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ORIGINAL ARTICLE

In-Vitro Assessment of Common Food Adulterants and Their Impact on Food Quality and Safety

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ABSTRACT
Food is one of the basic needs for every living being and is very important aspect for life. But nowadays foods are affected by different Adulterants Adulteration is a substance which reduces the viral importance of food. Adulterants like metanil yellow (an artificial colour) is used to identify the colour of the Turmeric Powder also adulterants like chalk powder; brick powder and toxic substances are added to gain profit and to lower the cost so as to compete with the market. Such adulterants can lead to anaemia, paralysis, brain damage, stomach disorders and also cancer. Spices may also be contaminated because of conditions under which they are cultivated and harvested. Contaminated spices have been reported to cause certain food -borne illnesses and spoilage. In our current study, we have collected a total number of products from various grocery stores and located in different parts of Hyderabad and performed a qualitative study for the detection of adulterants in them.
Keywords: *Food adulterants, Branded and unbranded; Food safety; Human health; Qualitative analysis.*

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INTRODUCTION

Adulteration is a practice of substituting original crude drug partially or wholly with other similar looking substances but later is either free from or inferior in chemical and therapeutic properties. Adulteration may be broadly defined as admixture or substitution of genuine articles with spurious, inferior, defective or harmless substances. [1, 2] Adulteration means incorporation of impurities in genuine or standard drugs. It may be accidental or deliberate. [3] Adulteration involves incorporation of impurities and also includes spoilage, deterioration, admixture with low grade and spoiled material or totally different material similar in appearance to the genuine drug. [4] The Federal Food, Drug, and Cosmetic (FD&C) Act (1938) provides that food is adulterated if it meets any one of the following criteria: [5]

Food Adulteration and Types of adulterants

Food adulteration can be of many types and the adulterants are of various substances below:

Poisonous or Deleterious substances

Generally, if a food contains a poisonous or deleterious substance that may render it injurious to health, it is adulterated. For example, apple cider contaminated with *E. coli* O157:H7 and Brie cheese contaminated with *Listeria monocytogenes* are adulterated. There are two exceptions to this general rule. First, if the poisonous substance is inherent or naturally occurring and its quantity in the food does not ordinarily render it injurious to health, the food will not be considered adulterated. Thus, a food that contains a natural toxin at very low levels that would not ordinarily be harmful (for instance, small amounts of amygdalin in apricotkernels) is not adulterated.

Second, if the poisonous or deleterious substance is unavoidable and is within an established tolerance, regulatory limit, or action level, the food will not be deemed to be adulterated.

Filth and Foreign Matter

In most cases, DALs are food-specific and defect-specific. For example, the DAL for insect fragments in peanut butter is an average of thirty or more insect fragments per 100 grams (g) [CPG § 570.300]. In the case of hard or sharp foreign objects, the DAL, which is basedon the size of the object and the likelihood it will pose a risk of choking or injury, applies to all foods (see CPG § 555.425).

Economic Adulteration

A food is adulterated if it omits a valuable constituent or substitutes anothersubstance, in whole or in part, for a valuable constituent (for instance, olive oil diluted with tea tree oil); conceals damage or inferiority in any manner (such as fresh fruit with food coloring on its surface to conceal defects); or any substance has been added to it or packed with it to increaseits bulk or weight, reduce its quality or strength, or make it appear bigger or of greater value than it is (for example, scallops to which water has been added to make them heavier).

Microbiological Contamination and Adulteration

For meat and poultry products, which are regulated by USDA, the rules aremore complicated. Ready-to-eat meat and poultry products contaminated with pathogens, such as *Salmonella* or *Listeria monocytogenes,* are adulterated. (Note that hotdogs are considered ready- to-eat products.) For raw meat or poultry products, the presence of pathogens will not always render a product adulterated (because raw meat and poultry products are intended to be cooked and proper cooking should kill pathogens). Raw poultry contaminated with *Salmonella* is not adulterated. However, USDA's Food Safety and Inspection Service (FSIS) have ruled that raw meat or poultry products contaminated with *E. coli* O157:H7 are adulterated. This is because normal cooking methods may not reduce *E. coli* O157:H7 below infectious levels. *E.coli*O157:H7 is the only pathogen that is considered an adulterant when present in raw meat or poultry products.

Adulteration in food and Beverages

Examples of adulteration include:

- Mogdad coffee, whose seeds have been used as an adulterant for coffee
- Roasted chicory roots, whose seeds have been used similarly, starting during the Napoleonic era in France (and continuing until today as a moderately popular additive for cheaper coffee)
- Roasted ground peas, beans, or wheat, which have been used to adulterate roasted chicory
- Diethylene glycol, used by some winemakers to fake sweet wines
- Oleomargarine or lard, added to butter and many more. [6-26]

Food Fraud: A 1041% Increase in Incidents from 2020 to 2023

In the last three years alone, from 2020 to 2023, food fraud incidents had recorded an increase of 1041%. This was indicative of the critical shift of risks that food supply chains are exposed to globally. Assuming that as early as May 2024, there were already 2479 incidents recorded, the number could further escalate; urgent measures are needed to provide a comprehensive answer toward food fraud.

