Original Paper

Differentiation of Different Brands of Alcoholic Beverages by Trace Element Profile - A Pilot Study

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ABSTRACT

A pilot study was conducted to differentiate various brands of alcoholic beverages commonly sold in Hyderabad city (Andhra Pradesh, India). Various brands of liquor were scanned up to parts per billion (PPB) level for more than 72 elements using the following method – Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES).

The results obtained showed significant difference in the elemental profiles of various brands of liquor. Absence of some elements such as copper showed marker parameter for the liquor brands. This survey shows that trace elemental profiling could be a reliable method for differentiating various brands of liquor.

Key Words: Alcoholic beverage; Liquor; Inductively coupled plasma atomic emission spectroscopy; ICP-AES

Introduction

Various brands of alcoholic beverages are available in the Indian market. They differ not only with regard to ethyl alcohol content (percentage), but also presence or absence of certain other active ingredients. The average ethyl alcohol content in some brands of liquor available in Hyderabad city of Andhra Pradesh state are mentioned in **Table 1**.

Ethyl alcohol (ethanol) in the form of various beverages such as beer, wine and distilled spirits is one of the commonest substances of intoxication used and abused by man through centuries. Pure ethanol is a transparent and volatile liquid, having a characteristic spirituous odour and a burning taste.[1] It is very hygroscopic, boils at 78.40°C, and burns as a blue, smokeless flame. Absolute alcohol contains 99.95 percent of alcohol. Rectified spirit contains 90 percent by volume of alcohol. Ethanol is used as a solvent for resins, fats, volatile oils, bromine, iodine etc., and as an antiseptic, chemical intermediate, and is present in alcoholic drinks.

Ethanol exists in alcoholic beverages in varying proportion. It is a small, water-soluble molecule, and its rate of migration into or within the body is dependent on its concentration in the fluids on either side of a membrane, as well as the nature of the membrane itself.[2] Ethanol is commonly ingested, and its absorption takes place via the gastrointestinal tract. It can also be absorbed through the lung if it is present in inspired air. When oxidized, ethanol is converted into aldehyde and acetic acid.

This study was carried out by collecting different alcoholic brands available in the local market, which were then coded. The quality and price of alcoholic beverages depends upon the raw material used and quantity of ethanol present. Inferior quality beverages are sometimes sold in the name of high quality brands. In order to distinguish between the various brands of liquor commonly sold locally, elemental analysis of the different brands were carried out on Jobin Yvon JY-24 Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES), with the help of Image Analysis standard less software.

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Table 1 Ethanol Content of Common Alcoholic Beverages

Beverage	Source	Alcohol Content (% by volume)
Beer	Barley	3-6
Wine	Fruit (Grape, Apple)	8-10
Whisky	Barley	40-50
Gin	Juniper Berries	40-50
Rum	Molasses	45-50
Brandy	Peaches, Cherries	40-50

Materials and Methods

One ml sample each of different brands of locally available liquor brands was taken and air dried under exhaust, and then dissolved in 1 mL of HNO_3 and 1 mL HCl, following a trial and error method of the standard wet digestion of organic compound process. A concentration of 2.5M was selected for the digestion. After dissolution of the dried sample, the solution was made to 3 ml with 0.1M HCl; blank was processed in the same way. The presence of 72 elements of the periodic table were scanned in the samples at wavelengths from 180 nm to 850 nm, and qualitatively analyzed. The analysis was done by sequential Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES). This is an excellent tool with several features such as high sensitivity for most of the elements in the periodic table, high speed, matrix effect correction, etc.[3]

In the ICP-AES technique, the sample solution is first aspirated by a nebuliser into micron-size droplets before being introduced into the plasma where the sample is decomposed, atomized, ionized, and finally excited. The excited electrons re-emit the energy they have acquired in the form of electromagnetic radiation, which is composed of wavelengths characteristic of the element emitting the radiation. The discrimination of these wavelengths is performed by an optical system called a monochromator, which is then fed to a photo multiplier tube (PM tube). The PM tube transforms the radiation into electric signals that are captured by the data processing system.

Table 2 Elemental Profile of Common Liquor Brands

Brand Name	Code No.	Na	Mg	Ca	Ni	Cu	Zn	Ba
Blank	JAIBLK							
Blenders Spirit Whisky	JAIS1	+	+	+	+	+	+	+
Directors Special Whisky	JAIS2	+	+	+	+	+	+	+
Hercules Rum	JAIS3	+	+	+			+	+
Imperial Blue Whisky	JAIS4	+	+	+		+	+	+
Royal Stag Whisky	JAIS5	+	+	+	+	+	+	+
8 PM Excellency Brandy	JAIS6	+	+	+	+			+
Mansion House French Brandy	JAIS7	+	+	+	+			
Signature Whisky	JAIS8	+	+	+	+	+		
Fosters Beer	JAIS9	+	+	+	+		+	+
Fosters Beer Repeat	JAIS9A	+	+	+	+		+	+
Fosters Beer Repeat	JAIS9B	+	+	+	+		+	+
Golden Eagle Beer	JAIS10	+	+	+	+		+	+
8 PM Regular Whisky	JAIS11	+	+	+	+	+		+
Hayward's 5000 Beer	JAIS12	+	+	+	+		+	+
Kingfisher Premium Beer	JAIS13	+	+	+	+		+	+
Officers Choice Whisky	JAIS14	+	+	+	+	+		+
Good Day Malt Whisky	JAIS16	+	+	+	+	+	+	+
McDowells Rum	JAIS17	+	+	+			+	+

Results and Discussion

Blood and urine analysis helps forensic investigators in detecting the presence or absence of alcohol in drunkenness cases, while viscera sample analysis becomes important in deceased individuals in whom the establishment of this fact is deemed imperative for some investigative purpose.[4,5]

In the study being presented, the elemental profile of various liquor samples was carried out by the digestion of the samples, and the analysis was done with ICP-AES. The results are mentioned in **Table 2**. A gaussian curve at the corresponding wavelength indicates the presence of the element. It is ensured that the gaussian curve appears at least in the first and second wavelength window. The intensity of the curve of sample is verified as to whether the intensity is above that of the blank intensity of the element. This is to ensure that the gaussian curve present is contributed by the sample and not the blank. The positive sign given with respect to each element is the intensity value of the peak of the corresponding element obtained on qualitative analysis. The element present is deduced as positive by subtracting from the blank results. The results of sample JAIS15 have not been included, as there was a shift in the wavelength of the results for all the elements.

It is evident that there is a characteristic pattern of elemental copper in all the whisky samples, which could be used as a marker for the differentiation of the different liquor brands. The absence of elemental nickel and copper in the samples of rum is also found to be characteristic for rum. The absence of copper and zinc in the samples of brandy is also characteristic, as also absence of copper in the samples of beer.

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