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METHODS FOR DETECTION OF COMMON ADULTERANTS IN FOOD

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Abstract:*Food is essential forliving. Food adulteration deceives consumers and can endanger their health. The purpose of this document is to list common food adulterant methods commonly found in India. An adulterant is a substance found in other substances such as food, cosmetics, pharmaceuticals, fuels, or other chemicals that compromise the safety or effectiveness of that substance. The addition of adulterants is called adulteration. The most common reason for adulteration is the use of undeclared materials by manufacturers that are cheaper than the correct and declared ones. The adulterants can be harmful or reduce the effectiveness of the product, or they can be harmless.*

Keywords:*Adulteration, food, cosmetics, pharmaceuticals, fuels, effectiveness.*

I. INTRODUCTION

Generally adulterant is added in any food item to increase its volume, weight etc. as well as to decrease its costing.Some of the most common adulterated foods are milk and dairy products, atta, edible oils, cereals, spices (whole and ground), legumes, coffee, tea, confectionery, baking soda, soft drinks, vinegar, besan, curry powder, etc. In general there are three types of Adulterants: 1) Intentional adulterants: like sand, marble splinters, stones, mud, other dirt, talc, chalk powder, water, mineral oil and harmful colors. 2) Secondary adulterants: e.g. pesticide residues, rodent feces, larvae in food. 3) Metallic impurities: e.g. arsenic from pesticides , Lead from water, waste water from the chemical industry, tin from cans. Adulterants can even be due to mishandling of ingredients as well as improper packaging.

Laboratory detection of adulteration in food items includes various methods such as High Performance Liquid Chromatography (HPLC) for analysis, HPTLC for investigation, GCMC, LCMS-MS for chemical analysis and many more. Such laboratory methods are based on some basic parameters of validation such as accuracy, precision, linearity, limit of detection, limit of quantitation, specificity and robustness. This methods require various instrumentation which is very costly. Laboratory methods provides us the exact results of adulteration with its various range of risk i.e. high, moderate, less depending upon the percentage of adulteration. Adulteration involves alteration in pH of the material and hence can cause severe problems in a healthy life style.

This paper is focused upon the methods of home detection of adulteration in our day to day essential food commodities with available material at home and few laboratory methods for the same. This inhouse methods provides us with the result of purity and impurity, though its percentage for the same cannot be measured, whereas laboratory methods gives accurate percentage wise result with the help of chromatographical detection. The paper also focus on the alteration of pH, its effects and its permissible limits.

II. EXPERIMENTAL

Adulteration of milk with H_2O

Such types of adulterants can give rise toother stomach disorders.

Testing method: Split milk on a polished slanting surface, Pure milk resist to move or moves slowly leaving a white mark behind.Milk adulterated with water will flow immediately without leaving a mark.

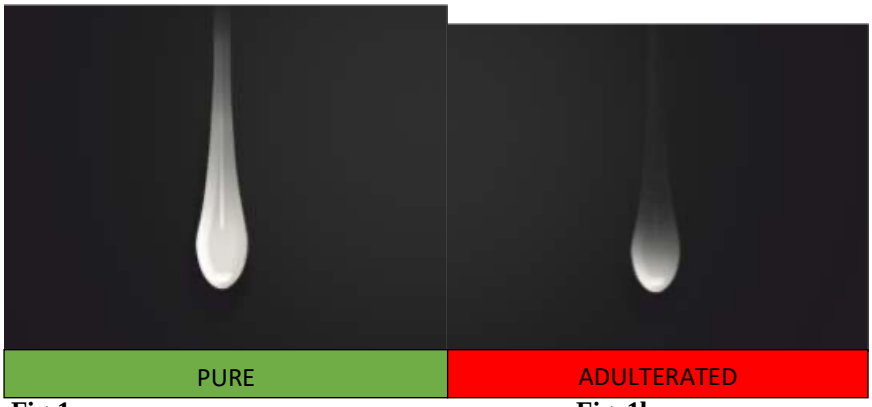

Fig:1a. **Fig. 1b.**

Detection of detergent in milk

Such types of adulterants can give rise to other stomach disorders.

Testing method: Take H_2O:milk in 1:1 proportion and shake thoroughly, If adulterated milk forms thickfroth whereasPure milk will form very finefroth due to distress.

