FOOD SAFETY AND STANDARDS AUTHORITY OF INDIA

Inspiring Trust, Assuring Safe & Nutritious Food

Ministry of Health and Family Welfare, Government of India

Food Safety MAGIC BOX

COMPANION BOOK

Food Safety
MAGIC BOX
Companion Book







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Preface

Children are born scientists, researchers and explorers. To test for the unknown, to discover the unexpected, is a great way to spend time in laboratory together and end up learning a new thing or two.

When it comes to making science relevant for your students, what better way than to apply it to something that's part of their everyday lives? Food gives you an ideal springboard for bringing a host of science concepts to life in your classroom!

The Food Safety Magic Box has 102 super-easy tests that are actually pretty mind-blowing, hands-on science experiments that can be done at school using materials available readily in the laboratory. This initiative is aimed at enhancing engagement, building a scientific temperament and unleashing creative potential amongst students through simple and fun experiments around food.

Food is fundamental to human experience and culture and can serve as a wonderful pedagogical tool to educate children about food safety. With this magic box, I hope that these young students become aware of food safety issues and play an active role as food safety champions to help build trust in the food available in the market.

Pawan Agarwal
Chief Executive Officer
Food Safety and Standards Authority of India

Introduction

Food Safety Magic Box Companion Book

Food travels through multiple stages such as production, processing, distribution, retail shops or restaurants to reach your plate. During this journey, the food may become unsafe because of various factors. The most commonly used terms in case of unsafe foods are 'contamination' and 'adulteration'. Contamination and adulteration both may involve the presence of a substance that is not intended to be in the food product. The difference is that contamination is unintentional. It may result from natural causes (e.g., heavy metals of the soil that are taken up by plants) or as a consequence of improper quality control in the factory producing food (e.g. introduction of hair or glass pieces during manufacturing).

Adulteration, on the other hand, is generally economically motivated. It often involves intentional replacement of superior quality ingredient, or its dilution, with a cheaper alternative. For e.g., dilution of milk with water to increase its volume. Not every case of adulteration will result in serious adverse health effects. However, adulteration always results in the introduction of unknown hazards and hence unknown risks into the food product.

Food spoilage occurs when there's a disagreeable change in the normal state of the food. This may be a change to the smell, taste, touch or sight of the food. Spoilage is usually caused by bacteria, moulds or yeasts. A typical example of spoilage is green fuzzy patches appearing on a piece of bread.

Food contamination, adulteration and spoilage put a lot of people at risk but it can be detected by different ways. One of the simplest ways to detect whether something is wrong with your food is through senses of sight, smell, touch and hearing. For example, signs of spoilage on fruits and vegetables are fuzzy and colored mould growth, a soft and mushy consistency and a bad smell. Other signs of spoilage such as in canned foods include a bulging can or lid, a strong smell when you open the can, gas or spurting liquids, or cloudy mushy food. Similarly, some of the common adulterants in food can also be detected through sensory examination. For example, addition of papaya seeds to black pepper can be detected visually.

However not all unsafe and/or adulterated foods may demonstrate bad quality, that is, unsafe food may appear to be of good quality. This distinction between safe and unsafe food therefore requires basic, intermediate and advanced level of analysis.

Basic analysis can be performed at home or in a school laboratory setting with the use of very few equipment's, chemicals and lab ware. Example of basic analysis would include detection of

adulteration with water in milk, adulteration with prohibited colors in jaggery and sugar, adulteration with mineral acid in beverages etc. Basic analytical tests are often used to indicate 'absence' or 'presence' of the negative attributes in a food. Such tests are often referred to as *'Qualitative'* and tell us 'WHAT' is there in a food sample.

However, at times, it is also important to go a step further and quantify certain attributes in a food. Some basic tests allow measurements to be made in a 'range' thereby giving *'semi-quantitative'* information. For example, rapid colorimetric test kits used to detect adulteration of mustard oil with butter yellow (adulterant). A drop of oil sample is placed on a colour detection strip. If adulterated with Butter Yellow, the colour of the strip changes to pink. Minimum detection limit of this test is 0.001% or 10 ppm (parts per million). The color produced by the oil sample can be by compared with standard colour bands printed on the cover sheet to identify the 'range' of concentration of the adulterant.

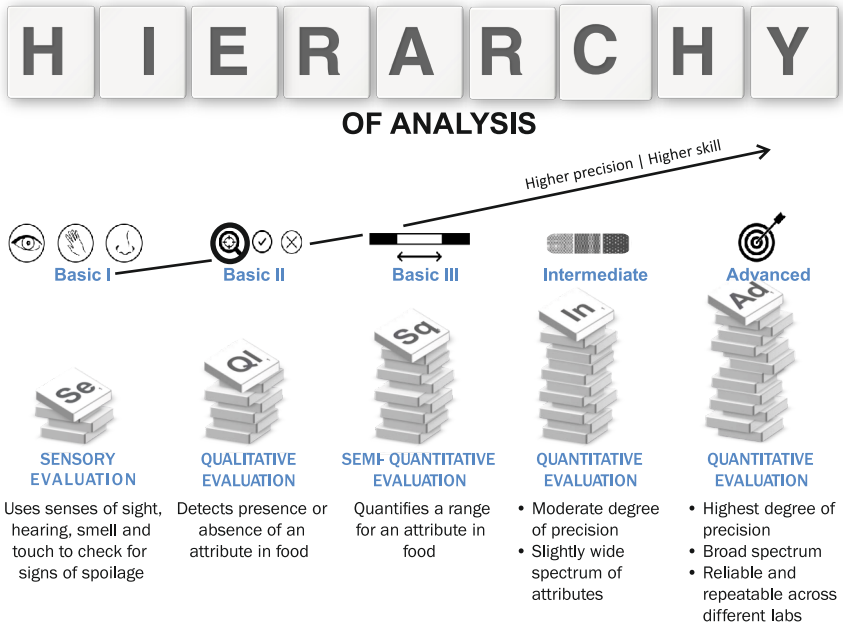
Intermediate tests; require slightly advanced level of instrumentation and skills. Such tests are often referred to as *'Quantitative'* and tell us 'HOW MUCH' is there in a food sample with a slightly higher degree of precision. These tests can be performed by semi-skilled technicians. For example, the Mobile Food Testing Laboratory, also known as 'Food Safety on Wheels' is a unique mobile lab that can perform 23 tests to check for adulteration in milk and milk products. It also has the facility of a rapid milk screening apparatus named Milkoscreen which can provide the values of Fat, Solids-Not-Fat, Protein and can also detect 5 common adulterants.

Sometimes it is difficult to detect very low levels of negative and positive attributes in a food or a much higher degree of precision is required than offered by intermediate analysis. Additionally, you may want very specific or targeted information about a food for example the botanical or geographical origin of honey. For all such requirements, 'Advanced' analysis is needed which is conducted in specialized laboratories by highly skilled technicians using state-of-the-art modern equipment's.

For example, inductively coupled plasma mass spectrometry (ICP-MS) is often used if to detect heavy metals contaminants like lead, copper, cadmium, arsenic etc. in food. This is an elemental analysis technology capable of detecting most of the periodic table elements at milligram to nanogram levels in a food sample. Similarly, HPLC (High Performance Liquid Chromatography) is used in the analysis of low to non-volatile organic compounds like certain Vitamins. It involves separation of the various constituents in a food sample followed by their individual detection and quantification. A liquid carrier stream termed as the mobile phase (solvent) serves to carry the injected sample through the separation column and to the detector. In the separation column the individual components are separated on the basis of physic-chemical interactions and the elution

order is based on such interactions. The separated components are detected by the detector on the basis of absorption of light or changes in refractive index, electrochemical/conductivity changes or simply the size distribution of eluting molecules. Another advanced technique called Gas Chromatography/Mass Spectrometry (GC/MS) separates chemical mixtures (the GC component) and identifies the components at a molecular level (the MS component).The heated gases of the sample are carried through a column with an inert gas (such as helium). As the separated substances emerge from the column opening, they flow into the MS. Mass spectrometry ionizes atoms or molecules to facilitate their separation and detection in accordance with their molecular masses and charges (mass to charge ratio). LC/MS (Liquid Chromatography – Mass Spectrometry) combines the separating power of HPLC with the detection power of Mass spectrometry. The difference between traditional LC and HPLC is that the solvent in LC travels by the force of gravity. In HPLC, the solvent travels under high pressure obtained by means of a pump to overcome the pressure drop in the packed column, which reduces the time of separation.

Based on the hierarchy of different types of analysis described above, Food Safety Magic Box sits within the 'Basic' level. It is expected to inculcate a sense of curiosity amongst students and empower them to differentiate between safe and unsafe food.



Before
We begin.....

Food Quality & Food Safety

Usually people get confused with the two terms i.e. food quality and food safety. Most of the time, these two words are used interchangeably. But, there is huge difference between food quality and food safety.

Food quality refers to the all those characteristics of food or food product that makes it acceptable or palatable to the consumers. It includes the physicochemical properties (acidity, sourness), texture (hardness, softness and consistency), appearance (size, shape, colour and gloss), flavor (mild, strong) etc.

Food safety is an assurance/set of processes that make food safe to eat, does not contain any hazard and does not cause any harm to consumer health. The focus on food safety is increasing day by day mainly due to change in food habits, increased processing and handling, innovations in technologies and products, and globalization of food trade. Hence, food safety has become a global concern.

Food Safety issues mainly arise due to hazards (intentional and/ or unintentional), spoilage and adulteration (intentional and/ or unintentional).

Hazard refers to any agent with the potential to cause adverse health consequences for consumers. The hazards can be of following types:

1. Physical hazard: Any kind of physical substance which is not a part of food and can cause adverse health effects to the consumers. E.g. Hair, Stones, fibres, threads, nails, bolts, screws, buttons, jewellery piece, bones, fragments etc.
2. Chemical hazard: Any chemical or harmful substance which is not a part of food but added to the food either intentionally or unintentionally. E.g. pesticide residues, veterinary drug residues, use of non permitted food additives, excess use of permitted food additives, Toxic metals, cleaning agents (detergents, soaps, liquids, disinfectants etc.)
3. Biological hazard : Any living organism that contaminates the foods include biological hazard. They can be of two types:
    a. Biological : living organism in food like worms, flies, cockroaches etc.
    b. Microorganism : These include bacteria, yeast, moulds, protozoan's etc.

Food spoilage and food adulteration are two major concerns of food safety. The Food adulteration can be intentional and/ or accidental. When spoiled food is added intentionally to the safe food, then the food spoilage becomes food adulteration.

Food Spoilage

Food spoilage means undesirable changes (physical, chemical or biological) in a food which makes it unfit for consumption. Spoilage 'may' cause changes in colour, flavour, texture and/or nutritional value of food.

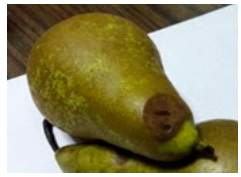
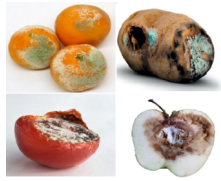
Types of Food Spoilage

1. *Physical Spoilage :* This includes physical stress or abuse caused by uncontrolled processing conditions such as freezing, drying etc, poor handling and storage practices, infestation by rodents, insects etc. E.g., bruising of fruits and vegetables during storage, handling and transportation.
2. *Chemical Spoilage :* This includes reaction due to environmental condition like moisture, oxygen, light, temperature as well as the biochemical reactions that occur within the food constituents (enzymatic action).
3. *Biological Spoilage :* It occurs due to the growth and activity of microorganisms like bacteria, moulds and yeast.

