Rapid Qualitative Test for Drunkenness Detection and the Presence of Alcohol in Beverages

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Abstract

In many situations like car accidents, troubles and crime scenes we need to know if someone is drunk. This research includes rapid test to detect the alcohol drinking for those that not exhibit any signs of drunk like ataxia and vomiting, and to detect the beverage containing alcohols. The study included 30 volunteers of alcoholics and five types of beverages (Whisky, vodka, beer, wine and barbican). The sampling includes random quantity of sputum and 2 ml of blood from the volunteers. The sputum and beverages are examined by qualitative method depending on the change of dichromate solution color which is saturated and dried up on a filter paper piece in polyethylene container ready for use. If the color changes from yellow to blue-green this means that the sample contains alcohol and the result is positive, and if the color of dichromate dose not changed the result is negative and the sample dose not contains alcohol. The blood samples were examined by the measuring of GGT enzyme to confirm alcohol drinking. All of the sputum samples showed positive results by changing the color of dichromate. All of the beverages except barbican showed positive results this means that these beverages contain alcohol while barbican not. The values of GGT for volunteers were higher than the normal values which confirm the test of sputum.

***Key words**: Alcoholics, beverages, sputum and potassium dichromate.*

Introduction

Alcohols are organic compounds which contain hydroxyl functional group (OH) connected to carbon atom.[1] The term alcohol belongs to primary alcohol ethanol which is the predominant type of alcohol in beverages produced by fermentation of sugars via yeasts[2]. Alcohols are neurotoxic and psychoactive drugs,[3]. Alcohols can cause alcohol intoxication when consumed in large amounts. Ethanol is colorless, flammable, liquid, light chemical odor with chemical formula CH_3CH_2OH which is abbreviated to C_2H_5OH.[4]. Ethanol has many uses like antiseptic,[5], antitussive,[6], antidotes[7], chemical solvent[8] and recreational[9]. Although alcohol has many benefits, its drinking causes adverse effects like ataxia (10), gastrointestinal diseases (11), cancer[12] and dependence,[13]. In human body ethanol is metabolized to acetaldehyde by alcohol dehydrogenase enzyme in liver and then oxidized by acetaldehyde dehydrogenase enzyme to acetyl Co-A which is the final product of fat and carbohydrate metabolism and can be used to produce energy. Ethanol is a macronutrient energetic molecule yields about 7 kcal.per gram[14]. The first product of ethanol metabolism acetaldehyde is more toxic than ethanol[15]. Acetaldehyde showed to increase the risk of developing cirrhosis and multiple forms of cancers[16]. When ethanol is metabolized by dehdrogenase liver enzymes NAD will be converted to reduced NAD, normally, NAD participates in the fat metabolism in the liver; therefore, alcohol competes with fat for NAD. Long term alcohol drinking leads to fat accumulation in the liver causing fatty liver. Alcoholism leads to cell death in the hepatocytes because the stored fat reduces the function of the cell. These cells are then converted to scar tissue leading to cirrhosis, Sherwood et al[17]. Liver can metabolize certain amounts of alcohol, when the consumed alcohol exceeds the ability of liver to metabolize, alcohol reaches the heart and reduces the force of heart contraction. Consequently, the heart will pump less blood, lowering the total body blood pressure. When alcohol reaches the heart it also reaches the lungs, in this stage the person can breathe out trace of alcohol, this is the major principle of alcohol breath testing to determine if a driver has been drinking and drive [18].

Materials and Methods

Principle

Alcohol reacts with yellow potassium dichromate ($K_2Cr_2O_7$) to produce blue-green Chromium (III) sulfate. Therefore the appearance of blue-green color means the presence of alcohol when a solution is added to potassium dichromate as shown below[19].

