L., 2003. The new traffic safety vision for the United States. American Journal of Public Health 93(9), 1384– 1386.
8. Mahawar P, Dixit S, Khatri AK, Rokade R, Bhurre R, Kirar S, et al. An Educational invention to improve awareness on road safety: A study among school going teenager in Indoor. Nat J Comm Med. 2013:4(3):529:32.
9. Kulkarni V, Palanivel C, Kumar N. Awareness and practice of road safety measures among undergraduate medical students in a South Indian state. J Forensic and Legal Med. 2012;30:1–4.

10. Al-Khaldi YM. Attitude and practice towards road traffic regulations among students of health sciences college in aseer region. J Family Community Med. 2006;13(3):109–113.
11. Kulothungan K. A cross sectional study on the knowledge, awareness and practice of safety rules among the young college students in Trichy City, Tamil Nadu. Int J Information Res Rev. 2015;2(09):1162–9.
12. Ansari S, Akhdar F, Mandoorah M, Moutaery K. Causes and effects of road traffic accidents in Saudi Arabia. Public Health. 2000;114(1):37–9.
13. Nofal FH, Saeed AA, Anokute CC. Aetiological factors contributing to road traffic accidents in Riyadh city, Saudi Arabia. J R Soci Health. 1996;116(5):304–11.
14. Reang T, Tripura A. Road Safety: knowledge, practice and determinants among undergraduate medical students of Agartala Government Medical College and Govinda Ballabh Pant Hospital. Int J Med Sci Public Health 2014;3:911–915.
15. Servadei F, Begliomini C, Gardini E, M Giustini, Taggi F, Kraus J Effect of italy's motorcycle helmet law on traumatic brain injuries. Injury Prevention. 2003;9:257–260.
16. Elvik R, Vaa T. The handbook of road safety measures. Amsterdam, Elsevier science, 2004.
17. Seat-belts and child restraints: increasing use and optimising performance. Brussels, European Transport safety council, 1996.
18. Ranjan DP, Fahim MA, Kirte RC. A cross sectional study to assess the knowledge, attitude and practice towards road traffic safety among adolescent students of a selected Pre University College in Raichur City. Int J Community Med Public Health 2018;5:2446–52.
19. Dr. A. Evangeline Mary, Dr. A. Chitra, Dr. R. Arunmozhi, Dr. T. Sheila Doris: A cross sectional study to assess the knowledge, attitude and practice towards road safety rules and regulations among Higher Secondary school students in Chennai: Indian Journal of Basic and Applied Medical Research; September 2016: Vol.-5, Issue-4,P.779–789.
20. Sharma, Suresh and Saini, Parul. Knowledge, Attitude and Practices towards Road Traffic Safety Regulations among Health Science Students in Uttarakhand: A cross-sectional study.. International Journal of Advanced Research. 2017: 5. 608–614.
21. Abhishek Singh, Anil Bhardwaj, Rambha Pathak, S K Ahluwalia An Epidemiological study of road traffic accident cases at a tertiary care hospital in rural Haryana, Indian Journal of Community Health July 2011, Vol 23, No. 2, 7–11.

Original Article

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Comparative Analysis of Human Hair Medulla Types among The Ashanti and Dagomba Ethnic Group of Ghana

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Abstract

Hair is an important piece of evidence in forensic investigations. Analysis of the morphological features (medulla) of hair has been reported since the early 1800's. However, many questions still remain unanswered especially as to, how local populations could be analysed and separated from each other based on the morphology (medulla) of their hair. In the Present Study medulla types of hair have been examined among the Ashanti and Dagomba, two important populations of Ghana by using the Comparison and Compound microscope together with Computer imaging. Statistical analysis has been performed on the data to determine the variability and relationships between the two populations. Medulla have been found to be absent in 51.5% of the Ashanti population examined while among the Dagomba it has been observed to be 33%. The difference between the two populations for their medulla types have been found to be statistically insignificant.

Keywords: Human Hair Medulla Types; Dagomba Ethnic Group of Ghana.

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Introduction

Hair analysis often required in forensic problems. It involves examination of the hair shaft including its medulla (inner core), cortex (intermediate layer) and cuticle (outer covering) using comparison microscopes. (Chatterjee, 2012).

Hair can easily be transferred from one person to another and clings to furniture, carpets, clothing, etc. Since hairs can withstand the vagaries of nature for a very long time they are very useful in crime investigation. Even if a suspect tries to clean up the crime scene, he or she would most likely leave hair behind (Collier, 2004).

Examination of hair is routinely done to determine its species origin, site of the body form which it comes from, sex, ethnic group (race) and individual characteristics which may ultimately help as a very important corroborative evidence in linking the suspect and the victim with one another or with the scene of crime. Hair evidence may also help in the elimination of a particular suspect, thereby exonerating him from his involvement in the crime (Weitzel, 1998).s Comparison of hair is usually done using a comparison microscope to determine if there are any matches in their morphology (Robertson, 2017).

The Ashanti population of Ghana has been described to possess some unique morphological characteristics (Awuah, Dzogbefia and Chattopadhyay, 2017). It is therefore expected that these uniqueness will show in the analysis of their hair medulla as well. The Ashanti and the Dagomba are two important geographically separated endogamous populations of Ghana; intermarriages between them are very rare.

Materials and Methods

Hair samples were collected from students of the Kwame Nkrumah University of Science and Technology, KNUST) Campus with their ages ranging between 15–20 years. Ethical consideration was sought from KNUST School of Medical Sciences.

After obtaining the consent from each subject, hair samples were collected from five different sites of the scalp using scissors as close to the root as possible; details about each subject (donor) such as name, age, sex, hometown, place of residence, place of birth (Town and Region), information on parents and grandparents, ethnic group among others were noted down in a register. Samples were examined with compound and comparison microscopes using Wet-mounting to prepare specimens for microscopic examination. Using a mounting fluid (glycerin) with a refractive index close to that of the hair reveals the medulla and other internal structures of the hair. Hair samples collected were labeled 'DA01' to 'DA200' for Dagomba and 'A01' to 'A200' for Ashanti and were stored in one Ziploc bag. Each hair specimen was examined individually under a Leica Compound microscope with the microscope connected to a Sony Trinitron colour video monitor by a Javelin Smart cam Video camera. This monitor allows a full-screen view of the microscopic image. In addition, the monitor was connected to a Gateway 2000 P-90 computer which allowed a good view of the medulla of hair shaft. Data was gathered from each hair and a database was generated. The medullary index (MI) which is the ratio of the maximum diameters of the medulla to the diameter of the shaft of the hair was calculated for each analyzed hair sample with the formula below:

$$\text{Medullary Index (MI)} = \frac{\text{(Maximum Breadth of Medulla)}}{\text{(Maximum Breadth of Shaft)}}$$

Results and Discussion

Hair is an appendage of the skin that grows out of an organ called the hair follicle. It is composed primarily of the protein keratin and is common feature in all mammals and therefore its relevance is not limited to humans, even in forensic investigations. Variability also exists in types of hairs found on different parts of the body; head, pubic region, arms, legs and other body areas. Human hair is one of the most frequently found pieces of evidence at the scene of a violent crime (Brown and Davenport, 2011). It can provide a link between the criminal and the crime scene due to its varying characteristics within and between populations. Morphological analysis of the shaft by microscopy is usually focused on either the cuticle (usually for specie identification) or on the medulla. From hair one can determine if the source is human or animal, the race (sometimes), origin of the location on the source's body, whether the hair was forcibly removed, if the hair has been treated with chemicals or if drugs have been ingested.

Variability in medulla types among Ashanti and Dagomba ethnic groups.

Fig. 1 is a sample obtained from the Ashanti population which shows an example of hair strand with absent medulla type. This hair medulla type is the most common. The sample's shaft diameter is 159.5 mm.

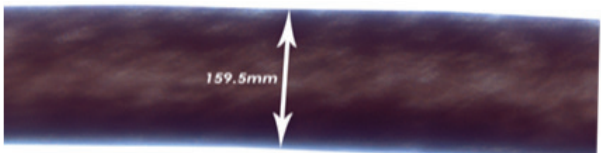

Fig. 1: Hair sample from Ashanti showing absent medulla type.

Fig. 2 is a sample obtained from the Dagomba population. Its microscopic image shows the sample lacked any form of medulla (absent medulla). The sample has a hair shaft diameter of 133.6 mm. The Dagomba population, like the Ashanti population has this hair medulla type being the most common.

Fig. 2: Hair sample from Dagomba showing absent medulla type.

Fig. 3 is a sample from the Dagomba population. It shows the continuous medulla type. Among the Dagombas about 33.5% of the population possesses the continuous type of medulla. It has medulla diameter of 28.8 mm and a hair shaft diameter of 171.2 mm. This happens to be the most dominant medulla pattern type.

Fig. 3: Hair sample from a Dagomba showing continuous medulla.

Fig. 4 is the microscopic image of a hair sample of a Dagomba showing fragmented medulla type. The hair shaft diameter (161.1mm) is far larger than the medulla diameter (20.6mm).

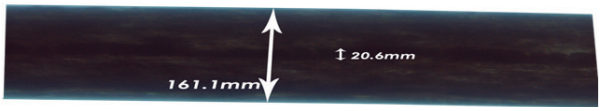

Fig. 4: Hair sample from a Dagomba showing fragmented medulla type.

Morphological hair characteristics are class evidence which can be of help for elimination purposes, but not for actual identification of a specific individual.

Fig. 5: Hair sample from an Ashanti showing continuous medulla.

Fig. 5 is a sample from the Ashanti population. It shows continuous medulla type. In the Ashanti population, only about 17% possesses this medulla type. The shaft and medulla diameters are 204.0 mm and 44.2 mm respectively.

Fig. 6 shows the microscopic image of a hair sample of an Ashanti showing fragmented medulla type. The hair shaft diameter (171.7mm) is far larger than the medulla diameter (23.8 mm).

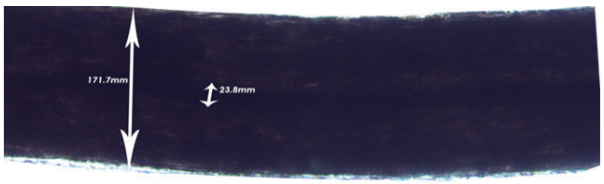

Fig. 6: Hair sample from an Ashanti showing fragmented medulla.

Fig. 7 is a microscopic image of a hair sample obtained from an Ashanti showing discontinuous medulla.

The hair shaft diameter is 156.4 mm for the sample illustrated.

Fig. 7: Hair sample from an Ashanti showing discontinuous medulla type.

It is evident from the above figures (Figs 1 – 7) that the medulla diameter is always equal or less than one-third of the hair shaft diameter, a feature that distinguishes human hair from animal hair (other mammals). The characteristics of hair medulla that prove to be useful in forensic analysis include the medulla diameter and medulla/hair shaft diameter ratio (Robbins, C.R., 2012a).

The frequency of medulla types in the Ashanti population has been summarized in Fig. 8 below. Over 103 sample units representing 51.5% of the total sample size of the Ashanti population had no medulla (medulla absent), 15.5% had fragmented medulla and 16% had discontinuous medulla. The continuous type of medulla represents about 17% of all medulla types in the Ashanti population.

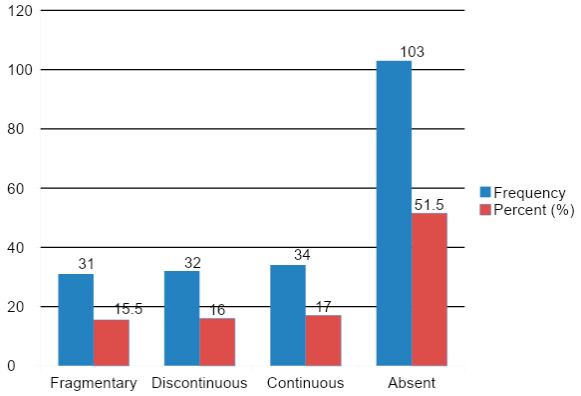

Fig. 8: Histogram of Medulla Types among the Ashanti population.

The greater percentage of the Ashanti population having no medulla therefore makes it very difficult to rely on the use of the medulla types to trace suspects at crime scenes among this ethnic group.

Comparing the medulla types of the Ashanti (Fig. 8) with those of the Dagomba (Fig. 9), there is no statistical difference (p– = 0.522) between the two ethnic groups. Although it has been observed that there is a relationship between these two populations (Taupin, 2004), similarities in one or two characters may not be due to an actual relationship but a matter of coincidence.

The mean medulla diameter and hair shaft diameter of the Dagomba were higher than those of the Ashanti population as shown below. It can be seen that 67 (33.5%) of the sample units have Continuous type of medulla while 38 (19%) of the population show Discontinuous medulla type, a smaller proportion of 29 representing 14.51% have Fragmented medulla type.

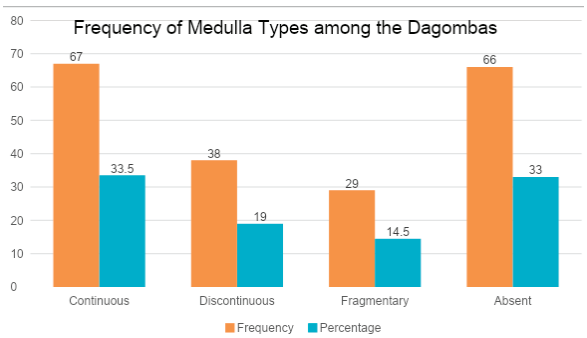

Fig. 9: Histogram of Medulla Types among the Dagomba population studied.

Fig. 9 is a graphical presentation of the medulla type distribution within the Dagomba population.

Unlike the Ashanti population, the Dagomba population is characterized by a higher percentage of medulla presence (14.5% + 19% + 33.5%). The percentage of individuals without medulla (33%) is almost equal to those with continuous medulla type alone (33.5%) as also shown above. Comparing the two histograms it can be deduced that the two ethnic groups have almost the same chart and look the same. Table below is the summary of the test for significance of the variation between the Ashanti and Dagomba populations.

Table 1: Paired Samples Test

		Paired Differences					T	Df	Sig (2 tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
HSD		–2.00202	86.40484	6.14052	–14.11162	10.10758	–.326	197	.745
MD	Ashanti – Dagomba	–.00968	.11834	.01503	–.03973	.02037	–.644	61	.522

From the paired sample T test analysis, it can be seen that the variation between the two populations in terms of hair shaft diameter (HSD) was insignificant. At 95% confidence level, the p-value was 0.745 which is greater than the α-0.05. The variation between the populations for medulla diameter (MD) was also not significant at α–0.05 (p-value 0.522). On the bases of these results, one may conclude that the Ashanti and Dagomba populations of Ghana do not vary significantly. However, Africa has been described as the most genetically diverse continent in the world (Tridico *et al*, 2014), therefore this result was least expected for populations that are geographically, culturally and historically diverse like the Ashantis and Dagombas of Ghana (Table 1).

Medulla types are influenced by age and hence its utility for forensic hair examination is limited (Chattopadhyay, Gonmori and Yoshioka 1994).

From the observation of the microscopic images of this work, it is evident that some level of differences exists between the Ashanti and Dagomba populations of Ghana as shown in the graphs above. However, it is difficult to rely on the results for any kind of identification at this level since the differences are all insignificant as shown in the table above.

Hair may provide evidence indicating either that it probably came from a given individual or that it could not possibly have come from this individual,'' (DiZinno, Wilson, and Budowle, 1999).

Others stated similarly that when comparing an unknown hair specimen with one from a known subject side-by-side, the examiner may conclude: 1) that the hairs are consistent or similar and could have come from the same source; 2) that the hairs are dissimilar and did not come from the same source; or 3) that the hairs possess characteristics which are not sufficiently defined to arrive at a meaningful conclusion (Ogle, 1998).

However, Randall (1994) stated that "The chance of individualizing hair by light microscopy alone is very difficult and in most cases impossible.'' The current research confirms Randall's statement since the findings of this work are inconclusive on individualization. According to the American Association of Physical Anthropologists, (Weitzel, 1998) and Lavker *et al* (2003) the distribution of physical traits resembles the distribution of genetic variation within and between human populations. This may be due to the fact that this investigation focused on only one parameter of hair (medulla).

Some investigators have used a combination of morphological features of hair to achieve stronger conclusions. Tridico *et al.,* (2014) however reported that these factors point to the possibility that human head hair may be positively individualized and used in personal identification. Combination of morphological, chemical and molecular analysis appears as the best method for determining intra-population variability and personal identification.

The findings of this research can therefore serve as an important part of a database of morphological characteristics of hair for the Ashanti and Dagomba populations of Ghana. According to Taupin (2004) "When you are dealing with hair morphology and issues of race you're dealing with range". Even though the study does not provide a method for determining the exact local population associated with an unknown hair of the above named ethnic groups, DNA from their hair would help to support conclusions made from morphological analysis of hair in Ghana.

Conclusion

The present study indicates that morphological characteristics of hair show population variation. Though these are useful for elimination purposes, they are not enough to identify a specific individual

and hence have limited value from the forensic point of view.

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References

- Araujo R, Margarida Fernandes, Artur Cavaco-Paulo, Andreia Gomea 2010. Biology of human hair: Know your hair to control it. Advances in Biochemical Engineering/ Biotechnology book series ABE, Vol.125, pp. 231–239
- Awuah, D, Dzogbefia, V P and Chattopadhyay, P K 2017. Finger dermatoglyphics of the Asante population of Ghana. *Int. J. Innovative Res. Adv. Studies* 4 (4): 333–336.
- Beary, M O and R Lee Lyman 2014. *A Companion to Forensic Anthropology*. Blackwell Publishing Ltd.
- Brown, R and Davenport, J 2011. *Forensic Science: Advanced Investigations.* Nelson Education Ltd.
- Chatterjee, A 2012. *A Method of Combining Multiple Experts for Human Hair Classification.* Department of Computer Science and Engineering, KIIT University, India.
- Chattha, S A, Anjum, K M, Altaf, M, and Yousaf, M Z 2011. Hair mounting technique: helpful in conservation of carnivores. *J. Biology* **1**(2): 53–54
- Chattopadhyay P K, Gonmori, K and Yoshioka N 1994. Medulla types of hair among the Japanese. *Act. Crim. Japon* 2: 142–148.
- Collier, J H 2004. Estimating the postmortem interval in forensic cases through the analysis of postmortem deterioration of human head hair. *J. Microscopy* 3: 52–55.
- Di Zinno, J A, Wilson, M R, and Budowle, B 1999. Typing of DNA derived from hairs: Forensic Examination of Hair. *J. Biology* 32 (2): 155–173.
- Lavker, R M, Sun, T T, Oshima, H, Barrandon, Y, Akiyama, M, Ferraris, C, and Panteleyev, A A 2003. Hair follicle stem cells. In: *Journal of Investigative Dermatology Symposium Proceedings***8** (1), 28–38.
- Ogle, R 1998. Individualization of human hair: The role of the hair atlas. *Microscope* 46(1): 17–22.
- Randall, V A 1994. Androgens and human hair growth. *Clinical Endocrinology* 40(4): 439–457.
- Robbins, C R 2012a. *Chemical and physical behavior of human hair*: Springer Science and Business Media.
- Robertson, J 2017. Managing the forensic examination of human hairs in contemporary forensic practice. *Australian Journal of Forensic Sciences* 49(3): 239–260.
- Taupin, J 2004. Forensic hair morphology comparison–a dying art or junk science? *Science and Justice,* 44 (2): 95–100.
- Tridico, S R, Rigby, P, Kirkbride, K P, Haile, J, and Bunce, M 2014. Megafaunal split ends: microscopical characterisation of hair structure and function in extinct woolly mammoth and woolly rhino. *Quarterly Science Reviews* 83**:** 68–75.
- Weitzel, M A 1998. A new method for the analysis of human hair: a morphological case study of five sample populations. *Journal of Forensic Sciences* 451: 43–63**.**

Original Article

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Survey of Youth Awareness Regarding Toxic Alcohol (Methanol) and HOOCH Tragedies

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Abstract

The term Toxic alcohol include as a proper name Methanol, and is applied both to the absolute substance further specified by chemists as methyl alcohol, and to its mixtures with smaller proportions of water and slight proportions of other substances. In chemistry, the word alcohol is used as a common or generic name to designate several series of substances containing Ethanol in different percentages.