How to check food is spoiled?

1. *Appearance:* Look at the food carefully to check for any kind of abnormality in texture, color, visible colored spots on the surface of food products, swelling of canned products etc.
2. **Taste and odour**
    a. Think about the normal taste and smell of the food; throw it out if it smells really bad or unusual, e.g.
        i. spoiled milk smells sour
        ii. rotten eggs have a very distinct and unpleasant smell
3. **Feel**
    a. Check if the texture of the food has changed e.g.
        i. slimy texture on meat

Some examples to check food spoilage

Check if there is any abnormal colour change.	Eg. bruised spot on rotten pear	
Check if there are green, white or blue spots on food surface	Eg. mouldy bread usually has green spots on its surface	
	Eg. Spots of different colors on fruits	
	E.g. Spots on cheese	
Check if there is abnormal curdling	E.g. curdling of spoiled milk	
Check packaged foods for signs of puffing/ swelling, leakage or damage	E.g. Puffing/Swelling in Canned Foods	

Food Adulteration

Food adulteration refers to the process by which the quality or nature of a given food is 'altered' through either the addition of adulterants and/or through removal of a vital substance from the food. Food adulterants refer to the foreign, usually inferior substances added to the food which may cause harm to the consumer or introduce unknown hazards in the food. Basically, during food adulteration, small quantities of non-nutritious substances are added intentionally to improve the appearance, texture or storage properties of the food.

The main type of adulteration is Economically Motivated Adulteration (EMA) which is intentional and targeted towards financial advantages. This is also known as 'Food Fraud'. The various forms of adulteration or food fraud with a potential to hamper food quality and safety could include the following:

- Dilution of food
- Substitution (whole or in part) of food with inferior or cheaper quality substances/ ingredients
- Addition of unapproved or illegal ingredients/substances
- Over use (in excess of legally prescribed limits) of certain ingredients, additives etc to improve appearance, texture or shelf life of foods
- Mislabelling of food with an intent to mislead consumers
- Tampering
- Counterfeiting etc.

Types of Food Adulteration

1. Intentional adulteration: The adulterants are added as a deliberate act with intention to increase profit. Eg. Sand, marble chips, stones, chalk powder, etc.
2. Incidental/ Unintentional Adulteration: Adulterants are found in food due to negligence, ignorance or lack of proper facilities. E.g., pesticide residues as a result of poor agricultural practices, insect larvae or bird droppings due to poor hygienic practices at processing level.

How to check if food is adulterated?

Various booklets and manuals have been provided by FSSAI related to food testing. Some of the booklets/ manuals are helpful to provide information regarding checking and testing of adulteration.

1. *DART* : Detect Adulteration with Rapid Test (DART) booklet is a compilation of common tests for detection of food adulteration at household level. These tests are simple, quick and can be performed without any chemicals. The primary objective of this initiative is to create food safety awareness amongst consumers.

2. *Food Safety Magic Box Companion guidebook*: This book contains more than 100 tests to support students in their food safety learning journey. The tests can be performed with or without chemicals and are helpful to detect common food adulterants.

3. *Manual of simple methods for testing common adulterants in food (Food Safety on Wheels)*: This manual is available on Mobile Food Testing Laboratories or Food Safety on Wheels. Food Safety on wheels can be used to perform more than 100 tests to detect common food adulterants. The tests are over and above what has been provided in DART and Food Safety Magic Box Companion Book.

The companion book of Food safety magic box is your innovative classroom link between food, science and health. So let's get started

How to use this book

This companion book provides you with some basic tests of Sensory evaluation and adulteration for seven categories of foods namely,

1. **Sensory Evaluation**
2. **Milk and Milk Products**
3. **Fats, Oils and Fat Emulsions**
4. **Sweetening agents**
5. **Food Grains and their products**
6. **Fruits, Vegetables and their products**
7. **Salt, Spices and Condiments**
8. **Beverages**

The tests are numbered sequentially based on the food category and include the list of chemicals, equipment's and other materials required to conduct the test. Each test includes a section on observation and inference to guide students in identification of adulterated food samples and also provide a scientific rationale for the chemistry involved.

You may introduce food category specific tests as part of the science or chemistry laboratory activities on a weekly or fortnightly basis. Such activities could be accompanied with brief introduction to the food category followed by information on common types of adulterants found therein.

This could also be integrated with 'Health and Fitness' and/or SEWA (Social Empowerment through Work Education and Action) component of Health and Physical education that is now mandated by the Central Board of Secondary Education (CBSE) for classes 9 to 12.

Inside the Magic Box

Chemical solution

- Iodine solution
- Phenolphthalein
- Brocresol purple Solution
- Ethyl alcohol
- Rosalic acid
- Barfoed's reagent
- Ether
- Iodine-Zinc chloride

Chemical powder

- Soybean or Arhar powder
- Potassium hydroxide (KOH)
- Ferric chloride (FeCl3)
- Sodium carbonate (Na2CO3)

Paper strip (PS)

- Red litmus paper
- Turmeric paper
- Diastrix strip
- Metanil yellow paper

Equipment

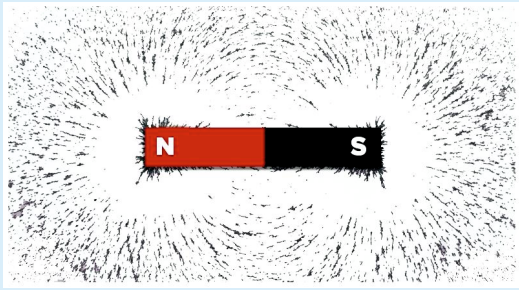
- Lactometer
- Magnet

Others

- Glass plates
- Nylon cloth
- Spirit lamp
- Blotting paper
- Plastic spoon of 1 gm
- Filter paper
- Beaker (50ml) (Borosilicate)
- Measuring cylinder (Plastic) (100ml)
- Cotton
- Spatula
- Test tubes
- Hand gloves
- Safety goggles
- Pasteur pipette

Chemical solutions		
1.	1% Iodine solution	Elemental iodine has low solubility in water. Potassium iodide is added to distilled water to make iodine solution. This solution is used to detect starch hydrolysis by giving a dark blue-black color.
2.	Zinc chloride iodine solution	Zinc chloride is the name of the chemical compound with formula ZnCl2. Iodine-Zinc chloride solution is used to detect adulteration of milk (and milk products) with cellulose based adulterants. Cellulose is known to dissolve in aqueous solutions of ZnCl2 and subsequent reaction with Iodine gives a blue-black color.
3.	Barfoed's reagent	It is named after the Danish chemist Christen Thomsen Barfoed who invented it to detect presence of monosacchrides (single unit sugars) in a sample. It is a solution of Cupric acetate in 1% acetic acid.
Chemicals powder		
4.	Potassium hydroxide	It is an inorganic compound with the formula KOH, and is commonly called caustic potash. This colorless solid is a prototypical strong base. It has many industrial and niche applications, most of which exploit its corrosive nature and its reactivity toward acids. It is soluble in water, Ethyl alcohol & glycerol.
5.	Ferric chloride	It is dark gray to black or brown colored odorless chemical compound, with the formula FeCl3. It is rarely observed in its natural form. When dissolved in water; it undergoes hydrolysis and gives off heat in an exothermic reaction. It is a fairly strong Lewis acid, and is used as a catalyst in organic synthesis.
6.	Sodium carbonate	It is white colored odorless chemical compound, with the formula Na2C03, (also known as washing soda, soda ash and soda crystals). It has strongly alkaline taste and gives moderately alkaline solutions in water.
7.	Soyabean powder	Soyabean is a legume. Legumes contain high content of urease enzyme. This enzyme breakdowns urea into carbamate and ammonium. Presence of ammonium ions makes the test solution alkaline.
Solvents		
8.	Ethyl alcohol	It is 95% Ethyl alcohol or Ethanol. Usually Ethanol, 95%, laboratory grade, contains ethanol, denaturants, and water. The denaturants are poisons added to the ethanol to make it undrinkable. The poisons are chosen such that they cannot easily be distilled or otherwise removed from the ethanol to make it drinkable. The percentage of denaturants in the ethanol varies, but usually accounts for 10% of the solution.
9.	Ether	Nonpolar compounds are generally more soluble in diethyl ether than alcohols because ethers do not have a hydrogen bonding network that must be broken up to dissolve the solute.

pH indicator solutions and strips				
The change of color is due to the presence of hydrogen molecule (Acidic) and absence Hydrogen molecule (Basic).			**Acidic**	**Basic**
10.	Phenolphthalein	It is an artificial indicator	Colorless (Below 6.8)	Pink Color (Above 8.0)
11.	Bromocresol purple	It is an artificial indicator. It is a purple coloured dye of tri-phenyl-methane family.	Yellow (Below 5.2)	Purple (Above 6.8)
12.	Rosalic acid (Aurin)	It is a natural indicator. It is prepared by heating phenol & oxalic acid in concentrated sulfuric acid	Yellow (Below 5.0)	Red (Above 6.8)
13.	Red Litmus paper	It is a natural pH indicator prepared from mixture of different water soluble dyes extracted from lichen. It contains a weak diprotic acid. When it is exposed to a basic compound, the hydrogen ions react with the added base. The conjugate base, formed from the litmus acid, has a blue color, so the wet red litmus paper turns blue in alkaline solution.	-	Blue (Above 8.3)
14.	Turmeric paper	It is a ntural pH indicator which contains diarylheptanoids (curcuminoids) which 'are' yellow in color.	Red (Below 1.2)	Yellow (Above 2.4)
15.	Metanil yellow paper	Metanil yellow is a synthetic dye of 'Azo' class. It can be prepared by dipping a strip of filter paper in 1% Metanil yellow solution.	No Change	Red
Reagent strips				
16.	Diastrix strip	A reagent strip, also called a dipstick, is a narrow strip of plastic with small pads attached to it. Each pad contains reagents for a different reaction, thus allowing for the simultaneous determination of several tests. The colors generated on each reagent pad vary according to the concentration of the analyte present. Colors generated by each pad are visually compared against a range of colors on brand specific color charts.		

Equipment		
17.	Lactometer	A lactometer is an instrument that is used to check for the purity of milk by measuring its specific gravity. It works on the 'Archimedes principle'. The lactometer reading is converted into specific gravity using conversion charts. The typical specific gravity for different types of milk is as follows: 1. Cow Milk : 1.028 to 1.03 2. Buffalo Milk : 1.03 to 1.032 3. Skimmed Milk : 1.035 to 1.037 Lower values on lactometer scale are indicative of adulteration.
18.	Bar Magnet	A magnet is a material or object that produces a magnetic field. This magnetic field is invisible but is responsible for the most notable property of a magnet: a force that pulls on other ferromagnetic materials, such as iron, and attracts or repels other magnets. 

1 Sensory evaluation

Sensory evaluation is a common and very useful tool in quality assessment of food and its products. It makes use of the senses to evaluate the general acceptability and quality attributes of the products.

- Sense of sight is used to evaluate the general appearance of the product such as colour, size, shape, sign of spoilage etc.
- Sense of smell for the odour
- Sense of taste for the flavor which includes the four basic tastes sour, sweet, bitter and salty
- Sense of touch for the texture either by mouth feel or finger feel.