2K2Cr2O7 + 8H2SO4 + 3CH3CH2OH → 2Cr2 (SO4)3 + 2K2SO4 + 3CH3COOH + 11 H2O

Orange-yellow alcohol blue-green

Preparation of test solution

In a clean dry 250 ml beaker add 5.0 ml of 0.25 M potassium dichromate ($K_2Cr_2O_7$) solution, add 1 drop of 0.1 M silver nitrate ($AgNO_3$) and swirl the beaker immediately after addition, add 5.0mL of 6 M sulfuric acid (H_2SO_4) and swirl the beaker immediately after addition. The color of this test solution is orange – yellow which is converted to blue – green after the addition to alcohol or the addition of any solution containing alcohol.

Technique: Saturate a filter paper with test solution prepared above for about 3 hours then dry this filter paper by using drying oven on 30°c until it be dry. The filter paper now is dry orange color containing the test solution; the filter paper is only holder for test solution. Cut the filter paper in a circle shape in a diameter of 3 cm and put it in plastic translucent cylindrical container with a volume of 10 ml and cap the container. The plastic container now is ready for use.

Sampling: The samples that are examined are sputum, blood, and beverages. The sputum and blood were collected from 30 volunteers, while the beverages (Whisky, vodka, beer, wine and barbican) were purchased from markets. The sputum samples and beverages have been examined by potassium dichromate test, while the blood samples are used to determine the concentration of GGT enzyme as confirmatory test of alcohol drinking. Sputum of non alcoholics and water were used as a control to be compared with alcoholics and beverages respectively.

Test procedure

1. Open the cap of the plastic container that contains the test solution filter paper.

2. Add the sample under test in a quantity of 1 – 3 ml.

3. Recap the plastic container and shake it gently for 5 minutes.

4. Notice the color change and record the result.

5. You can add ethanol instead of sample to checkup the validity of test.

GGT determination

The GGT level was determined by colorimetric method using assay kit from Linear Company.

Results and Discussion

The results showed a positive test for all beverages except barbican meaning that all the beverages contain alcohol, while barbican does not contain. The positive results means that the color of filter paper test solution is converted to blue color, the density of color is directly proportional to the concentration of alcohol present, so dark blue color means the presence of large percentage of ethanol. The samples of sputum gave a positive result for drunks and negative results for non alcoholics (control). In the sample of low ethanol concentration the color of dichromate disappeared only, this means a positive result. The results are depicted in Table 1and 2. The results of GGT determination showed an increase in the level of GGT for drunks in comparison with non alcoholics (control) and with normal values of W.H.O. This increase confirm the dichromate test because GGT level is an indicator for alcoholics and its level increases directly with the amount of alcohol consumption.

Table 1: The results of sputum samples

Sample	Drunks result	Control result	Positive result type	Negative result type
sputum	Positive	Negative	Color changes to blue	No changes in color

Table 2: The results of beverage samples

Sample	Result	Result type
Whisky	Positive	Color change to blue
vodka	Positive	Color change to blue
Wine	Positive	Color change to dark blue
beer	Positive	Color change to light blue
barbican	Negative	No change in color
Water	Negative	No change in color

The results depend on the presence of ethanol in the sample; if the sample contains ethanol positive result will appear and negative result appears if the sample does not contain alcohol. The density of appeared color depends up on the concentration of ethanol, dark blue-green color appears in high ethanol concentration and light blue in low concentration and the color of dichromate may disappear only in very small amounts of ethanol. The results are depicted in figure 1. The mechanism of this experiment depends on the presence of alcohol which reacts with an orange-yellow chemical compound called potassium dichromate ($K_2Cr_2O_7$). When the alcohol reacts with the potassium dichromate, a blue-green compound called Chromium (III) sulfate is produced. The reaction is as follows:

$$2K2Cr2O7 + 8H2SO4 + 3CH3CH2OH \rightarrow 2Cr2(SO4)3 + 2K2SO4 + 3CH3COOH + 11\ H2O$$

Conclusion

The results obtained showed a good method can be used to detect the drunkenness and presence of ethanol in various beverages; this is benefit for the investigation in crime scenes and for qualitative control and measuring. The method is rapid needs for five minutes only.

Conflict of Interest: Nil.

Source of Funding: Self.

Ethical Clearance:

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