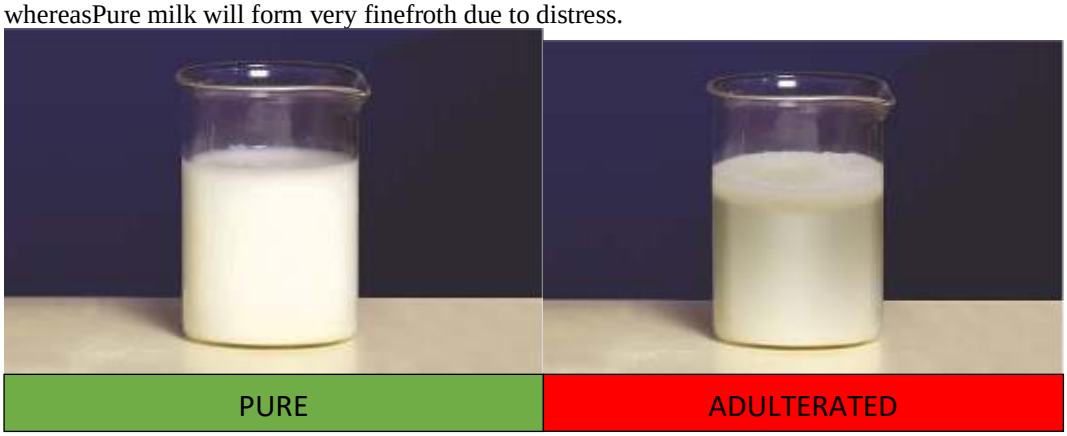

Fig: 2a **Fig:2b**

Adulteration of milk and milk products by starch. (khoya, chenna, paneer)

Such types of adulterants can give rise to gastro-intestinal disturbances and other stomach disorders.

Testing method: Take 1:2 proportion of sample: water, boil, cool + 2-3 drops of tincture iodine.Blue colour indicates the presence of starch, no change in colour if it is pure. (In case of milk, addition of water and boiling is not required.)

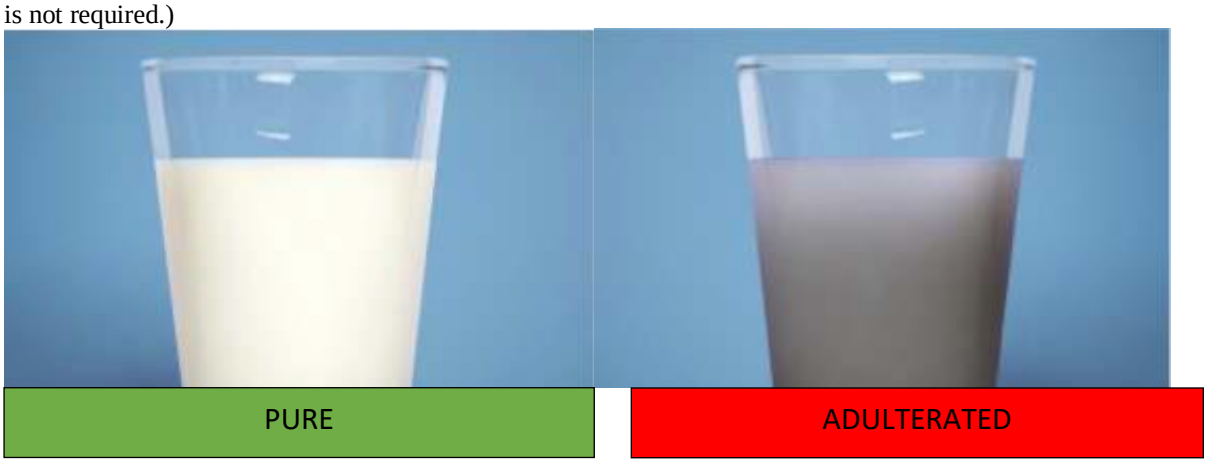

Fig:3a **Fig:3b**

Laboratory Test Method: For presence of sugar in milk, conc. HCl is added along with 0.1g resorcinol solution and place the test tube in water bath for 4-5 mins, if red colour appears indicates the presence of sugar similarly presence of starch can be detected by boiling, cooling milk and further adding 1 drop of 1% iodine solution, if blue color appears, starch is present, similarly for presence of glucose milk is treated with Barfoed`s reagent and heat in water bath then add phosphomolybdic acid reagent, if blue color appears the same is confirmed.

Acidity Test: Milk is treated with alizarin (dye) which changes the colour as per the pH.