USE YOUR SENSES

Labelling	FSSAI logo	Licensed
	Date of Expiry (Best Before or Used by)	Safe for consumption
	Vegetarian (green) or non-vegetarian (brown) symbol	Indicate type of ingredients used
	Nutritional labelling	What we are eating
Packaging and storage	Discoloration, unwanted growth of microbes	Food Spoilage
	Cracked, damaged or leakage of package	Improper storage and transportation
	Proper storage hygienic, refrigerated, well ventilated as per product requirement	Maintains the shelf life

Storage and Hygiene	Sour/ Foul/ Mouldy/Rotten	Food Spoilage
	Pungent/unpleasant/ chemical smell	Chemical contamination
	Smell in the Storage area or refrigerator	Poor Hygiene

Storage	Firmness, crispiness, Ripeness–under ripe or overripe	Freshness of product
	Puffiness in tetra packs	Food Spoilage
	Deflated packages	Leakage
	Temperature	Low temperature for Perishable products (Dairy, Fish, Meat etc.)

This guidebook includes few sensory tests which are as follows:

Code	Test
1	Detection of adulteration in Synthetic Milk
2	Detection of adulteration with Coating of mineral oil on Black pepper/Cloves
3	Detection of adulteration with Brick powder, salt powder or talc. Powder in chili powder
4	Detection of adulteration with Volatile oil extracted cloves (exhausted cloves)in Cloves
5	Detection of adulteration with Kernel Bluntin Wheat, Rice, Jowar, Bajra, Channa, Barley etc
6	Detection of adulteration with Maida in Atta
7	Detection of adulteration with Sand or Talcum in Sago
8	Detection of adulteration with Common salt in Powdered Spices
9	Detection of adulteration with Artificial Sweetener in Sweat Meats
10	Detection of adulteration with Urea in Sugar
11	Check the quality of Fish
12a	Check the quality of Egg (Float Test)
12b	Check the quality of Egg

Sensory Test

Test 1	Detection of adulteration in Synthetic Milk	
Procedure	Check for altered taste	Check for texture
Observation	Synthetic milk gives bitter after taste.	Synthetic milk gives a soapy feeling on rubbing between the fingers.
Inference	Presence of synthetic milk	Presence of synthetic milk

Test 2	Detection of adulteration with Coating of mineral oil on Black pepper/Cloves	
Procedure	Check for smell	
Observation	Sample gives no smell	Sample gives out kerosene like smell.
Inference	Absence of mineral oil coating	Presence of mineral oil coating

Test 3	Detection of adulteration with Brick powder, salt powder or talc. Powder in chili powder	
Procedure	Take teaspoon of chilli powder in a glass of water and examine the residue	
Observation	Examine the residue	
	When the residue is rubbed & if any grittiness is felt	When the white residue is rubbed, soapy and smooth feel
Inference	Presence of brick powder/sand	Presence of soap stone

Test 4	Detection of adulteration with Volatile oil extracted cloves (exhausted cloves) in Cloves	
Procedure	Check for size of the clove	Check for pungent smell
Observation	Characteristic pungency of genuine cloves is less pronounced	Small size and shrunken appearance
Inference	Presence of exhausted clove	Presence of exhausted cloves

Test 5	Detection of adulteration with Kernel Blunt in Wheat , Rice, Jowar, Bajra, Channa, Barley etc	
Procedure	Separate out the non-characteristic grains and	
Observation	Examine the sample	
	No such bunt found	Bunt with a dull appearance, blackish in colour and rotten fish smell
Inference	Absence of Kernel Bunt	Presence of Kernel bunt

Test 6	Detection of adulteration with Maida in Atta	
Procedure	Prepare dough of the Atta and then subsequently prepare roti/chapatti.	
Observation	Observe the quantity of water required to prepare dough. When dough is prepared from resultant Atta, less water is needed.	Observe the taste of the chapatti. The normal taste of chapatti prepared out of Atta is somewhat sweetish whereas those prepared out of adulterated will taste insipid (tasteless).
Inference	Presence of Resultant Atta	Presence of Resultant Atta

Test 7	Detection of adulteration with Sand or Talcum in Sago	
Procedure	Put a little quantity of sago in mouth	
Observation	Examine the texture of sago	
	Smooth texture	Presence of a gritty feel
Inference	Absence of Sand/Talcum	Presence of Sand/Talcum

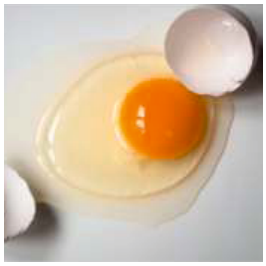
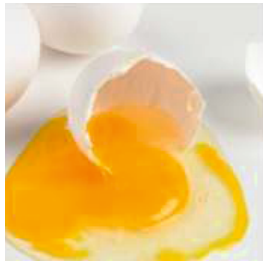
Test 8	Detection of adulteration with Common salt in Powdered Spices	
Procedure	Taste for addition of common salt.	
Observation	Examine the taste of the spice	
	No extra salty taste	Extra salty taste
Inference	Absence of common salt	Presence of common salt

Test 9	Detection of adulteration with Artificial Sweetener in Sweat Meats	
Procedure	Taste small quantity of sample.	
Observation	Examine the taste	
	Sweet taste and no bitter after taste	Artificial sweetener leaves a lingering sweetness on tongue for a considerable time and leaves a bitter after taste.
Inference	Absence of Artificial sweetener	Presence of Artificial Sweetener
Note: *This method is applicable if artificial sweetener is used in addition to sugar*		

Test 10	Detection of adulteration with Urea in Sugar	
Procedure	Take a small quantity of sample. Rub little sugar on palm and smell or Dissolve a small amount of sugar in water	
Observation	Examine the smell of the sample on the palm, or the solution so prepared	
	No smell of ammonia	Smell of ammonia hinted
Inference	Absence of urea	Presence of Urea
Note: *This method is applicable if artificial sweetener is used in addition to sugar*		

Test 11	Check the quality of Fish		
Procedure	Take a Fish Sample.		
	 Look (E)	 Smell (N)	 Touch (T)
Observation	• Shiny skin • Intact scales • Bright eyes • Red gills • Neatly displayed	• Fresh fish never ever smells fishy. • It smells like clean water, brine solution or cucumber	• Slippery and wet • Firm and rubbery to touch • Should not leave a dent when pressed
Inference	If the fish does not pass ENT test, don't buy / sell the fish		

Test 12a	Check the quality of Egg (Float Test)		
Procedure	1. Immerse the egg in glass container filled with water 2. Observe the position of egg		
Observation	Egg at the bottom width wise 	Egg at the bottom on one end 	Egg float on the surface 
Inference	Fresh Egg	Slightly Older egg	State or rotten egg
Science behind	As an egg ages, the small air pocket inside it grows larger as water is released and replaced by air. If the air pocket becomes large enough, the egg may float.		

Test 12b	Check the quality of Egg	
Procedure	1. Break the Egg on a flat surface 2. Observe the broken Egg	
Observation	The yolk rounded, small and stands high in a thick or gel-like egg white. The gel like mass of egg will not spread over a wide area 	The egg white thinner, runny and egg yolk and white dissolve into each other 
Inference	Fresh Egg	Older and rotten eggs
Science behind	As an egg ages, the small air pocket inside it grows larger as water is released and replaced by air. If the air pocket becomes large enough, the egg may float.	

Milk and Milk products

The story of milk goes back to the beginning of civilization itself. Milk is the normal secretion of the mammary glands of mammals. Its purpose in nature is to provide good nourishment for the young of the particular species producing it. Man has learnt the art of using milk and milk products as a food for his well-being.

India has the largest livestock population in the world and ranks highest in milk production globally. Milk from different sources, regardless of breed or even species, will contain the same classes of constituents. They are milk fat (3-6%), protein (3-4%), milk sugar (~5%), and ash (~0.7%). Water accounts for the balance of 85.5-88.5%. All the solids in milk are referred to as 'total solids' (11.4-14.5%) and the total solids without fat are known as 'milk solids not fat' (MSNF) or 'solids not fat' (SNF). The price of milk depends primarily on its fat content and to a lesser extent on its SNF content.

S. No.	Class of Milk	Minimum Milk Fat (% w/w)	Minimum Milk Solids-not-Fat (SNF) (% w/w)
1.	Standardized Milk	4.5	8.5
2.	Toned Milk	3.0	8.5
3.	Double Toned Milk	1.5	9.0
4.	Skim Milk Not more than	0.5	8.7
5.	Full Cream Milk	6.0	9.0
6.	Mixed Milk	4.5	8.5
7.	Cow Milk	3.2	8.3
8.	Buffalo Milk	Minimum 5.0 and maximum 6.0 (Variation depends on geographical location)	9.0
9.	Goat Milk	Minimum 3.0 and maximum 3.5 (Variation depends on geographical location)	9.0
10.	Camel Milk	2.0	6.0

Adulteration in Milk and Milk products

Tthe extensive consumption of milk and milk products makes them a natural target for adulteration for financial gains. Water is the most common adulterant which dilutes and decreases the nutritional value of milk. If the water is contaminated, for example, with pathogens or chemicals, this might pose a serious health risk for consumers. To the diluted milk, inferior or cheaper materials may be added such as milk powder, cane sugar and urea, even more hazardous chemicals including melamine, caustic soda, formalin, and detergents

to make up for the dilution or to manufacture synthetic milk. These additions have the potential to cause serious health related problems.

Some of the common adulterants in milk and milk products and the reason for their addition are listed below:

S.No.	Product	Adulterant	Reason for adulteration
1.	Milk	Water	To increase the volume of milk.
		Skimmed Milk Powder	To increase the solids-not-fat (SNF) content in milk. This would result in higher quantity of milk products manufactured from this adulterated milk owing to a higher total solids content. This is done specially to balance the SNF content in case of milk which has been diluted with water. Some of these adulterants may also be used to prepare synthetic milk.
		Ammonium sulfate	
		Starch	
		Sugars (sucrose/glucose)	
		Cellulose	
		Vegetable Oil/ Non-milk Fat	To replace milk fat with cheaper vegetable fat and increase overall fat content in milk. This is done specially to balance the fat content in case of milk which has been diluted with water. Some of these adulterants may also be used to prepare synthetic milk.
		Urea Melamine*	To increase the non-protein nitrogen content and thereby give an impression of a higher protein content when tested in a laboratory. This is done specially to balance the protein content in case of milk which has been diluted with water. Some of these adulterants may also be used to prepare synthetic milk.
		Formalin, Hydrogen peroxide, Salicyclic acid Sodium hydroxide Boric acid, Benzoic acid	To act as preservatives and extend the shelf-life of milk which is a perishable commodity otherwise with a short shelf-life.
		Carbonates and caustic soda	To neutralize acidity developed in milk. Developed acidity in milk is an indication of lactic acid produced by the action of bacteria on lactose (natural milk sugar) in milk.