Adulteration of Drugs

Apart from food there is also an evidence of drugs being adulterated whoseconsequences can be much more hazardous than those with food adulteration.

MATERIAL AND METHODS

In our detailed study, we have collected various groceries in Hyderabad. Procedures for detecting adulterants in various food products and the Results obtained for various test samples from experimentation were discussed in detail in the following tables.

Selection of Study Area

Food is the basic necessity of life. One works hard and earns to satisfy our hunger and relax later. But at the end, many of us are not sure of what we eat. We may be eating a dangerous dye, sawdust, soap stone, industrial starch and aluminium foil. Contaminated foods and drinks are common sources of infection.

The sample for the study was selected is Hyderabad, Telangana State, India. For assessing the qualitative testing of presence or absence of food adulteration for the collected varies sample both branded and unbranded under random sampling method. The samples were collected from the selected grocery stores and local shops from Hyderabad.

Collection of Samples

Adulteration means the addition of ingredients which are not permitted in food. They are added because of business profit only. Adulterated foods are harmful for human health as they contain the unauthorized food ingredients. Adulteration in foods also decreases our moral social value. [5]

The regular usage of food ingredients by housewives and on the basis of basic food groups the samples of the food items was selected. The list of the food items were selected for the study. The list was given below in table 1.

Table 1: List of the food items were selected for the study

S. No	Food Items
1.	Milk
2.	Ghee
3.	Honey
4.	Chilli Powder
5.	Turmeric Powder
6.	Coffee Powder
7.	Tea Powder
8.	Sugar
9.	Ice cream
10.	Salt
11.	Black pepper
12.	Jaggery
13.	Parched rice
14.	Edible oil
15.	Dry red chilli
16.	Green chilli
17.	Green peas
18.	Pulses
19.	Toor dal
20.	Moong dal
21.	Gram flour
22.	Asafoetida
23.	Mustard oil
24.	Lemonade
25.	Processed foods
27.	Sweets or syrup
28.	Silver foil
29.	Maize

To find out where the branded or unbranded which product have maximum adulteration is taken place the sample were collected on both branded and unbranded on the listed food items. The selected area of the grocery stores and local grocery vendors were selected based on random sampling method from both branded and unbranded sample were collected. Five sample of each food items (n=29) were collected from both branded and 25 unbranded at 20 stores. After the collection of the sample, the quality tests were done.

Analysis of Samples

Adulteration is commonly practiced in both branded and unbranded foods in daily life. From local market to the hyper market adulteration is prevalent everywhere. Majority of adulteration in India is Intentional adulteration and it affects the people of all the age group. Even today many people in India are unaware about adulteration and its harmful effects. Even if they know, they seldom take steps to stop adulteration. The carelessness of the buyers makes/encourages the traders to add unpermitted additives [6]. In collected samples to qualitative test are done for detecting presence or absence of adulterant by using standard procedure (FSSAI). Since the analysis of food adulteration was completed for five or six months. [27]

RESULTS AND DISCUSSION

Our study was involved by conducting, qualitative analysis with chemical tests based upon review of literature for identifying the adulterants in food substances. We have performed various tests for identifying the adulteration in different food substances collected from grocery stores according to standard procedures. The procedures and results were given under table 2.

Table 2: Different tests for identification of Adulteration in various substances