Alcohol consumption has existed in India for many centuries. The quantity of toxicity problem has undergone substantial changes over the past twenty years. In India many deaths are related to intake of toxic alcohol. These are liquors made in India under government license and the maximum Ethanol content allowed is 42.8%. Besides licensed distilleries, a number of small production units operate clandestinely. The toxic alcohol is industrial methylated sprits which regularly cause mass toxicity to humans, who lose their lives or suffer irreversible eye damage and overdose of methanol is death results in this research survey showed that maximum youth are not aware about the toxic alcohols. There is an urgent need to make people aware about methanol toxicity.

Keywords: Toxic Alcohol; Toxicity; Methanol; HOOCH; Snowfield blindness; etc.

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Introduction

Methyl alcohol (methanol) is a toxic and inexpensive substance among illicit drinks.[1] There is a slight level of methanol in commercially available alcoholic drinks while these drinks contain sufficient amounts of ethanol. In contrast, illicit alcoholic drinks contain high levels of methanol, which can lead to poisoning. Most of the patients survive, but some cases result in death, which cannot be even prevented using intensive care, dialysis, and treatment with antidotes.[2] Poisoning by counterfeit alcoholic drinks is one of the most hazardous poisonings that sometimes leads to death.[3-5] Since the sale, production, and consumption of alcoholic beverages are legally prohibited in some states of our country, thereis a high possibility of profiteering and fraud in their illicit production. There is not any detailed report available on the prevalence of methyl alcohol consumption in our country, but the increase in alcohol poisoning and even death indicates that substandard and counterfeit alcoholic beverages have targeted the young population's health.[5] Alcoholic beverages are among the preparations that have taken the lives of many people to date and sometimes lead to their intoxication. One of the hazardous alcohol is wood alcohol or methanol.[8,9] Due to reported

cases of mass epidemics of methanol poisoning, familiarity with the principles of diagnosis and treatment of them are of paramount importance in some cities of the country.[8,10,11] World Health Organization (WHO) reports that 7.5% of people in a attempt alcohol abuse on average[12] Although statistics in our country is much lower than this amount.[13] The remarkable thing is that most cases of alcohol abuse and its related complications are reported in the country side in peripheries, among migrated youngsters.[14]

Material and Method

This research data is used for the purpose of study of Youth Awareness Regarding Toxic Alcohol (Methanol). The data was collected as per the Google form of during 2019 year. Youth were being surveyed all over Delhi NCR region of our country, which was carefully chosen to ensure submission with respect to google form survey. The selected 17 above 29 years age group of youth 101 (male and female) answered the entire question and then statically graph shows result.

Result and Discussion

After doing Analysis of data of we found that 54.5% students of age group 17–29 yrs belonged to metropolitans (Fig. 1), and both males and females in survey almost equally participated proportionately (Fig. 2), but maximum participants were below 20 yrs age (Fig. 3). The estimates show the connection between Youngsters toxic alcohol awareness and consequent HOOCH tragedy consequences. This data was being analysed and we have used percentage analysis for this data to describe/Predict the outcomes.

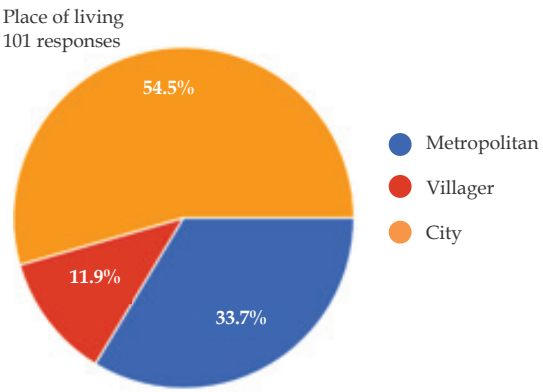


Fig. 1: Place of living among the surveyed participants.

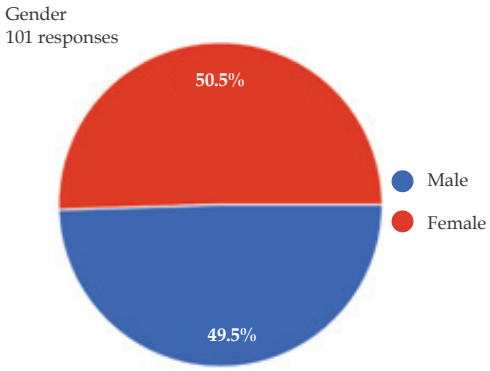


Fig. 2: Gender of participants in our survey.

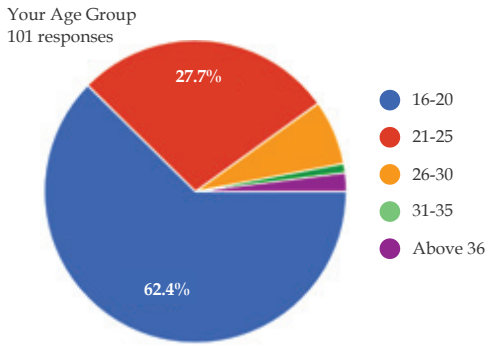


Fig. 3: Age of participants in our survey.

Indian youth suffer frequent casualties after Methyl Alcohol poisoning from consuming Wines, Beer, Arrack, Country liquor, Indian made foreign liquor and different other branded alcoholic beverages Counterfeited for quick money illegally. The alcohol produced illegally is called illicit alcohol. They do not follow any set standards and thus have no quality control. The alcohol produced from these units is usually adulterated and may contain a highly fatal substance called methylated spirit or methanol. This added methylated spirit can lead to death or blindness. Illicit alcohol also evades all national and state-level taxes and duties, thus making it very cheap and affordable. Illicit alcohol is produced under unregulated circumstances and

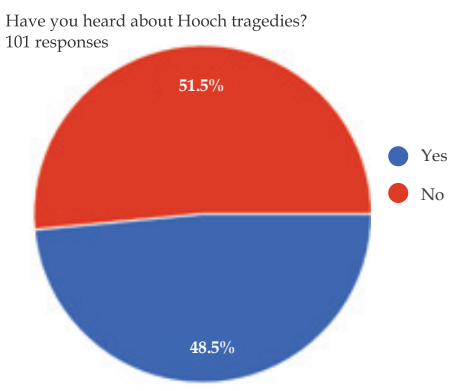


Fig. 4: Awareness about Hooch tragedy.

is often adulterated with chemicals like methanol, to save costs. This adulteration makes it absolutely unfit for human consumption and could lead to blindness or even be fatal to the consumer. In spite that, our survey found that 51.5% are unaware about Hooch tragedy (Fig. 4) and internet was the main source of information for 42.6% (Fig. 5).

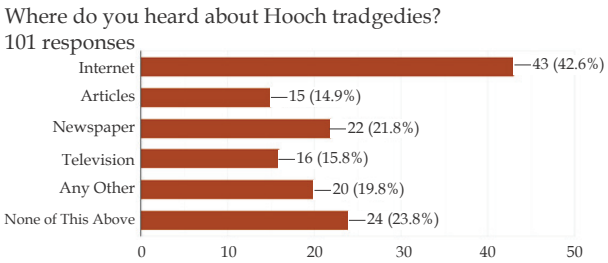


Fig. 5: Source of information about Hooch tragedy.

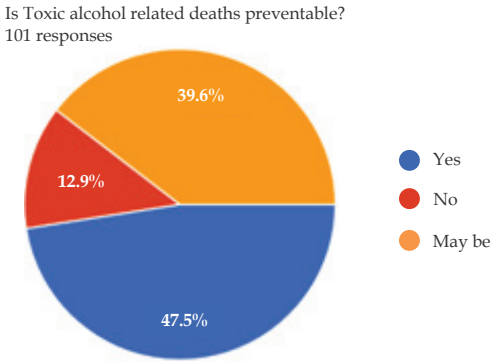


Fig. 6: Alcohol related Poisonings are Avoidable.

Alcohol related Poisonings are Avoidable, and 47.5% of our participants agreed to it (Fig. 6). So, if we educate the public on its harms and can "Prevent the Repent" of Fatal Predictable Epidemics.

Alcohol is the most commonly used intoxicating substance in India. It is a legal product but there is a minimum legal drinking age limit that varies from state to state (from 18–25 years).

Alcohol prohibition is one of the Directive Principles of the Constitution of India (Article 47) (15), but taxation on sales of alcohol is a major revenue-earner for most states.

As alcohol is a state subject, the production, distribution, and sale of alcohol is a state responsibility. Different state ministries and departments regulate different aspects of alcohol. For example, the Ministry of Social Justice and Empowerment (MoSJE) looks after alcohol use prevention programs, developing networks and capacity building for alcohol prevention and control, and monitoring. The Ministry of Health and Family Welfare (MoHFW) runs de-addiction centres.

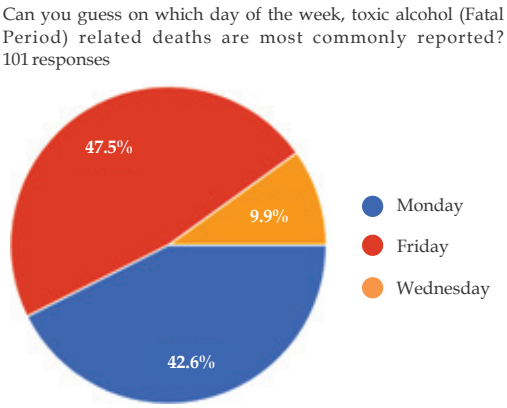


Fig. 7: Which day of the week, toxic alcohol related deaths are reported

As methanol is consumed in adulterated alcohol unknowingly, and maximum alcohol consumption occurs on weekends (Friday), but the methanol itself is not toxic, but its metabolite formic acid becomes toxic to the consumer, which takes 24–36 hrs for its conversion inside victim's liver. Thus the victims of methanol poisoning lands up in emergency on Mondays, mostly, if they have abused alcohol on weekends. This observation is verified from the past incidence of HOOCH tragedies, which was reported on week's onset, enabling the contradiction, to what the maximum youngsters (47.5%) in our study were surveyed (Fig. 7).

Incidence of fatal outcome of these HOOCH Tragedies by Methanol has some unique features: Uniquely in Males, Mostly on Weekends, as Adult Males have tendency to party with alcoholic beverages like beer, whisky, brandy, rum and arrack on weekends. HOOCH word is formed by rearranging by shifting C in the chemical formula of toxic metabolite formic acid (HCOOH) due to metabolism of methyl alcohol by liver causing toxicity by- formic acid chemical formula is CH_2O_2- which can also be written as HOOCH. HCOOH is Formic acid derived from ants and toxic in nature in body, methyl alcohol turns into formaldehyde, that causes blindness, and then to Formic acid, all are toxic to humans. Victims often only seek medical care after a significant delay, mainly because there is a latent period between ingestion and toxic effects. Awareness regarding Latent period of Methyl alcohol was surveyed, and revealed that maximum think its within 24 hrs (Fig. 8), but actually it takes 24–36 hrs to manifest toxic symptoms of snow field blindness. Late medical care contributes to the high level of morbidity and mortality seen in many methanol poisoning outbreak. Because patients with methanol poisoning often need intensive medical care, outbreaks of methanol poisoning can rapidly overwhelm medical facilities.

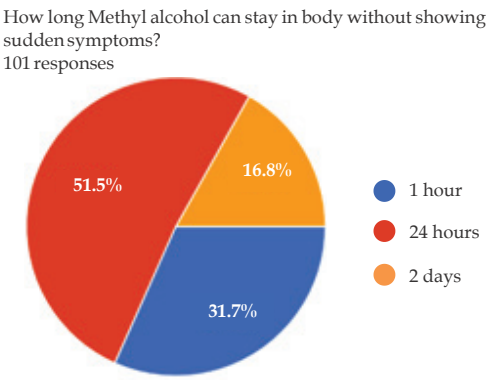


Fig. 8: Latent period of Methyl alcohol.

Fatal period of Methanol

1. If Methanol is consumed in non-fatal doses, it may not show any signs and symptoms, till its chronic accumulation occurs to toxic levels over weeks or months. In acute consumption of fatal doses of methanol, there may be a variable latent period between methanol ingestion and the development of symptoms, even though very short intervals have been reported following ingestion of very large quantities. The latency represents the time needed for sufficient amounts of formic acid to accumulate. Since ethanol inhibits methanol metabolism, concomitant ethanol intake may considerably lengthen the latent period.[16]
2. The phenomenon of continual methanol build up has been heavily investigated, as methanol metabolism is inhibited by ADH when ethanol levels are above approximately 0.2 g/kg. This is regularly seen in alcoholics allowing methanol concentrations to build up to potentially toxic levels, well above the endogenous levels of 0.86 ± 0.76 mg/kg that are found to be in the blood of non-alcoholic drinkers. For this reason, measurement of blood methanol has been shown to be useful as a diagnostic tool to distinguish acute from chronic Alcoholism.[17]

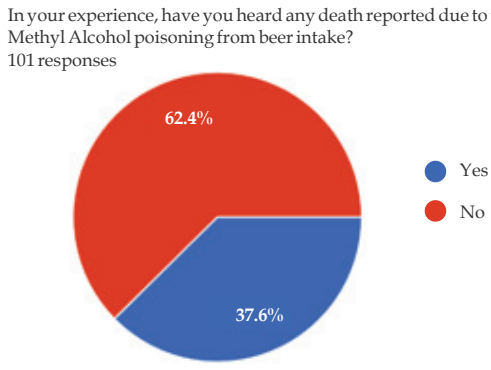


Fig. 9: Deaths from Methyl alcohol.

Deaths from Methyl alcohol

Methanol related deaths are frequently reported in newspapers at depressing regular intervals from all parts of the world every year due to the Methyl Alcohol related fatal poisonings, in western countries it is mostly due to consumption of automobile AC coolants – anti freeze containing methyl alcohol, and Indian population suffer frequent casualties after Methyl Alcohol poisoning from consuming Wines, Beer, Arrack, Country liquor, Indian made foreign liquor and different other branded alcoholic beverages Counterfeited for quick money illegally. But our survey revealed that 62.4% are unaware of the fatal toxicity and Deaths from Methyl alcohol (Fig. 9).

1. The Indian liquor industry comprises the Indian Made Foreign Liquor (IMFL), country liquor, foreign Liquor Bottled in Origin (BIO), illicit alcohol, beer and wine segments. Beer has become a popular beverage in the country only over the last two decades and it's growing at a rate of about 17 per cent per year. The highest levels of beer consumption in India are observed in the southern states. South India dominates the alcohol market in India, with that region accounting for about 60 per cent of total IMFL sales and 45 per cent of total beer sales. The alcohol produced illegally is called illicit alcohol. They do not follow any set standards and thus have no quality control. The illicit industry is also a local industry and is run by local criminals directly or sometimes indirectly when they provide protection to the owners of the illicit distilleries. The alcohol produced from these units is usually adulterated and may contain a highly fatal substance called methylated spirit or methanol. This added methylated spirit can lead to death or blindness. Illicit alcohol also evades all national and state-level taxes and duties, thus making it very cheap and affordable. Country liquor produced in local licensed distilleries and is made of cheap raw material, primarily rectified spirits of grains or molasses. The production cost for country liquor is low; the excise duties are also lower than they are for other liquor. Imported liquor forms a very small part of alcohol consumption in India and growing at the rate of 25 per cent annually.[18]
2. Incidence of fatal outcome of these Hooch Tragedies by Methanol: Uniquely in Males, Mostly on Weekends, as Adult Males have tendency to party with alcoholic beverages like beer, whisky, brandy, rum and arrack on weekends.

3. March 03, 2019: In Assam, which faced its worst liquor tragedy in which 160 people died and more than 500 were affected, many of those who survived have lost their eyesight and are dealing with major health complications.[19]
4. Feb 11, 2019: UP hooch tragedy: At least 116 died in Saharanpur, Kushinagar, Meerut and Haridwar.[20]
5. The preponderance of methanol poisonings have resulted from the consumption of adulterated alcoholic beverages, e.g., "moonshine", or "bootleg whiskey", wood alcohol and spirits mixed with whiskey. Bennett et al. (1953) described a case that occurred in Atlanta, Georgia, USA, in 1951, when within a 5-day period, 323 people consumed bootlegged whiskey contaminated with 35–40% methanol and 41 of them died. Before 1978, many alcoholics in Sweden were reported to supplement their intake of alcohol with readily available cleansing solutions containing up to 80% methanol. Since 1978, the methanol content of such solutions has been limited to 5%. However, consumption of these solutions by alcoholics is still widely seen, exposures of 1–2 weeks being associated with blood methanol concentrations ranging from 1000 to 2000 mg/litre (31–62 mmol/litre) (Heath, 1983).[21]
6. In medicolegal study by Fedakar, R. et al (2008), 73.7% of the alcohol poisonings were observed in years 2000–2002, and of the methyl alcohol poisoning, 35.9% and 29.7% were seen in years 2001 and 2002, respectively.[22]

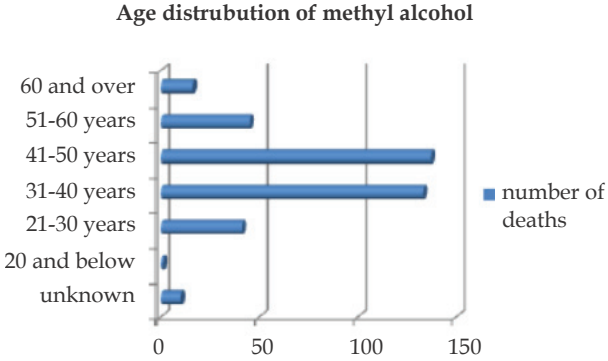
Table 1: Liquor tragedies timeline in 21st Century.[23]

Liquor Tragedies in 21st Century India - The Terrible Timeline

Date	Location	Deaths
Jan 2015	Uttar Pradesh	32
Oct 2013	Uttar Pradesh	40
Feb 2012	Odisha	35
Dec 2011	West Bengal	170
Oct 2010	Punjab	12
March 2010	Uttar Pradesh	35
Feb 2010	Uttar Pradesh	13
Jan 2010	Andhra Pradesh	14
Sept 2009	Uttar Pradesh	29
July 2009	Gujarat	136
May 2009	West Bengal	20
March 2009	Delhi	12
Jan 2009	West Bengal	27
May 2008	Karnataka	180
March 2006	Odisha	22
Dec 2004	Maharashtra	87
Oct 2001	Uttar Pradesh	18

7. In 2012, Total 63 males were admittedto V.S. Hospital (Ahmedabad) between 18 to 60 years, due to methyl alcohol poisoning after commercial alcohol consumption. 17 patients were terminally ill with hypotension, could not be subjected for hemodialysis and expired. Of remaining 46 patients, 20 responded to conservative management whereas 26 underwent hemodialysis of which only 3 died.[24]

Graph 1: Age Distribution of methyl alcohol death by Kurtas, U. et al. 2017[25].