S.No.	Product	Adulterant	Reason for adulteration
		Detergents, soap	To act as an emulsifier and help to stabilize oil (fat) in water to give a typical white milky froth. Some of these adulterants may also be used to prepare synthetic milk.
2.	Butter / Ghee/ Cream	Oil/ Vanaspati	To replace milk fat with cheaper fat sources for financial gains.
		Palmolein	
		Animal Body Fats	
		Refined vegetable oil	
3.	Khoa	Cellulose	To increase the total solids content as well as the weight of khoa with cheaper alternatives.
		Starch	
4.	Curd	Blotting Paper	To increase the total solids content and improve consistency.
		Carboxy methyl Cellulose	
5.	Ice Cream	Prohibited colours – Rhodamine B, Metanil Yellow, Orange II etc.	To use cheaper substitutes in place of costlier options of permitted food colors

*Presence not reported in India

This guidebook includes tests to check few common adulterants like water, detergent, starch, pulverized soap, cellulose and urea. The list of 26 tests for milk and milk products described in this guidebook are as follows :

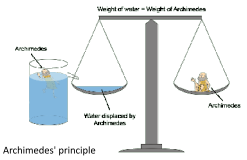
Code	Test
13a	Detection of adulteration with water (Method1)
13b	Detection of adulteration with water (Method2)
14a	Detection of adulteration with starch & cereal flour (Method1)
14b	Detection of adulteration with starch
15	Detection of adulteration with Pulverized soap
16	Detection of adulteration with Urea
17a	Detection of adulteration with Detergent (Method1)
17b	Detection of adulteration with Detergent (Method2)
18	Detection of adulteration with Cellulose
19	Detection of adulteration with Glucose
20	Detection of adulteration with Malodextrin
21	Detectionof adulteration with hypochlorites
22	Detection of increased acidity and heat stability of milk (Clot-on-Boiling Test)

Code	Test
23	Detection of abnormal milk such as colostrums or mastitis milk. (Alcohol test)
24	Detection of adulteration with Starch sources in Ghee/butter
25	Detection of adulteration with Washing Powder in Ice Cream
26	Detection of adulteration with Formalin
27	Detection of adulteration with Benzoic acid
28	Detection of adulteration with Salicyclic acid
29	Detection of adulteration with Neutralizers (NaOH, 0.1% for Na2CO3 and 0.2% for NaHCO3)
30	Detection of adulteration with Skimmed milk
31	Detection of adulteration with Added Glucose
32	Detection of adulteration with Boric Acid and Borate
33	Detection of adulteration with Azo Dyes (Metanil yellow)
34	Detection of adulteration with Coal Tar Dyes in Ghee, Butter, Khoa, Cheese, Condensed Milk, Milk Powder
35	Detection of adulteration with Vanaspati/Hydrogenated Edible Fat in Sweet curd
36	Detection of adulteration with Vanaspati/Hydrogenated Edible Fat in Ghee
	(Baudouin test), Butter, Khoa, Cheese & Condensed Milk.
37	Detection of adulteration with Blotting Paper in Rabdi
38	Detection of adulteration with Metanil Yellow in Ice Cream/ Milk-based sweets

For further understanding of adulteration in milk, it is recommended to utilize the services of FSSAI's mobile food laboratory also known as “Food Safety on Wheels”. This unique mobile lab can perform 23 tests to check for adulteration in milk and milk products. It also has the facility of a rapid milk screening apparatus named Milkoscreen which can provide the values of fat, SNF, protein and can also detect 5 common adulterants.

Additionally, some advanced quality parameters viz. protein, fat, SNF, lactose, specific gravity and safety parameters such as heavy metals contaminants (lead, copper, cadmium, arsenic etc.), pesticide, mycotoxins, antibiotics etc. can also be tested. However, such analysis would require a mix of basic as well as high-end analytical equipment's for e.g., ICP-MS, GC-MS/MS, LC-MS/MS etc, respectively. For such analysis, it is recommended to utilize the facilities of any of the FSSAI notified laboratories.

Test 13a	Detection of adulteration with water (Method1)	
Method	Glass plate/slide Method	
Procedure	1. Take a clean glass slide. 2. Slowly pour 1-2ml of the milk sample vertically on the surface of glass plate/slide	
Observation	Drop moves slowly leaving a white trail behind  Pure milk	Drop flows down rapidly without any trail  Adulterated milk
Scientific Explanation	Adulteration of milk with water reduces the viscosity of the milk. According to the laws of viscosity, lower the viscosity, faster is the flow of fluid on solid surfaces because of the lower cohesion forces between the fluid molecules. In comparison, pure milk sample has higher viscosity because of the right proportion of constituents like milk fats , proteins etc.	

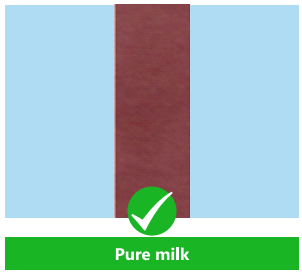
<table>
<tr><th>Test 13b</th><th>Detection of adulteration with water (Method2)</th></tr>
<tr><td>Method</td><td>Lactometer Procedure</td></tr>
<tr><td>Procedure</td><td>1. Pour the evenly mixed milk sample into a clean and dry measuring cylinder (250-500 ml) along the sides at room temperature
2. Clean the lactometer with water and wipe dry. Lower the lactometer gently into the milk holding it by the stem with the bulb going first
3. Release the lactometer when it is approximately in its position of equilibrium.
4. Add additional milk (if required) up to the brim of cylinder.
5. As soon as the lactometer is at rest, read and record reading on the scale corresponding to the top of the meniscus (top surface) of the milk.
6. Repeat the reading after depressing the lactometer about 3 mm and allowing it to come to rest
7. Observe the lactometer scale reading</td></tr>
<tr><td>Observation</td><td> 
</td></tr>
<tr><td>Inference</td><td>
<table>
<tr><th>Lactometer reading</th><th>Specific gravity</th><th>Type of Milk</th><th>Inference</th></tr>
<tr><td>less than 20</td><td></td><td>–</td><td>Water has been added to milk</td></tr>
<tr><td>28-30</td><td>1.028 to 1.030</td><td colspan="2">Cow milk</td></tr>
<tr><td>30-32</td><td>1.030 to 1.032</td><td colspan="2">Buffalo milk</td></tr>
<tr><td>35-37</td><td>1.035 to 1.037</td><td colspan="2">Skim milk</td></tr>
</table>
</td></tr>
<tr><td>Scientific Explanation</td><td>Lactometer works on the Archimedes' principle which states that a solid suspended in a fluid will be buoyed up by a force equal to the weight of the fluid displaced. Lower the density of the milk, more the lactometer will sink. If the milk sample is pure, then the lactometer floats on top and if it is adulterated or impure, then the lactometer sinks.
 

 
Lactometer</td></tr>
<tr><td colspan="2">Note: 1. Lactometer is standardized for measurement at 27 °C. Hence, milk should be at 27 °C, while taking the lactometer reading.
2. This method is not applicable for reconstituted milk. It is also not suited for samples wherein skimmed milk powder (SMP) or thickening agents have been added.</td></tr>
</table>

Test 14a	Detection of adulteration with starch and/or cereal flour (Method1)	
Procedure	1. Boil 2-3 ml of sample with 5mL of water and let it cool down. 2. Add 2-3 drops of **Iodine solution**	
Observation	No color change observed	Color changes to blue
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Amylose in Starch produces a blue colored complex with iodine	

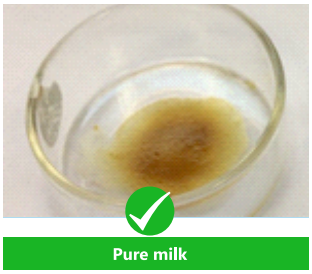
Test 14b	Detection of adulteration with starch (Method2)	
Procedure	1. Take 10 ml of milk in a test tube with equal amount of the water. 2. Shake the contents thoroughly	
Observation	Appearance of very thin layer of foam	Appearance of a thick layer of foam
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	On increased agitation of milk, the starch molecules absorb more water from the milk and burst, eventually forming smaller molecules of starch and thicker foam.	

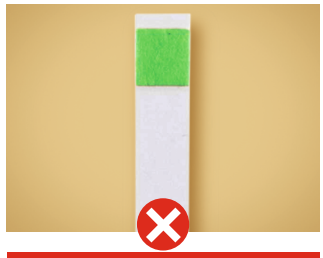
Test 15	Detection of adulteration with pulverized soap	
Procedure	1. Take 10 ml of milk in a test tube 2. Add 10 ml of hot water followed by 2-3 drops of **phenolphthalein indicator**	
Observation	No color change observed	Color changes to red/pink
Inference		
Scientific Explanation	Soap is alkaline in nature. Phenolphthalein solution is a pH indicator which gives pink color under alkaline conditions.	

Test 16	Detection of adulteration with urea	
Procedure	1. Take a teaspoon of milk in a test tube 2. Add ½ teaspoon of **soybean or arhar dal powder.** Mix up the contents thoroughly by shaking the test tube. 3. After 5 minutes, dip a **red litmus paper** in it. Remove the paper after ½ a minute.	
Observation	No color change observed in red litmus paper	Color of red litmus paper changes to blue
Inference		
Scientific Explanation	Urea is hydrolyzed by the enzyme urease leading to generation of alkaline conditions that turn red litmus blue.	

Test 17a	Detection of adulteration with detergent (Method1)	
Procedure	1. Take 5ml-10ml milk sample 2. Shake the contents vigorously	
Observation	No bubble formation observed in the sample	Bubble formation or effervescence observed in the sample
Inference		
Scientific Explanation	Addition of detergent in the milk lowers *the surface tension* of the milk and hence, on agitation bubbles are formed.	

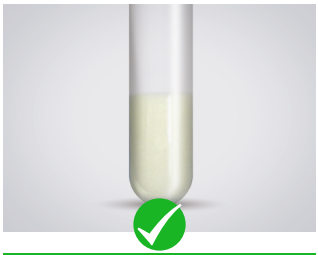
Test 17b	Detection of adulteration with detergent (Method2)	
Procedure	1. Take 5 ml of milk in a test tube 2. Add 0.2 ml (1 to 2 drops) of **Bromocresol blue or Bromocresol purple solution**	
Observation	No color change observed	Color of milk sample changes to faint violet
Inference		
Scientific Explanation	Detergent is used as an emulsifier for preparation of synthetic milk. Bromocresol blue solution is a pH indicator which gives blue color under alkaline condition.	

<table>
<tr><th>Test 18</th><th colspan="2">Detection of adulteration with</th></tr>
<tr><td>Procedure</td><td colspan="2">1. Take 10g of milk or milk product, add 50 ml of hot distilled water and stir thoroughly for about 2 minutes
2. Pour the mixture on a nylon cloth and allow liquid to flow through
3. Wash the residue on the cloth with 50 ml of hot distilled water two times
4. Scrape the residue with a spatula and place on a spotting plate at two different places
5. Stain one with iodine - zinc chloride reagent and the other with iodine solution</td></tr>
<tr><td>Observation</td><td>No color change observed after staining with iodine solution</td><td>Color of sample changes to blue after staining with iodine-zinc chloride reagent</td></tr>
<tr><td>Inference</td><td> 
</td><td> 
</td></tr>
<tr><td>Scientific Explanation</td><td colspan="2">Cellulose gives blue color in presence of iodine and zinc chloride while it does not give a color with iodine alone.</td></tr>
<tr><td colspan="3">Note: Test can be applied to curd, rabri, evaporated milk etc. Test is not applicable if sample tests positive for added starch with 1% iodine</td></tr>
</table>

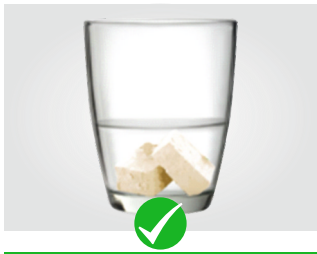
Test 19	Detection of adulteration with glucose	
Procedure	1. Take 1ml of milk sample 2. Dip **Diastrix strip** in the milk sample	
Observation	No color change observed in the Diastrix **strip**	Color of the Diastrix **strip** changes from blue to green
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Diastrix strips have glucose oxidase enzyme that has been dried onto a paper pad. The glucose, if present in milk sample, reacts to produce gluconic acid and hydrogen peroxide. The enzyme peroxidase is also present on the paper pad, and it utilizes the hydrogen peroxide produced to oxidise a dye that results in a color change from blue to green. The intensity of the color change on the pad reflects the amount of glucose present in the milk.	