S. No	TEST	OBSERVATION	INFERENCE
1	**TEST FOR MILK**		
1	**Adulteration of Sugar in Milk**		
	Procedure Take 3 ml of the milk in a test tube. Add 2 ml of hydrochloric acid or Muratic acid in it. Heat thetest tube after adding 50 mg of resorcinol.	The red coloration indicates the use of sugarin milk.	Presence of Adulteration
1.1	Product - A	Red colour appeared	Adulteration ispresent
1.2	Product-B	No red colour appeared	Negative
1.3	Product-C	No red colour appeared	Negative
1.4	Product-D	No red colour appeared	Negative
1.5	Product-E	No red colour appeared	Negative
2	**Adulteration of Cereal Starch inMilk**		
	Procedure		
	Take 3 ml of the milk in a test tube. Add 1 drop of 1% aqueoussolution of iodine.	The blue of deep blue coloration indicates the presence of cereal starch in milk	If blue colour appears, it indicates the presence of adulterant
2.1	Product -A	No blue colour is found	Negative
2.2	Product-B	No blue colour is found	Negative
2.3	Product-C	Blue colour appeared	Positive
2.4	Product-D	No blue colour is found	Negative
2.5	Product-E	No blue colour is found	Negative
3	**Adulteration of Dalda in Milk**		
	Procedure		
	Take 3 ml of milk in a test tube. Add 10 drops of hydrochloric acidor Muratic acid. Mix up one teaspoonful of sugar. After 5 minutes, examine the mixture.	The red coloration indicates the presence ofdalda in the milk.	If red colour appears, it indicates the presence of adulterant
3.1	Product-A	No red colour appeared	Negative
3.2	Product-B	No red colour appeared	Negative
3.3	Product-C	No red colour appeared	Positive
3.4	Product-D	No red colour appeared	Negative
3.5	Product-E	No red colour appeared	Negative
4	**Adulteration of Water in Milk** **Procedure**		
	Put a drop of milk on polishedvertical surface	The drop of pure milk either stops or flows slowly and leaving a white stain or spot. Whereas adulterated with water will flow immediately without leaving a mark.	If stain appears and the drop moves, it indicates presence of adulterant
4.1	Product-A	Milk drop moved slowly	Positive
4.2	Product-B	Milk drop moved slowly and also a white spot appeared	Positive
4.3	Product-C	Milk drop moved slowly and also a white spot appeared	Positive
4.4	Product-D	Milk drop moved slowly and also a white spot appeared	Positive
4.5	Product-E	Milk drop did not move	Negative

5	**TEST FOR UREA IN MILK** **Procedure**		
	Mix 1 ml of milk with 1 ml of 1.6% DMAB reagent. Distinct yellow colour is observed in milk containing added urea. The control (normal milk) shows a slight yellow colour due to presence of natural urea.	If milk turns to other than yellow colour, then it contains adulterants	If any colour other than yellow is detected it will be a positive
5.1	Product-A	Blue coloration not observed	Negative
5.2	Product-B	Blue coloration observed	Positive
5.3	Product-C	Blue coloration not observed	Negative
5.4	Product-D	Blue coloration not observed	Negative
6	**TEST FOR BORIC ACID IN MILK** **Procedure**		
	Test for Ammonia Add a drop of ammonia solution to the turmeric paper.	If the red color changes to green, it confirms the presence of boric acid.	If the red color changes to green, then the test is positive
6.1	Product-A	Colour change from Green not observed	Negative
6.2	Product-B	Colour change from Green observed	Negative
6.3	Product-C	Colour change from Green observed	Negative
6.4	Product-D	Colour change from Green observed	Negative
2	**TEST FOR GHEE**		
1	**Adulteration of Dalda in Ghee** **Procedure**		
	Procedure Take 3 ml of ghee in a test tube. Add 10 drops of hydrochloric acidor muratic acid, and 1/4th of teaspoon of sugar. Shake the tube to mix up the contents thoroughly. Examine the test tube after 5minutes.	The red coloration willindicate the presence ofdalda in the ghee	If red color appears, there is presence of dalda in Ghee
1.1	Product -A	No red colour appeared	Negative
1.2	Product -B	Red colour appeared	Positive
1.3	Product -C	No red colour appeared	Negative
2	**Adulteration of Ghee Procedure**		
	Take 5ml of ghee add 2 drops ofiodine	Red colour indication if adulterated	If red color appears, there is a presence of adulteration
2.1	Product -A	No red colour appeared	Negative
2.2	Product -B	No red colour appeared	Negative
2.3	Product -C	No red colour appeared	Negative
3	**TEST FOR HONEY**		
1	**Adulteration of Vinegar**		
	Procedure Mix 2- 3 teaspoons of vinegar inone tablespoon of honey along with some water.	The formation of soluble mixtureindicates adulteration, which isn't the case if no mixture gets formed.	If mixture soluble appears, there is presence of adulterant.