Table No.1

Colour	Red-brown	Yellowish-brown	Yellow	Lilac/pale red
pH	6.6-6.7	6.4-6.6	< 6.3	> 6.8
Remark	Normal Milk	Slightly acidic	Acidic (coagulates)	Alkaline

Adulterationof ghee/butter by mashed potatoes, sweet potatoes and other starches.

Such types of adulterants can give rise to gastro-intestinal disturbances and other stomach disorders.

Testing method:1 teaspoon of ghee/butter + 2-3 drops of tincture iodine.Blue colour appears it shows the presence of mashedpotatoes, sweet potatoesand other starches.

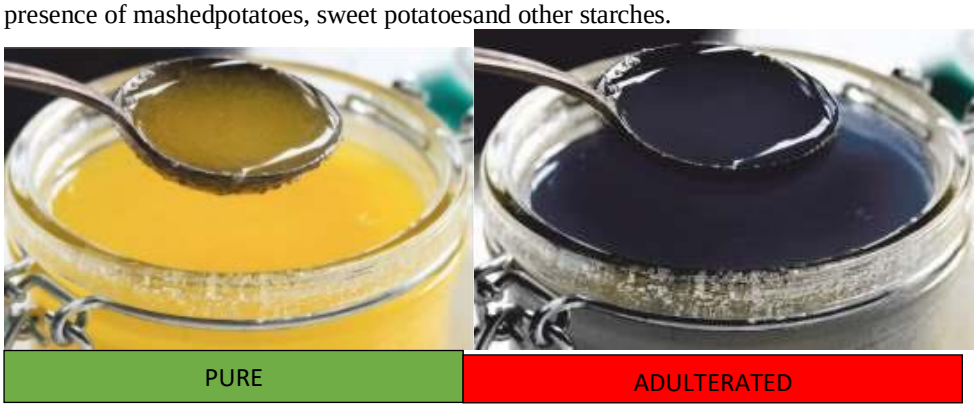

Fig:4a **Fig:4b**

Laboratory Testing Method: Equal proportion of pure ghee and tallow taken and melted separately + chloroform and make it homogeneous mixture, use it as stock solution. The same above procedure is repeated with different ratios of ghee and tallow ranging from 9:1 to 1:9 and studied in the range of 200-400 nm using UV visible recording spectrometer.

Detection of other oils in edible oils

Adulterants such as mineral oil, karanja oil, castor oil and artificial colours in edible oils can give rise to gallbladder cancer, allergies, paralysis, cardiac arrest and increased LDL cholesterol.

Testing method:

Take a transparent glass containing coconut Oil in it. Place this glass in refrigerator for 20-30 minutes. (no freezingrequired)

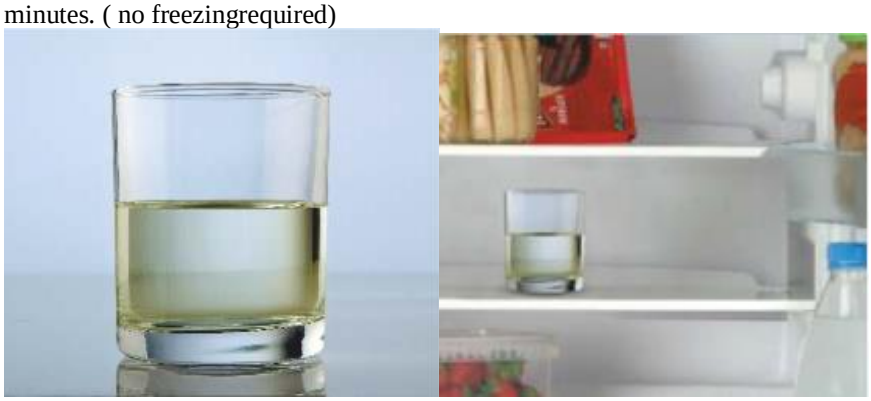

Fig:5a **Fig:5b**

Pure coconut oil solidifies.If oil is adulterated,

the other oil does not solidifyand remains as a separate layer.

