Different Alcoholic Beverages Chemical Analysis

Dr Jyotirmaya Sahoo, Professor

Department of Health & Allied Science, Arka Jain University, Jamshedpur, Jharkhand, India

Email Id- dr.jyotirmaya@arkajainuniversity.ac.in

ABSTRACT: ***The objective of the study is to test 50 different brands of alcoholic drinks made by local brewers in Kerala to determine if adulterants were present and in what quantities. All 50 samples were submitted to chemical analysis, and none of them returned positive findings, indicating that the alcohol samples are free of adulteration. The physical structure of the beverage samples was revealed by functional measures such as colour and odour examination, while microscopic examination of samples revealed the presence of sediments when analyzed under a microscope, showing that the alcoholic beverage samples had not been sufficiently purified. An ultra-violate (UV) visible spectrometer was utilized in the instrumentation procedure to verify the presence or absence of furfural and to determine its quantity in the required sample. To evaluate furfural concentrations, various chemical experiments may be performed, however in this research, a UV-Visible spectrometer was chosen since it is extremely sensitive and gives precise concentrations of the material under evaluation. Although, different study have been done in this area throughout past decade but there is enormous potential of additional research in this sector in future.***

KEYWORDS: ***Alcoholic Beverages, Beer, Brandy, Furfural, Illegal Alcohol, Kerala, People, Rum, Vodka.***

1. INTRODUCTION

In the widest sense, forensic science is the application of scientific techniques and concepts to the functioning of the criminal justice system. To perform their jobs successfully, forensic scientists must examine the values, definitions, and methods. Forensic scientists search for chemicals that may be used to connect offenders to crimes or recreate them. This area of science is generally considered as fascinating, and its popularity is increasing. Toxicology is a key component of forensic medicine [1]. Toxicology and allied disciplines such as analytical chemistry, pharmacology, and medicinal chemistry are utilized in forensic toxicology to assist medical and legal investigations of suicide, overdose, and drug usage. The primary focus in forensic toxicology is the collection and analysis of findings, not the regulatory conclusion of the toxicological study or the equipment employed. Toxicological testing may be conducted on a number of items. Any item discovered at a crime scene that may restrict the search, such as pill bottles, powders, trace residue, and any accessible chemicals, must be evaluated by a forensic toxicologist. With this information and samples to work with, the forensic toxicologist must evaluate which toxic substances are present, at what dosages, and what effect such chemicals are likely to have on the victim [2].

The identification of poisons, medications, and pharmaceuticals in biological samples is usually done by an initial screening followed by clarification of the compound(s), which may need quantitation(s). Different analytical methods are employed for sampling and validation, but this is not always the case. To guarantee accurate and unambiguous results at all times, every analytical methodology employed in forensic toxicology should be carefully verified by performing a validation of the procedure. To ensure the best possible results and the safety of every individual, a forensic toxicology testing facility should follow a quality plan. The technique of testing selected is highly reliant on the kind of material anticipated to be found and the specimen on which the testing is performed. The matrix effect, as well as the metabolism and conjugation of the target chemicals, make biological samples more challenging to examine. The bulk of toxicological data or samples are evaluated using two kinds of testing: presumptive or tentative tests and confirmatory tests. In medical and forensic science, presumptive exams analyze a sample and determine one of the following [3]:

- The sample does not offer any proof of the presence of a particular drug.
- The substance is most likely present in the sample.

The testing required to validate the study are known as confirmatory tests. Since confirmatory tests are more costly than simpler presumptive testing, presumptive tests are frequently employed to determine if confirmatory tests are required. Color and screening tests are frequently employed as presumptive tests, with instrumental examination utilized as a confirming measure. Alcohol is a colorless, volatile, flammable liquid produced by

spontaneous sugar fermentation. It is the intoxicating component in wine, beer, spirits, and other drinks, as well as an industrial solvent and gasoline [4]. Alcohol is a chemical which is a basic, tiny molecule (CH_3CH_2OH) that's water soluble and volatile. It also has basic pharmacokinetics (how the body responds to the medication), especially when compared to tetra-hydro-cannabinol (THC). In contrast to other drugs, alcohol is relatively non-toxic and may exist in high levels in the blood. The concentration of alcohol in the blood is calculated in milligrams (1/1,000th of a gram), whereas the quantity of THC in the blood is measured in Nano grams (1/1,000,000,000th of a gram). In contrast to many other medicines, this makes alcohol identification considerably better [5].