1.1	Product -A	No soluble mixture is seen	Negative
1.2	Product -B	Solubulization appeared	Positive
1.3	Product -C	No soluble mixture is seen	Negative
2	**Common Adulterants in Honey**		
	Procedure A cotton wick dipped in pure honey burns when ignited with amatch stick.	Cotton wick gets burnt, then there presence of water.	If there is presence of water in honey, it will not allow the honey to burn
2.1	Product -A	Cotton wick gets burnt	Positive
2.2	Product -B	Not burnt	Negative
2.3	Product -C	Not burnt	Negative
4	**TEST FOR RED CHILLI POWDER**		
1	**Adulteration of Rhodamine B colour in Red Chilli Powder**		
	Procedure Take 1/4th teaspoon of the red chilli powder in a test tube. Add 3ml of distilled water in it, and 10 drops of carbon tetrachloride. Vigorously shake theflask to mix-up the contents	Red colour will disappearafter shaking. Or if the Red colour reappears with theaddition of a drop of Hydrochloric acid, then there is presence of adulterant	If Red colour appears or disappears
1.1	Product -A	Red color not disappeared	Negative
1.2	Product -B	Red color not disappeared	Negative
1.3	Product -C	Red color disappeared	Positive
2	**Adulteration of Brick Powder in Red Chilli Powder**		
	Procedure Take beaker, pour half water in itand then add half spoon of chilli powder in it.	Brick powder settles fast chilli powder settles slowlywhen put in water.	If the powder settles slowly, then there is no presence of adulteration
2.1	Product -A	Chilli powder settled slowly	Negative
2.2	Product -B	Chilli powder settled faster	Positive
2.3	Product -C	Chilli powder settled slowly	Negative
2.4	Product -D	Chilli powder settled slowly	Negative
5	**TEST FOR TURMERIC POWDER**		
Adulteration of Metanil Yellow Colour in Turmeric Powder			
	Procedure Take 1/4th teaspoon of the red chilli in a test tube. Add 3ml of alcohol in it. Shake the tube thoroughly to mix up the contents. Add 10 drops of Muratic Acid or Hydrochloric acid in the test tube.	A pink colourationindicates the presence of Metanil yellow color in the Turmeric powder.	If pink colour appears, there is presence of adulterant
1.1	Product A	Pink colour does not appear	Negative
1.2	Product B	Pink colour appeared	Positive
2	**Adulteration of Chalk Powder inTurmeric Powder**		
	Procedure Take a teaspoon of turmericpowder in a test tube and add few drops of water and few drops of hydrochloric acid in it.	If the solution releases bubbles then it indicates the presence of chalk powder.	If effervescence is seen, adulteration is present
2.1	Product-A	No bubbles are seen	Negative
2.2	Product -B	No bubbles are seen	Negative
6	**TEST FOR COFFEE POWDER**		
1	**Adulteration of Cereal Starch in Coffee Powder**		

	Procedure Take 1/4 of teaspoon of coffeepowder, Add 3ml of distilled water in it and heat. Add 3ml of potassium permanganate solution and add 1:1 muratic acid.	Formation of blue colour in mixture when added with drop of 1% aq solution of iodine.	Blue colour indicate presence of adulteration
1.1	Product-A	No blue colour is produced	Negative
1.2	Product-B	No blue colour is produced	Negative
1.3	Product-C	No blue colour is produced	Negative
1.4	Product-D	No blue colour is produced	Negative
2	**Adulteration of Scorched Persimmon stones in Coffee Powder**		
	Procedure Take 1 teaspoon of the coffeepowder and spread it on a moisturizedblotting paper. Pour 3ml of 2 percent Aqueous solution of sodium carbonateslowly and	A red coloration indicatesthe presence of the powder Scorched Persimmonstones in coffee powder.	Red colour indicate presence of adulteration
8	**TEST FOR TEA**		
1	**Adulteration of Coloured Leaves InTea**		
	Procedure Rub leaves on white paper	Artificial colour comes out on paper	If there is no colour produced test is negative
1.1	Product-A	No colour is produced	Negative
1.2	Product-B	Green colour is produced	Positive
1.3	Product-C	No colour is produced	Negative
2	**Adulteration of used Tea Powder in New Tea Powder**		
	Procedure Tea leaves sprinkled on wet filterpaper	Pink or red spots on papershow colour	If no colour is produced, there is no presence of adulteration
2.1	Product-A	No colour is produced	Negative
2.2	Product-B	No colour is produced	Negative
2.3	Product-C	Pink colour appeared	Positive
3	**Adulteration of Iron Fillings in Tea Powder**		
	Procedure Move a magnet through thesample	Iron will stick to themagnet	If no iron particles are seen on magnet, indicated no iron filling are added
3.1	Product-A	No adherence of iron filling to the magnet were seen	Negative
3.2	Product-B	Adherence of iron filling to the magnet were seen	Positive
3.3	Product-C	No adherence of iron filling to the magnet were seen	Negative
9	**TEST FOR SUGAR**		
1	**Adulteration of Chalk in Sugar**		
	Procedure Dissolve sugar in a glass of water	Chalk powder will settle down at bottom	If chalk powder gets settled down, adulteration is present
10	**TEST FOR ICE CREAM**		
	Adulteration of Washing Powder in Ice cream		