8. Nand, L. et al (2014) reported a case of methyl alcohol poisoning after commercial alcohol consumption, manifestation of typical toxicity and outcome which revealed severe metabolic acidosis with high anion gap, blindness complicating bilateral optic atrophy and putaminal hemorrhagic necrosis. The patient improved with aggressive treatment including oral ethyl alcohol, but the occurrence of permanent blindness could not be prevented probably due to late presentation.[26]
9. The fatal dose varies greatly but is usually between 100 and 200mL in adults, although ingestion of 30mL can sometimes be lethal; permanent blindness has been caused by as little as 10mL. Toxic effects are usually associated with blood concentrations >100mg/L and blood concentrations >200mg/L are indicative of severe poisoning and may be lethal. The maximum permissible atmospheric concentration is 200 ppm.[27]
10. Serious Methanol (CH_3OH) toxicity is most commonly associated with ingestion. Following ingestion, the parent alcohol can cause CNS depression, ataxia, difficult breathing, acute gastritis or pancreatitis, anorexia, intense abdominal pain, vomiting, and diarrhea (Tephly, 1991). Left untreated, acute CH_3OH poisoning in humans is characterized by an asymptomatic latent period of 12 to 24 hours followed by formic acidemia, ocular toxicity, coma, and in extreme cases death (Lanigan, 2001). These

effects are caused by its metabolites. Respiratory failure or sudden respiratory arrest is the most common cause of death in methanol poisoning. Visual disturbances generally develop between 18 and 48 hours after ingestion and range from mild photophobia and misty or blurred vision to markedly reduced visual acuity and complete blindness (Eells et al., 1996). Although there is considerable variability among individuals in susceptibility to CH_3OH, a frequently cited lethal oral dosage is 1 mL/kg. Blindness and death have been reported with dosages as low as 0.1 mL/kg (ATSDR, 1993).[28]

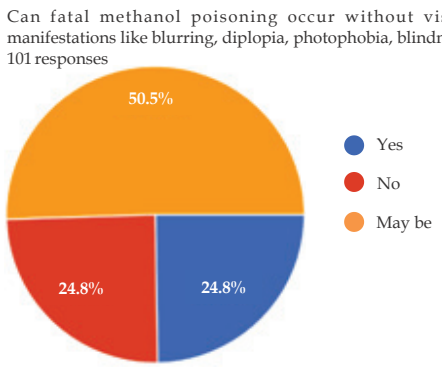


Fig. 10: Optic toxicity with Methanol.

Snow field Vision

As Methanol's selective toxicity of the optic nerve is well-known manifestation of methanol poisoning. Visual disturbances, like photophobia, blurred or misty vision (snowfield vision), central or peripheral scotoma, decreased light perception, concentric diminution of visual fields causing temporary or complete blindness due to optic neuritis and atrophy from accumulation of formic acid within the optic nerve. Retinal edema and hyperemia may be seen. Our survey showed that only 24.8% youth in our survey were aware regarding optic toxicity (Fig. 10).

Classic symptoms includes: Vertigo, Vomiting and Vision Loss; typical onset 24–36 hrs after consumption of country made liquor.[29] Awareness regarding classical symptoms of methanol toxicity revealed that 35.6% youths think that kidney damage occurs. (Fig. 11).

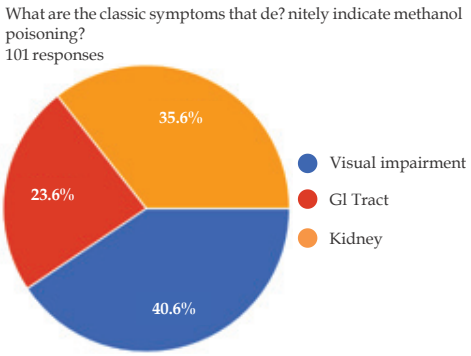


Fig. 11: Awareness regarding classical symptoms of methanol toxicity.

Methanol is cheap and readily accessible; therefore, it is one of the most common adulterants found in commercially available alcoholic beverages, especially in developing countries.

1. *Beer:* It is an un-distilled alcoholic beverage made from any malted grain, but commonly from barley malt, with hops or products obtained from hops to impart a bitter flavor and sometimes added with adjuncts like wheat, maize, corn rice and sugar. Methanol, a potent toxicant in humans, occurs naturally at low levels in most alcoholic beverages. Illicit alcohol is produced under unregulated circumstances and is often adulterated with chemicals like methanol, organophosphorus compounds, together with ethanol to save costs. This adulteration makes it unfit for human consumption and could lead to blindness or even be fatal to the consumer in the long or short run.[30]

Table 2: Top five Beer Producers of alcohol in the world by Sowmyashree et al 2016.[31]

Sl. No.	Brewer	Headquarters	Market share (%)	Rank
1.	Anheuser-busch InBev	Belgium	20.00	1
2.	SAB miller plc	UK	12.90	2
3.	Heineken NV	Netherlands	8.30	3
4.	Carlsberg breweries A/S	Denmark	6.50	4
5.	China Resources Enterprises Ltd.	China	5.30	5

Source: *www.ias.org.uk*

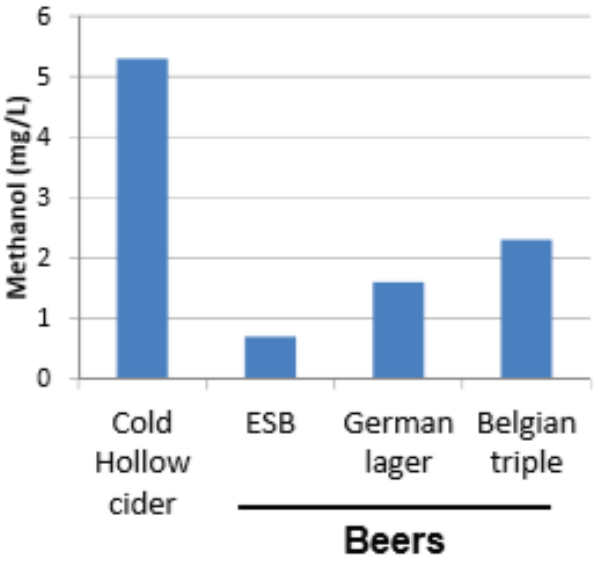
Beer commonly contains approximately 800 congeners (Methanol, butanol, isopropanol), wine: 600 and spirits: 800 at generally very low concentrations (~ 1:1000) compared with the corresponding ethanol content.

Table 3: Methanol content in foods and beverages.[32]

Methanol Levels in Foods and Beverages

Sample	Methanol Level
Fresh and canned fruit juices (orange and grapefruit juices)	1-43 mg/l 11-80 mg/l 12-640 mg/l *(average of 140 mg/l)*
Beer	6-27 mg/l
Wines	96-329 mg/l
Beans	1.5-7.9 mg/kg
Lentils	4.4 mg/kg
Carbonated beverages	~56 mg/l

2. Tolerable ("safe") daily dose of methanol in an adult is 2 g and a toxic dose is 8 g. The simultaneous ingestion of ethanol has no appreciable effect on the proposed "safe" and "toxic" doses when considering exposure over several hours. Thus, assuming that an adult consumes 4 x 25-ml standard measures of a drink containing 40% alcohol by volume over a period of 2 h, the maximum tolerable concentration (MTC) of methanol in such a drink would be 2% (v/v) by volume. However, this value only allows a safety factor of 4 to cover variation in the volume consumed and for the effects of malnutrition (i.e., folate deficiency), ill health and other personal factors (i.e., ethnicity). In contrast, the current EU general limit for naturally occurring methanol of 10 g methanol/L ethanol [which equates to 0.4% (v/v) methanol at 40% alcohol] provides a greater margin of safety.[33]



Graph 2: Bar diagram of Methanol in different liquors by Buglass, AJ. et al. 2011.[34]

3. Since most of the commercial brands of Beer have methanol contamination at different levels, establishment of a definitive relationship between the methanol content and toxicological effects can be vital. EDI of methanol for Iranian people through consumption of Beer was determined 0.023mg/kg bw/day.[35]
4. Illicit liquor becomes fatal when mixed with chemicals and repacked in new bottles. Adulteration of liquor is a major concern as it can lead to fatalities. At times the bootleggers are mixing methanol with liquor to increase the quantity which is a worrying sign for us as that could result in a huge tragedy.[36]

Table 4: FSSAI(Food Safety and Standards Act 2006) standards for Canned Beer.[37]

Table - 3 Requirement for Beer (canned/bottled)					
Sr. No.	Characteristic	Beer			
		Light	Standard	Strong	Super strong
1.	Ethyl alcohol content at 20 degree C percent by volume (Range)	0.5-4.0	4.1-5.0	5.1-6.0	6.1-8.0
2.	pH (Range)	3.8-4.5	3.8-4.5	3.8-4.5	3.8-4.5
3.	Carbon dioxide, v/v (not less than)	2.5	2.5	2.5	2.5
4.	Methyl alcohol mg/l max.	50.0	50.0	50.0	50.0
5.	Copper (mg/l), Max.	1.0	1.0	1.0	1.0
6.	Iron (as Fe) mg/l, Max.	5.0	5.0	5.0	5.0
7.	Lead (mg/l), Max.	0.2	0.2	0.2	0.2
8.	Arsenic (mg/l), Max.	0.25	0.25	0.25	0.25
9.	Cadmium (mg/l), Max.	0.1	0.1	0.1	0.1
10.	Total plate count, cfu per ml, max	2.0	2.0	2.0	2.0
11.	Coliform count, cfu per ml	Absent	Absent	Absent	Absent
12.	Yeast & Mould, cfu per ml	Absent	Absent	Absent	Absent

Table 5: FSSAI (Food Safety and Standards Act 2006) standards for Draught Beer.[37]

Table – 4: Requirements for Draught Beer					
Sr. No.	Characteristic	Beer			
		Light	Standard	strong	Super strong
1.	Ethyl alcohol content at 20 degree C percent by volume(Range)	0.5-4.0	4.1-5.0	5.1-6.0	6.1-8.0
2.	pH (Range)	3.8-4.5	3.8-4.5	3.8-4.5	3.8-4.5
3.	Carbon dioxide, v/v (not less than)	2.5	2.5	2.5	2.5
4.	Methyl alcohol mg/l max.	50.0	50.0	50.0	50.0
5.	Copper (mg/l), Max.	1.0	1.0	1.0	1.0
6.	Iron (as Fe) mg/l, Max.	5.0	5.0	5.0	5.0
7.	Lead (mg/l), Max.	0.2	0.2	0.2	0.2
8.	Arsenic (mg/l), Max.	0.25	0.25	0.25	0.25
9.	Cadmium (mg/l), Max.	0.1	0.1	0.1	0.1
10.	Total plate count, cfu per ml, max	50	50	50	50
11.	Coliform count, cfu per ml	Absent	Absent	Absent	Absent
12.	Yeast & Mould, cfu/ml, max	40	40	40	40

: Alcohol companies and their major brands in India							
Sr. No.	Company	Whisky	Rum	Vodka	Brandy	Beer	Gin
1.	Empee Distilleries		Old Secret, Victoria,Sixer		Napoleon		
2.	Globus Spirits	County club	Hannibal Rum		Le' Mans		White Lace
3.	Imperial Spirits	Glen Special, Gold Coast Malt	Black Magic, Hatrick	Black Magic, Imperial Iceberg Premium	Imperial, Imperial Exclusive VSOP		Seagull London Dry
4.	Mohan Meakins	Summer Hall, Colonel's special, Golden Eagle	Old Monk		Triple Crown, Doctor's Reserve No.1		Big Ben London
5.	Radico Khaitan	After Dark, 8PM	Contessa	Magic Moments	Old Admiral, Morpheus		
6.	Som Distilleries		Black Fort			Hunter,Wood pecker	
7.	Tilaknagar Inds.	Mansion House, Senate Royale	Madira XXX Rum	Castle Club	Mansion House		Savoy Club
8.	United Breweries					Kingfisher, Zingaro, London Pilsner Heineken, Sandpiper. Black label,	
9.	United Spirits	McDowell N0.1, RC, Bagpiper, Black Dog, Whyte and Mackay, Vat 69, Officer's Choice, Royal Stag.	McDowell Celebrations, Old Cask	Red Romanov, White Mischief	McDowell No.1, Honey Bee		Blue Riband

Table 6: Alcohol Companies and their major brands in India.Sowmyashree, KL, et al (2016). [31]

5. The producer of branded beer, which is among three brands of alcohol blamed for causing the deaths of 21 people in Malaysia in September 2018. The liquor company has yet to explain why methanol is found in their product despite deaths occurring after drinking it, pointing out that it was the number one selling brand in India and sold in 52 countries worldwide.[38] Branded beers contain Methanol or not, was discussed in a panel discussion too.[39]
6. Howland, J. et al. (2008) described effects of heavy drinking of Beer on next day performance. A total of 172 participants received alcoholic beverage. In studies 1 and 2 the beverage alcohol was beer (7.3% alcohol by weight).[40]

S.No. (1)	Characteristics (2)	Requirements (3)
1.	Ethyl alcohol content at 20 degree C, per cent by volume	0.5 to 8.0
2.	Residue on evaporation, per cent. (g/liter), Max.	25.0
3.	Total acids as tartaric acid, per cent. (m/v), Max.	1.0
4.	Methyl alcohol (expressed in terms of g/100 l of absolute alcohol), Max.	25.0
5.	Sugar, per cent. (w/v), Max.	20.0
6.	pH	2.0 to 5.0
7.	Copper (mg/l), Max.	1.0
8.	Iron (as Fe) mg/l, Max.	5.0
9.	Lead (mg/l), Max.	0.2
10.	Arsenic (mg/l), Max.	0.25
11.	Cadmium (mg/l), Max.	0.1 "

Table 7: New guidelines for Lowered Methanol levels to 25 mg/dl in alcoholic beverages by FSSAI in 2019.[41]

7. Characterization of Indian beers. The study by Pai, TP. et al (2015) describes the variations in phenolic content and antioxidant activities of commercial beers among several commercial brands of beer sold in India. DPPH radical scavenging activity and ABTS radical cation scavenging activity were positively correlated to each other and the phenolic content of the beer. The phenolic compounds are responsible for beer antioxidant activity.[42]
8. Beer's Methanol determination done by Tomassetti, M. et al. (2016) in which the cell was used to check methanol content in several commercial wine and beer samples.[43]
9. Loguercio, C. et al. (2009) did Human Study on Beer effects on gastric function and harmful impacts on Gastric epithelial cell viability due to oxidative stress-induced damage.[44]

Blood in vomiting after alcohol toxicity can have multiple causes

1. Liver cirrhosis is a serious form of alcoholic liver disease and is irreversible. Complications such as liver cirrhosis can develop after 5 to 10 years. About 10–20 percent of heavy drinkers usually develop cirrhosis around 10 or more years. Generally, drinking 80 grams of ethanol daily for 10–20 years is required to develop cirrhosis which corresponds to approximately one liter of wine, eight standard sized beers, or one half pint of hard liquor each day. (Fig. 12).

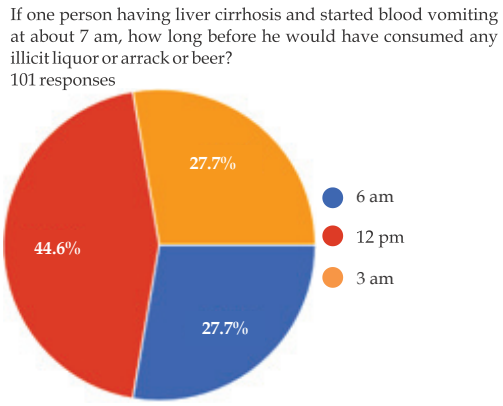


Fig. 12: Liver cirrhosis and started blood vomiting.

2. Apart from symptoms similar to alcoholic hepatitis, one can develop other serious complications such as accumulation of fluid in the abdomen (ascites), bleeding from esophageal or stomach veins, kidney failure, liver cancer or significant liver failure, signs of acute changes in mental status and possibly coma within 4–5 yrs of chronic alcohol abuse.
3. Esophagitis and gastroesophageal reflux: Stomach acid that returns, or "refluxes" back into the esophagus from the stomach can cause irritation and inflammation of the esophagus (esophagitis) that may lead to bleeding within few hours after alcohol consumption.
4. *Varices:* These are abnormally enlarged veins usually located at the lower end of the esophagus or the upper stomach. They may break open and bleed. Cirrhosis of the liver is the most common cause of esophagealvarices. It takes a few years to develop on regular alcohol consumption.

5. *Mallory-Weiss tears:* These are tears in the lining of the esophagus. It is usually caused by severe vomiting, immediately or within few hours after excessive intake of alcohol.
6. *Gastritis:* Inflammation of the stomach. Alcohol and some pain medicines can cause it.
7 *Ulcers:* If they are present in the stomach, they may enlarge and erode through a blood vessel, causing bleeding.[45]
8. According to Karnataka Excise Rules (1997), the ethanol content of whisky, rum and gin (IMFL) are mandated at 42.8% volume by volume (75° proof) and of country liquor or "arrack" at 33.3% volume by volume (65° proof) at 15/15°C. The Karnataka Excise Act specifies that for the manufacture of IMFL and arrack, the basic material is Rectified spirit (95% Ethanol and 5% Methanol) [manufactured by distillation of molasses].[46]
9. *Arrack:* It is a distilled alcoholic beverage typically produced from either the fermented sap of coconut flowers, palm, sugarcane, grain or fruit. The clear distillate may be blended, aged in wooden barrels, or repeatedly distilled and filtered depending upon the taste and colour objectives of the manufacturer. This beverage contains about 36–50 percent of alcohol.

   Arak or Araq: It is a clear, colourless, unsweetened anise-flavored distilled alcoholic beverage.[47]
10. Blood methanol concentrations during experimentally induced ethanol intoxication in alcoholics during a 10–15 day period of chronic alcohol intake showed that blood methanol levels increased progressively from 2–27 mg/litre from the first to the 11th day of drinking, when blood ethanol concentrations ranged between 1500 and 4500 mg/litre. Blood methanol levels decreased at the rate of 2.9 ± 0.4 mg/litre per h only after blood ethanol levels decreased to 700 to 200 mg/litre. Blood methanol disappearance lagged behind the linear disappearance of ethanol by approximately 6–8 h and complete clearance of methanol required several days. Methanol probably accumulates in the blood as a result of the competitive inhibition of alcohol dehydrogenase by ethanol and the presence of endogenously formed methanol, Oral doses of 71–84 mg methanol/kg in humans resulted in blood levels of 47–76 mg/litre blood 2–3 h later. The urinary concentrations of methanol rapidly reached a peak capacity in 1 h and declined exponentially, reaching control values in 13–16 h. The urine/blood concentration ratio was found to be relatively constant at 0.30.[48]

Hemodialysis

1. Yes, Hemodialysis can help in the removal of toxic alcohols accumulated in circulating blood. Hemodialysis removes both methanol (half life reduced to 3–6 hours) and formate.[49] (Fig. 13).

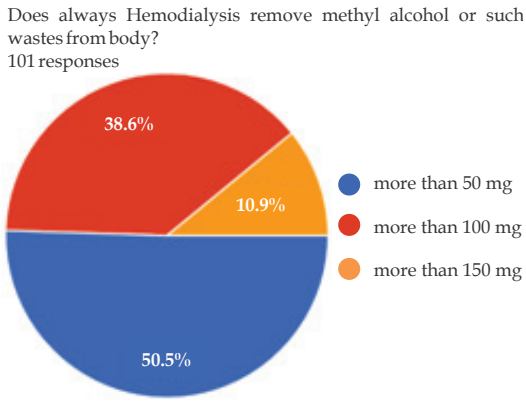


Fig. 13: Hemodialysis remove methyl alcohol or such wastes from body.

2. Hemodialysis is effective in removing methanol and formate and in correcting severe metabolic acidosis.[50]
3. The management of methanol intoxication by haemodialysis is a well-known and clinically effective treatment.[51]
4. The definitive therapy for symptomatic for clinically ill patients poisoned by toxic alcohols is hemodialysis. Hemodialysis clears both the alcohols and their toxic metabolites from the blood and corrects the acid–base disorder.[52]

Accumulation of Methanol in chronic alcohol abuser

It can be due to multiple reasons mentioned below:-

1. Patients presenting late after ingestion may already have metabolized all parent compound to toxic metabolites and thus may have low or no measurable toxic alcohol concentrations.[52]
2. Trace amounts of methanol are found naturally in fruit juices - this is non-toxic. Methanol is also a product of fermentation and is found in both alcoholic and non-alcoholic fermented drinks. Concentrations of 6–27 mg/L have been measured in beer and 10–220 mg/L in spirit. In these concentrations methanol is not harmful. Problems arise when higher concentrations are formed during incorrectly managed distillation processes, but more particularly when methanol is deliberately added to fortify informally-

produced spirits and illicit alcoholic drinks. Some illicitly-produced drinks are made to appear legitimate through bottle design and labelling and consumers can be misled into believing they are buying a genuine brand of alcohol.[53] (Fig. 14).

