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1. Learning Outcomes

After studying this module, you shall be able to know about-

- The significance of some common items of daily use
- Their forensic importance and examination
- Some procedures of laboratory examination

2. Introduction

There was a time when food and daily use items were only used for their genuine purpose, food materials to meet food necessity and the other items for respective usage. As the human civilization developed, so did the criminal mindedness. In order to gain more monetary benefits, illegal activities originates out from the vivid minds. They started adulterating in the various daily use items with extraneous substances to fulfill their felonious intents. However, the adulterations were so naïve that they were reluctantly tolerated by the society as those defilements were fairly noticeable and be removed, but as it is the criminal psychology which motivated to generate other innovational activities which prevented a layman to identify the adulterations. Still, some of the items were not decipherable from the beginning such as Jewelries, Petro Products, dairy products, etc. Jewels and ornaments have fascinated the women from the almost advent of the human civilization and which makes them more vulnerable for criminal activities. Thus, the manufacturer may add other metals, of similar texture and colour, in the gold or silver items in the process of manufacture. Similarly, due to the international crisis of petro-products due to its scarcity and limited resource, they are frequently mixed with various chemical compounds. In the case of Alcohols, they are easily available in the market to every man, what makes them so open to misuse. The answer is the laws and rules of the respective state. Liquors are manufactured only with the prior permission from the governing authority and the state administration.

In order to escape from rules and regulations and procedures, one clandestinely manufactures liquor by the limited sources which have been deprived to him due to its ineligibility. To overcome the shortage of resources added with the aim to earn more, cheap substitutes are added. This problem is not only limited for the illegal manufacture of liquor but also it is frequently observed in the Country made liquors. This may sometimes may not be intentional but the contamination is though a menace.

3. Forensic Issues

Oils and fats examination covers a major part in forensic chemistry as these are often adulterated in many ways which are adulteration of lower grade, diverse origin or misbranding or contra-banding of products etc. The cases as above may occur recurrently as oils and fats are extremely used as cooking means and also in industries like paints, varnishes, and pharmaceutical industries. There may be theft cases or unlawful possession associated to oils and fats. In such cases the samples are frequently referred for their examinations for different purposes under the Essential Commodities Act 1955. The samples are very often required to be tested for various factors based on physical and chemical properties of individual oil and fat to determine the nature, quality, adulteration etc. Similarly in the case of Gold as it is a precious and valuable metal. These ornaments are required their preservation which includes repairing and polishing etc. These exhibits are to be examined in the laboratory for the analysis of gold. Equally, Petroleum Products most frequently referred to any Forensic Science Laboratories for examination are Petrol, Kerosene, Diesel, Lubricating oil, furnace oil, waste oil, etc. These samples are forwarded to Forensic Science Laboratory for their purity, detection of adulteration if any. Liquor is normally known as a mixture of water and alcohol. Samples are seized by the Police and submitted to the Forensic Laboratory for their examination. The liquor is examined in the laboratory for two purposes, firstly, for Excise purpose where, mainly the presence of alcohol plays an important role and accordingly the examination of liquor samples for the qualitative and quantitative analysis is the main purpose of the investigation and secondly, the liquor is examined for quality control or duplicate samples, which are being peddled in the market.

4. Examination of Edible Oils

4.1 Detection of Argemone in Edible Oils

Ferric chloride test: About 5ml of filtered oil is taken and dissolved in 5ml of toluene in a stoppered glass test tube. 5 ml of concentrated hydrochloric acid is added to it. It is then shaken vigorously and allowed the acid layer to separate. The acid layer is separated with the help of separating funnel to a test tube. 1 ml of Ferric chloride solution is added to it through the side wall of the test tube. The reagent and acid layer is mixed well in the test tube and heated in water bath for about 10 minutes. On cooling, formation of straight or curved needle shaped reddish brown crystals in clusters indicates the positive test for the presence of Argemone oil. The method is not sensitive enough to detect argemone oil in less than 0.1% level.

4.2 Detection of Mineral Oils in Edible in Oils

About 22 ml of the 0.5 N alcoholic KOH solution is taken in a conical flask and 1ml of the suspected oil sample is added. It is then boiled till the mixture becomes clear and free from any oil drops on the side wall of the flask. The whole content is transferred into a wide mouthed warm test tube. After that 25 ml of boiling water is added along the side of the wall and shaken lightly. The appearance of turbidity indicates the positive test for the presence of mineral oil.