1	**Procedure** Adulteration of washing powderinice cream and Put some lemon juice in ice cream	Bubbles are observed onthe presence of washing powder	If no effervescence is seen, there is no adulteration
1.1	Product-A	No effervescence/bubbles were observed	Negative
1.2	Product-B	No effervescence/bubbles were observed	Negative
1.3	Product-C	No effervescence/bubbles were observed	Negative
1.4	Product-D	No effervescence/bubbles were observed	Negative
11	**TEST FOR COMMON SALT**		
	Adulteration of White PowderedStone in Common Salt		
1	**Procedure** Stir a spoonful of sample salt inwater	Chalk will make the solution white and otherinsoluble impurities will settle down	If white colour is seen, there is no adulteration
1.1	Product-A	No colour is seen	Negative
1.2	Product-B	No colour is seen	Negative
1.3	Product-C	Pink colour is seen	Positive
12	**TEST FOR BLACK PEPPER**		
1	**Adulteration of Papaya Seeds in Black Pepper**		
	Procedure Float the sample in alcohol	Mature black pepper berries sink while papaya seedsand light black pepper float	If seeds sink, there is a presence of adulteration
1.1	Product-A	Sinking of berries is not found	Negative
1.2	Product-B	Sinking of berries is not found	Negative
13	**TEST FOR JAGGERY**		
1	**Adulteration of SodiumBicarbonate in Jaggery**		
	Procedure Take 1/4th of a teaspoon of jaggery in a test tube. Add 3ml ofMuratic Acid.	The presence of sodiumcarbonate effects effervescence	No effervescence indicates that adulteration is not present
1.1	Product-A	No effervescence is produced	Negative
1.2	Product-B	No effervescence is prodcued	Negative
2	**Adulteration of Metanil Yellow Colour in Jaggery**		
	Procedure Take 1/4th of a teaspoon of jaggery In a test tube. Add 3ml of alcohol and shake the tube vigorously to mix up the contents.Pour 10 drops of Hydrochloric acid in it	A pink colouration indicates the presence of Metanil yellow colour in jaggery	Pink colour indicated presence of adulteration
2.1	Product-A	Pink colour is produced	Positive
2.2	Product-B	No pink colour is seen	Negative
14	**TEST FOR PARCHED RICE**		
1	**Adulteration of Urea in ParchedRice**		
	Procedure Take 30 numbers of parched rice in a test tube. Add 5ml of distilled water in it. Mix up contents thoroughly by shaking the test tube. After 5 minutes filter the water-contents and add 1/2 teaspoon of powder of arhar or soyabean in it. Leave it for 5 minutes and then dip a red litmus paper in the mixture. Take out thelitmus paper after 30 seconds andexamine it.	A Blue colouration indicates the presence ofurea in the parched rice	

1.1	Product-A		Negative
1.2	Product - B		Negative
15	**TEST FOR EDIBLE OIL**		
1	**Adulteration of Prohibited Colour inEdible Oils**		
	Procedure Add 20 drops of the edible oil in each of 4 test tubes. Make 3 different solutions, mixing up 1part of distilled water, 3 parts of distilled water and 4 parts of distilled water. Add 2 ml of each solution in each of e test tubes and add 2 ml of hydrochloric acid in the 4th testtube. Shake up each tube to mix up the contents thoroughly.	A rosy colouration in themixture of any tube, Indicates the presence ofprohibited colour in the edible oil.	If rosy color is observed there is a presence of adulterant
1.1	Product- A	Rosy colour is not seen	Negative
1.2	Product –B	Rosy colour is not seen	Negative
1.3	Product –C	Rosy colour is seen	Positive
2	**Adulteration of Cyanide in Edible Oil**		
	Procedure Take 3 ml of the edible oil in a testtube. Add 10 drops of alcoholic potash, and heat the tube on the flame of a spirit lamp. Make an addition of a little amount of eachof ferrous sulphate and ferric chloride in the test tube, and shake it to mix up the contents thoroughly. Add 3 ml hydrochloricacid.	The blue colouration indicates the presence of hydrocyanic acid, which get produced due to presence of cyanide in edible oil.	If blue colour is seen, adulteration is present
2.1	Product-A	Blue colour is produced	Present
2.2	Product- B	Blue colour is not produced	Negative
2.3	Product-C	Blue colour is not produced	Negative
3	**Adulteration of Lube oils**		
	20 drops of edible oil in a test tube. Add 10 drops of alcoholic potash. Heat the tube on the flame of a spirit lamp. The mixturewill de-colourise. Now add 10 drops of dichloroquinol chloride. Again heat the tube.	The appearance of the blue colour indicates the presence of a compoundof triorthocrysyle phosphate (TOCP), whichleads to incidence of paralysis. Traces of this compound in edible oil, point to an admixture of edible oil, with lube oil.	If blue colour is seen, adulteration is present
3.1	Product- A	Blue coloration observed	Positive
3.2	Product B	Blue coloration not observed	Negative
3.3	Product- C	Blue coloration not observed	Negative
	Adulteration of Rancidity in Edible Oils		
	Product-A	Pink /Red coloration observed	Positive
	Product- B	Pink/Red coloration not observed	Negative
	Product-C	Pink/Red coloration not observed	Negative
16	**TEST FOR DRY RED CHILLI**		
1	**Adulteration of Rhodamine-BColour on Dry Red Chilli**		
	Procedure Take a red chilly for the dry red chilly, and rub the outer surfacewith a piece of cotton soaked inLiquid Paraffin.	If the cotton becomes red,the sample is adulterated.	If red colour is seen, adulteration is present
1.1	Product A	No red colour observed	Negative