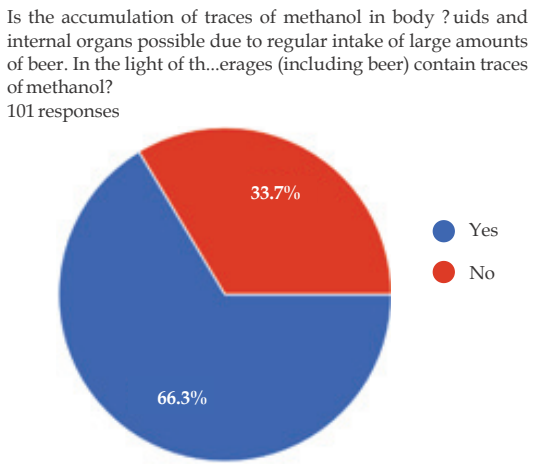
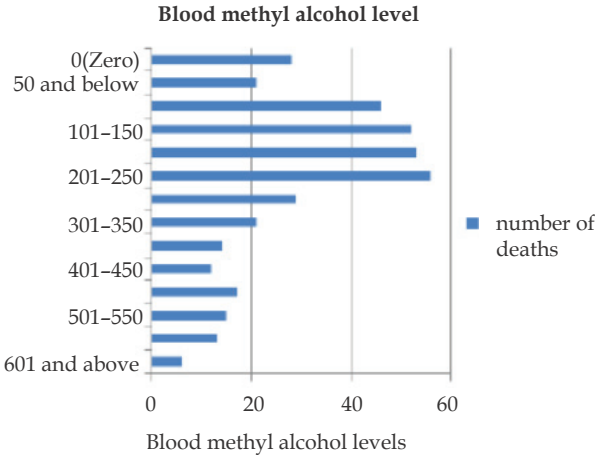


Fig. 14: Accumulation of Traces of Methanol in Body Fluids and Internal Organs.

3. Small amounts of methanol are present as congeners in some fermented alcoholic beverages. Heavy drinking of alcohol (ethanol) blocks the oxidation of endogenous methanol because alcohol dehydrogenase is engaged with ethanol metabolism, resulting in accumulation of methanol - both endogenous and exogenous - from beverage-related congeners. Endogenous blood-methanol concentrations are about 1.5 mg/L, and urinary formic acid concentrations are about 12–17 mg/L.[54]
4. Frequent exposure to methanol and its toxic products of metabolism, formaldehyde and formic acid, might constitute an additional health risk associated with heavy drinking in predisposed individuals.[55]
5. Since Methanol is volatile Alcohol at room temperature, and it evaporates quickly. It is possible to find Different levels of methanol in antemortem samples at different timings during treatment and hemodialysis of the patient, and can be found different levels of methanol in postmortem samples due to endogenous production of methanol causing false high/low levels. Was it the same extent of serum alcohol levels, or some amount of volatile alcohol is lost due to evaporation from the time of collection to the time of testing the sample at different laboratories during transport, lessening the quantitative levels.[56]
6. Ethanol and other alcohols including methanol can be produced during putrefaction by fermentation of the carbohydrates and proteins of the body, which may be as high as 0.2%.[57]
7. The routine Laboratory sample collection method practiced in Hospitalised patients for any blood sampling is first disinfecting the site of pricking needle by using methylated spirit, which contains 95% by volume of Ethanol and 5% Methanol, which can give false positive results for high methanol and ethanol concentration.[58]
8. Range of dose levels of methanol that are toxic, 120 ml (4 fluid ounces) of Columbian spirits, or 95 g of methanol (Columbian spirits is basically pure methanol), was lethal in 40% of the poisoning cases. For a 70-kg person, this dose is equivalent to about 1.4 g methanol/kg body weight. This figure is consistent with currently accepted values for lethality, and 0.3 to 1 g/kg is considered the range of a minimum lethal dose for untreated cases of methanol poisoning.[59]



Graph 3: Evaluation of deaths due to methyl alcohol intoxication. Kurtas, U. et al 2017.[25]

9. Methanol has been identified as a volatile component of dried legumes with reported levels of 1.5–7.9 mg/kg in beans, 3.6 mg/kg in split peas and 4.4 mg/kg in lentils. Methanol has also been reported (no levels stated) in roasted filberts and baked potatoes. It has been detected in low-boiling volatile fractions of cooked foods, including Brussels sprouts, carrots, celery, corn, onion, parsnip, peas and potatoes. Humans can also ingest varying amounts of methanol in foods and or drugs isolated or recrystallized from methanol, e.g., methanol is used as an extraction solvent for spice oleoresins and hops. Additionally, certain foods and drugs, consumed or administered as their methyl ester, can release methanol during their metabolism and excretion. For example, 10% of the sweetening agent aspartame (L-aspartyl-L-phenylalanine

methyl ester) hydrolyzes in the gastrointestinal tract to become free methanol. Carbonated beverages contain about 555 mg aspartame/litre, equivalent to approximately 56 mg methanol per litre. The amount of methanol present in an average serving of beverage sweetened by aspartame alone is considerably less than in the same volume of many fruit and vegetable juices. For instance, tomato juice will result in 6 times the amount of methanol exposure than consumption of an equivalent volume of aspartame sweetened beverage.[60] (Fig. 15).

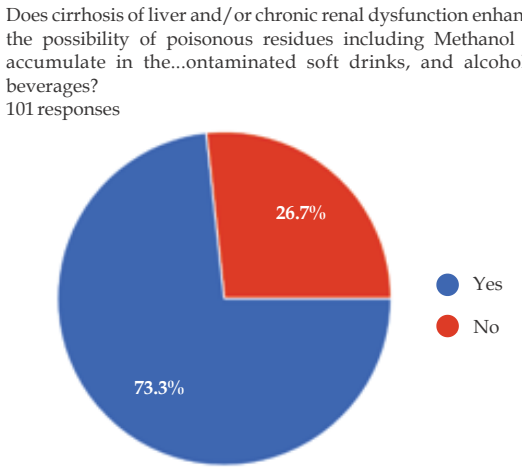


Fig. 15: Cirrhosis of Liver and/or Chronic Renal Dysfunction Enhance.

Fatal concentrations of methanol

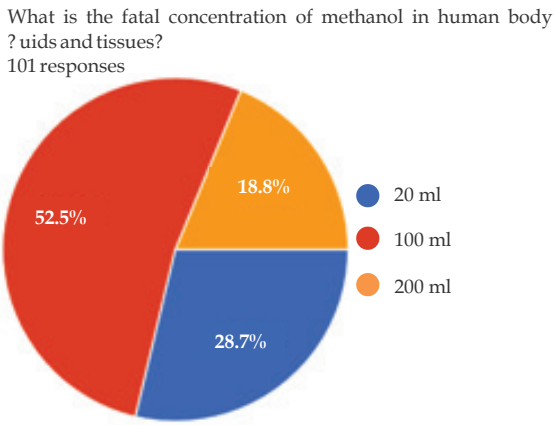


Fig. 16: What is the Fatal Concentration of Methanol in Human Body Fluids and Tissues 101 Responses.

Different Toxicology books have different values of fatal concentrations of methanol mentioned in different units, as per the author's research and reported cases in their Hospitals observed by them, (Fig. 16) as mentioned below:-

1. Fatal dose of methanol is 15–30 ml of 40 percent methanol have produced deaths.[61]
2. Blood Methanol Levels of 200 mg % can be fatal.[62]
3. Blood Methanol Levels of 50 mg/100ml indicates serious poisoning.[63]
4. > 50 mg/dL-Methanol level- Severe toxicity.

>30 ml of methyl alcohol ingestion- causes optic N toxicity-potentially lethal dose-– indication of dialysis. (Fig. 17).

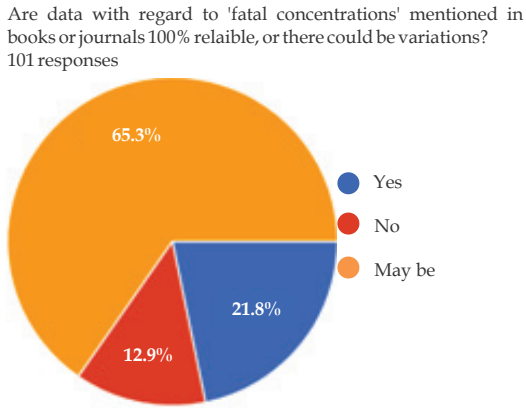


Fig. 17: 'Fatal Concentrations' Mentioned.

Conclusion

Understanding the type of alcohol toxicity problems that precede future possible HOOCH tragedies is critical for developing effective intervention programs which are targeted at youth who suffer from these emergencies. These Research outcomes, provides strong sustenance for a progressive alcohol intake and possibility of methanol poisoning in chronic abusers. Our Research result shows that male and female are both unaware regarding harmful effects of alcohol, which indicates the risk of methanol toxicity and high vulnerability.

Visual disturbances, dyspnoea, and gastrointestinal symptoms are among the variable symptoms, while severe metabolic acidosis, coma, and increased pCO_2 are associated with inappropriate and poor treatment outcomes. Due to this increment they are being involved in mass tragedies of intoxication, and various morbidities and resulting mortality rate, thus we must create awareness among society to restrain from consuming alcohol casually in the Youth population and provide them supportive environment for alcohol deaddiction.

Author's Contributions: All authors have read, reviewed and contributed to the final manuscript.

Conflict Of Interest: Nil.

References

1. Kute VB, Godara SM, Shah PR, Gumber MR, Goplani KR, Vanikar AV, et al. Hemodialysis for methyl alcohol poisoning: A single-center experience. Saudi Journal of Kidney Diseases and Transplantation.2012;23(1):37.
2. Andresen H, Schmoldt H, Matschke J, Flachskampf F, Turk E. Fatal methanol intoxication with different survival times—morphological findings and postmortemmethanol distribution. Forensic science international.2008;179(2):206–10.
3. Oberts DM, Yates C, Megarbane B, Winchester JF, Maclaren R, Gosselin S, et al. Recommendations for the role of extracorporeal treatments in the management of acute methanol poisoning: a systematic review and consensus statement. Critical care medicine.2015;43(2):461–72.
4. Rostrup M, Edwards JK, Abukalish M, Ezzabi M, Some D, Ritter H, et al. The Methanol Poisoning Outbreaks in Libya 2013 and Kenya 2014. PloS one.2016;11(3):e0152676.
5. Massoumi G, Saberi K, Eizadi-Mood N, Shamsi M, Alavi M, Morteza A. Methanol poisoning in Iran, from 2000 to 2009. Drug and chemical toxicology.2012;35(3):330–3.
6. Oberts DM, Yates C, Megarbane B, Winchester JF, Maclaren R, Gosselin S, et al. Recommendations for the role of extracorporeal treatments in the management of acute methanol poisoning: a systematic review and consensus statement. Critical care medicine. 2015;43(2):461–72.
7. Rostrup M, Edwards JK, Abukalish M, Ezzabi M, Some D, Ritter H, et al. The Methanol Poisoning Outbreaks in Libya 2013 and Kenya 2014. PloS one. 2016;11(3):e0152676.
8. Massoumi G, Saberi K, Eizadi-Mood N, Shamsi M, Alavi M, Morteza A. Methanol poisoning in Iran, from 2000 to 2009. Drug and chemical toxicology. 2012;35(3):330–3.
9. Zakharov S, Pelclova D, Navratil T, Belacek J, Komarc M, Eddleston M, et al. Fomepizole versus ethanol in the treatment of acute methanol poisoning: Comparison of clinical effectiveness in a mass poisoning outbreak. Clinical Toxicology. 2015;53(8):797–806.
10. Rafzadeh A, Shariati S, Pourmohammad L, Fooladmehr S. Application a colorimetric method for qualitative analysis of methanol. IJFM. 2010;16(2):89–94.
11. Hassanian-Moghaddam H, Nikfarjam A, Mirafzal A, Saberinia A, Nasehi AA, Asl HM, et al. Methanol mass poisoning in Iran: role of case finding in outbreak management. Journal of public health. 2015;37(2):354–9.
12. Organization WHO. Global status report on alcohol and health, 2014.
13. Poznyak V, Fleischmann A, Rekve D, Rylett M, Rehm J, Gmel G. The World Health Organization's global monitoring system on alcohol and health. Alcohol res. 2013;35:244–9.
14. Mostafazadeh B, Eghbali H. An Epidemiologic Study on Methyl Alcohol Poisoning in Tehran, Iran. Asia Pacific Journal of Medical Toxicology. 2014;3:8.
15. Article 47 in the Constitution of India 1949.47. Duty of the State to raise the level of nutrition and the standard of living and to improve public health. The State shall regard the raising of the level of nutrition and the standard of living of its people and the improvement of public health as among its primary duties and, in particular, the State shall endeavour to bring about prohibition of the consumption except for medicinal purposes of intoxicating drinks and of drugs which are injurious to health. https://indiankanoon.org/doc/1551554/
16. Human Toxicology - J. Descotes (Elsevier, 1996) WW. Chapter 24 — Alcohols and glycols. P632–35.
17. Roine, RP, CJ Eriksson, R Ylikahri, A Penttilä, and M. Salaspuro, Methanol as a marker of alcohol abuse. Alcohol ClinExp Res, 1989. 13(2): p. 172–175.
18. Sowmyashree, KL Et al. An overview of Indian alcohol industry. Volume 9 | Issue 1 | April, 2016| 80–86. International Journal of Commerce and Business Management. DOI:10.15740/HAS/IJCBM/9.1/80–86. Link: http://www.researchjournal.co.in/online/IJCBM/IJCBM%209(1)/9_80–86_A.pdf)
19. Chaudhary, R. Assam Liquor Tragedy Exposes Isolation, Neglect Of Tea Garden Workers. https://www.ndtv.com/india-news/assam-hooch-tragedy-assam-liquor-tragedy-exposes-isolation-neglect-of-tea-garden-workers-2001917
20. UP hooch tragedy: 116 died in Saharanpur, Kushinagar, Meerut and Haridwar. Link: https://www.financialexpress.com/india-news/hooch-tragedy-saharanpur-live-toll-deaths-uttar-pradesh-uttarakhand-haridwar-yogi-adityanath-up/1483734/
21. Fishbein, L Methanol. World Health Organization, Geneva, 1997.International Programme on Chemical Safety (IPCS) http://www.inchem.org/documents/ehc/ehc/ehc196.htm#SectionNumber:1.2
22. Fedakar, R et al. Fatal Poisonings In The South Marmara Region Of Turkey, 1996–2003. European Journal of General Medicine (ISSN: 1304–3897) Vol 5 Num 1. May 2018. DOI: 10.29333/ejgm/82566 Link: https://www.researchgate.net/publication/27794746_Fatal_Poisonings_In_The_South_Marmara_Region_Of_Turkey_1996–2003)
23. Pillay, VV. Textbook of Forensic Medicine and Toxicology. 19th Ed. 2019. Chapter 33. Alcohols and Sedatives. Terrible Toxic Tragedies on Timeline of India. p 639.

24. Shah,S. et al. Study of 63 cases of methyl alcohol poisoning (hooch tragedy in Ahmedabad). May 2012. The Journal of the Association of Physicians of India 60(5):34–6. https://www.researchgate.net/publication/231816032_Study_of_63_cases_of_methyl_alcohol_poisoning_hooch_tragedy_in_Ahmedabad)
25. Kurtas, U. et al. The evaluation of deaths due to methyl alcohol intoxication. Biomedical Research (2017) Volume 28, Issue 8. Link: http://www.alliedacademies.org/articles/the-evaluation-of-deaths-due-tomethyl-alcohol-intoxication.html)
26. N and, L. et al. Methyl alcohol poisoning: A manifestation of typical toxicity and outcome. August 2014. The Journal of the Association of Physicians of India 62(8):756–9 link: https://www.researchgate.net/publication/274724605_Methyl_alcohol_poisoning_A_manifestation_of_typical_toxicity_and_outcome)
27. Clarke's Analysis of Poisons. 4th Ed. 2011. Methanol. p1652–53.
28. Casarett and Doull's Toxicology: Basic Science of Poisons, 9th edition. McGraw Hills 2019. Chapter 24. Toxic Effects of Solvents and Vapors. p1207.
29. Modi, JP. Medical Jurisprudence and Toxicology. 26th Edition. Lexis Nexis. 2018 p 244.
30. Alcohol Marketing and Regulatory Policy Environment in India. A Report. 2013: https://iogt.org/wp-content/uploads/2013/12/PHFI-Alcohol-Industry-Report.pdf)
31. Sowmyashree, KL. Et al. An overview of Indian alcohol industry. Volume 9 | Issue 1 | April, 2016 | 80– 86. International Journal of Commerce and Business Management.
32. Methanol Safe Handling Manual 1st Ed. Methanol Institute. 2008. http://www.southernchemical.com/wp/wpcontent/uploads/2009/12/Methanol-Safe-Handling-Manual-Oct-20081.pdf
33. Paine A, Davan AD. Defining a tolerable concentration of methanol in alcoholic drinks. Hum Exp Toxicol. 2001 Nov;20(11):563–8)
34. Buglass, AJ. Handbook of Alcoholic Beverages. Technical, Analytical and Nutritional Aspects. Volume I. Wiley Publication. 2011).
35. Shirani K, Bostan HB, Baroti A, et al. Ethanol and Methanol Concentration in Commonly Used Brands of Ma-al-shaeer in Iran: Estimation of Dietary Intakes and Risk Assessment. J Pharmacopuncture 2018; 21(3): 168–176.
36. Nigam, Chayyanika. Delhi authorities worry over adulteration of liquor, smuggling from Haryana. India Today. New Delhi. June 1, 2018 https://www.indiatoday.in/mail-today/story/delhi-authorities-worry-over-adulteration-of-liquor-smuggling-from-haryana-1247522–2018–06–01)
37. FSSAI (Food Safety and Standards Act 2006) standards for Alcoholic beverages. https://old.fssai.gov.in/Portals/0/Pdf/Notice_Comments__WTO_TBT_Alcoholic_Beverages.pdf
38. Looi, S. What's in Kingfisher beer? Perak exco demands answers after alcohol poisoning deaths. Reported in Malaymail. September 2018. https://www.malaymail.com/news/malaysia/2018/09/21/whats-in-kingfisher-beer-perak-exco-demands-answers-after-alcohol-poisoning/1675074)
39. Kingfisher beers contain Methanol or not?(Ref:https://www.nst.com.my/news/nation/2018/09/415522/kingfishermanufacturer-denies-viral-message-saying-beer-cause-methanol)
40. Howland, J et al. The incidence and severity of hangover the morning after moderate alcohol intoxication. Addiction. Volume 103, Issue 5. May 2008. p758–765. Link: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1360–0443.2008.02181.x)
41. New guidelines for Lowered Methanol levels to 25mg/dl in alcoholic beverages by FSSAI (Food Safety and Standards Direction_Alcoholic_Beverages_29_03_2019.
42. Pai, TP. Characterization of Indian beers: chemical composition. J Food Sci Technol. 2015 Mar; 52(3): 1414–1423. doi: 10.1007/s13197–013–1152–2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4348278/)
43. Tomassetti, M. et al.Catalytic fuel cell used as an analytical tool for methanol and ethanol determination. Application to ethanol determination in alcoholic beverages. ElectrochimicaActa 191 (2016) xxx–xxx. Link: https://iris.uniroma1.it/retrieve/handle/11573/856583/201712/Tomassetti_Catalytic-fuel_post-print_2016.pdf
44. Loguercio, C. Alcoholic beverages and Gastric epithelial cell viability. Journal of Physiology And Pharmacology 2009, 60, Suppl 7, 87–92 Link: https://pdfs.semanticscholar.org/636b/bcfc5efd088f318b982b19193fce4d43b91b.pdf
45. Burt AD, MacSwee R. (1999) Pathology of Alcoholic Liver Disease. In: Bircher J, Benhamou JP, McIntyre N, Rizzetto M, Rodes J (eds). Oxford Textbook of Clinical Hepatology. Oxford University Press, Oxford, pp1179–84).
46. Ref: Pandey, RK., Sankhla MS, Kumar, R. Determination of adulterants in suspected liquor samples using chemical tests MOJ Toxicol.2018;4(4):309□314. Link: https://medcraveonline.com/MOJT/MOJT–04–00118.pdf
47. FSSAI (Food Safety and Standards Act 2006) Definitions for Alcoholic beverages. 2.2.5 https://old.fssai.gov.in/Portals/0/Pdf/Notice_Comments__WTO_TBT_Alcoholic_Beverages.pdf
48. Fishbein, L. Methanol. World Health Organization, Geneva, 1997.International Programme on Chemical Safety (IPCS) http://www.inchem.org/documents/ehc/ehc/ehc196.htm#SectionNumber:1.2)