An alcoholic beverage contains ethanol, a type of alcohol produced through the fermentation of grains, fruits, or other sugar sources. In many nations, consuming alcohol serves an important social function. The production, sale, and consumption of alcoholic beverages are all controlled in most nations. In general, alcoholic drinks are not harmful, although they may be deadly and lethal in exceptional instances. Each hour, our bodies can only metabolize one unit of alcohol. When individuals consume a lot of alcohol in a short amount of time, their liver will fail owing to the level of alcohol in their blood. It has the capacity to [6]:

- Slow down brain processes, causing us to lose our sense of equilibrium.
- Irritate the throat, which induces vomiting and inhibits the function of our gag reflex.
- Affect the nerves that regulate breathing and heartbeat, resulting in both being stopped.
- Dehydration, which can result in long-term brain injury.
- Lowering the body's temperature can cause hypothermia.
- Lower blood sugar levels, which could lead to seizures.

2. LITERATURE REVIEW

P. Panagiotopoulou et al. presented that utilizing 2-propanol as a solvent. Furfural hydrogenation resulting in furfural alcohol, which subsequently undergoes hydro-hemolysis to produce methyl furan. Furfural decarboxylation and furfural alcohol ring hydrogenation also include tiny amounts of furan and traces of tetra-hydro-furfural alcohol. With 2-propanol, furfural alcohol may dimerism or release ether. Increasing the reaction temperature or duration increases the yield of methyl furan. Cross 95 percent and 61 percent, respectively, after 10 hours of reaction at 180 °C, maximum recorded process at temperatures less than 200 °C. Starting with furfural alcohol, methyl furan, and furan hydrogenation, the reaction network was investigated by looking at the development of reaction intermediates and products. When starting with furfural alcohol as the reactant instead of furfural, intermediates and methyl furan are released quicker, indicating furfural. Experiments with show that, however, furfural improves at the expense of methyl furan. After catalyst recovery, the original catalytic operation resumed. Author demonstrates that Ru and RuOx are engaged in the catalyst's active step [5].

World Health Organization (WHO) stated that drug addiction is one of the main causes of premature mortality and illness, and it has a substantial impact on public health. The quantity of alcohol consumed over time; the pattern of consumption, which involves intermittent or frequent drinking to intoxication; the drinking environment, which raises public health risks; and the nature or toxicity of alcoholic drinks are all factors that contribute to the unhealthy use of alcohol. About every organ and structure in the body may be damaged by alcohol. Its usage has been related to approximately 60 illnesses and disorders. In 2002, it was estimated that 2.3 million individuals died prematurely as a consequence of excessive alcohol use across the globe (3.7 percent of worldwide fatalities). It is the world's fifth-largest contributor to disease burden [7].

M. S. Sankhla stated in the article that the term alcohol is used as a legitimate name for both the pure substance, which scientists refer to as ethyl alcohol, and its mixes of smaller quantities of water and minor amounts of other chemicals. The word alcohol is used as a broad or generic name in chemistry to describe a variety of distinct substances. India has had a long history of alcohol addiction. Over the past two decades, the amount trend being utilized and the associated problems have changed significantly. This revenue-generating category comprises western-style alcoholic spirits including bourbon, rum, and gin. The highest alcohol level allowed is 42.8 percent. Aside from regulated distilleries, there are a plethora of tiny processing facilities that operate under the surface. They utilize comparable basic ingredients to produce liquor, evade legal quality requirements, the alcohol level in their products varies, and adulteration is frequent. It's not unusual to obtain samples of rum, bourbon, or gin that contain up to 56 percent alcohol. Industrial methylated sprit is a hazardous adulterant that produces mass

poisoning in humans, resulting in death or severe eye damage. Due to the absence of government income, illicit booze is considerably less expensive than regulated country liquor, and thus has a ready market among the weak [2].