Test 20	Detection of adulteration with maltodextrin	
Procedure	1. Take about 5 ml of milk sample in a test tube. 2. Add 2 ml of Iodine reagents to the tube. 3. Mix well and observe for the change in color.	
Observation	No color change and it will be very slight yellowish brown in color.	Appearance of chocolate-red brown color
Inference	Milk sample is pure  Pure milk	Milk sample is adulterated with Maltodextrin  Adulterated milk
Scientific Explanation	Maltodextrins having six or more glucose units which react with iodine-iodide solutions to form complexes of chocolate red brown color.	

Test 21	Detection of adulteration with hypochlorites	
Procedure	1. Take 5 ml of sample in a test tube. 2. Add 1.5 ml of potassium iodide solution. 3. Mix thoroughly and observe color.	
Observation	No color change	Appearance of yellow color indicates the presence of residual chlorine. Depending upon the available chlorine concentration, the color can range from pale yellow to yellowish brown
Inference	Milk sample is pure  Pure milk	Milk sample is adulterated with hypochlorite  Adulterated milk
Scientific Explanation	Maltodextrins having six or more glucose units which react with iodine - iodide solutions to form complexes of chocolate red brown color.	

Test 22	Detection of increased acidity and heat stability of milk (Clot-on-Boiling Test)	
Procedure	1. Take 5 ml of milk in the test tube. 2. Put this on boiling water bath for 5 minutes. 3. Remove the tube from water bath without shaking. 4. Note any acid smell or precipitated particles on the sides of the test tube	
Observation	No smell or precipitated particles	Appearance of precipitated particles or acidic smell shows positive test.
Inference	Milk sample is pure  Pure milk	Milk sample is with increased acidity  Adulterated milk
Scientific Explanation	If milk is kept as such at room temperature, there will be increased in the acidity which is called as developed acidity. If acidity is increased to more than 0.2 percent, there is coagulation due to heat treatment, which is the result of dissociation of calcium caseinate salt.	

Test 23	Detection of abnormal milk such as colostrums or mastitis milk (Alcohol test)	
Procedure	1. Take 5 ml. of milk in test tube. 2. Add 5 ml. of 68% Ethyl alcohol. 3. Mix the contents of the test tube by inverting several times. 4. Examine the tube and note any coagulation	
Observation	No change	Fine particles of curd will be visible on the inside surface, presence of flake or curd denotes positive alcohol test.
Inference	Milk sample is pure  Pure milk	Milk sample is adulterated with hypochlorite  Adulterated milk
Scientific Explanation	The alcohol test is used for rapid assessment of stability of milk for processing particularly for condensing and sterilization. The alcohol test is useful as an indication of the mineral balance of milk and not as an index of developed acidity. The test aids in detection abnormal milk such as colostrums, milk from animals in late lactation, milk from animals suffering from mastitis and milk in which mineral **balance has been disturbed.**	

Test 24	Detection of adulteration with starch sources in Ghee/butter	
Procedure	1. Take ½ teaspoon of ghee/butter in a transparent glass bowl 2. Add 2-3 drops of Iodine solution	
Observation	No color change observed	Color of sample changes to blue
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Amylose in Starch produces a blue colored complex with iodine	

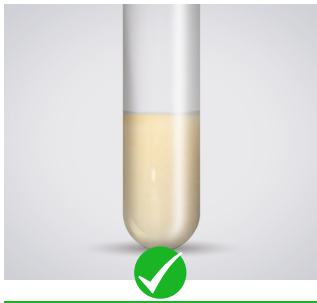
Test 25	Detection of adulteration with washing powder in Ice Cream	
Procedure	1. Take 1 scoop of Ice Cream in a transparent glass bowl 2. Add 2-3 drops of lemon juice	
Observation	No bubbles observed in the sample	Formation of bubbles observed in the sample
Inference		

Caution: Reagents like Concentrated Hydrochloric acid and Nitric acid will be used to perform the following tests.

Test 26	Detection of adulteration with Formalin	
Procedure	1. Take 5.0 ml of milk in a test tube. 2. Add an equal volume of **concentrated HCl containing ferric chloride solution.** 3. Place in a boiling water bath five minutes.	
Observation	No color change observed in the sample	Appearance of brownish pink color layer
Inference		
Scientific Explanation	Under acidic conditions, Formalin (40%Formaldehyde by weight) forms a brownish precipitate with ferric chloride.	

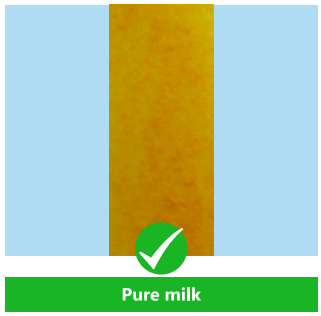
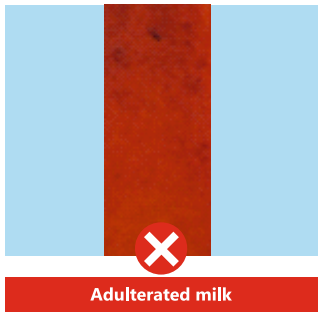
Test 27	Detection of adulteration with Benzoic acid	
Procedure	1. Take 5.0 ml of milk in a test tube. 2. Acidify the milk with concentrated HCl 3. 0.5% ferric chloride solution is added drop by drop and mixed well.	
Observation	No color change observed in the sample	Appearance of pale orange-brown colour precipitate (buff color)
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Under acidic conditions, Benzoic acid reacts with ferric chloride to form a ferric benzoate which is a buff color precipitate	

Test 28	Detection of adulteration with Salicyclic acid	
Procedure	1. Take 5.0 ml of milk in a test tube. 2. Acidify the milk with concentrated HCl 3. 0.5% ferric chloride solution is added drop by drop and mixed well.	
Observation	No color change observed in the sample	Appearance of violet color
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Under acidic conditions, the phenol group of salicylic acid reacts with ferric chloride to form a complex salt of salicylic acid and iron giving violet colored solution	

Test 29	Detection of adulteration with neutralizers (NaOH, 0.1% for Na2CO3 and 0.2% for NaHCO3)	
Procedure	1. Take 5 ml of milk in a test tube 2. Add 5 ml of Ethyl alcohol and a **few drops of Rosalic acid solution** and mix the contents of the test tube	
Observation	Light brown color observed in the sample	Color changes to rose red
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Rosalic acid gives rose red colour in alkaline conditions due to presence of carbonates.	

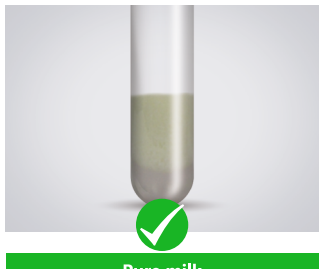
Test 30	Detection of adulteration with skimmed milk	
Procedure	1. Take 5 ml of milk in a test tube 2. Add **concentrated Nitric acid (HNO_3)** drop by drop using a Pasteur pipette or an eye dropper.	
Observation	Light yellow color observed in the sample	Color changes to Orange
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	It is a Xanthoprotein Test. This is a characteristic reaction of proteins that contain phenyl rings. Concentrated nitric acid reacts with the phenyl ring to give a yellow-orange colored aromatic nitro compound.	

Test 31	Detection of adulteration with Added Glucose	
Procedure	1. Setup the boiling water bath 2. To 1 ml of milk sample in a test tube add 1 ml of Barfoed's reagent 3. Heat the mixture for exactly 3 min in a boiling water bath 4. Rapidly cool under tap water	
Observation	Faint bluish color is observed	A scanty red brick precipitate is observed
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Monosaccharides also called simple sugars are the simplest form of sugar and the most basic units of carbohydrates. E.g. Glucose, fructose and galactose. The glucose reduces the copper acetate present in Barfoed's reagent to copper oxide, which give brick-red precipitate	

Test 32	Detection of adulteration with Boric Acid and Borate	
Procedure	1. Take 20 ml of milk in a porcelain dish and add **1.4 ml of Conc. HCl** and mix it thoroughly 2. Dip a strip of turmeric paper in the acidified milk	
Observation	No color change observed in the Turmeric paper	Color of the Turmeric paper changes to red
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	In acidic condition and presence of boric acid, yellow turmeric paper turns red.	

Test 33	Detection of adulteration with Azo Dyes (Metanil yellow)	
Procedure	1. To 1 ml milk in a test tube, add **1 ml ether** and shake vigorously. Allow to stand 2. Presence of any color is indicated by yellow color of the ether layer 3. Add a few drops of **Concentrated HCl**	
Observation	No color change observed in the Ether layer	Color of Ether layer changes to pink or dark red
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Azo dye, for example Metanil yellow, can be extracted into a separate layer using ether. Metanil yellow gives pink to dark red color under acidic conditions.	

Test 34	Detection of adulteration with Coal Tar Dyes in Ghee, Butter, Khoa, Cheese, Condensed milk, Milk powder	
Procedure	1. Take one full teaspoon (2 ml) of melted sample in a test tube 2. Add **5 ml of concentrated HCl** 3. Shake well and allow it to stand	
Observation	No color change observed in the sample	Color changes to crimson red
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Coal tar dyes are *aromatic hydrocarbon compounds*. These compounds react with hydrochloric acid to give red color.	

Test 35	Detection of adulteration with Vanaspati/Hydrogenated Edible Fat in Sweet curd	
Procedure	1. Take 5g of sweet curd in a test tube. 2. Add 10ml of concentrated hydrochloric acid. 3. Mix the contents by shaking the test tube gently. After 5 minutes, examine the mixture.	
Observation	No color change observed in the sample	A crimson red color develops in the acid layer
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Hydrochloric acid breaks down sugar molecule into glucose and fructose. On *dehydration, glucose and fructose produce furfurals.* These furfurals react with phenols present in Vanaspati/sesame oil which gives red or pink color.	

Test 36	Detection of adulteration with Vanaspati/Hydrogenated Edible Fat in Ghee (Baudouin test), Butter, Khoa, Cheese & Condensed Milk.	
Procedure	1. To 1 ml melted ghee in a test tube, add 1ml **conc. HCl** 2. Add half tea spoon table (cane) sugar 3. Stopper and shake vigorously for 2 minutes and allow the mixture to separate	
Observation	No color change observed in the sample	A crimson red or pink color develops in the acid layer
Inference	 **Pure milk**	 **Adulterated milk**
Scientific Explanation	Hydrochloric acid breaks down sugar molecule into glucose and fructose. On *dehydration, glucose and fructose produce furfurals*. These furfurals react with phenols present in Vanaspati/sesame oil which gives red or pink color.	

Test 37	Detection of adulteration with Blotting Paper in Rabri	
Procedure	1. Take a teaspoon of Rabri (1g) in a test tube 2. Add **3 ml of Concentrated HCl** and 3 ml of distilled water 3. Stir the content with a glass rod	
Observation	No changes observed on the glass rod. It appears relatively clean.	Fine fibers observed on the glass rod
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Milk contains lactose (carbohydrates) which is the naturally occurring milk sugar. During the preparation of Rabri, lactose gets concentrated. Blotting paper is made of cotton fibers which mainly comprise of cellulose (long chain carbohydrates). Hydrochloric acid dissolves all molecules and breaks blotting paper into fibers that stick on the glass rod due to the phenomenon of positively charged glass rod attracting uncharged paper pieces.	

