Forensic Analysis of Illicit Liquor of Himachal Pradesh By Color Tests And Fourier Transform Infrared Spectroscopy

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ABSTRACT

Illicit liquor is the kind of alcohol that is manufactured in unlicensed breweries and the samples are analyzed for excise purpose and to check the quality control. Hooch poisoning cases are also encountered in which mostly used liquor is illicit liquor (containing methanol) that leads in large number of fatalities and deaths. The present study aims at the analysis of Illicit Liquor of Himachal Pradesh by color tests and Fourier Transform Infrared Spectroscopy. Samples of illicit liquor were analyzed by performing color tests to check the presence of Ethanol, Methanol, Copper, Iron and Furfural. Fourier Transform Infrared Spectroscopy was also performed to check the presence of Alcohol and other harmful components present in illicit liquor. From color tests on samples of illicit liquor, it has been found that ethanol may be present while other harmful components like methanol, furfural and metals like copper and iron may not be present. When these samples were cross- checked by FTIR for the presence of various adulterants, presence of alcohols has been established along with many other harmful compounds like acid anhydrides, hydrocarbons, sulfonyls etc. So the conducted study will be very helpful as preliminary examination of illicit liquor samples of Himachal Pradesh from hooch poisoning cases.

KEYWORDS: Illicit, Liquor, Ethanol, Adulterants.

1. INTRODUCTION

Alcohol is a type of CNS depressant having –OH as functional group. The 'alcohol' often used by people for purpose of drinking is mainly 'Ethanol or Ethyl Alcohol'. Intoxication caused by alcohol produces light headedness, confusion, disorientation, and drowsiness thus act as an inebriant poison. Alcoholic beverages can be broadly classified into four classes: Beer, Country Liquor, Illicit liquor and India made foreign liquor (IMFL). Indian made foreign liquor is western styled distilled liquor made in India under government licenses. This category consists of beverages such as brandy, gin, rum, vodka, whisky etc. and having maximum alcohol content up to 42.8%. Country liquors are distilled alcoholic beverages manufactured using low cost raw material such as sugarcane, palm, rice, coconut or coarse grains. Country liquor is produced under government licenses to be sold within the same district. Arrack, desi sharab, tari (toddy) are common types of country liquor having alcoholic content around 40%. Illicit liquor is manufactured in unlicensed breweries. It is produced in small production units having same raw material as used in country liquor. This type of liquor is manufactured in order to elude taxes. These liquors evade quality controls so the alcohol concentration varies (upto 56%) and adulteration is frequent. Beer is manufactured in large licensed breweries with an alcohol content ranging from 5% to 9%. [1]

Ethanol belongs to group of alcohol family which is transparent, flammable and volatile liquid. It is manufactured by the fermentation of sugars from grains, fruits, juices and starches with the help of yeast (*Saccharomyces cerevisiae*). During the production of alcohol, glucose is formed that produces two ethanol and two carbon dioxide molecules. [2]

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

Composition of illicit liquor varies due to unregulated conditions or frequent adulteration in illicit liquor leads to variation in alcohol concentration. The sale of illicit liquors is far more than licit liquors because of the low cost of the former than latter. Transportation of liquor from one state to another is allowed under the rule as Excise and Prohibition Act to prevent the smuggling of illegal possession without valid documents.

Varietal differentiation of grape juice was performed by Cozzolino et al. by using visible, near-infrared reflectance and mid-infrared spectroscopic techniques combined with pattern

recognition methods. The results showed that spectral differences was present between the juice samples of different origins. This study indicates that IR spectroscopy coupled with pattern recognition methods contain important information which further helps in classifying different samples of juices according to their origin. [3]

Preliminary study on illicit liquor of Northern India was performed by Punia et.al by using Headspace Gas Chromatography-Mass spectroscopy technique. Samples were found to contain number of components. A total of 561 components were identified by and classified by them into alcohols, esters, acids, nitrogen-containing compounds, ketones and aldehydes. [4]

Yadav et al. classified illicit liquor on the basis of their geographical origin by using Fourier Transform Infrared Spectroscopy along with chemometric tools. From the study it was concluded that similar results were produced by spectroscopic technique as that by traditional chemical techniques. ATR-FTIR spectroscopy technique with chemometric tools can be used to classify samples based on their geographical origin. [5]

2. MATERIALS AND METHODS

Simple Deliberate Sampling method was used for the collection of samples. In this type of sampling, samples are selected deliberately based on their ease to access and it is called as convenience sampling.