H. Zhang, Q. Ping, J. Zhang, and N. Li presented that based on UV spectroscopy, a fast technique for measuring distinct furfural concentrations in ethanol-water hydro lysate of reed was presented in this article. As a trace, chemicals were removed first by distillation. By measuring the maximum that wavelength, the distillate was utilized to detect the existence of furfural. The total absorption wavelength of the signature peak in an ethanol water solution correlated well with the composition of furfural mixture. These connections may be used to assess the relative quantities of furfural in a mixed solution [4].

3. ALCOHOL POISONING SYMPTOMS

After ingesting contaminated alcohols, a person may become dangerously drunk in seconds. Knowing the symptoms and consequences of alcohol intoxication is essential because if someone people care for is suffering from acute alcohol poisoning, they will be unable to rescue themselves. The following are the most frequent signs and symptoms:

- Vomiting
- Seizures
- Confusion and loss of control
- Breathing that is uneven or slow
- Blue-tinged or pale skin
- Hypothermia
- Stupor
- Unconsciousness

3.1. Different Types of Alcoholic Beverages:

There are many distinct types of alcoholic beverages, and the quantity of ethanol in each one varies. Since yeast stops growing when the concentration of ethanol reaches approximately 15 percent, alcoholic beverages produced using yeast to ferment various sugar-containing plant sources usually have a low concentration. Distillation, on the other hand, is used to create stronger liquors [8]. Brandy is an alcoholic drink typically drunk as an after-dinner digestive. Some are decorated with caramel coloring to imitate age. Brandy is sometimes described as burned champagne, or to put it another way, it is a golden brown spirit produced from wine. Certain fruits' wines, such as pears and apples, may also be used to create brandy. There are many distinct types of brandy, but the one people are most certainly acquainted with is Cognac, sometimes known as Hennessy. Cognac is a brandy produced solely from grapes cultivated in a limited region of France. Brandy has its own language that enables people to identify how old it is. When a brandy is marked Very Special (VS) or has three stars on the bottle, it has been matured for at least two years. This is the most common brandy used in cocktails. Brandy that has been matured for at least four years is classified as Very Special Old Pale (VSOP). The word Xo brandy refers to a brandy that has been matured for at least six and a half years. Vintage brandy, often called as hors drag, is a super-special brandy that has been aged for over a decade and may carry the year of production [9].

Vodka is a fermented alcoholic beverage composed primarily of water and ethanol, but with residues of contaminants and flavorings. It is manufactured in Poland. In the vodka belt nations of Belarus, Estonia, Finland, Iceland, Lithuania, Latvia, Norway, Poland, Russia, Sweden, and Ukraine, vodka is usually drank "neat" or "straight", however it is frequently served freezer cooled. Vodka martinis, Cosmopolitans, Vodka Tonics, Screwdrivers, Greyhounds, Russians, Moscow Mules, Bloody Marys, and Bloody Caesars are just a handful of the cocktails and blended beverages that utilize it. Vodka may be manufactured material, but the bulk of vodka nowadays is made from grains like sorghum, maize, rye, or wheat. Rye and wheat vodkas are generally considered as better grain vodkas. Oranges, oats, extraction and are used to create certain vodkas. Some vodka is produced in, by just fermenting a crystal sugar and yeast solution. Many favorites created in traditional areas, may improve the flavor of vodka. Mango is among the flavorings. Pertsovka, a vodka popular in Russia. Ubrówka (Polish) and zubrovka (Belarusian) vodkas are produced with and have slightly sweet tastes and light amber hues. Krupnik is a popular honey-infused vodka in Lithuania and Poland. Vodka may also be utilized in the kitchen, and many dishes profit from the usage primary component. In the 1970s, vodka sauce became

popular as with milk, as well as vodka. Vodka may be used to create flakier pie crusts by replacing it for water in baking [10].