Test 38	Detection of adulteration with Metanil yellow in Ice Cream/ milk-based sweets	
Procedure	1. Take one gram of the ice-cream/milk-based sweets in a test tube 2. Add lukewarm water to make a solution 3. Shake the contents and let the mixture stand 4. Add 0.5ml of concentrated HC	
Observation	No color change is observed	Immediate development of pink color is observed
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Metanil yellow on reaction with hydrochloric acid gives pink color.	

2 Fats, Oils and Fat emulsion

Edible fats and oils are among the basic components of the human diet, along with carbohydrates and proteins, and they are the source of high energy and essential fatty acids such as linoleic and linolenic acids. Edible fats and oils are used for pan- and deep-frying, and in salad dressings, mayonnaise and processed foods such as chocolates and ice creams. The physical and chemical properties of edible fats and oils have a strong effect on the quality of foods. A simple difference between fats and oils is that fats are solid at room temperature whereas oils are liquid at room temperature. Butter would therefore qualify as a fat whereas coconut oil would be termed as oil.

India is fortunate in having a wide range of oilseeds crops grown in its different agro-climatic zones. Groundnut, mustard/rapeseed, sesame, safflower, linseed, niger seed/castor are the major traditionally cultivated oilseeds. Soyabean and sunflower have also assumed importance in recent years. Coconut is most important amongst the plantation crops. Among the non-conventional oils, rice bran oil and cottonseed oil are the most important. In addition, oilseeds of tree and forest origin, which grow mostly in tribal inhabited areas, are also a significant source of oil.

Adulteration in oils

About 50% of domestic demand of edible oils is met through imports as there is a huge shortage of oils as compared to the demand. This shortage leads to an increased scope for adulteration in vegetable oils. Premium or high-quality edible oils are often adulterated with cheaper oils in order to make economic gains.

The type of adulterants in edible oils and the reason for their addition is listed below:

S. No.	Product	Adulterant	Reason for adulteration
1.	All oils	Refined Palm Oil	Refined Palm Oil is the cheapest oil with no odor or color of its own. It easily blends into other premium or costly oils. This is done for economic gain.
2.	Mustard oil	Oils like Castor oil, Argemone oil, Mineral oil, Karanja oil, refined rice bran oil	Cheaper substitutes which can easily blend with higher quality oils are used for partial substitution or replacement to make economic gains.
3.	Olive oil	Low grade oil e.g. Canola oil	
4.	Groundnut oil	Palm kernel oil, Palm oil	
5.	Groundnut, Soybean and Sunflower oil	Cotton seed oil	
6.	Mustard oil	Low grade vegetable oil with 'prohibited colors'	Cheaper substitutes can also be made to appear like the original oil by the addition of colors and flavors. Such oils can then be used for partial substitution or replacement to make economic gains.

Other adulterants may include Tricresyl Phosphate (TCP), Rancid Oil, BHA and BHT (beyond prescribed limit) and solvent residue (beyond prescribed limit) etc.

Each edible vegetable oil has a specific range for various quality parameters viz. Iodine Value, Refractive Index, Saponification Value, Unsaponifiable matter etc. Adulteration can therefore be checked by these parameters. However, the value for a quality parameter (as mentioned above) in two different types of oil may not differ thus making it difficult to distinguish between the two oils. In such cases, recently notified standards of Fatty Acid Composition of different Vegetable Oils are helpful. Fatty acid composition analysis would require high end laboratory equipment.

This guidebook includes following 6 tests to check common adulterants in edible oils :

Code	Test
39	Detection of adulteration in Coconut Oil
40	Detection of adulteration with lube oil
41	Detection of adulteration with mineral oil
42	Detection of adulteration with castor oil
43	Detection of adulteration with prohibited color
44	Detection of adulteration with argemone oil in mustard oil

For further understanding of adulteration in edible oils and fats, it is recommended to utilize the services of FSSAI's mobile food laboratory also known as “Food Safety on Wheels”. This unique mobile lab can perform 9 tests to check for adulteration in edible oils, fats and similar products.

Additionally, some advanced quality parameters viz. Iodine Value, Refractive Index, Saponification Value, Unsaponifiable matter etc. and safety parameters such as heavy metals contaminants (lead, nickel, arsenic etc.), pesticide, mycotoxins, etc.can also be tested. However, such analysis would require a mix of basic as well as high-end analytical equipment's for e.g., ICP-MS, GC-MS/MS, LC-MS/MS etc, respectively. For such analysis, it is recommended to utilize the facilities of any of the FSSAI notified laboratories.

Test 39	Detection of adulteration in Coconut Oil	
Procedure	1. Place a small bottle of oil in a refrigerator (5-10 °C) 2. Check the pattern of the solidification of the oil after 60-90 minutes	
Observation	No change observed	A separate layer is observed after solidification of oil
	 Pure	 Adulterated
Scientific Explanation	Difference in the freezing temperature of different oils is responsible for appearance of separate layers upon solidification.	

Test 40	Detection of adulteration with lube oil	
Procedure	1. Take 2 ml of the sample of oil 2. Add on a little amount of yellow butter	
Observation	No color change observed	Color changes to red immediately
	 Pure	 Adulterated
Scientific Explanation	Tri-ortho-cresyl-phosphate is an additive in lube oil which reacts with butter (methyl yellow) crystal to give instant red color.	

Test 41	Detection of adulteration with Mineral oil	
Procedure	1. Take 2ml Edible Oil in a dry test tube. 2. Add 2ml of **Ethyl alcoholic Potash** 3. Heat in boiling water for about 15 minutes 4. Add 10ml of water	
Observation	No change observed in the oil sample	Sample turns turbid
Inference	 Pure	 Adulterated
Scientific Explanation	A triglyceride reacts with Ethyl alcoholic KOH to form potassium carboxylates (soap)and glycerol. When hot distilled water is added to this soap mixture, the solution turns turbid.	
Note- Ethyl alcoholic Potash: Dissolve 1g of KOH pellets in 1ml of water. Then make up to 10 ml with free Ethyl alcohol		

Test 42	Detection of adulteration with Castor oil	
Procedure	1. Dissolve some oil in **petroleum ether** in a test tube 2. Cool in a **ice-salt mixture**	
Observation	No change observed in the oil sample	Sample turns turbid
Inference	 Pure	 Adulterated
Scientific Explanation	Upon extraction of castor oil with ether, castor oil cools (Not freeze) rapidly in presence of ice/rock salt mixture causing turbidity.	

Caution: Reagents like Concentrated Hydrochloric acid and Nitric acid will be used to perform the following tests.

Test 43	Detection of adulteration with prohibited color like metanil yellow	
Procedure	1. 1. Take 1ml oil in a test tube 2. Add 4ml of distilled water and shake it. 3. Take 2 ml of this mixture in another test tube and add **2ml concentrated HCl**	
Observation	No color change observed in the upper layer	Color changes in the upper acid layer
Inference	 Pure	 Adulterated
Scientific Explanation	Hydrochloric acid extracts the prohibited color, like metanil yellow from the adulterated oil sample and givecolor change in the acid layer while pure oil does notshow change in color.	

Test 44	Detection of adulteration with argemone oil in mustard oil	
Procedure	1. Take 5 ml of adulterated mustard oil in a test tube. 2. Add 5 ml of concentrated nitric acid and shake well	
Observation	No color change observed in the acid layer	Orange yellow to red color developed in the acid layer
Inference	 Pure	 Adulterated
Scientific Explanation	Sanguinarine is a toxic polycyclic salt present in argemone oil. The reaction is very sensitive and intensity of color formed due to formation of sanguinarine nitrate.	

3 Sweetening agents

A sweetener or sweetening agent is any naturally occurring or synthetically made substance that provides a sweet taste in food and beverages.

Sugar is primarily derived from sugarcane. Sugarcane contains 12-15% sugars (Sucrose, Glucose and Fructose). In India, 80-90% of sugarcane is used for the manufacture of three products widely used in food, viz., Gur, Open pan sugar or khandasari, and vacuum pan sugar or white sugar.

Jaggery or Gur is mainly obtained from sugarcane. It is also obtained from Date Palm and Coconut. Because of its color and flavor, it is used for special preparations such as burfi, groundnut toffee (Chikki), holige (puranpoli) etc. Apart from being used in households as a sweetener and a flavoring agent, it is also used extensively in the food and beverage industry. It is used in chocolates, candies, sorbets, traditional Indian health tonics and syrups.

Honey is produced by honeybees from the nectar of flowers. It is extracted from the honeycomb, strained and marketed. Honey contains large amounts of fructose (~38%) followed by glucose (~31%).

Sweetening agents are added to food products for enhancing the taste (sweetness), color, flavor, texture and also to preserve certain foods like jams and jellies. Given the wide range of uses in confectionary items (candies, chocolates), traditional Indian sweets as well as in daily food preparation, there is a scope for adulteration primarily to make economic gains.

The type of adulterants in sweetening agents and the reason for their addition is listed below:

S. No.	Food Commodity	Adulterant	Reason
1.	Sugar	Chalk Powder Urea Sodium carbonate or Washing soda (Na2CO3)	Cheaper substitutes to replace part of the sugar or to increase the weight/ amount. Primary reason is economic gain.
		Yellow Colour (Non-permitted) in Pithi Sugar	Sugar Pithi (Castor Sugar) is finely granulated white sugar. This kind of sugar is used for icing, essentially for its quick dissolving property. Non-permitted colors are added to give a color based on consumer preference or demand. Such colors are cheaper than the permitted colors.
2.	Honey	Sucrose solution Corn syrup Rice syrup	Because of its high nutritional value and unique flavor, the price of natural bee honey is relatively much higher than that of other sweeteners. Adulteration with cheaper sweeteners is primarily done for economic gains.

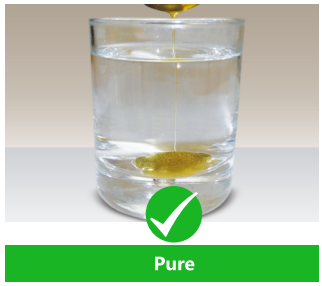
S. No.	Food Commodity	Adulterant	Reason
4.	Jaggery	Sodium bicarbonate (NaHCO3) (Baking soda)	Different consumers have a color preference for Jaggery (Gur). Adulteration with these chemicals is done to alter the color of Jaggery.
		Metanil yellow colour	
		Washing Soda	
		Chalk Powder or Calcium carbonate (Lime)	This is added to improve color, as well as to add weight, since lime is far cheaper.

This guidebook includes tests for common adulterants found in sugar, jaggery and honey. The details of these tests are as follows:

Code	Test
45	Detection of adulteration in Honey
46	Detection of adulteration in Sugar/pithi/jaggery powder
47	Detection of adulteration with Metanil yellow) in Jaggery
48	Detection of adulteration with Sodium Bicarbonate in Jaggery
49	Detection of adulteration with Sodium carbonate (Washing Soda) in Jaggery
50	Detection of adulteration with Sodium carbonate (Washing Soda) in Bura Sugar or pithi sugar etc.
51	Detection of adulteration with prohibited colour in Sugar

For further understanding of adulteration in sweetening agents, it is recommended to utilize the services of FSSAI's mobile food laboratory also known as “Food Safety on Wheels”. This unique mobile lab can perform 2 tests to check for adulteration in sweetening agents.