49. Olson KR. Poisoning and Drug Overdose 7th Ed. 2018. McGraw-Hill Education. p314–16.
50. Roberts DM, Yates C, Megarbane B, et al. Recommendations for the role of extracorporeal treatments in the management of acute methanol poisoning: a systematic review and consensus statement. Crit Care Med 2015; 43(2): 461–472.)
51. Kraut Jeffrey A, Kurtz Ira. Toxic alcohol ingestions: clinical features, diagnosis, and management. Clin J Am SocNephrol 2008; 3: 208–25.
52. Goldfrank, L. Goldfrank's Textbook of Toxicological Emergencies. 10th Ed. McGraw Hills. 2015. Toxic Alcohols. Ch 109.
53. World Health Organisation- environmental health emergencies-methanol poisoning information note. July 2014. p1–2. https://www.who.int/environmental_health_emergencies/poisoning/methanol_information.pdf)
54. Knight, Bernard. Forensic Pathology. 4th edition. CRC Press 2016. p586.
55. (Jones AW, Lowinger H. Relationship between the concentration of ethanol and methanol in blood samples from Swedish drinking drivers. Forensic SciInt 1988; 37(4): 277–85.
56. Biswas, G. Recent Advances in Forensic Medicine and Toxicology. Volume 2. Jaypee Publishers. 2018. Section 5: Forensic Science. Chapter 23: Controversies in Forensic Tests, Investigations and Expertise. p642.
57. Reddy, KSN. Medicolegal Manual. 5th Ed. ALT publications. 2014 p239.
58. Dikshit, PC. Textbook of Forensic Medicine and Toxicology. 2nd Edition. 2014. Chapter 41. CNS Depressants- Methanol. p546.
59. Röe, 1955; Erlanson et al., 1965; Gonda et al., 1978.(Ref: Fishbein, L. Methanol. World Health Organization, Geneva, 1997. International Programme on Chemical Safety (IPCS) http://www.inchem.org/documents/ehc/ehc/ehc196.htm#SectionNumber:1.2)
60. Cruz-Pamplona M, Margaix-Muñoz M, Gracia Sarrión-Pérez MG. Dental considerations in patients with liver disease. J ClinExp Dent 2011; 3(2): e127–34.
61. Agarwal, Praveen. Diagnosis and management of Common poisoning. Oxford 1st ed. OUP. 1998. Chapter: Methanol p133.)
62. Agarwal, Anil. Textbook of Forensic Medicine and Toxicology. 1st Ed. Avichal publishers. 2015. Chapter: Toxic Alcohols.
63. Pillay, VV. Comprehensive Medical Toxicology. 3rd ed. Paras Publishers. 2018. Chapter 8: Alcohols p276.

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Review Article

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A Review of a Hallucinogenic Plant (Brugmensia) Used as Criminal Tools and Exercises

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Abstract

Scopolamine, named also hyoscine, is a tropane alkaloid drug with antimuscarinic effects. It is also a tertiary ammonium compound, so it can be easily absorbed by the gut and the most important thing is that it crosses the hematoencephalic barrier (blood-brain barrier).

This substance has many effects on the human body and it is produces effects on a range of micrograms. Scopolamine itself is used as a treatment for some diseases in low doses (like kinetosis), but when it comes to use it as a weapon, it's mixed up with some other substances to produce the compost called burundanga. Burundanga is the cocktail and scopolamine is the main active principle. Regarding to its physical appearance, burundanga is a white thin dust similar to cocaine, tasteless and odourless.

Scopolamine can be find almost in all the species of the Solenaceae family. The drug is stored in the plant's flowers, leaves, and stems. Scopolamine is obtained principally from Datura stramonium, Brugmansia candida, and Hyoscyamus albus. There are many ways to commit a crime, but the perfect crime is not a concept easily achieved. Scopolamine is the ideal example. This substance has been utilised for a long time by humans and has been considered a gate to extra sensorial experiences with spirits. Nowadays though, it has turned into a majestic crime weapon or tool.

Keywords: Hallucinogenic Plant; Brugmensia.

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Introduction

Robbery without violence is become too common on the streets of Nairobi. They use scopolamine powder to immobilize their victims.

Angel's trumpets, scientifically known as Brugmansia, is a genus of seven different species of flowering plants in the Solanaceae family. The Solanaceae family is extensively utilized by humans for food and medicine but is often rich in alkaloids that can cause life-threatening toxicity in humans. Plants causing human toxicity include Atropa belladonna (deadly nightshade), Mandragora officinarum (mandrake), Hyoscyamus niger (henbane), Datura and Brugmansia.[3] In addition to poisonous plants, a number of food staples, such as potato, tomato, eggplant and chili pepper belong to the Solanaceae family.

Fig. 1: Angels trumpets.

Brugmansia flowers hang downward, giving them their trumpet shape. Their flowers are usually

white, yellow or pink in colour. Angel's trumpets are native to the tropical areas of South America (Coloubia, Equador, Brazil, Peru etc.) (Fig. 1).[5]

Tropane Alkaloids

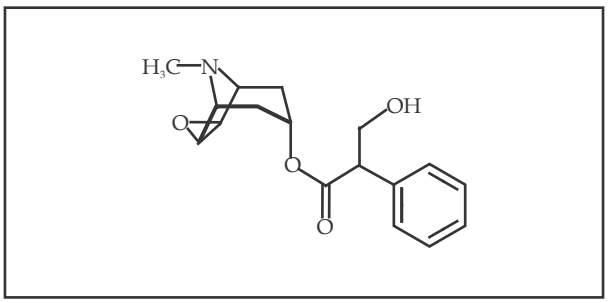
This plant contains the tropane alkaloids—scopolamine, hyoscyamine and atropine which are concentrated primarily in the seeds and flowers. These alkaloids competitively block the neuro transmitter acetylcholine at the muscarinic receptor.[3-5]

Tropane alkaloids (TA) are valuable secondary plant metabolites which are mostly found in high concentrations in the Solanaceae and Erythroxylaceae families. The TAs, which are characterized by their unique bicyclic tropane ring system, can be divided into three major groups: hyoscyamine and scopolamine, cocaine and calystegines. Although all TAs have the same basic structure, they differ immensely in their biological, chemical and pharmacological properties. Scopolamine, acting as an antagonist at both peripheral and central muscarinic receptors, is thought to be the primary compound responsible for the toxic effects of the plant.[6,7]

Scopolamine, also known as hyoscine, has the largest legitimate market as a pharmacological agent due to its treatment of nausea, vomiting, motion sickness, as well as smooth muscle spasms while cocaine is the 2nd most frequently consumed illicit drug globally. Scopolamine crosses the blood-brain barrier and is responsible for central nervous system effects such as delirium, drowsiness, agitation, and dementia.[8,9]

Atropine is a racemic mix of the R- an L-enantiomer of hyoscyamine.

Chemical Structure



Effect of Scopolamine on human health

Since the drug is instantly absorbed in your skin, its effects are nearly immediate and they include; Drowsiness, dizziness, a dry mouth or skin, blurred vision, restlessness, confusion, hallucinations, paranoia, difficulty speaking, difficulty urinating, constipation or dry and dilated pupils. In high dosages, Scopolamine completely zonks us out and we don't remember what was goingon.[10]

Pharmacology of scopolamine

They affect the central and peripheral nervous system as competitive, non-selective muscarinic acetylcholine receptor (mAChR) antagonists, that prevent binding of the physiological neurotransmitter acetylcholine. In humans, two acetylcholine receptor types are known: Muscarinic and nicotinic receptors, which are named after their agonists, muscarine and nicotine.[11]

TAs are absorbed from the gastrointestinal tract, rapidly distributed into the tissues and excreted predominantly through the renal system. The short half-life in plasma and dose-dependent adverse effects limit the administration of scopolamine to transdermal application After absorption, scopolamine experiences a significant first-pass effect, because only a minor amount (2.6%) is excreted in the urine in the pharmacologically active form. Cytochrome P450 enzymes seem to be especially involved in the metabolism of scopolamine by oxidative demethylation.[11,12] Inhibition of CYP3A by ingestion of grapefruit juice prolonged the tmax and increased the AUC0–24h value of scopolamine metabolization. Additionally, it has been observed that scopolamine and its apo- and nor-metabolites are conjugated to glucuronide (glucuronidation) or sulphate during phase II metabolism for excretion into urine. Scopolamine and hyoscyamine do not accumulate in the human body, nor exhibit genotoxic or chronic toxicity, an adverse effect due to long-term exposure have not been reported (EFSA, 2013).[11,14]

Occurring side effects of anticholinergic drug substances occur from inhibition of the parasympathetic nervous system. Symptoms include decelerated heart rate, dry mouth and reduced perspiration. At higher therapeutic oral doses, increased heart rate, inhibition of the respiratory tract secretory activity as well as bronchodilation and mydriasis have been observed.[14,15] Sweating is also inhibited which is accompanied by a consequent rise in body temperature.

Scopolamine

Scopolamine causes mydriatic, spasmolytic and local anaesthetics effects yet exhibits side effects

which can be hallucinogenic and even lethal. The most important mode of application for scopolamine is transdermal, a technology which was developed as transdermal therapeutic systems (TTS) in 1981. Scopoderm TTS® is the trade name for a scopolamine delivery system used in the treatment of motion sickness. During the Second World War, scopolamine was used to treat shell shock, psychoactive side effects and also motion sickness.[17,18] The drawbacks of scopolamine lay in the manifold peripheral and central nervous system side effects. To overcome these issues, scopolamine derivates have been developed, leading to its classification as a drug lead substance.

Hyoscyamine and Atropine

Hyoscyamine and atropine have similar modes of action and effects as scopolamine.

Scopolamine uses

In the 1920s, Robert House pioneered the use of scopolamine as a truth serum. House found the drug would "depress the cerebrum to such a degree as to destroy the power of reasoning" In other words, the drug turns people into zombies.[12,17] It also blocks memories from forming, so a subject will not remember what happened under the influence.

Medicinal use

Scopolamine is used to treat motion sickness, Parkinson's Disease, muscle spasms, irritable bowel syndrome, asthma, and depression. It is even used off-label to help stop smoking. Despite the obvious criminal uses of scopolamine, the World Health Organization lists it as one of the safest and most effective medicines. It is prescribed and available in drug store on the name of Hyscione butylbromide.[12,17]

Use in criminal activity

More than 50,000 criminal assaults cases have been reported every year connected with scopolamine. The prime categories of criminal cases where scopolamine are largely used are: kidnapping, sexual assault and robbery.[17,18] In its powdered form, scopolamine has no taste or smell, so it can easily be slipped into someone's drink. Also, it can be smoked in cigarettes, blown in someone's face, or administered in a transdermal patch. Once it enters the bloodstream, the victim loses free will and becomes suggestible. The drug delivers its action so fast, that it takes 5–10 mins to come into effect.

Nowadays, the drug is used to facilitate crimes without violence. Because of this it is gaining popularity among criminals. Scopolamine renders us incapable of exercising our free will, leaving us vulnerable to do anything an attacker demands. Once we recover from its effects, we wouldn't not have so much of memory of what happened and neither we can identify a perpetrator.

Common Scopolamine poisoning cases include giving out confidential details like bank PINs, passwords, ATMs, withdrawing or transferring money from bank account or even helping an attacker rob your home. In incidences of sexual assault, a victim is not able to fight back and neither do they have the will or ability to call out for help.

It is seen and proved from many crime cases, that the drug can be effective if passed through a handshake, a laced piece of paper, a business card, or blown-in your face.

In the past, many American tribes have used scopolamine in several rituals to induce visions to individuals.[19] Nowadays, it is used in the same geographic zones by prostitutes to drug their clients and rob them. But it's usually used by criminals too. A myth has been created and the media has been helping on its growth. This myth resides in the power of the drug to overturn people's will. Any scientific study has demonstrated this fact, taking into account that this substance has been largely studied by medicine for many centuries.[19] Nowadays burundanga is being used for rob and rape, but most of the cases where this drug is used is to steal without resistance. This substance has been the interest of many people throughout history, in EE. UU the CIA started the MK-ULTRA and MK-SEARCH programs between the 50s and 70s of last century to find this truth serum between different legal and illegal psychoactive.[7,19,20] Drugs were administered to subjects without their knowledge or consent as evidenced by documents declassified a few years ago. The search for a truth serum has been an obsession for Intelligence Services during the last century without having come to find this substance. Scopolamine has been extensively studied in this regard without any success.[19,20] The incoherent, disorganized speech and uninhibited that can produce scopolamine is not useful as a truth serum for this type of purposes.

Discussion

The degree of toxicity varies depending on the part of the plant, the season, stage of maturation and the state of hydration. Toxicity can occur via ingestion, smoking, and absorption topically, particularly

through mucous membranes. All parts (flower, seed and root) of the plant can be toxic, but most significantly the seeds. Scopolamine, sometimes called devil's breath is an antimuscarinic agent, which means it has an effect on the central nervous system. It is derived from the flower of the "borrachero" shrub, common in Colombia. It has been used for years in South America for spiritual rituals.

Conclusion

Scopolamine (Hyoscine) can render a victim unconscious for 24 hours or more depending on the doses ingest. In large doses, it can cause respiratory failure and death. It is most often administered in liquid or powder form in foods and beverages. The majority of these incidents occur in night clubs and bars, and usually men, perceived to be wealthy, are targeted by young, attractive women. To avoid becoming a victim of hyoscine (scopolamine), one should never accept food or beverages offered by strangers or new acquaintances or leave food or beverages unattended. Victims of hyoscine or other drugs should seek immediate medical attention.

Abbreviations

TA: Tropane Alkaloids, ATM: Automatic Teller machine, PIN: Personal Identification Number, CIA: Central Investigation Agency, TTS: Transdermal Therapeutic Systems.

AUC: Area Under the Plasma Concentration.

References

1. Forrester MB. Jimsonweed (Datura stramonium) exposures in Texas, 1998–2004. J Toxicol Environ Health A. 2006;69(19):1757–62.
2. Papoutsis I, Nikolaou P, Athanaselis S, et al. Mass intoxication with Datura innoxia – caseseries and confirmation by analytical toxicology. Clin Toxicol (Phila). 2010;48(2):143–5.
3. European Food Safety Authority (EFSA), Parma, Italy-Scientific Opinion on Tropane alkaloids in food and feed.
4. Steenkamp PA, Harding NM, van Heerden FR, van Wyk BE. Fatal Daturapoisoning: identification of atropine and scopolamine by high performance liquidchromatography/ photodiode array/mass spectrometry. Forensic SciInt. 2004;145:31–39.
5. Helander A1, Rylski A Analytical investigation of a suspected case of drug-facilitated crime.
6. Gupta SK, Peshin SS, Srivastara A, Kaleekal T (2003) A study of childhood poisoning at National Poisons Information Centre, All India Institute of Medical Sciences, New Delhi. J Occup Health 45:191–196.
7. Wiebe TH, Sigurdson ES, Katz LY (2008) Angel's trumpet (Datura stramonium) poisoning and delirium in adolescents in Winnipeg, Manitoba: summer 2006. Paediatr Child Health 13:193–196 (PMID: 19252697).
8. Disel NR, Yilmaz M, Kekec Z, Karanlik M (2015) Poisoned after dinner: dolma with Datura stramonium. Turk J Emerg Med 15:51–55.
9. Trancă SD, Szabo R, Cociş M (2017) Acute poisoning due to ingestion of Datura stramonium—a case report. Rom J Anaesth Intensive Care 24:65–68.
10. Lusthof KJ, Bosman IJ, Kubat B, Vincenten-van Maanen MJ (2017) Toxicological results in a fatal and two non-fatal cases of scopolamine-facilitated robberies. Forensic Sci Int 274:79–82.
11. Isbister GK, Oakley P, Dawson AH, Whyte IM (2003) Presumed Angel's trumpet (Brugmansia) poisoning: clinical effects and epidemiology. Emerg Med 15:376–382.
12. Centers for Disease Control and Prevention (CDC) (1995) Jimson weed poisoning—Texas, New York, and California, 1994. MMWR Morb Mortal Wkly Rep 44:41–44.
13. Soneral SN, Connor NP (2005) Jimson weed intoxication in five adolescents. Wisconsin Med J 104:70–72.
14. van Wyk B-E, Oudtshoorn B, Gericke N (2002) Medicinal plants of South Africa, 2nd edn. Briza Publications, Pretoria.
15. Osváth P, Nagy A, Fekete S, Tényi T, Trixler M (2000) A case of Datura stramonium poisoning—general problems of differential diagnosis. Orv Hetil 141:133–136.
16. Marciniak J, Sikorski M (1972) Poisoning by alkaloids of Datura stramonium and D. inoxia after ingestion of honey.
17. Beyer J, Drummer OH, Maurer HH (2009) Analysis of toxic alkaloids in body samples. Forensic Sci Int 185(1–3):1–9.
18. Dupraz J-M, Christen P, Kapetanidis I (1994) Tropane alkaloids in transformed roots of Datura quercolia.
19. Lockwood TE, 1973. Generic recognition of Brugmansia. Harvard University Botanical Museum Leaflets, 23:273–283.
20. Evans WC, Wellendorf M (1959) The alkaloids of the roots of Datura. J Chem Soc:1406–1409.

Review Article

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Contemporary Advances of Electrochemical Sensors in Forensic Applications

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Abstract

The present review article discusses the advances in electrochemical sensing for applications in forensic science to solve criminal conspiracy and cases. The basic principle involved in electrochemical sensing has been discussed along with their technical features and limitations. Furthermore, the significance of electrochemical sensing in the analysis of forensic samples i.e heavy metals, drugs, illicit compounds, biological weapons with suitable illustrations have been presented. The advances in electrochemical sensors have so far documented tremendous findings to assist forensic experts in correlating crime incidents with documents with some drawbacks. This linkage between the success and failure of electrochemical sensing in forensic sciences has tried to establish in interest in the safety and security of a society.

Keywords: Electrochemical Sensors; Forensic Science; Illicit Compounds; Sensing Parameters and Challenges.

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Introduction

Advances in sensing materials, techniques, and mechanisms have immensely improved the analytical science and its applications in different fields like water pollutions, biosensing, atmospheric prediction, and quality controls in various industries.[1] Although, the sensing is an old testing method but the recent advances i.e. portability, unprecedented wide range sensing parameters and stability in very harsh conditions have been made.[2–3] These features revealed its application in various fields like environment, clinics, healthcare, packaging, chemical engineering, automotive, space, and human comforts.[4–5] But, nowadays wide range sensing of different analytes like metals, organic molecules and inorganic molecules have also attracted the interests of forensic experts in analyzing different metals, drugs, liquors, medicine, narcotics, and explosive residue to solve the criminal cases and understand the history of a crime.[6–7]

In the above context, the current integration in size confinements to hybrid materials to dimensional optimization has provided unique features for designing electrochemical sensors to detect heavy metals, narcotics, alcohol in body fluid, and other forensic samples such as gunshot sites.[8] The area of sensing is widely studied, however, several limitations are still inviting the attention of scientists for its advance contemporary applications.[9] In light of the above developments, the present review article discusses the contribution of electrochemical sensors in forensic sciences with suitable illustrations along with the basic principle of electrochemical sensors. To the best of our

knowledge. It is a unique focused review article on electrochemical sensing for forensic science.[this line we have already added.

Overview of the electrochemical sensor: The basic principle involved in electrochemical sensing is the monitoring of induced electrical responses develops after the interaction of analytes over sensing electrodes. Fig. 1 is concisely illustrating the fundamental principle of electrochemical sensors in brief.