4. DISCUSSION

4.1. Alcohol Laws in India:

In India, the legal drinking age and the regulations regulating the sale and consumption of alcohol vary considerably from state to state. In India, the states and union territories, prohibit the drinking of liquor whereas some districts in Manipur have a partial ban on alcohol. In some countries, the minimum drinking age changes based on the quantity of alcoholic beverage drunk. Despite legal restrictions, India's alcohol consumption has risen by 72.5 percent in the past 20 years. Alcohol is listed under the Indian Constitution's VII Schedule. As a consequence, the laws governing alcohol vary from one jurisdiction to the next. Liquor is mainly accessible in India at casinos. Private parties are banned from purchasing liquor shops in some states, such as Kerala and Tamil Nadu. Liquor may be sold at grocery stores, department in certain states. Unique regulations enable the sale of alcohol on beaches and houseboats in select tourist regions. In Delhi, it is illegal to deliver alcoholic beverages to people's homes. In Delhi, however, individual vendors and department shops are permitted to sell beer and wine to consumers' houses. Kerala's legal drinking age is 23, and the state government intends to phase down hard liquor ban in 10 years. The maximum limit for blood alcohol concentration (BAC) is 0.05 percent, or 30 milligrams of alcohol per 100 milliliters of blood. Penalties were raised, with fines ranging from $2,000 to $10,000 and prison sentences ranging from 6 months to four years. Most Indian states commemorate these days (2 October, 16 August and 26 January) as well as in and during the election days, there are other dry days.

4.2. Adulteration of Alcoholic Beverages:

Adulteration refers to the act of reducing the content of something by adding another ingredient. An adulterant is a drug that is present in other substances such as fruit, drinks, oils, or chemicals despite the fact that it is not allowed for legal or other reasons. It is unlikely to be in the specification or stated content of the product, and it may be unlawful. Adulterated alcoholic drinks are legal alcoholic beverages that have been altered with unlawfully, putting them in new cans to conceal their real nature, or adding toxic chemicals to change the characteristics of the drink. Alcoholic drinks that are properly designed and authorized are composed of ethanol, a type of alcohol that is safe to take in moderation. Fake alcoholic drinks, on the other hand, may be produced using cheaper types of alcohol, which might have severe health implications. Methanol, chloryl hydrate, acetone, furfural, copper, and iron are common adulterants found in alcoholic beverages. National alcohol laws do not address the production and consumption of alcohol that happens outside of the authority of law enforcement. The consumption of such alcohol is known as "unrecorded alcohol usage", and the alcohol that is trafficked is known as "illicit alcohol" or "criminal alcohol".

The licit or legal market, as well as publicly recorded intake, are the focus of regulations to reveal alcohol problems. They reduce the topic of illicit drinking to a footnote or a fleeting remark. When illicit alcohol use is restricted, as it is in most industrialized countries, the efficacy of alcohol regulations is not affected. However, in many impoverished countries, illicit alcohol accounts for the bulk of alcohol consumption. When these nations realize the need for alcohol regulations and explore the globe for suggested or evidence-based rules, they discover those that are still in existence in the richer world. Alcohol regulations in affluent nations are considerably more inclusive. Policies that assist in the decrease of alcohol-related problems in wealthy nations are also effective in poor countries, although maybe not to the same degree. In many of the emerging countries, there is a flourishing illicit alcohol business. When it comes to establishing alcohol regulations, this part is typically disregarded as a nuisance. Researchers must regard unrecorded alcohol consumption as more than simply a barrier to policy implementation in impoverished nations. This area must be given special attention when it accounts for a fair percentage of total consumption. The problem is that illegal or illicit output is impossible to measure by its mere presence.

Having alcohol regulations that are sufficiently comprehensive to cover both licit and illicit alcohol is a tough issue. There are no real-life situations to model for. Scientists don't actually have a theoretical foundation to operate with. But, because they are already late, the initiative must begin now. The notion that illicit alcohol is somehow harmful because it isn't "safe" is widespread. Deaths arising from the consumption of an illegal brew frequently make the headlines. The obvious conclusion from such reports is that ethyl alcohol in officially sold beers is entirely harmless, whereas adulterants and contaminants in illegally produced beverages are the problem.

The fact that impurities are not always unintentional backs up these sentiments. Some illicit producers add a range of odd ingredients to their beverage in an attempt to make it more "strong" and even advertise it.