1.2	Product B	No red colour observed	Negative
17	**TEST FOR GREEN CHILLI**		
1	**Adulteration of Malachite in GreenChilli**		
1.1	**Procedure** Take a small part of the sampleand place it over a moistened white blotting paper	Green colour appears if adulteration is present	If red colour is seen, adulteration is present
	Product-A	Green colour not observed	Negative
	Product- B	Green colour not observed	Negative
	Product-C	Green colour not observed	Negative
18	**TEST FOR GREEN PEAS**		
1	**Procedure** Take a small part of the sampleand place it over a moistened white blotting paper.	The impression of the colour on paper indicates the presence of malachitegreen	If green colour is seen, adulteration is present
1.1	Product-A	Green colour not observed	Negative
	Product- B	Green colour not observed	Negative
	Product-C	Green colour not observed	Negative
19	**TEST FOR PULSES**		
1	**Adulteration of Metanil Yellow Colour in Toor Dal (Arhar)**		
	Procedure Extract the colour with Luke warmwater from the sample of pulses, add drops of HCl	A pink colour indicatespresence of metanil yellow.	If pink colour is seen, adulteration is present
1.1	Product- A	No pink colour appeared	Negative
1.2	Product - B	No pink colour appeared	Negative
2	**Adulteration of Metanil Yellow Colour in Moong Dal**		
	Procedure Extract the colour with Luke warm water from the sample of pulses, add drops of HCl.	A pink colour appears indicatespresence of metanil yellow.	If pink colour is seen, adulteration is present
3.1	Product A	No pink colour appeared	Negative
3.2	Product - B	No pink colour appeared	Negative
20	**TEST FOR GRAM FLOUR**		
1	**Adulteration of Khesari in Gram Flour**		
	Procedure Take ½ teaspoon of the gram powder in a test tube and add 3 ml of distilled water in it. Then pour 3 ml of Muratic Acid in the test tube. Immense the test tube in water. Check the test tube after 15 minutes. A violet colouration indicates that Khesari Powder is present in the Gram Powder	Violet colour not observed	If violet colur appears, there is presence of adulteration
1.1	Product-A	Violet colour not observed	Negative
1.2	Product- B	Violet colour not observed	Negative
1.3	Product-C	Violet colour not observed	Negative
2	Adulteration of Metanil Yellow Colour in Gram Flour		
2.1	**Procedure** Take ½ teaspoon of the gram powder in a test tube. Pour 3 ml of alcohol in the test tube. Mix up the contents thoroughly by shaking the test tube. Add 10 drops of Hydrochloric Acid in it. A pink colouration indicated presence of Metanil Yellow in the Gram Powder.	Pink colour appears	If pink colour is seen, adulteration is present
2.2	Product-A	Pink colour appeared	Positive
2.3	Product- B	No pink colour is observed	Negative
	Product-C	No pink colour is observed	Negative

21	**TEST FOR ASAFOETIDA**		
1	**Adulteration of Resin and Colour in Asafoetida**		
	Procedure Take a small quantity of the asafetida in test tube. Add 3 ml of distilled water and shake the tube gently. Pure Asafetida dissolves in the water soon, and produces a milky white colour. But in case of adulteration by the chemical colour, the mixture turns to be colored. The purity of Asafetida also can be tested by taking a small quantity of it, on the tip of forceps and placing the same on the flame of a spirit lamp. Asafetida produces bright flame burning quickly, leaving the impurities behind.	Milky White Colour appears	If Milky White Colour is observed, then adulteration is present
1.1	Product-A	Milky White Colour is notobserved	Negative
1.2	Product- B	Milky White Colour is notobserved	Negative
1.3	Product-C	Milky White Colour is observed	Positive
2	**Adulteration of Soap Stone or Earthy Matter in Asafoetida**		
	Procedure Shake a little portion of sample with water and allow to settle Soap stone or earthy matter will settle down at the bottom	Soap stone or earthy matter will settle down at the bottom	If Soap stone or earthy matter will settle down at the bottom, then adulteration is present
2.1	Product-A	No settling appears	Negative
2.2	Product-B	No settling appears	Negative
2.3	Product-C	No settling appears	Negative
22	**TEST FOR MUSTARD OIL**		
	Adulteration of Argemone Oil in Mustard Oil		
	Procedure Take about 3 ml of the mustard oil in a test tube. Add 20 drops of nitric acid. For 3 minutes, heat the tube on the flame of a spirit lamp. A red colouration indicates the presence of Argemone oil in the mustard oil.	Red colouration observed	If red colouration observed then aregemone oil if present
1.1	Product-A	No red colouration observed	Negative
1.2	Product-B	No red colouration observed	Negative
1.3	Product-C	No red colouration observed	Negative
	Procedure Take about 3 ml of the mustard oil in a test tube. Add 2 ml of amyl alcohol in it and 1 ml of carbon disulphide and a little amount of sulphur. Plug the mouth of the test tube and heat it on the flame of a spirit lamp for 3 minutes. A red colouration indicates the presence of cotton seed oil in the mustard oil.	A red colouration appears	A red colouration indicates the presence of cotton seed oil in the mustard oil.
2.1	Product-A	No red colouration observed	Negative
2,2	Product-B	No red colour is observed	Negative
2,3	Product-C	Red colour is observed	Positive