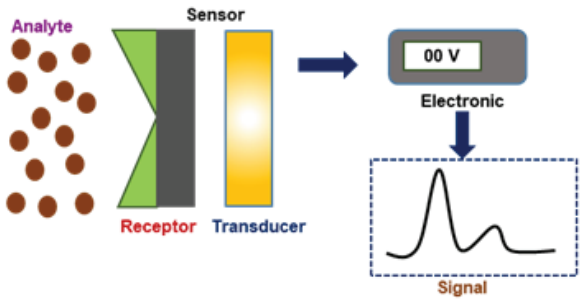

Fig. 1: The basic principle of electrochemical sensors.

The important induced electrical responses monitored in electrochemical sensing are resistance, conductance, and impedance, potential and induced current. These all induced electrical properties are the basis for classifications sensing purposes with their own and demerits. A comparative basic principle of electrochemical sensing is depicted in Table 1.

Table 1: Brief of different electrochemical sensing techniques

S.N.	Methods	Monitored properties	Unit
1	Potentiometry	Potential difference	Volts (V)
2	Conductometry	Resistance	Ohm (Ω)
3	Amperometery	Current as a function of potential	Ampere (I)
4	Coulometry	Current as a function of time	Coulombs (C)
5	Capacitance	Potential Load	Farads (F)

The other methods to classify the electrochemical sensors are interfacial methods and non-interfacial methods. In the interfacial method, the analyte directly interacts on the surface of the electrode and yield electrical responses as a sensing unit in a static (zero external disturbance) condition as well as dynamic, which exploits a redox reaction on the surface to electron transfer from analytes to the sensing electrode. However, in the non-interfacial method interaction took place in the bulk of electrode.

The composition, structure, morphology, and size of materials used in sensing electrodes are other important features to improve electrochemical sensing. In this regards several polymers, biopolymers, ceramic, metals and carbon compounds, are exploited with their inherited advantages and limitations. Currently, the blending of size reduction, polymer matrix, and inorganic catalytic molecules yield polymer nanocomposite, metal-organic framework, hydrogel, aerogel, xerogel for advanced electrochemical sensing in the efficient monitoring of forensically significant compounds like metals, narcotics, drugs, and explosives. In this regard, Shukla etal., has designed an integrated composite from chitin and polyaniline for efficient electrode materials.[10] The grafting chitin with polyaniline develops free interacting carbonyl groups present in the chitin matrix to interact with metal ions like copper. Thus, the interaction between cupric ion with chitin grafted polyaniline develops induced potential for efficient sensing of copper metals in natural (laboratory and groundwater) as well as artificial samples with negligible interference. The designed sensing setup and sensing parameters by authors are shown in Fig. 2.

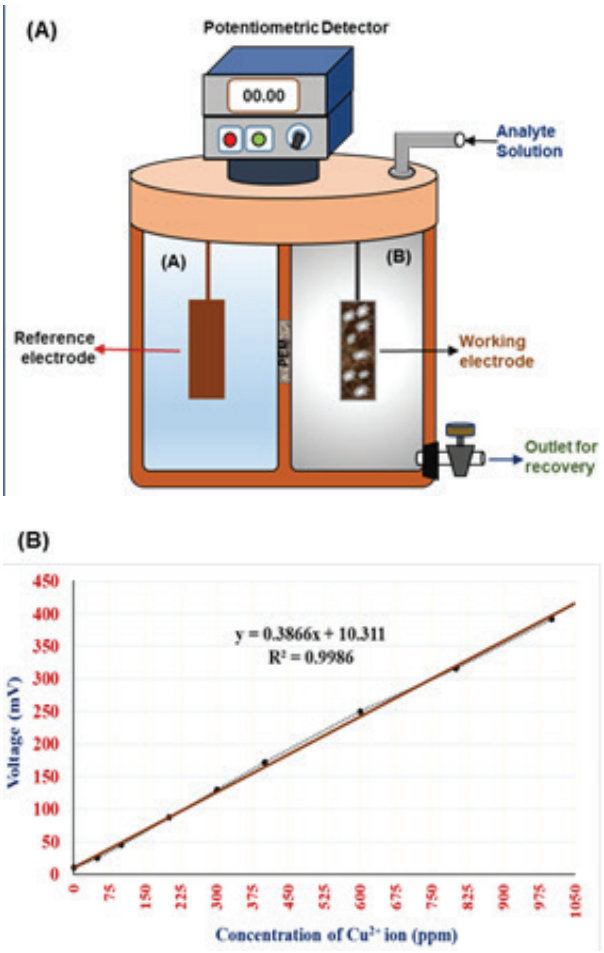

Fig. 2: Potentiometric sensing setup (A) and B is the sensing behaviour of cupric ion.[10]

Table 2: Representative electrochemical sensing materials along with properties.

S.N.	Composition	Objective	Sensing properties	Ref.
1	Nano materials	Use of nano materials	H_2O_2, H_2S and NO inside cells	11
2	Mesoporous Materials	Organic-inorganic hybrid mesostructures	Direct and electrochemical	12
3	Nanostructured metal oxide	Size confinement effects	Chemical, bio and gas sensor	13
4	ZnO nanostructure	Specific surface area and high catalytic efficiency	electrochemical sensors and biosensors	14
5	Metal oxides	Composite sensing and flexible/wearable	pH sensors	15
6	Metal Oxide	Size confinements	Heavy metals	16
7	Metal organic Frameworks	Chemically Stable	Wide range analytes	17
8	Conducting Polymer Nanostructures	Stable and functionalization	DNA, proteins, peptides, and other biological biomarkers	18
9	Conducting Polymers composite	Small dimensions; and large surface area	Chemical and bio sensor	19
10	Wide range	Wearable	Forensic sample and clinical samples	20

Similarly, several pristine and hybrids materials-based electrodes are exploited in electrochemical sensing using different transducers. Another modification in sensing materials is size confinements at the nano level and dimensional optimizations. The reduction in size improves the surface area and the dimension optimization channelizes the better response conduction in efficient electrochemical sensors. Some of the important reviews on electrochemical sensing materials are listed in Table 2 along with their composition, significant properties and sensing parameters.

Applications

The potential of electrochemical sensing has been extensively endorsed by the scientific community by precise chemical and compositional analysis of different forensic samplesqualitatively and quantitatively. Although the most scientific evidence to study as well as solve the crime is a compositional analysis of forensic residues like dead bodies, fingerprint soils of crime sites, and atmosphericgases. In this context, several techniques are already in practice to establish justice against crime but the development of sensing science has added several advantageous features in facilitating the criminal investigation to quick judgement and thus ensuring the law and order.[21]

Metal detection

The metals and its weapons are used in crimes since ancient times for various purposes but, with time their use has taken several destructive forms in doing criminal offenses as poison, weapon, arm, bombs, and ammunition. Recently the uncontrolled discharge of metals in water and edible items is also creating serious criminal cases towards the society.[22] Some of the poisonous metals are arsenic, antimony, barium, mercury, copper, lead, and thulium. In this regard, several electrochemical sensors are used to sense different heavy metals present in water and soil, collected from crime sites, and edible items with the help of several sensing materials and setups. Hence, the precise and accurate sensing of metals is always beneficial in solving and controlling crimes in society. Ott et al., has reported the use of electrochemical sensors for simultaneous monitoring of different metals i.e., lead, antimony and copper present in gunshot sites with a high population using square-wave anodic stripping voltammetry and screen-printed carbon electrode. The measurement is based on monitoring of potential shift in the redox potential of different metals i.e. lead ~0.784, antimony ~0.401 and copper ~0.282 v.[23] Similarly, the use of crime weapons like knives is having their composition which depends on the types and nature of their impact. In general, the knives used on homicide are consisting of iron, chromium, phosphorous, molybdenum, and vanadium. These weapons are creating serious problems in humans as well as leaving their own impacts on the surface and body. The presence of metal accumulated in the soft tissue of the human body reveals its chemistry to deteriorate the body functioning as well as metal toxicology. The main sources of metal poisoning are medication, the use of contaminated food and water, ingestion of herbicides, pesticides, fungicides and occupational exposures.

The presence of metals in water, edible items, and body fluids are extensively investigated by

electrochemical sensors using various sensing materials. In the interfacial method, amperometry and potentiometry setups are used for sensing different heavy metals like lead, iron, copper, arsenic, chromium, and mercury. In general, these metals electrostatically interact on the charged electrode and develop induced potential or current in proportion to the concentration heavy metal ions present in testing fluid but sensing of simultaneous multiple metals are need of the time to improve the analytical chemistry and forensic science. In an innovative step, Durai et al., has reported, aluminium ferrite modified glass electrode for simultaneous monitoring of trace level heavy metals (cadmium, lead, copper and mercury (Hg2+) present in human blood serum using differential pulse anodic stripping voltammetry (DPASV) technique in the potential range of −1.2 to 0.4 V with excellent sensing parameters i.e limits of detection values 1.5 nM for Hg, 4 nM for Cd, 1.6 nM for Pb and 0.5 nM for Cu2+. The scheme of the sensing mechanism has been illustrated in Fig. 3 along with results.[24]

Some other important electrochemical sensors for heavy metal in human body fluid, water, edible item and soil collected from crime and gunshots are given in Table 3 with salient features.

Illicit organic compounds

Currently, the uses of organic compounds in criminal cases are exponentially increasing as narcotics, drugs, medicines, poison, and liquors. Although the narcotics and drugs are in practice since ancient times, but adulteration, controlled monitoring, bad practice, and the criminal mindset of society is using these compounds too much knowingly and unknowingly for crimes. Some time the narcotics are having medicinal importance but their uncontrolled consumption is fatal. Hence, their monitoring is important for solving several criminal

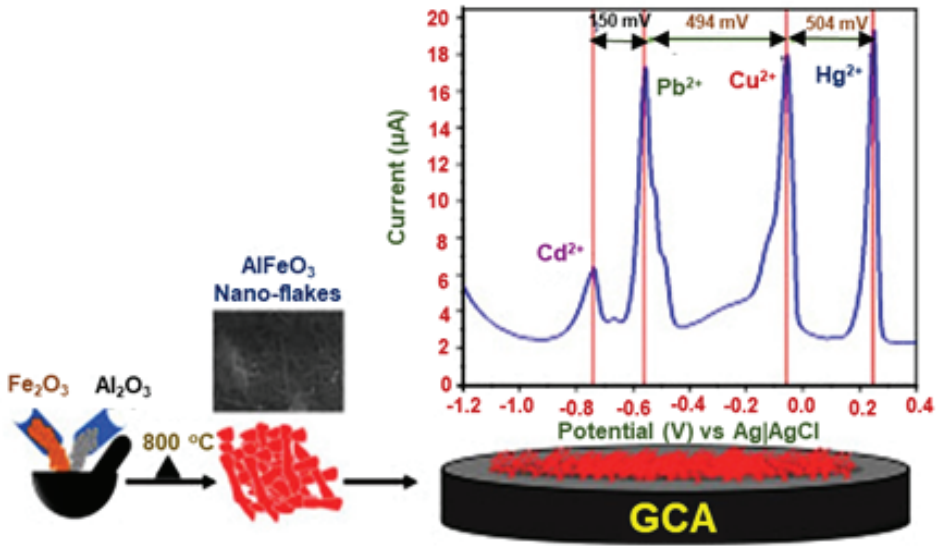

Fig. 3: Multiple metal sensing in human blood using electrochemical sensing[24].

Table 3: Electrochemical sensor for heavy metals.

S.N.	Composition	Transducer	Sensing metals	References
1	Graphene/PLA	Voltammetric	Simultaneous lead and antimony	25
2	Mercury-coated graphite	Anodic stripping voltammetry	Lead and antimony	26
3	Acetylcholinesterase (ACh) and acid phosphatase	Chronoamperometric	As (III)	27
4	Graphene oxide	Anodic stripping voltammetry	Zn in seminal fluid	28
5	Calix[4]pyrrole capped gold nanoparticles	Electrochemical sensing	As(III)	29
6	Ultrathin mercury film	Voltammetry	Barium	30
7	Nafion/ionic liquid/graphene	Anodic stripping voltammetry	Zn, Cd and Pb	31
8	Phthalocyanine	Amperometric	Lead	32

cases and crime related issues. Several sophisticated instruments are used for their monitoring with some limitations. Thus, the development of specific, reliable, and simple methods to detect illicit drugs in biological samples is the utmost requirement.[33] Gandhi et al., described an effective immunosensor for monitoring illicit drug abuse.[34] The finding has offered a low-cost detection of narcotics; thereby, providing a confirmatory platform to complement the existing analytical methods. Generally, electrochemical sensors monitor the current or voltage generated by oxidation or reduction of these illicit drugs. Shukla et al., has monitored residual pesticides i.e malathion and drug paracetamol in water samples after monitoring the induced potential on a suitable electrode. The potential was developed in the case of malathion after surface interaction between sulphur and polyaniline, due to oxidation of paracetamol by iron present iron oxide encapsulated in chitosan-grafted polyaniline hybrid matrix.[35-36] The scheme of potentiometric sensing of paracetamol in water is shown in Fig. 4.

Some other important electrochemical sensing of illicit organic compounds are given in Table 4 along with transducer and properties.

Applications in biological weapons

Bioterrorism is another most fatal kind of abuse in human society and has currently been used in different ways. Biological warfare includes germs like bacteria, viruses, insects, and fungi, which are more potent than conventional and chemical weapons. Furthermore, the current progress in biochemistry, biotechnology, and genetic engineering has made science simpler in developing biological warfare with more fatal characteristics. Lately, these weapons have become more sophisticated in use with severe impacts on

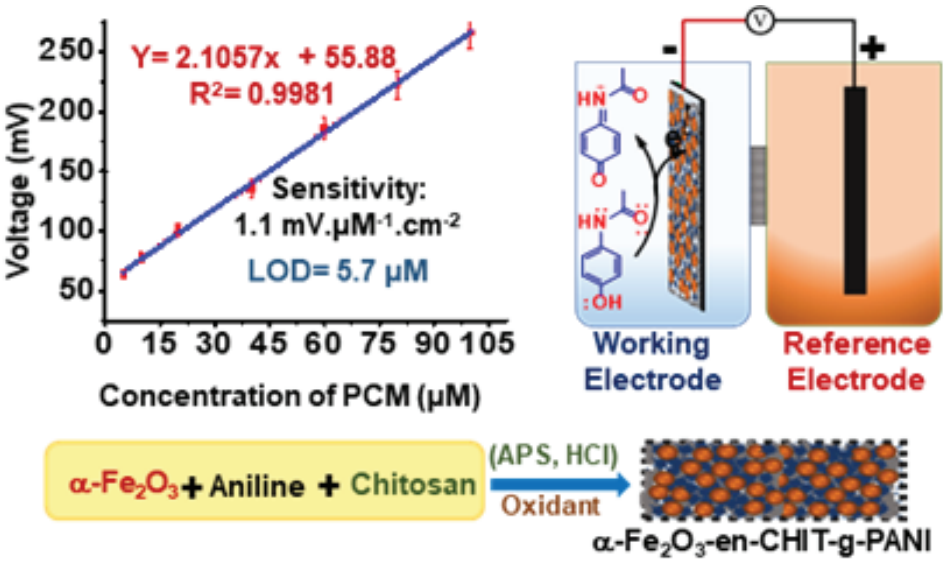

Fig 4: Potentiometric sensing of paracetamol over iron oxide encapsulated in chitosan-grafted-polyaniline.[36]

Table 4: Electrochemical sensing of illicit organic compounds.

S.N.	Composition	Transducer	Sensing compound and properties	References
1	Carbon nanotube β-cyclodextrin	Linear sweep voltammetry	Cocaine with detection limit of 1.02 µM	37
2	Carbon electrodes/ gold/graphene oxide	Voltammetry	Carbofuran in sensing range linear range of 1–250 µM	38
3	Graphene-Au	Differential pulse voltammetry	Carbaryl and detection limit of 0.0012 µM	39
4	Schiff base complex	Linear sweep voltammetry	Cocaine hydrochloride	40
5	Gold electrode	Voltametry	Methanol and ethanol	41
6	Pd impregnated graphene	Cyclic voltammetry	Cocaine	42
7	Catechol-Attached Polypeptide	Differential pulse voltammetry	Cannabinoids	43
8	Au/Fe_2O_3/MWCNT	Voltammetry	Methamphetamine	44

the health and life of organisms. Therefore, the monitoring of these weapons is highly important and many electrochemical based sensors are being used to detect the biological warfare substances used in crimes for individuals or in groups.[45] Some of the used biological weapons are microbes i.e., bacteria, virus and toxic chemical substances. The plant-based toxic substances are also used which are categorized into alkaloids, glycosides, tannins, proteins, oxalic acid and oxalates and volatile oils. For example, mushroom poisoning is caused by wild varieties of mushroom-like Amanita group members which produce amatoxins and muscimol that would affect the health of human beings. The phytochemicals adverselyaffect human health like white color latex of the plant, i.e. Calotropisprocera acts as a poison if taken inthe excessive amount.[46] In this context, several electrochemical sensors have been developed to detect biological warfare including algal toxins such as Cylindrospermopsin, Anatoxin-a, Brevetoxins, and cyanotoxins in water.[47] Recently, a DNA based biosensor has developed to detect the fungal toxin (mycotoxins) i.e. Ochratoxin A from plant-based food and beverages.[48] Thus, developing the biosensors especially to detect some plant-based chemical substances, which are poisonous to human beings or other organisms, isimmensely important in the field of drug analysis and forensic toxicology. Electrochemical sensors are also used for sensing themicrobes after monitoring induced potential and current due to electrochemical interactions. For example, the microbial activity induces the impedance of the system and has been used for monitoring the temperature-dependent activeness of microbes.[49] A simple electro sensing strategy has been reported by Joshi to monitor the virus in saliva through change in impedance over reduced graphene. The sensors exhibit high stability and reproducibility due to the high adhesion of sensing materials due to the presence of phenolic (-OH) moiety with the limits of detection of 26 and 33 plaque-forming units.[50]

Conclusion

The brief principles and applications of electrochemical sensing in forensic sciences have been discussed for three types of illicit materials i.e., heavy metals, organic compounds, and biological warfares. The sensing mechanism and role of sensing materials have been discussed with suitable illustration. Furthermore, the sensing properties with an emphasis on highlighting the importance for the scientists to amplify research and applications have also been discussed.

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References

1. J. Janata, Principles of Chemical Sensors, IInd Edition, (2009), Springer.
2. Timothy Swager, Katherine A. Mirica, Introduction: Chemical Sensors, Chemical Review 2019, 119, 1, 1–2.
3. W R Fahrner, R Job, M Werner, Sensors and smart electronics in harsh environment applications, Microsystem Technologies, 2001, 7, 138–144.
4. Neelima Dubey, Chandra Shekhar Kushwaha, S K Shukla, A review on electrically conducting polymer bionanocomposites for biomedical and other applications, International Journal of Polymeric Materials and Polymeric Biomaterials, 2019, 1–19.
5. S K Shukla, Sudheesh K Shukla, Penny P. Govender and N G Giri, Biodegradable polymeric nanostructures in therapeutic applications: opportunities and challenges, RSC Advances, 2016, 6(97), 94325.
6. Zhang, W, Wang, R, Luo, F, Wang, P, and Lin, Z (2020). Miniaturized electrochemical sensors and their point-of-care applications. Chinese Chemical Letters, 31(3), 589–600.
7. Karimi, F, Zakariae, N, Esmaeili, R, Alizadeh, M, Tamadon, A M Carbon Nanotubes for Amplification of Electrochemical Signal in Drug and Food Analysis; A Mini Review. Current Biochemical Engineering,2020, 6(2), 114–119.
8. Castro, S V, Lima, A P, Rocha, R G, Cardoso, R M, Montes, R H, Santana, M H, Munoz, R A. Simultaneous determination of lead and antimony in gunshot residue using a 3D-printed platform working as sampler and sensor. Analytica Chimica Acta, 2020, 1130,126–136.
9. Barreto, D N, Ribeiro, M M, Sudo, J T, Richter, E M, Muñoz, R A, Silva, S G. High-throughput screening of cocaine, adulterants, and diluents in seized samples using capillary electrophoresis with capacitively coupled contactless conductivity detection. Talanta, 2020, 120987.
10. V K Singh, Chandra Shekhar Kushwaha, S K Shukla, Potentiometric detection of copper ion using chitin grafted polyaniline electrode,International Journal of Biological Macromolecules,147, 2020, 250–257.