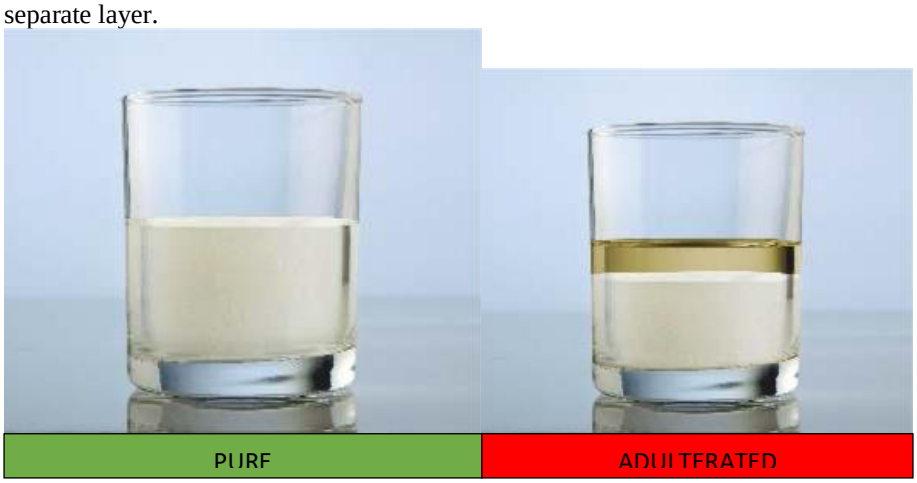

Fig:5c **Fig:5d**

Laboratory Testing Method: Analytical methods such as ESI-MS fingerprinting analysis, GC/MS, HPTLC fingerprinting, FTIR spectroscopy etc. are used to detect the exact concentration of adulteration.

Acidity Test:5gm sample + 50 ml neutral hot ethanol + 1ml phenolphthalein indicator, boil in water bath for 5 mins, titrate when hot with alkali shaking vigorously, gives pink colour.

Acid Value is given by: 56 X Normality of alkali X Volume of alkali/ weight of sample in grams.

The permissible value of ghee/butter/edible oils is 0.6mg NaOH/g

Detection of molasses, dextrose, sugar and corn syrups in honey

This type of adulterants results in stomach disorders.

Household Testing method 1:Testing method 2:

Water+ few drops of honeyLit a honey dipped cotton wick

pure honey will not disperse in

water and adulteratedwill disperse in Unadulterated honey will burn vigorously while

water, confirming thepresence of added sugaradulterated will produce cracking sound due to presence of water

Fig:6a **Fig:6b**

Laboratory testing method: Analytical methods such as isotopic chromatography, spectroscopy, trace elements techniques and thermal analysis can be opted. Differential scanning calorimetry (DSC) can examine heat flows resulting from phase transitions.

Acidity Test:1gm of sample + 7.5ml of CO_2 free water, mix + 1 drop of phenolphthalein indicator, titrate against sodium hydroxide solution till pink colour persists. Determine blank on water and calculate acidity by using formula: Acidity by weight = 0.23 X V(corrected vol. of 0.05 N NaOH)/ M (wt in gm of sample taken for test)

Purity of honey is measured in terms of hydroxymethylfurfural, high percentage of HMF in honey is a sign of additives or severe heat treatments, permissible value of HMF is 80 mg/kg.

Adulteration in sugar/powder sugar/ jaggery by chalk powder, washing soda

Testing Method: Sample + H_2O dissolve,if sample is adulterated, the adulterant will precipitate at the bottom. Such type of adulterants results in vomiting and other stomach disorders.

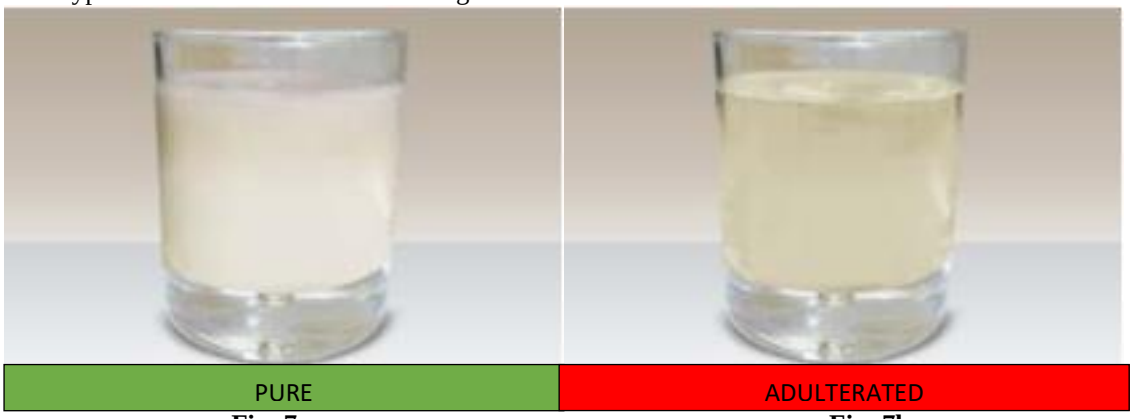

Fig: 7a **Fig: 7b**

Laboratory testing method: Sugar sample is treated with a few drops of conc. HCl, if gives rise to brisk effervescence, presence of chalk powder or washing soda is confirmed, further with the help of chromatography percentage of adulteration can be detected.