4.3 Detection of Hydrocyanic Acid in Edible Oils

15 –30 ml of suspected oil sample is taken in a 250 ml conical flask, and about 50 ml of water is added and mixed well. To it 15 ml of 10% tartaric acid solution is added and mixed. A stopper is put to the flask, with a velvet cork from which a picric acid soaked paper is hanged of about 75 mm long wetted with a drop of 5% sodium carbonate solution. The flask is kept on a hot water bath by the side of the steam vent but not directly on the steam for 30 to 45 min. The red colour on picric paper indicates the presence of hydrocyanic acid.

4.4 Detection of Coal Tar Oil and Soluble Colors in Edible Oils

About 5 ml of suspected sample of oil is taken in some test tubes. 15 ml of petroleum ether is added to each tube followed by 5ml of HCl of different concentrations (4:1, 3:1, 2:1, and 1:1 of HCl and water). Change in color indicates the presence of coal tar oil soluble colors in the sample.

5. Examination of Gold Ornaments

5.1 Analysis of Gold Polishing Powder

Generally the gold polishing powder is reddish in colour and shows the presence of inorganic radicals such as Copper, Sodium, Potassium, Ammonium, Iron, Chloride, Sulphate, Nitrate etc. The analysis of gold polishing powder is carried out by the procedures used for the analysis of inorganic qualitative analysis. The gold polishing powder may also be tested for the presence of Gold.

5.1.1 Test for Copper

5.1.1.1 Test with Ammonium Hydroxide

The test sample solution (the sample is dissolved in water or HCl or HNO_3 or Aqua-Regia to form original solution) is taken and Ammonium Hydroxide is added to it. Appearance of blue color indicates the positive test for the presence of Copper.

5.1.1.2 Test with Alizarin blue

A drop of reagent (saturated solution of Alizarin Blue in Pyridine) is taken in a spot plate and to it a drop of test solution is added. A parallel blank test should be run with water also. Blue color appears in both the cases. Now 1-2 drops of Acetic Anhydride is added, the color in the blank test converts into yellow but remaining of blue-violet precipitate in test sample indicates the positive test for the presence of Copper.

5.1.1.3 Test with Glacial Acetic Acid

1- 2 drops of test solution are taken in a depression spot plate and evaporated to dryness. A drop of Alizarin Blue reagent is added followed by a drop of Glacial Acetic Acid. Appearance of blue-violet color indicates the positive test for the presence of Copper.

5.1.1.4 Flame Test

Copper gives bluish green color when it is tested by flame test.

5.1.2 Test for Iron

5.1.2.1 Test with Potassium Ferrocyanide:

Few drops of test solution or original solution are taken in test tubes, and to it a drop of conc. Nitric acid is added and boiled for few minutes. Potassium Ferrocyanide solution is then added to it. Appearance of blue color indicates the positive test for the presence of Iron.

5.1.2.2 Test with Thiocyanate

Few drops of test solution or original solution are taken, and to it a drop of conc. Nitric Acid is added and boiled for few minutes. After that Ammonium or Potassium Thiocyanate solution is added. Appearance of red color indicates the positive test for the presence of Iron.

5.2 Test for Gold

5.2.1 Test with Benzidine:

Preparation of Reagent: 0.05% solution of Benzidine in 10% Acetic Acid

Few drops of the exhibit solution are placed on a filter paper and added 1-2 drops of Benzidine reagent solution on it. A blue colour appears on the filter paper, which indicates the presence of gold.

5.2.2 Test with Rhodamine B

Preparation of Reagent: 0.2% aq. Rhodamine B solution

Few drops of the exhibit solution is placed in a micro test tube and added one-two drops of Hydrochloric acid and 1-2 drops of Rhodamine B reagent solution and mixed properly. The test tube is shaken with about 8-10 drops of benzene. Appearance of red-violet to pink colour in benzene layer indicates the presence gold. After about 1-2 minutes it displays an orange fluorescence if it is observed under quartz lamp.

5.2.3 Test with Oxalic Acid

An appropriate portion of the exhibit generally heated till NO_2 fumes removed. This solution is made alkaline by adding Sodium Hydroxide solution. Solid Oxalic Acid was added and generally heated. Brownish black precipitate indicates the presence of gold.

6. Examination of Petroleum Products

Filter Paper Test for the detection of Kerosene or Diesel in Petrol

Petrol is highly volatile liquid fuel. It is a clean fuel. Hence drops of Petrol vaporize extremely fast and they vanish without leaving any trace behind. Kerosene and other high boiling compound are very much less volatile as compared to Petrol and it does not vaporize quickly. Hence, if Petrol containing Kerosene or Diesel is placed on any filter paper, Petrol will evaporate leaving behind Kerosene/Diesel, which looks like oily patch with characteristic smell of kerosene or diesel. If Petrol is adulterated with volatile hydrocarbon solvents like aliphatics, aromatics, naphtha, etc., then this test may not detect the adulteration.