11. Liu, H, Weng, L, Yang, C. A review on nanomaterial-based electrochemical sensors for H_2O_2, H_2S and NO inside cells or released by cells. Microchimica Acta, 2017, 184(5), 1267–1283.
12. Walcarius, A, Mesoporous materials-based electrochemical sensors. Electroanalysis,2015, 27(6), 1303–1340.
13. Abdullah, M M, Singh, P, Ikram, S. Recent developments in nanostructured metal oxide-based electrochemical sensors. Micro and Nano Technologies, 2020, 123–134.
14. Beitollahi, H, Tajik, S, Nejad, F G, Safaei, M, Recent advances in ZnOnanostruture based electrochemical sensors and biosensors J Mater. Chem. B, 2020,8, 5826–5844.
15. Manjakkal, L, Szwagierczak, D, Dahiya, R. Metal oxides based electrochemical pH sensors: Current progress and future perspectives. Progress in Materials Science, 2020, 109, 100635.
16. Akanji, S P, Ama, O M, Ray, S S, Osifo, P O, Metal Oxide Nanomaterials for Electrochemical Detection of Heavy Metals in Water. In Nanostructured Metal-Oxide Electrode Materials for Water Purification 2020, 113–126, Springer, Cham.
17. Cheng-Hsun Chuang, Chung-Wei Kung, Metal–Organic Frameworks toward Electrochemical Sensors: Challenges and Opportunities, Electroanalysis, 2020, 32 (9), 1885–1895.
18. El-Said, W A, Abdelshakour, M, Choi, J H, Choi, J W, Application of conducting polymer nanostructures to electrochemical biosensors. Molecules, 2020, 25(2), 307.
19. Alqarni, S A, Hussein, M A, Ganash, A A, Khan, A, Composite Material–Based Conducting Polymers for Electrochemical Sensor Applications: a Mini Review. Bio Nano Science,2020,10,351–364.
20. Ferreira, P C, Ataide, V N, Chagas, C L S, Angnes, L, Coltro, W K T, Paixão, T R L C, de Araujo, W R, Wearable electrochemical sensors for forensic and clinical applications. TrAC Trends in Analytical Chemistry, 2019, 119, 115622.
21. Salles, MO, Bertotti, M, Paixão, TR, Use of a gold microelectrode for discrimination of gunshot residues. Sensors and Actuators B: Chemical, 2012, 166, 848–852.
22. Sall, M L, Fall, B, Diédhiou, I, Lo, M, Diaw, A K D, Gningue-Sall, D Fall, M, Toxicity and Electrochemical Detection of Lead, Cadmium and Nitrite Ions by Organic Conducting Polymers: A Review. Chemistry Africa, 2020,doi.org/10.1007/s42250-020-00157-0.
23. Ott, C E, Dalzell, K A, Calderón-Arce, P J, Alvarado-Gámez, A L, Trejos, T, Arroyo, L E, Evaluation of the Simultaneous Analysis of Organic and Inorganic Gunshot Residues Within a Large Population Data Set Using Electrochemical Sensors. Journal of Forensic Sciences, 2020 doi.org/10.1111/1556-4029.14548.
24. Durai, L, and Badhulika, S (2020). Simultaneous sensing of copper, lead, cadmium and mercury traces in human blood serum using orthorhombic phase aluminium ferrite. Materials Science and Engineering: C,2020, 112, 110865.
25. Castro, S V, Lima, A P, Rocha, R G, Cardoso, R M, Montes, R H, Santana, M H, Munoz, R A, Simultaneous determination of lead and antimony in gunshot residue using a 3D-printed platform working as sampler and sensor. Analytica Chimica Acta.2020, 1130, 126–136.
26. Konanur, NK, Determination of lead and antimony in firearm discharge residues on hands by anodic stripping voltammetry. Talanta, 1977, 24 (3), 184–187.
27. Del Torno-de Román, L; Alonso-Lomillo, M A; Domínguez-Renedo, O; Arcos-Martínez, M J Dual biosensing device for the speciation of arsenic. Electroanalysis 2015, 27, 302–308.
28. Seanghirun, W, Samoson, K, Cotchim, S, Kongkaew, S, Limbut, W, Green electrochemical sensor for Zn (II) ions detection in human seminal fluid. Microchemical Journal, 2020,157, 104958.
29. Kongor, A, Panchal, M, Athar, M, Vora, M, Verma, N, Pandya, A, Jain, V. Colorimetric and electrochemical sensing of As (III) using calix [4] pyrrole capped gold nanoparticles and evaluation of its cytotoxic activity. Journal of Inclusion Phenomena and Macrocyclic Chemistry, 2020, 98, 29–41.
30. Ridgway, S, Wajrak, M, Development of an in-field method for the detection of barium in various water samples using differential pulse anodic stripping voltammetry. International Journal of Electrochemistry, Volume 2019, Article ID 5813492, doi.org/10.1155/2019/5813492.
31. Sajjan, VA, Aralekallu, S, Nemakal, M, Palanna, M, Prabhu, C K,Sannegowda, LK, Nanomolar detection of lead using electrochemical methods based on a novel phthalocyanine. Inorganica Chimica Acta, 2020, 506, 119564.
32. Wassana Yantasee, Yuehe Lin, Kitiya Hongsirikarn, Glen E. Fryxell, Raymond Addleman, Charles Timchalk, Electrochemical Sensors for the Detection of Lead and Other Toxic Heavy Metals: The Next Generation of Personal Exposure Biomonitors, Environmental Health Perspectives, 2007, 115 (12), 1683–1779.
33. Dujourdy L, Barbati G, Taroni F, Gueniat O, Esseiva P, Anglada F, et al. Evaluation of links in heroin seizures. Forensic Sci Int., 2003, 131, 171–183.
34. Sonu Gandhi, Pankaj Suman, Ashok Kumar, Prince Sharma, Neena Capalash, C. Raman Suri, Recent advances in immunosensor for narcotic drug detection. BioImpacts, 2015, 5(4), 207–213.
35. Chandra Shekhar Kushwaha, S K Shukla, Non-enzymatic potentiometric malathion sensing over chitosan-grafted polyaniline hybrid

electrode,Journal of Materials Science, 54, 2019,10846–10855.

36. Chandra Shekhar Kushwaha, S K Shukla, Electrochemical Sensing of Paracetamol Using Iron Oxide Encapsulated in Chitosan-Grafted-Polyaniline, ACS Applied Polymer Materials, 2020, 2, 2252-2259.
37. Garrido, J M P J, Borges, F, Brett, Brett C M A. and Garrido E M P J, Carbon nanotube β-cyclodextrin-modified electrode for quantification of cocaine in seized street samples, Ionics 2016, 22, 2511–2518.
38. Jirasirichote, A, Punrat, E, Suea-Ngam, A, Chailapakul, O, Chuanuwatanakul, S,Voltammetric detection of carbofuran determination using screen-printed carbon electrodes modified with gold nanoparticles and graphene oxide. Talanta, 2017, 175, 331–337.
39. Rahmani, T, Bagheri, H, Behbahani, M, Hajian, A, Afkhami, A, Modified 3D graphene-Au as a novel sensing layer for direct and sensitive electrochemical determination of carbaryl pesticide in fruit, vegetable, and water samples. Food Analytical Methods, 2018, 11(11), 3005–3014.
40. Castro, A S, de Menezes, M M T, Alves, G M, de Oliveira, M F, Voltammetric analysis of cocaine hydrochloride at carbon paste electrode chemically modified with N, N′-ethylene-bis-(salicylideneiminato) manganese (II) Schiff base complex. Microchemical Journal, 2020, 153, 104399.
41. P F Pereira, R M F Sousa, R A A Munoz and E M Richter, Simultaneous determination of ethanol and methanol in fuel ethanol using cyclic voltammetry,Fuel, 2013, 103, 725–729.
42. Florea, A, Cowen, T, Piletsky, S, De Wael, K, Electrochemical sensing of cocaine in real samples based on electrodeposited biomimetic affinity ligands. Analyst, 2019, 144(15), 4639–4646.
43. Durmus, C, Aydindogan, E, Gumus, Z P, Endo, T, Yamada, S, Coskunol, H Yagci, Y, Catechol-Attached Polypeptide with Functional Groups as Electrochemical Sensing Platform for Synthetic Cannabinoids. ACS Applied Polymer Materials, 2019, 2(2), 172–177.
44. Haghighi, M, Shahlaei, M, Irandoust, M, Hassanpour, A. New and sensitive sensor for voltammetry determination of Methamphetamine in biological samples,Journal of Materials Science: Materials in Electronics, 2020, 31, 10989–11000.
45. Riedel, S, Biological warfare and bioterrorism: a historical review. In Baylor University Medical Center Proceedings 2004, 17(4)400–406.
46. Khajja, S, Sharma, B, and Singh, R, Forensic Study of Indian Toxicological Plants as Botanical Weapon (BW): A Review, Journal of Environmental and Analytical Toxicology, 2011, 1(4) 1000112.
47. Zhang, W, Dixon, M, Saint, C, Teng, K and Furumai, H, Electrochemical Biosensing of Algal Toxins in Water: The Current State-of-the-Art. ACS Sensors, 2018, 3(7), 1233–1245.
48. Suea-Ngam, A, Howes, P, Stanley, C and deMello, A, An Exonuclease I-Assisted Silver-Metallized Electrochemical Aptasensor for Ochratoxin A Detection. ACS Sensors,2019, 4(6), 1560–1568.
49. McGlennen, M, Neubauer, M, Driesler, M, Dieser, M, Foreman, C M, Warnat, S, Microsensors in Icy Environments to Detect Microbial Activities. Journal of Microelectromechanical Systems, 2020, DOI. 10.1109/JMEMS.2020.3012420.
50. Joshi, S R, Sharma, A, Kim, G H, and Jang, J, Low cost synthesis of reduced graphene oxide using biopolymer for influenza virus sensor. Materials Science and Engineering: C, 2020, 108, 110465.

Review Article

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Toxic Calendar for Predicting Toxicity, To Prepare Emergency Medical Services in Preventing Toxic Disasters: An Indian Society of Toxicology Initiative

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Abstract

It's popular Myth among medical professionals that All Poisonings are unpredictable, unpreventable and unsalvageable. But the Fact is we can predict the Seasons of Poisons, Environmental hazards, Toxic Disasters. And prepare our Emergency Medical Services for better management by stocking the relevant antidotes, thus preventing mortality and morbidity by public awareness prior to the season of poisons. And based on Toxic Calendar, we can Promote Safety Precautions for safely storing Household Poisons, Toxins, and Chemicals.

Keywords: Calendar; Toxic; Venomous; Poisonous; Detective; Safety; Security; Antidotes; Toxicity prediction.

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Introduction

Indian Society of Toxicology has devised a Toxic Calendar according the incidence of common poisonings in India.

Seafood Poisoning: Algal Blooms and Red tide in India: Pre-monsoon Period

The reports of algal blooms indicate their predominance along the west coast of India especially the southern part. Majority of the blooms are reported along the western coastline of Indian subcontinent are caused by dinoflagellates, whereas diatom blooms prevail along the east coast. There have been thirty nine causative diatom species responsible for the toxic blooms, of which Noctilucascintillans and Trichodesmiumerythraeum are the most common. Reporting of massive fish mortality in Indian waters has been associated with the blooming of Cochlodiniumpolykrikoides, Kareniabrevis, Kareniamikimotoi, N scintillans, T erythraeum, Trichodesmiumthiebautii and Chattonella marina.[1] Most of the toxic blooms occurred during return of the southern-west monsoon and pre-monsoon shower. In Indian waters, this process is mainly influenced by seasonal upwelling and monsoonal forcing that causes high riverine discharge resulting in nutrient-enriched waters that provides a competitive edge for blooming of phytoplankton species.[2]

Toxic Calendar by Toxic Detective.

January (Extreme Cold)	February	March
• Toxic Mushroom Harvest • Carbon monoxide poisoning- Fireplace, Sigdi, Kangri, Gas Geyser • Antifreeze – Ethylene Glycol in Northern India.	Around Valentine Day- Suicidal attempts by youth after Breakups, consuming household poisons – PCM, vitamins, Corrosive Toilet cleaners • Pre-Harvest OPC Pesticide sprayed in Farms	Board Exam - Suicidal attempts by youth after failure, consuming household poisons –AlP PCM, vitamins, Corrosive Toilet cleaners शिवरात्रि -भांग toxicity Dhatura Blooms होली - Heavy Metal salts- Bright colours- Pb, Hg
April	**May (Spring)**	**June (Pre-Monsoon) Heat**
बैसाखी – Harvest Pesticides, Fungicides	Lily in the valley Bloom Opium flower bloom Honey Bee and Wasp Stings in flowers blooming in spring	Red-tide + algal Bloom in coastal India – Seafood poisoning- Ciguatera AC coolant Car (Ethylene glycol) due extreme hot Mad Honey flower Bloom
July (Monsoon in south)	**August (Monsoon in Centre)**	**September (Monsoon in North)**
Venomous Snake Bites and scorpion stings Arsenic floods in East Toxic Runoff in floods Fertiliser, Herbicides, Insecticides	Venomous Snake Bites and scorpion stings Floods- Arsenic floods CO poisoning – Burners for drying Flooded Flats	Venomous Snake Bites and scorpion stings Mosquito Bites Arsenic Floods
October	**November**	**December**
दिवाली Crop Pre-Harvest: Insecticides, Herbicides (Paraquat) poisoning	Crop Harvest: Fungicides to save the crop fruits from infestation	Post- Harvest drying grains (Rodenticides, Fumigants- AlP)अनाज घर क्रिसमस – Rumcakes and Alcohol intoxication

Toxic Flowers and Seasons of their Bloom

The various climatic changes that occur in cyclic patterns are termed as 'seasons'. There are four seasons occurring on our planet - Spring, Summer, Autumn and Winter. Seasons are intimately bound to each other with flowers. Most of the flowers are season - specific. Though some flora are found throughout the year, there are some not particularly affected by changing seasons, viz. Chrysanthemum, Gerbera Daisy, Lily, Asiatic Lily.[3]

Spring Flowers: Spring Time is the peak time of blooming and renewal of new plant and animal life. Spring comes at different times in the North and South Hemispheres. Spring time in the Northern region is from March to May, and from September to November in the Southern region. Most flower bloom during spring season. Therefore, flowers that bloom only during spring, Spring Flowers, bloom at different times in the two hemispheres.

Flowers Blooming in Spring are: Agapanthus, Amaryllis, Anemone, Apple blossom, Bird of Paradise, Brodea, Calla lily, Cherry Blossom, Corn flower, Cosmose, Dahlia, Delphinium, Delwood, Forsythia, Freesia, Gardenia, Heather, Helleborus, Hollyhock, Hyacinth, Larkspur, Casa Blanca Lily, Gloriosa Lily, Stargazer, Liatrus, Lilac, Lisianthus, Narcissus, Orchid, Peach blossom, Peony, Phlox, Poppy (Opium), Protea, Pussy willow, Ranunculus, Rose, Seeded Eucalyptus, Solidago, Statice, Stephanotis, Stock, Sweet Pea, Tulip, Viburnum, Wax flower, Zinnia.[3]

Summer Flowers: Summer is the time of hot and warm weather. Floral growth is best in the summer season. The Northern region experiences summersfrom June, July, and August, while in the Southern region, from December to February. Summer is the season of the Midnight sun in the North pole and Ice land. The Flowers Blooming in Summer are: Alchemilla, Allium, Alstromeria, Amaranthus, Baby's Breath , Bird of Paradise, Calla lily, Campanula, Carnation, Chrysanthemum, Cockscomb, Cosmos, Dahlia, Delphinium, Dianthus, Didiscus, Euphorbia, Foxglove, Freesia, Gardenia, Genista, Ginger, Gladiolus, Hallaconia, Heather, Hydrangea, Hypericum, Iris, Kangaroo paw, Liatrus, Lilac, Casa Blanca Lily, Gloriosa Lily, Star Gazer, Lisianthus.[3]

Autumn Flowers: Autumn is the season of the primary harvest. Autumn falls from September to November in the Northern region, and from September to November in the Southern region. Crops get harvested during Autumn. Beautiful flowers that change colours are seen, at their best. Flowers Blooming in Autumn are: Amaranthus, Anemone, Baby's Breath, Bittersweet, China berry, Chrysanthemum, Cockscomb, Lily, Asiatic Lily, Gloriosa, Misty Blue, Orchid.[3]

Winter Flowers: Winter is the season of cold climate. The season occurs from December to February in the Northern region. In the Southern region winter occurs from June to August. The Flowers Blooming in Winter are: Helleborus, Holly berry, Lily, Asiatic Lily.[3]

Opium Poppy: Native to Southeastern Europe and Western Asia, breadseed poppy, Papaversomniferum plant contains narcotic alkaloids which are the active compounds of opium and many refined opiates, such as morphine and codeine. Somniferum – meaning "sleep bringing" in Latin – refers to the narcotic properties of the plant.[4] Most of the medicinal opium in the world is produced in India and Turkey. Opium is extracted primarily from the seed capsules. Blooming from mid-summer, this common annual can have flowers in many shades of yellow, pink, and purple, as well as white.[5]

Arsenic Floods during Rice Harvest in Eastern India

Some crops, such as rice, absorb arsenic easily, leading to contamination in the food chain. An estimated arsenic are pumped up by the tubewells and added yearly to the fertile soils here. From the last few years, many have been trying to explain how the toxic arsenic leaches into groundwater in the Ganga river-Brahmaputra floodplain. The latest research says floodwaters can remove arsenic.[6]

Latest research by LeMonte et al (2017) have highlighted that floods contaminated with arsenic, which may occur in sea levels rise due to climatic changes, could result into the mobilisation of this toxic arsenic in the soil. Research showed that element is more stable in environmental soil flooded with salty water, compared to fresh water, as saline stabilises mineral oxides, so it could inhibit microbial growth. However, micro organisms that transform toxic arsenic into water-soluble forms may adapt to salty conditions, and the risk of toxic element entering drinking waters due to rising sea levels should receive further attention.[7]

Flooding will cause arsenic to be released into water due to the transformation of mineral oxide compounds within the soil that contain arsenic. However, this study shows that this effect is more pronounced with river water flooding.[8]

Toxic Runoff during Floods

The inundation of an area with water can cause chemical release in other ways. In rural areas, runoff from flooded areas can carry with it eroded soil containing fertilizers, herbicides and insecticides. Runoff in motorways, roadsideor bridges may contain toxic arsenic and hydrocarbons. Toxic Runoff through the inundated waste sites may reveal a variety of toxic materials, depending on what was present on the location.[9]

Carbon monoxide poisoning during floods and winters

Carbon monoxide poisoning resulting from the incorrect use of fuel burning generators for electricity, barbeques, braziers or buckets of coal or charcoal for heating and cooking, or petrol-driven pumps and dehumidifiers to dry out flooded rooms.[10]

CO poisoning must form part of syndromic (Toxidrome) and event based surveillance systems for flooding and should be included in measures of the health impact of flooding.

During extreme winters in Northern part of Indian suburbs, wood burning, Kangri – amini Sigdi – Burnwood Coal inside their blankets or infrequently used places, inside closed cabinets (to prevent entry of freezing breeze of wind) sleep inside the smoke filled huts, which generate combustion gases in starting, but due to lack of air ventilation, vital oxygen is depleted, and toxic Carbon monoxide is produced, killing most of the innocent residents sleeping permanently.

Similarly in cold winters, Gas geysers get prominently utilised as low-cost alternative to electrical water heaters in economy class washrooms with poor air circulation and cheap hotels with congested rooms, without any ventilating windows, and the box shaped bathrooms. Gas water heater utilise the surrounding oxygen for burning the combustible gas as fuel, and release intoxicating CO in their bathrooms, thus if there is no ventilatory exhaust fan, the residing victim gets into deep sleep and sedated with odourless, colourless Carbon monoxide- as Asphyxiant gas, and the residing occupant suffers painless silent fatality, if not rescued urgently. CO monitors in our domestic setup should be installed not only in proximity to known CO generators and emitters but also in sleeping locations where portable or short term CO emitting appliances may be placed, including woodburners and infrequently used heating fireplaces at cold places in old buildings.