Acidity Test: Faster the rate of acidity (low pH) fastens the deterioration process of jaggery by inversion. Various jaggery samples were stored for a period of 3 months and following result were observed.

Table No. 2

Strains	Acidity
S98-SP-108	5.43
CPHS-35	5.23
CP81-1254	5.21
S2001-US-400	5.31
HSF-240 (std)	5.14

Adulteration in green chilli and green vegetables of malachitee green colour

Testing methods: Cotton piece soaked with water or vegetable oil is rubbed at the outer green surface of green vegetable/chilli, if the cotton turns green, then it is adulterated with malachite green. Such type of adulterants results in stomach disorders, vomiting and dyes used are highly carcinogenic.

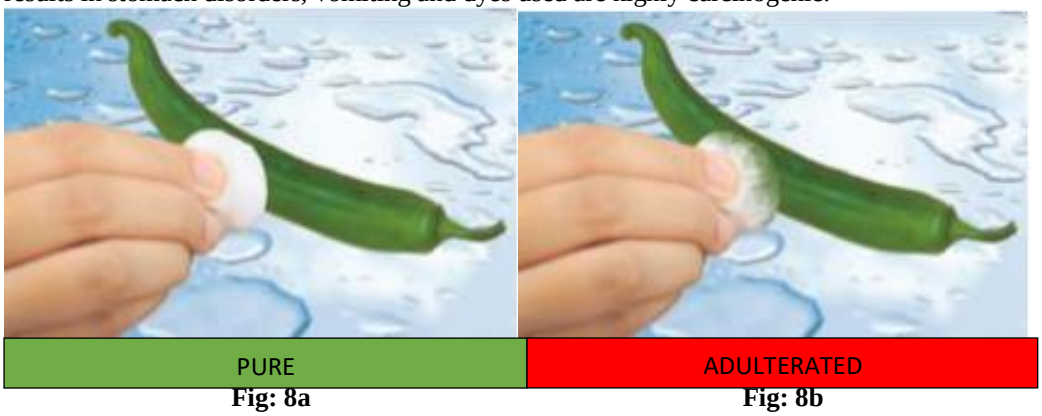

Fig: 8a **Fig: 8b**

Laboratory testing method: Microcantilever based sensors are used to detect presence of malachite green colour even when present at low concentrations.

Acidity Test: Permissible limit for malachite green is 2µg/kg.

Differentiation of common salt and iodised salt

Testing Method: Piece of potato + salt + wait for a minute + two drops of lemon juice, if the salt is iodised, appearance of blue colour will be seen, if it is common saltno blue colour will appear.

IODISED SALT COMMON SALT

Fig: 9a **Fig: 9b**

Laboratory testing method: Salt + distilled water, stir till it dissolves + white vinegar and hydrogen peroxide in equal proportion + starch solution, stir well, allow the solution to stand for few minutes, if blue-purple colour persists iodine content is confirmed.

Acidity Test: Various samples can be examined through HPLC and iodine content can be found. Permissible amount is 150 mcg/day for adults, 200 mcg/day for lactating or pregnant womens, lower amounts for childrens. Permissible alkalinity is 0.15%.

III. CONCLUSION

Selecting healthy and non-adulterated foods is essential to daily life to ensure that such foods do not pose any health risks. It is not possible to guarantee healthy food only by visual inspection when the toxic impurities are in ppm. Visually inspecting the food before purchasing it will ensure that there are no insects, visible fungi, foreign objects, etc. Avoid dark coloured, junk and other processed foods. Wash fruits and vegetables thoroughly in running water before it is used. Therefore, after careful examination, the care taken by the consumer at the time of purchase of the food can be of great help. Packaged foods are very important to know the ingredients and the nutritional value. They also help in checking the freshness of the food and the shelf life before use. The consumer should avoid taking food from an unsanitary place and preparing food in unsanitary conditions. Types of food can cause various diseases. Consumption of cut fruits sold in unsanitary conditions should be avoided. It is always better to buy certified food from certified stores.

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