Others attach synthetic alcohol to their brews and distillates, which has its own set of pollutants. And the death of one or two individuals in a remote area of the globe as a consequence of contaminated alcohol use attracts worldwide media attention. However, it reinforces the impression that illicit alcohol is extremely "unwholesome", whereas legal alcohol is "wholesome". This is related to the popular resistance to any action limiting the sale of legal alcohols on the grounds that it would lead to greater illicit alcohol manufacturing, which would have catastrophic health consequences. The argument is then extended to include making regulated alcohols more readily accessible on the grounds that it would minimize the harm caused by illegal brews. In some countries, the damage caused by illicit alcohol is attributable to its substantial exposure to total alcohol consumption rather than impurities and toxins contained in it. This truth is frequently ignored, possibly because the idea that alcohol consumption, whether legal or illicit, is exactly proportionate to the degree of harm is unpopular with some powerful entrenched interests.

4.3. Reason for Adulteration:

The illicit production and sale of alcohol is the most frequent drug crime in many cultures. It has far-reaching negative consequences, owing to the coercion, security, and political patronage required to keep it running. It's also allowed to exist more freely than any other criminal enterprise, including the trade of other prohibited substances like opium or cocaine. Despite its exposure and general knowledge of its locations, the illicit alcohol trade is frequently characterized as a problem that law enforcement authorities are unable to capture or control. One reason for its persistence may be a lack of real interest in eliminating the prohibited company. In a small town, the local illicit alcohol trader is generally not regarded as a major societal adversary. This is partly due to the fact that local merchants are typically incorporated into the community and are regarded as supplying a demand that they did not create. The local merchant is considered as a member of the society by at least a part of the people.

Among the others, the village trader has friends and family. On the other hand, illicit alcohol is mass-produced and distributed via a network of distributors. This kind of organized large company is managed by criminals who require government support to keep their operations operating successfully. The earnings are considerable, the operation is organized by syndicates, and many of the society hate it, but it is allowed since anyone who falls foul of the trade is regarded as a threat. And if everyone in a community knows where illicit alcohol is sold, the unlawful crime continues. Authorities appear to be acting simply for show, resulting in raids that essentially replace one dealer with another. There is greater neighborhood dissatisfaction when the trade is structured and regarded by the community as deliberately encouraging more and more individuals to drink excessively. When the illicit alcohol trade is part of a wider organized operation, people in a group may be reluctant to strike back. However, there have been a few occasions when communities have joined together to force traffickers to depart. Such activities are helpful, at least in the short run, when there is broad participation.

National alcohol policies are frequently focused at striking the greatest possible balance between the harm caused by alcohol and the perceived economic and other benefits it offers. In terms of national policy, unrecorded alcohol is regarded as a trivial issue that does not warrant governmental attention. If illegal alcohol is addressed at all, it is usually in the context of arguments that restrictions on legal alcohol should not be too harsh, since this would ultimately lead to greater criminal usage. Large-scale illicit alcohol operations are likely to have worldwide sponsors. Corruption will eventually permeate to high levels of government and law enforcement. Money from unlawful activity that is not disclosed leads to additional criminal conduct as a ready source of income or to illicit financial activities as a method of ‘laundering' those assets. Many of them have unwanted or unexpected consequences.

The alcohol industry has a strong interest in decreasing the quantity of illegal alcohol on the market. The difference between illegal and legal beverages helps consumers understand that legal products are fundamentally superior. The alcohol business frequently utilizes poor quality to convince the public that unrecorded alcohol is more harmful. According to the International Center for Alcohol Policies (ICAP), the alcohol industry's front organization, permitting intoxication. The industry frequently refers to unrecorded alcohol in policy formulation to oppose realistic and cost-efficient remedies and promote market-friendly involvements. Evidence-based methods initiatives, including careful consideration of local context, are required to successfully address

problems associated with unrecorded alcohol. Unfortunately, two forces govern unrecorded alcohol, commercial demands and myth. Policymakers safeguarding its economic income. In the other hand, for the scientific community, this is a desolate wasteland. The technique of addressing not only unrecorded but also reported and full alcohol consumption and problems is hindered by a lack of data. Perhaps significantly, efforts targeting unrecorded alcohol may be utilized as a complement rather than a substitute for attempts to fight registered alcohol. Regardless of its legal status, a certain amount of ethanol is equally hazardous.