Season of Suicides- Valentine Day and Boards

Suicides are more common in February - March,

We may Predictthe possible Suicidal attempts: More common in February to March. February- Valentine Day.

March- during Final Exams for education Boards -secondary, senior secondary, professional courses like Medical, Engineering.

So Keep our Emergency department Ready and well equipped for the calamity.

Research on seasonal effects on suicide rates suggests that the prevalence of suicide is greatest during the late spring and early summer months, despite the common belief that suicide rates peak during the cold and dark months of the winter season. Suicides actually peak in the Spring and are not more common during the winter holiday period. Despite the fact that the majority of persons who commit suicide are already suffering undiagnosed from a mental disorder such as depression.[11]

M-Marijuana for M-Merry Making in M-March (MM) – Festival in Hostels

Cannabis smoking and Bhang drinking is promoted socially during festival of colours- Holi and Shivratri, in groups of college students living in Hostels, under peer- pressure are motivated to try once as no elder family member regulation is possible in Hostellers.[12] So Keep our Emergency Team Ready for the calamity. Associated Alcohol abuse and violence is common, and be ready for mass casualty.

Prevent – Serpent- Repent- Went

Some fatal calamities by Venomous bites and stings may be predictable, like the venomous serpentine bites and scorpions stings occur frequentlyin July to September, during rainy season, as their residential places underground like the -rat holes in the earth get flooded with rain water. So we must Keep our Emergency Team well equipped with sufficient stock of Anti-snake Venom (ASV) and Prazosin in pharmacy, for managing this predictable calamity, in better manner.

Alcohol

Similarly toxic methyl alcohol related toxicity is more common on the Weekends, but the pathognomic symptoms of methyl alcohol – Blind Drunks, may be delayed upto 24 to 48 hours, and may present on the Mondays – the first day of the week as Monday Blues, unlike ethyl alcohol.

So we must keep our Emergency department ready for receiving HOOCH mass casualty with their pharmacological Antidote-Fomepizole, Ethanol, Thiamine and Hemo Dialysis.

Pesticides

Pesticides used may be for different purposes in separate months around the year may be used for predicting the possible occupational and intentional poisoning (suicides more common in rural areas by villagers- farmers, due to debts and failure of crops).

Prior to harvest: many Insecticides (Organophosphates) and Herbicides (Paraquat) getutilized by farmers for protecting the harvest.

During Harvest: Mainly Fungicides and fumigants for preventing fungus infestation to the crop fruits, vegetables and consumption of grains by rats and birds.

Post-Harvest: Rat killers, Rodenticides, to protect the stored grains in storehouses from rodents like rats and mice.

Household Poisoning

More common in school and college students attempting suicide for failure in love affair during valentine days, or in exams, in March by consuming pills – Paracetamol kept in wardrobes, and corrosive – Toilet cleaner (Carbolic acid, Hydrochloric acid).

Diwali

Diwali is celebrated as the festival of lights, and phosphorescence producing colourful fire by crackers are popular among our children toddlers and teens, who may try to lick, smell and taste anything they found attractive. Thus they may suffer phosphorus poisoning or burns while manhandling the fire-cracker remainsduring mass celebrations in the households.

Christmas

Christmas is the festival of making rum cakes, and celebration goes on till new year with dance parties and alcohol abuse in Metro cities.

Discussion

Calendars are used to help people manage their personal schedules, time and activities, particularly when individuals have numerous work, school, and family commitments. The term calendar is taken from calendae, the term for the first day of the month in the Roman calender, related to the verb calare "to call out", referring to the "calling" of the new moon when it was first seen.[13] Latin calendarium meant "account book, register" (as accounts were settled and debts were collected on the calends of each month). The Latin word was adopted in French vocabulary as calendier and inoxford English as calender by the 13th century (the spelling calendar is early modern).[14]

So, this Toxic calendar is prepared by the indian Society of Toxicology to call out the emergency medical services to prepare for managing the toxic disasters, based on the common toxins in that season, easily available to the vulnerable population (children exploring the attractive ornamental toxic plants or the pesticide liquids of bright color stored in water bottles). Or the depressed victims, look around in their environment for harming themselves, and consume the toxin found easily.

Prediction of possible toxic tragedies is very important for the safety of public health. Among its many uses, its prediction is necessary to reduce the expenditure and work labor of a medication's preclinical and clinical trials, because a lot of research evaluations (cellular trials, animal trials, and clinical trials) can be spared due to the possible toxicity. In our era of huge Data sharing and artificial intelligence by internet, prediction of toxicity can benefit from machine learning, which has been widely used in many fields such as natural language processing, speech recognition, image recognition, computational chemistry, and bioinformatics, performing with excellence.[15]

The goal of the initiative is to prioritize toxic xenobiotic substances for further in-depth toxicological evaluation as well as identify their pattern of availability in the environment, in their season of production (toxic flowers), migration (venomous snakes and scorpions) or utility (different pesticides indicated differently in preservation of crop during pre-harvest, harvest and post-harvest months every year) for further prevention of such as toxin-associated morbidity and mortality.

Conclusion

Toxicity prediction is vital to safety of public health. So, the Toxic calendar is prepared by the Indian Society of Toxicology to predict the common poisonings and call out the emergency medical services to prepare for managing the toxic disasters, based on the common toxins in that season, easily available to the vulnerable population. Among its many applications, prediction oftoxicity by Toxic Calendarcan reduce the expenditure and efforts of Medical Services in the long run, by preventing the morbidity and mortality of innocent victims.

References

1. S R Bhat and S G Prabhu Matondkar. Algal blooms in the seas around India – Networking for research and outreach. Current Science.Vol. 87, No. 8 (25 October 2004), pp. 1079–1083. https://www.jstor.org/stable/24108978
2. D'Silva, Maria and Anil, Arga and Naik, R K and D'Costa, Priya. (2012). Algal blooms: a perspective from the coasts of India. Natural Hazards. 63. 10.1007/s11069–012–0190–9.
3. https://www.theflowerexpert.com/content/growingflowers/flowers-and-seasons
4. https://en.wikipedia.org/wiki/Papaver_somniferum
5. https://wimastergardener.org/article/breadseed-or-opium-poppy-papaver-somniferum/
6. Susmita Dey. Saturday 04 July 2015. https://www.downtoearth.org.in/news/flooding-out-arsenic-730. Last accessed: 1st Jan 2020.
7. Le Monte, J J, Stuckey, J W, Sanchez, J Z, Tappero, R V, Rinklebe, J and Sparks, D L (2017). Sea level rise induced arsenic release from historically contaminated coastal soils. Environmental Science and Technology, 51(11): 5913– 5922 DOI: 10.1021/acs.est.6b06152. https://ec.europa.eu/environment/integration/research/newsalert/pdf/floods_due_to_rising_sea_levels_may_mobilise_arsenic_contaminated_soils_501na2_en.pdf
8. Noah R Lottig, H. Maurice Vallet et, al. Flooding and arsenic contamination: Influences on ecosystem structure and function in an Appalachian headwater stream. Limnol Oceanogr 52(5) 2007. 1991–2001. https://www.srs.fs.fed.us/pubs/ja/ja_lottig001.pdf
9. Chemical releases associated with floods - World Health Organisation https://apps.who.int/iris/bitstream/handle/10665/272392/WHO-CED-PHE-EPE-18.02-eng.pdf

10. Waite T, Murray V, Baker D. Carbon monoxide poisoning and flooding: changes in risk before, during and after flooding require appropriate public health interventions. PLoS Currents Disasters. 2014 July 3; Edition 1. doi: 0.1371/currents. dis.2b 2eb9e15f9b98278493880358448 7f1. http://currents. plos.org/disasters/article/carbon-monoxide-poisoning-and-flooding changes-in-risk-before-during-and-after-flooding-require-appropriate public-health-interventions/ (Last accessed 2 Jan 2020)
11. Clauss-Ehlers, Caroline (2010). "Encyclopedia of Cross-Cultural School Psychology".2: 961.
12. Vivekanshu Verma. Utilizing Toxidromal Approach in Managing Series of Botanically Related Medicolegal Emergencies. J Forensic Chemistry Toxicol. 2019;5(2):143–148.
13. "calendar", American Heritage Dictionary (5th ed.), 2017
14. https://en.wikipedia.org/wiki/Calendar
15. Wu Y, Wang G. Machine Learning Based Toxicity Prediction: From Chemical Structural Description to Transcriptome Analysis. Int J Mol Sci. 2018;19(8):2358. Published 2018 Aug 10. doi:10.3390/ijms19082358.

Case Report

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Fatality Due to Acetaminophen-Ibuprofen Poisoning: A Rare Occurrence

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Abstract

Over-The-Counter (OTC) analgesics are very commonly used in our country and sometimes taken without the doctor's prescription. Though generally these medicines are considered safe, but they can produce complications when taken in excess doses. The authors report a case of an adolescent girl who consumed acetaminophen-ibuprofen combination pills present in her home for headache, which proved fatal. The authors aim to highlight and increase awareness about the hidden dangers in careless and unsupervised use of these medicines. The possibility of death with overdose of even commonly prescribed drugs should be understood, studied well and should be taught to patients to keep such medications away from their children. Accessibility and availability of OTC drugs should be restricted in accordance with the recommended daily usage.

Keywords: Ibuprofen Toxicity; Acetaminophen; Non-Steroidal Anti-Inflammatory Drugs (NSAIDs); Poisoning.

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Introduction

Over-The-Counter (OTC) analgesics are very commonly used in our country and sometimes taken without the doctor's prescription. Though generally these medicines are considered safe, but they can produce complications when taken in excess doses. The authors report a case of an adolescent girl who consumed acetaminophen-ibuprofen combination pills present in her home for headache, which proved fatal. The authors aim to highlight and increase awareness about the hidden dangers in careless and unsupervised use of these medicines.

Case Details

A 15-year old girl was allegedly doing a fast ritual and was on empty stomach since morning. In the evening, she had headache for which she took six tablets of Ibuprofen 400 mg + Paracetamol 325 mg combination. Soon after, she started vomiting, which gradually worsened and then she developed frothing from mouth. She was taken to a private hospital where she was declared brought dead. The police seized a strip with fourteen white colored tablets of Ibuprofen 400 mg + Paracetamol 325 mg combination from the crime scene and it was sent for chemical analysis.

Autopsy Findings

Deceased was average built and rigor mortis was established all over the body. Clothes were intact. Lividity was present and fixed, in back and dependent parts, in supine position except pressure areas. Mouth was closed and white coloured

froth was seen oozing out of mouth. No external or internal injury was present over the Body. Genitalia was intact. The lungs were congested and edematous and weighed 420 gm and 380 gm respectively. Stomach contained around 150 ml of brown coloured fluid with black coloured particles. Mucosa was congested and a peculiar smell was present. Stomach and its contents, small intestine, liver, spleen, kidney and blood were preserved for toxicological analysis and opinion was reserved at that point of time.

Chemical analysis report could not detect any common poisons in blood or other viscera. On Chemical analysis of the tablets recovered from the crime scene, the composition of acetaminophen and ibuprofen were confirmed. The cause of death was concluded as "Poisoning due to combined effect of Ibuprofen and acetaminophen".

Discussion

Ibuprofen and Acetaminophen are Non-Steroidal Anti-Inflammatory Drugs (NSAIDs).[1] Ibuprofen 400 mg and Paracetamol 325 mg combination is available in many trade names in India. The mechanism of action of both the drugs is cyclo oxygenase (COX) enzyme inhibition. Inhibition of COX enzymes affects the prostaglandin synthesis. Prostaglandins play an important role in pain pathway. They are also involved in fever mechanisms and they are inflammatory mediators. Therefore prostaglandin inhibition can significantly control pain, fever and inflammation thereby having a therapeutic effect.[2]

Ibuprofen, an Over-The Counter medication is commonly available in many countries. Although accessibility of ibuprofen is easy, ibuprofen overdose is seldom reported in literature. They usually present with nausea, vomiting, dizziness, drowsiness and blurred vision.[3-4] Our case had history of vomiting immediately after ingestion of the tablets. Death due to acute ibuprofen overdose is rare. Reported deaths in literature are mostly associated with some other drug or some other cause as in our case. Deaths due to isolated ibuprofen poisoning is scarce as hen's teeth.[5] Immediate life threatening complications following ingestion of ibuprofen are hepatotoxicity, coma, hypotension, respiratory arrest, thrombocytopenia, seizures, refractory multi system organ failure and death.[6–7] In our case, we did not get any significant postmortem findings, which could explain the possibility of coma, respiratory arrest or hypotension contributing to the death of the deceased. Using NSAIDs for a longer period without prescriptions, especially in patients suffering from chronic diseases can lead to other complications such as chronic renal failure and gastro intestinal ulcer followed by bleeding.[4] Renal failure is one such complication, which can manifest in both acute and chronic overdose of ibuprofen. Glomerulus contains afferent arteriole, which receives the arterial blood from body for the process of ultrafiltration. PGE2 (a type of prostaglandin) cause dilatation of afferent arterioles of glomerulus in normal individuals. This process will increase the renal plasma flow, which maintains homeostasis of Glomerular Filtration Rate (GFR). Use of NSAIDs can disrupt the above-mentioned homeostasis by inhibiting prostaglandin synthesis.[8] We did not find any features of renal failure in our case. Another reported fatal complication is high anion gap metabolic acidosis which could be due to impaired kidney function and accumulation of toxic metabolites[9] which again is difficult to pick up in postmortem examination. Ibuprofen induced apneic episodes can cause Aspiration Pneumonia[3] which was not present in our case. These fatal complications have occurred only when the ingested amount of ibuprofen was greater than 400 mg/kg.[10] In our case, according to the history, only about 5 to 6 tablets were consumed by the deceased, which amounts to only 2000 mg to 2400 mg. This shows ibuprofen could have had only contributory effects to death and not the sole factor that was responsible.

Acetaminophen (Paracetamol) is a commonly used OTC analgesic-antipyretic. It is metabolized in liver and is converted into non-toxic and toxic (NAPQI-N-acetyl-p-benzoquinone imine) products. Toxic products will be neutralized by glutathione. It is generally tolerated well and safe for healthy individuals, if prescribed in recommended doses. Overdose or chronic supra-therapeutic use can lead to hepatotoxicity and death.[11] Toxic dose when taken as a single dose is 140 mg/kg or 7.5 gm if taken over a 24-hour period.[12] The toxicity occurs in four stages. First stage is the immediate 24 period where patients will be asymptomatic or having non-specific symptoms. On second or third day initial stages of hepatotoxicity sets in.After this stage, some patients recover without any sequel and some develop characteristic findings like metabolic acidosis, renal failure, coagulopathy,encephalopathy, and recurrentgastrointestinal (GI) symptoms, which suggest Fulminant hepatic failure. Histopathology shows Centrilobular Hepatic necrosis. If the patient survives this stage, over the next week hepatic functions return to normal.[12] Acetaminophen poisoning cases presenting as brought dead is

seldom reported in literature and the contributory effect of ibuprofen could have had an impact in our case. Our case had symptoms of only vomiting and frothing after ingestion of tablets, collapsed rapidly and was declared brought dead in the casualty. Autopsy showed liver to be normal grossly. Other known complications are metabolic acidosis, lactemia and altered mental status. Usually metabolic acidosis develops late in the patients, after liver failure, but early occurrence of metabolic acidosis suggests excessive NAPQI accumulation.[13]

Drug absorption is increased generally in empty stomach. Presence of food always hampers absorption and has a control on any given drug. Faster gastric emptying increases absorption of drugs, since small intestine has large surface area due to presence of villi. Acetaminophen being a basic drug will be in unionized state in small intestine, which further increases absorption of the drug. In our case, the deceased was on empty stomach, which could have probably lead to erroneous absorption of both the drugs, especially acetaminophen.[10] Consumption of combination tablet of ibuprofen and acetaminophen could cause synergistic adverse drug reactions. Metabolic acidosis is common in both the drugs, which could possibly explain cause of death in our case. Even though individual pathological feature of each drug is not visible structurally during autopsy, the combined functional pathology of both the drugs should be considered in opining the cause of death. The cause of death was concluded as "Poisoning due to combined effect of Ibuprofen and acetaminophen", despite the Viscera report being negative. A negative viscera report does not rule out death due to poisoning as the viscera tests has a lot of limitations and restricted to very few common poisons. As per judgments of the apex court, the doctor who has conducted the postmortem examination depending upon PM findings, the medical records, circumstantial evidences and after ruling out any other cause of death can very well give the manner of death as unnatural due to a poisonous substance, just as in this case.[14,15]

Conclusion

The possibility of death with overdose of even commonly prescribed drugs should be understood, studied well and should be taught to patients to keep such medications away from their children. Accessibility and availability of OTC drugs should be restricted in accordance with the recommended daily usage. Even though gross findings are absent and viscera turn out to be negative in chemical analysis, the pharmacopathology of the drugs should be understood well to opine cause of death under such circumstances. The autopsy surgeon should not be deterred by mere non detection of poison in the chemical analysis of viscera.

References

1. Wood D, Monaghan J, Streete P, Jones A, Dargan P. Crit Care. 2006;10(2):R44.
2. Nazu K: Ibuprofen: highly potent inhibitor of prostaglandin synthesis. Biochim Biophys Acta 1978, 529:493–494.
3. Hall AH, Smolinske SC, Conrad FL, Wruk KM, Kulig KW, Dwelle TL, Rumack BH: Ibuprofen overdose: 126 cases. Ann Emerg Med 1986, 15: 1308–1313.
4. Chyka PA, Seger D. Position paper: single-dose activated charcoa. J Clin Toxicol. 2005: 43 (2); 61–87.
5. Hall AH, Smolinske SC, Kulig KW, Rumack BH: Ibuprofen overdose – a prospective study. West J Med 1988, 148:653–656.
6. McElwee NE, Veltri JC, Bradford DC, Rollins DE: A prospective, population based study of acute ibuprofen overdose: complications are rare and routine serum levels not warranted. Ann Emerg Med 1990, 19:657–662.
7. Seifert SA, Bronstein AC, McGuire T. Massive ibuprofen ingestion with survival. Clin Tox. 2000;38:55–57.
8. Smetana M, Picard K, Boehm KM. An Acute Ibuprofen Overdose Masking a Severe Staphylococcus aureus Meningitis: A Case Report. Case Reports in Emergency Medicine. 2013:1–5.
9. Halpern SM, Fitzpatrick R, Volans GN: Ibuprofen toxicity. A review of adverse reactions and overdose. Adverse Drug React Toxicol Rev 1993, 12:107–128.
10. Smolinske SC, Hall AH, Vandenberg SA, Spoerke DG, McBride PV: Toxic effects of nonsteroidal anti-inflammatory drugs in overdose. An overview of recent evidence on clinical effects and dose-response relationships. Drug Saf 1990, 5:252–274.
11. Larson AM, Polson J, Fontana RJ, et al. Acetaminophen-induced acute liver failure: results of a United States multicenter, prospective study. Hepatology 2005; 42: 1364–1372.
12. Hung O, Nelson LS. Acetaminophen. In Tintinalli JE, Kelen GD, Stapczynski JS. Emergency Medicine: A Comprehensive Study Guide 6th ed. New York, NY: McGraw Hill; 2004. 1088– 1094.
13. Ghannoum M, Kazim S, Grunbaum SA, Villeneuve E, Gosselinc S. Massive acetaminophen overdose: effect of hemodialysis on acetaminophen and acetylcysteine kinetics. Clin Toxicol. 2016: 54 (6), 519–22.

14. Jaiswal A K, Gupta S K, Millo T, Yadav A, Prasad K. Death is Due to Poisoning but Viscera Report is Negative. Ind Journal of Forensic Med and Pathol. 2015; 8(1): 29–36.

15. Yadav A, Gupta S K, Kulbhushan, Kumar A, Punia S, Jaiswal A K. Death Is Due To Poisning: Negative Viscera Report-Intricacies Thereof. Indian Police Journal. 2015; 62 (1): 216–27.

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[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003; 61: 347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3-9.

Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O,

Kidd EAM, editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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