Additionally, some advanced quality parameters viz. moisture, sucrose, ash, specific gravity and safety parameters such as heavy metals contaminants (lead, nickel, arsenic etc.), pesticide, mycotoxins, antibiotics in honey etc. can also be tested. However, such analysis would require a mix of basic as well as high-end analytical equipment's for e.g., ICP-MS, GC-MS/MS, LC-MS/MS etc, respectively. For such analysis, it is recommended to utilize the facilities of any of the FSSAI notified laboratories.

Test 45	Detection of adulteration in Honey	
Procedure	1. Take a transparent glass of water. 2. Add a drop of honey to the glass.	
Observation	No dispersion is observed. The drop settles at the bottom of the glass.	Drop of honey disperses in water.
	 Pure	 Adulterated
Scientific Explanation	Addition of sugar reduces the viscosity of the honey and increases solubility in water. Therefore, honey adulterated with sugar disperses readily in water.	

Test 46	Detection of adulteration of chalk powder in Sugar/Pithi/jaggery powder	
Procedure	1. Take a transparent glass of water. 2. Dissolve 10g of sample in water.	
Observation	No settling is observed. Complete dissolution of sample.	Settling of particles observed at bottom of the glass
Inference	 Pure	 Adulterated
Scientific Explanation	Sugar/pithi/jaggery powder is readily soluble in water while chalk powder is insoluble and hence settles at the bottom.	

Caution: Reagents like Concentrated Hydrochloric acid and Nitric acid will be used to perform the following tests.

Test 47	**Detection of adulteration with Metanil yellow in Jaggery**	
Procedure	1. Measure 1/4th teaspoon of crushed jaggery into a glass container or test tube 2. Add 3ml of **Ethyl alcohol** to the test tube and stir to blend it properly 3. Add 1ml **of HCl acid** with the help of dropper	
Observation	No color change is observed	Color of the solution changes to red
Inference	 **Pure**	 **Adulterated**
Scientific Explanation	Metanil yellow gets extracted into a separate layer using Ethyl alcohol and develops red color under acidic conditions.	

Test 48	**Detection of adulteration with Sodium Bicarbonate (Baking Soda) in Jaggery**	
Procedure	1. Measure 1/4th teaspoon of crushed jaggery into a glass container or test tube 2. Add 3ml HCL acid into the test tube	
Observation	No bubbles observed in the sample	Bubble formation observed in the sample
Inference	 **Pure**	 **Adulterated**
Scientific Explanation	Sodium bicarbonate reacts with acid to release carbon dioxide which is the reason behind bubble formation. $NaHCO3 + HCl \longrightarrow NaCl + CO2 + H2O$ Sodium bicarbonate + Hydrochloric acid ⟶ Sodium Chloride + Carbon dioxide + Water	

Test 49	Detection of adulteration with Sodium carbonate (Washing Soda) in Jaggery	
Procedure	1. Take 2 gm of crushed jaggery into a glass container or testtube 2. Add 1 ml HCL acid into the test tube	
Observation	No bubbles observed in the sample	Bubble formation observed in the sample
Inference	 Pure	 Adulterated
Scientific Explanation	Sodium bicarbonate reacts with acid to release carbon dioxide which is the reason behind bubble formation. $Na_2CO_3 + HCl \longrightarrow NaCl + CO_2 + H_2O$ Sodium carbonate + Hydrochloric acid ⟶ Sodium Chloride + Carbon dioxide + Water	

Test 50	Detection of adulteration with Sodium carbonate (Washing Soda) in Bura Sugar or pithi sugar etc.	
Procedure	1. Take 2 gm of sugar into a glass container or test tube 2. Add 1 ml HCL acid into the test tube	
Observation	No bubbles observed in the sample	Bubble formation observed in the sample
Inference	 Pure	 Adulterated
Scientific Explanation	Sodium bicarbonate reacts with acid to release carbon dioxide which is the reason behind bubble formation. $Na_2CO_3 + HCl \longrightarrow NaCl + CO_2 + H_2O$ Sodium carbonate + Hydrochloric acid ⟶ Sodium Chloride + Carbon dioxide + Water	

Test 51	Detection of adulteration with prohibited color in Sugar or pithi sugar	
Procedure	1. Dissolve 1gm of sugar in 3ml of Ethyl alcohol in a test tube. 2. Shake the tube vigorously to mix the contents. 3. Add **1ml Conc. HCl acid** to the solution.	
Observation	No color change is observed	Color changes to pink in the acid layer
Inference	 **Pure**	 **Adulterated**
Scientific Explanation	Prohibited colours, like metanil yellow develop pink colour under acidic condition.	

4 Food grains and their products

Cereals supply the bulk of energy through the food consumed by humans. The chemical constituents of cereals are carbohydrates, proteins, lipids (fats), minerals and moisture (Water), together with small quantities of vitamins, enzymes and other substances. Some common cereal grains consumed in India include wheat, rice, maize (corn), sorghum (jowar), millets (e.g. Ragi, Bajra) etc.

Cereals, if not stored properly, deteriorate in quality. Moisture, temperature, supply of oxygen, characteristics of grain and infestation with molds and insects also contribute to deterioration. The grains should therefore be dried by appropriate methods to ensure a moisture content of less than 14%. The storage conditions should also be appropriate to avoid damage due to insects and rodents.

Cereals are used in many different ways. Some are used as flours for e.g. Whole wheat flour (atta), refined wheat flour (maida), rice flour, corn flour etc. Other processed foods include baked products such as bread, biscuits, breakfast cereals, cakes, muffins, pasta, macaroni etc. Traditional Indian fermented products also use cereal flours such as Idli, Appam, Dosa, Dhokla etc.

India is the largest producer of pulses in the world. Pulses is the major sources of protein in the Indian diet. Pulses are 20 to 25 per cent protein by weight which is double the protein content of wheat and three times that of rice. An alternate name for pulses is 'legumes'. In India, the term 'gram' is commonly used for dry legume seeds (e.g. Bengal gram or chana) with husk while split grains are called 'dals' (e.g. Arhar dal).

Pulses are consumed in multiple ways. Bengal gram (Chana) for e.g. is used in the preparation of curry/dal and also used as flour (Besan). Gram flour (Besan) is used to prepare many savoury and sweet preparations.

Adulteration in cereals and pulses is primarily intended for economic gains. Cereal grains are often adulterated with pebbles, stones, weed seeds, weevilled grains etc to increase the weight. Pulses are adulterated with Sand, marble chips, stones, filth, khesari dal or other inferior pulses, Metanil yellow, Soluble coal tar dye. Inferior quality pulses are colored with non-permitted dyes to make them look superior. Some of these adulterants are harmful for human health.

S. No.	Food Article	Adulterant	Reason
1.	Wheat, Rice, Maize, Jawar, Bajra, Chana, Barley etc.	*Extraneous matter (Dust, pebble, Stone, Straw, weed seeds, damaged grain, weevilled grain, insects, hair and excreta of rodent)	Presence of extraneous matter (beyond the prescribed limit) indicates deliberate addition to increase the weight of the grains in order to make economic gains
2.	Food grains	Prohibited colors	To mask poor quality grains and mislead the consumers into believing that it is actually good; To mask other cheaper grains to look similar to the original grains
3.	Ragi	Rhodamine B	
4.	Basmati rice	Addition of flavor to Non-basmati rice	Basmati rice sells at a premium in the market and is known for its typical aroma. Addition of flavor to non-basmati rice is done to make economic gains by either partly or wholly substituting Basmati rice with Non-Basmati rice.
5.	Food grains	Addition of broken or inferior quality grains	Most food grains are graded on the basis of physical attributes such as grain length, appearance etc. and their market price is fixed accordingly. Addition of broken or inferior quality grains (beyond the prescribed limit) is done to make economic gains by blending them with whole or superior quality grains.
6.	Maida	Resultant atta or cheap flour	Resultant Atta or other cheap flours are used as cheaper substitutes to partially replace good quality Maida or to increase the weight/quantity for the purpose of economic gain.
7.	Maida/Rice	Boric Acid	Boric acid is added to close the pores in case of rice and to enhance the brightness as well.
8.	Wheat, bajra	Dhatura	Cheaper substitutes to partially replace good quality wheat grains or to increase the weight/ quantity for the purpose of economic gain.
9.	Wheat, bajra and other grain	Wheat grains affected from Karnal Bunt (a fungal disease)	

S. No.	Food Article	Adulterant	Reason
10.	Sella Rice (Parboiled Rice)	Metanil yellow (a non-permitted coal tar colour	Sella or Parboiled Rice is preferred in certain parts of India. The processing of this rice involves soaking paddy in water for some time followed by heating and drying prior to milling. This process gives Sella/Parboiled rice a typical color. Addition of metanil yellow or turmeric is done to give the same color to lower quality rice for the purpose of economic gain.
		Turmeric (coloring for golden appearance)	
11.	Parched / puffed rice	Urea	Parched or puffed rice is preferred by consumers for its white color. Urea is enhancing the white color of parched/puffed rice for the purpose of economic gain.
12.	Wheat flour	Excess Bran	Cheaper substitutes to partially replace good quality wheat flour or to increase the weight/quantity for the purpose of economic gain.
13.	Dal whole and spilt (Bengal Gram dhal & Toor Dal)	Khesari Dal	Cheaper substitutes to partially replace good quality dals/pulses or to increase the weight/quantity for the purpose of economic gain. Presence of clay, stones, gravels, webs, insects etc also indicates poor hygiene practices followed by the processing unit where dals are processed and packaged. Added to old stocks of pulses to enhance color and increase brightness.
		Clay, stone, gravels, webs, insects, rodent hair and excreta	
		Metanil yellow (a non-permitted coal tar colour)	
14.	Atta, Maida Suji (Rawa)	Sand, soil, insects, webs, lumps. rodent hair and excreta	Cheaper substitutes to partially replace good quality Atta/Maida/ Suji/Bajra/Sago or to increase the weight/quantity for the purpose of economic gain
15.	Bajra	Ergot infested Bajra	
16.	Sago	Sand or talcum	

S. No.	Food Article	Adulterant	Reason
17.	Besan	Metanil Yellow	Besan is manufactured from Bengal Gram Dal (Chana). Metanil yellow is added to old stocks of Bengal gram dal to enhance color and increase brightness.
		Khesari Dal Flour	Cheaper substitute to partially replace good quality Besan or to increase the weight/quantity for the purpose of economic gain.
18.	Pulses	Lead Chromate	Added to old stocks of pulses to enhance color and increase brightness.
		Chakunda beans	Cheaper substitute to partially replace good quality pulses or to increase the weight/quantity for the purpose of economic gain.

*__Note:__ The food laws for grains have cut-off limits for the following:

a) Extraneous matter

b) Other edible grains

c) Damaged grains

d) Weevilled grains

This is to address incidental contamination since these are agricultural commodities which might undergo minimal processing and handling before reaching consumers. In such instances, accidental presence of extraneous matter, other edible grains, damaged grains and weevilled grains might be found.

This guidebook can help to check nine common adulterants like extraneous matter, dhatura, added color in food grains, excess bran in wheat flour, khesari dal, turmeric in sella rice, Rhodamine B in ragi etc.