5. CONCLUSION

The research looked at 50 various types of alcoholic beverages (Brandy, Whiskey, Rum, Beer, Vodka, and Toddy) produced by local brewers in Kerala to determine whether adulterants (Methanol, Copper, and Furfural) were present and at what quantities. The chemical tests were conducted on all 50 samples, and no positive results were discovered on any of them, suggesting that the alcohol samples are free of adulteration. So that they're safe to consume. Functional measurements such as colour and odor analysis revealed the physical composition of the beverage samples, while microscopic inspection of samples 21, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, and 50 revealed the presence of sediments when examined under a microscope, indicating that the alcoholic beverage samples had not been properly purified.

In the instrumentation process, a UV-Visible spectrometer was utilized to confirm the presence or absence of furfural and to quantify its concentration in the provided sample. The absorbance of each solution was determined at absorption limit using 10mm quartz cuvettes using a working regular solution. The samples 2,5,13, and 19 were found to have the highest absorbance at 280nm, and the normal furfural solution likewise had the greatest absorbance at 280nm, according to the UV-Visible spectrometer findings. At 281nm, the highest level of furfural concentration was discovered in sample 6, i.e. 0.88910-3 mg/ml, while the lowest level of furfural concentration was found in sample-8, i.e. 0.11310-3 mg/ml. Many chemical tests may be performed to evaluate furfural concentrations, however in this study, a UV-Visible spectrometer was employed since it is highly sensitive and gives exact concentrations of the material under inquiry.

REFERENCES

[1] B. Askew and D. B. Lisle, "Variation in the concentrations of higher alcohols, methanol and ethyl acetate in brandies," *J. Sci. Food Agric.*, 1971, doi: 10.1002/jsfa.2740220216.

[2] M. S. Sankhla, "Determination of adulterants in suspected liquor samples using chemical tests," *MOJ Toxicol.*, 2018, doi: 10.15406/mojt.2018.04.00118.

[3] D. K. Molina and V. M. Hargrove, *Handbook of Forensic Toxicology for Medical Examiners*. 2018.

[4] H. Zhang, Q. Ping, J. Zhang, and N. Li, "Determination of Furfural and Hydroxymethyl furfural by UV Spectroscopy in ethanol-water hydrolysate of Reed," *J. Bioresour. Bioprod.*, 2017.

[5] P. Panagiotopoulou and D. G. Vlachos, "Liquid phase catalytic transfer hydrogenation of furfural over a Ru/C catalyst," *Appl. Catal. A Gen.*, 2014, doi: 10.1016/j.apcata.2014.04.018.

[6] C. A. Castro-Donlan, "Impact of co-occurring disorders: Adolescent functioning post alcohol and other drug treatment," *Diss. Abstr. Int. Sect. B Sci. Eng.*, 2018.

[7] World Health Organization, "Harmful use of alcohol," *NMH Fact Sheet*, 2009.

[8] R. Nagarajan, R. Mehrotra, and M. M. Bajaj, "Quantitative analysis of methanol, an adulterant in alcoholic beverages, using attenuated total reflectance spectroscopy," *J. Sci. Ind. Res. (India).*, 2006.

[9] Y. Zhou, J. Zheng, S. Li, T. Zhou, P. Zhang, and H. Bin Li, "Alcoholic beverage consumption and chronic diseases," *International Journal of Environmental Research and Public Health*. 2016, doi: 10.3390/ijerph13060522.

[10] W. D. Shoesmith, N. Oo Tha, K. S. Naing, R. B. H. Abbas, and A. F. Abdullah, "Unrecorded alcohol and alcohol-related harm in rural Sabah, Malaysia: A socio-economically deprived region with expensive beer and cheap local spirits," *Alcohol Alcohol.*, 2016, doi: 10.1093/alcalc/agw005.