2.1 *Collection of Samples*

Eight samples of illicit liquor were collected from three districts of Himachal Pradesh. Samples were collected from district Kullu, Mandi and Kangra of Himachal Pradesh.

2.2 *Analysis*

Samples were analyzed by performing color tests and Fourier Transform Infrared Spectroscopy. Color tests were performed to check the ethanol, methanol, Copper and Iron, Furfural. Fourier Transform Infrared Spectroscopy was performed to check the presence of ethanol and other harmful components.

2.2.1 COLOR TESTS [6]

Test for ethanol

Iodoform Test

1ml of sample has been taken in a test tube in which addition of 1ml of 5% NaOH have been done followed by addition of iodine solution (20gm potassium iodide+10gm iodine in 100ml of distill water) dropwise until persistent dark brown color appeared . Diluted NaOH solution has been added in order to remove excess of iodine. At last addition of equal amount of water has been done and kept for 10 minutes. Yellow crystalline precipitates signifies the presence of ethanol.

Dichromate Test

1ml sample has been taken in a test tube and 0.2ml of 2% potassium dichromate have been added followed by the addition of conc.H_2SO_4. Yellow color of dichromate changed to blue or green color that indicates the presence of alcohol.

Test for methanol

Chromotrophic acid Test

1ml sample has been taken in a test tube in which addition of 2ml of potassium permanganate ($KMnO_4$) solution (3gm of $KMnO_4$ and 15ml of o-phosphoric acid in 100ml of distill water)have been done. Then addition of few crystals of sodium bisulphate ($NaHSO_3$) have been done till the color of the solution disappear. After that 1ml of 0.005% Chromotrophic acid has been added to the colorless solution followed by the addition of conc.H_2SO_4 slowly along the sides of tube. No color formed which indicated the absence of methanol.

Test for copper and iron

5ml of sample was taken in a test tube. 1drop of nitric acid was added. Then 1ml of 0.025 M potassium ferrocyanide was added. No color appeared which shows the absence of copper and iron.

Test for Furfural

5ml of sample has been taken in a test tube in which 0.2ml of aniline was added. Then addition 0.4 ml of glacial acetic acid have been done. No color was formed that indicated the absence of furfural.

❖ All the samples have been compared with the control samples.

2.2.2 Instrumental Analysis

FTIR instrument that has been used in the present study has following specifications:

Samples were analyzed by using Shimadzu FTIR-8400S model. The wavenumber of each spectra ranges from 4000-500cm^{-1} and the percentage of transmittance ranges from 0-120%. The spectra's were obtained by using 12 scans per sample. Resolution of the instrument was 4cm^{-1}.

Experimental Setup of FTIR Spectrophotometer

3. RESULTS

In the present study, all of the eight samples showed positive results for Iodoform and dichromate test that indicates the presence of ethanol. Whereas, all samples showed negative results by for the presence of Methanol, Copper, Iron and Furfural.

FTIR spectrum showed the presence of alcohols along with many other compounds like acid anhydrides, hydrocarbons, sulfonyls etc. that can be harmful to consumers.

4. CONCLUSION

In the present study, out of the color tests performed on samples of illicit liquor, it is concluded that ethanol may be present while other harmful components like methanol, furfural and metals like copper and iron are not present. When these samples are cross- checked by FTIR for the presence of various adulterants, it is found that alcohols are present along with many other compounds like acid anhydrides, hydrocarbons, sulfonyls etc. which are very harmful for the body like acid anhydride is highly corrosive in nature and can also cause allergic reactions, hydrocarbons can affect lungs badly. This study is a stepping stone for analysis of illicit liquor samples by FTIR which can be extended in future for both qualitative and quantitative purposes.

5. REFERENCES

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