	Procedure Take about 3 ml of the mustard oil in a test tube. Add 20 drops of alcoholic potash. For 3 minutes, heat the test tube on the flame of a spirit lamp, to effect de-colourisation of the mixture. Shake the test tube after adding 10 drops of distilled water. Examine the Test tube to trace the turbidity. Continue the activity of adding water upto 15 ml, and the examination of the test tube for appearance of turbidity. The turbidity appearance indicates the presence of mineral oil in the mustard oil.	Turbidity appears	If Turbidity appears, then adulteration is present
3.1	Product-A	No appearance of turbidity	Negative
3.2	Product-B	Appearance of turbidity	Positive
3.3	Product-C	No appearance of turbidity	Negative
	Procedure Take about 3 ml of the mustard oil in a test tube. Add 2 ml of petroleum ether. Shake the test tube and mix up the contents thoroughly. Keep the tube immersed in the salt-ice mixture, or in a pot of cold saline water. Examine the test tube after 5 minutes. The appearance of turbidity in the mixture indicates the presence of castor oil in the mustard oil.		
4.1	Product-A	No appearance of turbidity	Negative
4.2	Product-B	Appearance of turbidity	Positive
4.3	Product-C	No appearance of turbidity	Negative
	Procedure Take about 3 ml of the mustard oil in a test tube. Add 2 ml of petroleum ether. Shake the test tube and mix up the contents thoroughly. Keep the tube immersed in the salt-ice mixture, or in a pot of cold saline water. Examine the test tube after 5 minutes. The appearance of turbidity in the mixture indicates the presence of coconut oil in the mustard oil.	Appearance of turbidity	If, Appearance of turbidity is seen, then adulteration is present
5.1	Product-A	No appearance of turbidity	Negative
5.2	Product-B	No appearance of turbidity	Negative
5.3	Product-C	Appearance of turbidity	Positive
	Procedure Take about 3 ml of the mustard oil in a test tube. Add 2 ml of petroleum ether. Shake the test tube and mix up the contents thoroughly. Keep the tube immersed in the salt-ice mixture, or in a pot of cold saline water. Examine the test tube after 5 minutes. The appearance of turbidity in the mixture indicates the presence of dalda (vanaspati) in the mustard oil.	Appearance of turbidity	If, Appearance of turbidity is seen, then adulteration is present
6.1	Product-A	Appearance of turbidity	Positive
6.2	Product-B	No appearance of turbidity	Negative
6.3	Product-C	No appearance of turbidity	Negative
23	**TEST FOR LEMONADE**		
	Adulteration of Mineral Acid in Lemonade Soda		

1.1	Product-A	No violet colouration	Negative
1.2	Product-B	No violet colouration	Negative
1.3	Product-C	Violet colouration	Positive
24	**TEST FOR PROCESSED FOODS, SWEETS OR SYRUP**		
	Adulteration of Rhodamine B Colour in Processed Foods, Sweets or Syrup		
	Procedure If this chemical colour is present in the food, it is very easy to detect. Because it shines very brightly under the sun. Also it can be detected by a more precise method. Take ½ teaspoon of the sample in a test tube. Pour 3 ml of Carbon Tetrachloride and shake the test tube to mix up the contents thoroughly. The mixture turns colourless and addition of a drop of Hydrochloric Acid brings the colour back, when food contains Rhodamine B colour.		
1.1	Product-A	Colourless	Negative
1.2	Product-B	Colourless	Negative
1.3	Product-C	Coloured solution	Positive
25	**TEST FOR SILVER FOIL**		
	Adulteration of Aluminium Foil in Silver Foil		
	Procedure Pour 2 drops of the lemonade soda on a Metanil yellow paper-strip. A violet colouration indicates the presence of mineral acid in aerated water. The colour impression gets retained even after drying the paper (you can prepare Metanil yellow paper-strips by soaking filter paper-strips in 0.1% aqueous solution, and then drying the paper-strips).	Black grey colour ash is observed	Positive
1.1	Product-A	Black grey colour ash is observed	Positive
1.2	Product-B	Black grey colour ash is observed	Positive
26	**TEST FOR MAIZE**		
	Adulteration of Coloured Dried Tendrils of Maize Cob in Saffron		
	Procedure Pure saffron will not break easily like artificial. Pure saffron when allowed to dissolve in water will continue to give its colour so long as it lasts.	If Breaks easily adulteration is present	Positive
1.1	Product-A	Breaks easily	Negative
1.2	Product-B	Coloration observed	Positive