7. Examination of Alcohol in Liquor

7.1 Test for Ethyl Alcohol

7.1.1 Iodoform Test:

Appropriate amount of sample (distilled or as such depending upon the nature of sample and concentration of ethanol) is taken and about 1 ml of 5% Sodium Hydroxide solution added to it and then iodine solution (20 gm Potassium iodide + 10 gm Iodine in 100 ml water) is added drop-wise with shaking until the liquid becomes persistent dark brown in colour. It is kept for 2-3 minutes. If the iodine colour disappears more drops of iodine solution is added until persistent brown colour of iodine appears. Few drops of dilute Sodium Hydroxide solution are added to remove extra iodine. Equal volume of water is added and left for ten minutes. Yellow crystalline precipitate indicates the positive test for the presence of Ethanol.

7.1.2 Dichromate Test

About 1 ml or appropriate amount of sample (distilled or as such depending upon the nature of samples and concentration of ethanol) is added with about 0.2 ml of 2% Potassium Dichromate solution followed by about 1 ml of concentration Sulphuric Acid. The yellow colour of the dichromate changes to green or blue indicates the presence of ethanol.

7.2 Test for Methanol

7.2.1 Chromotropic Acid Test

About 1 ml or appropriate amount of sample (distilled or as such depending upon the nature of sample and concentration of methanol) is taken in a test tube and about 2 ml of Potassium Permanganate solution (3 gm potassium permanganate and 15 ml of Phosphoric/Ortho Phosphoric Acid in 100 ml distilled water) is taken and shaken well. Now few crystals of Sodium Bisulphate are added with shaking till disappearance of colour (Potassium Permanganate colour) of the solution. About 1 ml of Chromotropic Acid (5% of aqueous solution of sodium salt of Chromotropic Acid) and concentrate Sulphuric Acid is added slowly with inner sidewall of the test tube to the extent of 15 ml. Appearance of violet colour indicates the presence of Methanol.

7.2.2 Schiff's Reagent Test

About 4.5 ml of sample (distilled or as such depending upon the nature of sample) is taken in a test tube and 0.5 ml of ethanol (if the concentration of ethanol is high in the sample, the sample is fortified accordingly is added so that 5 ml volume should contain only 0.5 ml ethanol. 2 ml of 3% Potassium Permanganate solution and .2ml of Phosphoric Acid is added.

The whole content is left for 10 minutes. 1 ml of 10% Oxalic Acid is added followed by 1ml of concentrated Sulphuric Acid. The contents are cooled at room temperature. 5 ml of Schiff's reagent is now added and kept for half an hour to observe the colour. Appearance of purple colour indicates positive test for the presence of methanol.

7.3 Test for Furfural

About 5 ml or appropriate amount of sample (distilled or as such depending upon the nature of sample and concentration of furfural) is taken in a test tube and about 1 ml Aniline and about 0.5 ml Hydrochloric Acid is added to it and kept for 15 minutes. Appearance of red colour indicates the presence of Furfural.

Alternative method

About 2 ml or appropriate amount of the sample (distilled or as such depending upon the nature of sample) is taken in a test tube and about 0.2 ml of Aniline and about 0.4 ml of Glacial Acetic Acid is added to it. If the furfural is present in the sample, red colour develops in a few seconds & reaches its maximum intensity in 5-10 minutes.

8. Summary

- Oils and fats may be divided into two classes based on their origin, vegetable oil and animal fat. The words oil and fat are synonymous. They differ in their physical state i.e. oil is liquid and fat is solid.
- The examination of oils and fats is based on their composition. Oils and fats are tri-glycerides of fatty acids of saturated and unsaturated acids (oleic, linoleic, linolenic) in varying proportions.
- The criminals often polish the ornaments with polishing powder and by using aqua-regia solution. Generally, criminals dupe the housewives in the name of cleaning and polishing their ornament and dissolve the gold from their ornament in aqua-regia during the process of cleaning/ polishing.
- In order to adulterate petrol, Diesel and Kerosene is mixed very often as they are cheap in compare to the petrol.
- Methanol is a cheap substitute of ethanol used in the illegal liquor manufacturing units.
- There is a varied difference between the illicit liquor manufacture and the Country made liquor. Even though, the use of methanol for malafide purpose cannot be denied in either case.