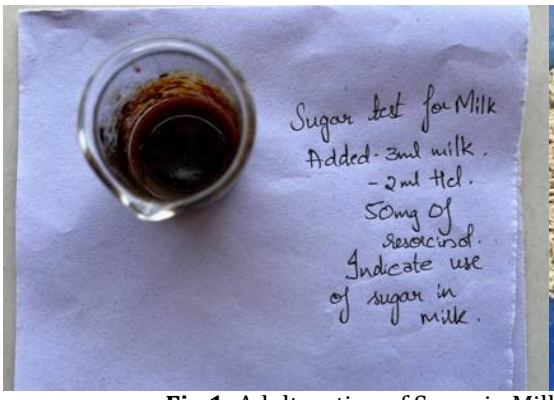

Fig 1: Adulteration of Sugar in Milk

Fig: 2 Adulteration of Ghee

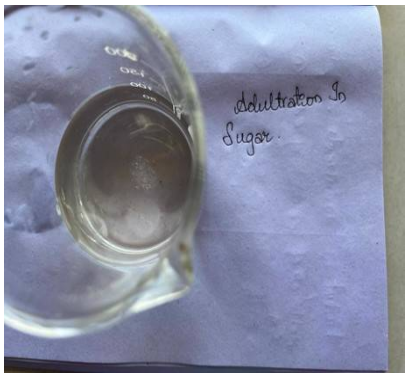

Fig 3: Adulteration of Chalk in Sugar

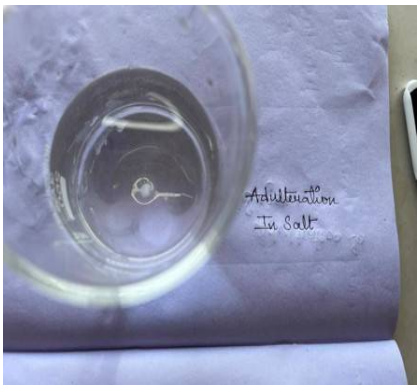

Fig 4: Adulteration of White Powdered Stone in Common Salt

Fig 5: Adulteration of Urea in Parched Rice

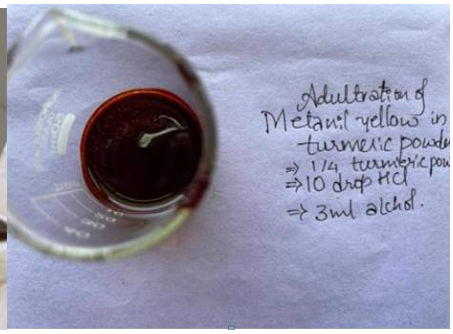

Fig 6: Adulteration of Metanil yellow Colour in Turmeric

Fig 7: Adulteration of Chicory in Coffee Powder

Fig 8: Adulteration of Rhodomine B Colour on Toor Dal

Fi g 9: Adulteration of Malachite Colour in Green Chilli

Fig 10: Adulteration of Metanil Yellow Colour on Sweet Potato

CONCLUSION

In our study, we found majority of food substances were adulterated. The quantitative detection of these adulterants plays a major role in understanding the toxic side effects produced by these chemical substances. The research suggests that careful selection of wholesome and non-adulterated food is essential for daily life to make sure that such foods do not cause any health hazard. It is not possible to ensure wholesome food only on visual examination when the toxic contaminants are present in ppm level. However, visual examination of the food before purchase makes sure to ensure absence of insects, visual fungus, foreign matters, etc. Therefore, due care taken by the consumer at the time of purchase of food after thoroughly examining can be of great help. Secondly, label declaration on packed food is very important for knowing the ingredients and nutritional value. It also helps in checking the freshness of the food and the period of best before use. The awareness of these health hazards help the consumer to avoid taking food from an unhygienic place and food may cause various diseases. Consumption of cut fruits being sold in unhygienic conditions should also be avoided. Safety concerns among the people consuming adulterated food must be well explained and there is a high need to avoid the diseases caused by them especially to the rural people.

AUTHOR CONTRIBUTIONS

Every author contributed equally to the research with significant efforts in handling the instruments, drafting the manuscript, reviewing the study results, preparing the draft, and making the final decision for approving the manuscript for publication.

CONSENT TO PUBLISH

All authors have reviewed and approved the final version of the manuscript and consent to its submission and potential publication in this journal.

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