The list of 15 tests those are present in this guidebook are as follows:

Code	Test
52.	Detection of adulteration with extraneous matter (dust , pebble, stone, straw, weed seeds, damaged grains, insects, rodent hair, excreta etc) in Food Grains
53	Detection of adulteration with Dhatura in food grains
54	Detection of adulteration with excess bran in wheat flour
55	Detection of adulteration with Khesari Dal in dal (whole and spilt)
56	Detection of adulteration with added colour in food grains
57	Detection of adulteration with turmeric in sella rice
58	Detection of adulteration with RhodamineB in Ragi
59	Detection of adulteration with chakunda beans in pulses
60	Detection of adulteration with sand soil, insects, webs, lumps, rodent hair, and excreta in Atta , Maida, Suji (Rawa)
61	Detection of adulteration with urea in Parched rice (☐☐☐)
62	Detection of adulteration with Lead Chromate in Pulses/Other Foods
63	Detection of adulteration with Metanil Yellow in Pulses/Parboiled rice
64	Detection of adulteration with Metanil Yellow in Gram-flour (Besan)
65	Detection of adulteration with Khesari dal flour in Gram-flour (Besan)
66	Detection of adulteration with Boric Acid in Maida/Rice Flour

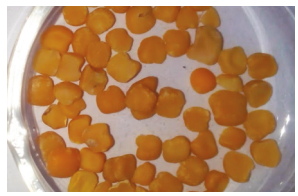
For further understanding of adulteration in food grains and their products, it is recommended to utilize the services of FSSAI's mobile food laboratory also known as “Food Safety on Wheels”. This unique mobile lab can perform 5 tests to check for adulteration in food grains and their products.

Additionally, some advanced quality parameters viz. moisture, protein, fat, ash, acid insoluble ash etc. and safety parameters such as heavy metals contaminants (lead, nickel, arsenic etc.), pesticide, mycotoxins etc. can also be tested. However, such analysis would require a mix of basic as well as high-end analytical equipment's for e.g., ICP-MS, GC-MS/MS, LC-MS/MS etc, respectively. For such analysis, it is recommended to utilize the facilities of any of the FSSAI notified laboratories.

Test 52	Detection of adulteration with extraneous matter (dust, pebble, stone, straw, weed seeds, damaged grains, insects, rodent hair, excreta etc) in food grains	
Procedure	1. Take small quantity of sample in a glass plate 2. Examine the sample visually	
Inference	 Pure	 Adulterated
Note: FSSAI has regulated the presence of extraneous matter to be not more than 1% by weight in food grains. Good quality unadulterated food grains would comply with the prescribed limit for presence of extraneous matter.		

Test 53	Detection of adulteration with Dhatura in food grains	
Procedure	1. Take small quantity of food grains in a glass plate. 2. Examine the sample visually	
Inference	 Dhatura seeds in food grains	 Dhatura seeds
Note: Dhatura seeds are blackish brown in colour and have flat edges. These seeds can be separated out easily by close visual examination.		

Test 54	Detection of adulteration with excess bran in wheat flour	
Procedure	1. Take a transparent glass of water. 2. Sprinkle a spoon of wheat flour on the surface of water.	
Observation	Some bran particles would be observed on the top surface	A lot of bran particles would be observed on the top surface
Inference	 Pure wheat flour	 Excess bran in wheat flour

Test 55	Detection of adulteration with Khesari Dal in Arhar/Tur dal (whole and spilt)	
Procedure	1. Take small quantity of dal (whole or split)on a glass plate 2. Examine the sample visually	
Inference	 Pure dal	 Khesari dal
Note: Khesari dal has rough edges with a slant on one side. The shape of Khesari Dal is square and therefore it can be separated out easily by close visual examination.		

Test 56	Detection of adulteration (with added colour) in food grains	
Procedure	1. Take a transparent glass of water 2. Add 2 teaspoons of food grains and mix thoroughly	
Observation	No color change observed in the water	Color leaches out into the water
Inference	 Pure	 Adulterated

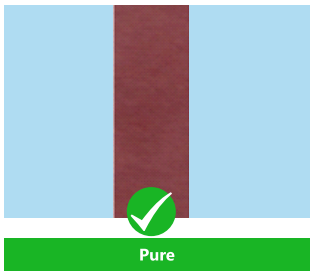
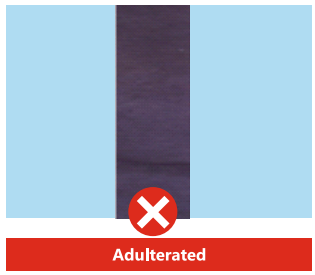
Test 57	Detection of adulteration (with turmeric) in sella rice	
Procedure	1. Take a tea spoon of rice on a glass plate 2. Sprinkle a small amount of soaked lime (commonly known as chuna which is used in pan) on the rice grains 3. Observe any color changes in soaked lime	
Observation	No color change observed in soaked lime	Color of soaked lime changes to red
Inference	 Pure	 Adulterated

Test 58	Detection of adulteration with Rhodamine B in Ragi	
Procedure	1. Take cotton ball soaked in water or vegetable oil 2. Rub the outer surface of the Ragi 3. Observe the color on the cotton ball	
Observation	No color change observed in the cotton ball	Color of the cotton ball changes to pink/red
Inference	 Pure	 Adulterated

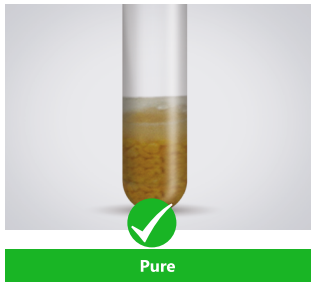
Test 59	Detection of adulteration (with chakunda beans) in pulses
Procedure	1. Take small quantity of pulses on a transparent glass plate 2. Examine the sample visually
Inference	 Chakunda beans

Note: Chakunda beans can be separated out easily by close visual examination.

Test 60	Detection of adulteration with sand soil, insects, webs, lumps, rodent hair, and excreta in Atta , Maida, Suji (Rawa)	
Procedure	1. Examine the sample visually	
Inference	 Atta, Maida, Suji (Rawa)	 Sand, Soil, insects, webs, lumps, rodent hair and excreta

Test 61	Detection of adulteration (with urea) in Parched rice (लाई)	
Procedure	1. Take 30 numbers of parched rice kernels in a test tube and add 5ml of water in it 2. Take a teaspoon of milk in a test tube 3. Add ½ teaspoon of **soybean or arhardal powder.** Mix up the contents thoroughly by shaking the test tube. 4. After 5 minutes, dip **a red litmus paper** in it. Remove the paper after ½ a minute 5. Observe the color change of the litmus paper	
Observation	No color change observed in **red litmus paper**	Color of the **red litmus paper** changes to **blue**
Inference	 Pure	 Adulterated
Scientific Explanation	If urea is present in the parched rice, the urease enzyme present in arhar dal or raw soybean powder will react with urea and liberate ammonia.This ammonia is responsible for the change in red litmus paper color to blue.	

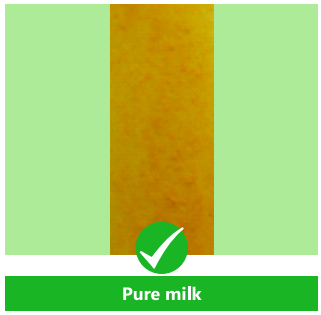
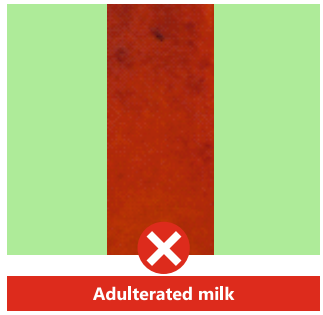
Caution: Reagents like Concentrated Hydrochloric acid and Nitric acid will be used to perform the following tests.

Test 62	Detection of adulteration with Lead chromate in Pulses/ Other grains	
Procedure	1. Shake 5g of pulse/food sample with 5ml of water 2. Add a few drops **of concentrated HCl** 3. Observe the change in color	
Observation	No color change observed	Color of solution changes to pink
Inference		
Scientific Explanation	The principle of this test is based on the color change of hexavalent chromate ions under acidic conditions.	

Test 63	Detection of adulteration with Metanil Yellow in Pulses/Parboiled rice	
Procedure	1. Take 1g of the pulse/food sample in a test tube 2. Add lukewarm water to extract Metanil yellow into the solution 3. Vortex the contents and let the mixture stand 4. Add a few drops **of concentrated HCl** 5. Observe the change in color	
Observation	No color change observed	Color of the solution changes to pink
Inference		
Scientific Explanation	Metanil yellow on reaction with hydrochloric acid gives pink coloration.	

Test 64	Detection of adulteration with Metanil Yellow in Gram flour (Besan)	
Procedure	1. Take 1g of Gram flour (Besan) in a test tube 2. Add 3ml of Ethyl alcohol to extract Metanil yellow into the solution 3. Shake the contents and let the mixture stand 4. Add 10 drops **of concentrated HCl** 5. Observe the change in color	
Observation	No color change observed	Color of the solution changes to pink
Inference		
Scientific Explanation	Metanil yellow on reaction with hydrochloric acid gives pink coloration.	

Test 65	Detection of adulteration with Khesari dal flour in Gram flour (Besan)	
Procedure	1. Take 1g of Gramflour (Besan) in a test tube 2. Add 3ml water to extract plant pigments into the solution 3. Add 2ml of concentrated HCl 4. Shake the contents and let the mixture stand 5. Observe the change in color	
Observation	No color change observed	Color of the solution changes to pink
Inference		
Scientific Explanation	Metanil yellow on reaction with hydrochloric acid gives pink coloration.	

Test 66	Detection of adulteration (with Boric Acid) in Maida/Rice Flour	
Procedure	1. Take 1g sample in a test tube 2. Add 5ml water and shake 3. Add a few drops of **concentrated HCl** 4. Dip a **turmeric paper strip** 5. Observe for any color change on the turmeric paper strip	
Observation	No color change observed in the turmeric paper strip	Color of the turmeric paper strip changes to red
Inference		
Scientific Explanation	The solution to be tested is acidified with dilute Hydrochloric acid. The turmeric paper is dipped into this solution and allowed to dry. Depending on the concentration of Boric acid (Borate), the turmeric paper changes color from yellow to orange-red.	

5 Fruits, Vegetables and their products

India with its diverse but favorable agro climatic conditions produces a wide range of tropical and temperate fruits and vegetables. Fruits contain a high amount of water ranging from 80-90%. They are a good source of vitamins. Some citrus fruits such as oranges are valued for their ascorbic acid content.

Vegetables are plants or parts of plants served with the main course of a meal. Apart from their nutritive value, vegetables add an appetizing color, texture and flavor to the Indian diet.

Fruits and Vegetables are consumed fresh and are perishable commodities. The color, size, overall appearance and freshness are important factors while making a purchase decision in case of fruits and vegetables. This is the primary reason for adulteration in fruits and vegetables.

Some common types of adulteration related to fruits and vegetable are listed as follows:

S. No.	Food Article	Adulterant	Reason
1.	Apple, pears, peach, plums, guavas, brinjal, bell pepper, etc.	Mineral oils and non-permitted waxes	To give a glossy appearance (which is perceived as an indicator of freshness)
1.	Watermelon	Injecting colors like Congo red, Sudan Dye	To give a brighter red color (which is perceived as an indicator of ripeness)
2.	Green chilies, pointed gourds, bitter gourds, green leafy vegetables, green peas, carrots litchi, strawberry, cherry etc.	Use of artificial colors like malachite green, copper sulphate, Congo red, Sudan red etc.	To enhance brightness and overall appearance (which is perceived as an indicator of freshness)
3.	cucurbitaceous vegetables like bottle gourd, pumpkin, and other vegetables	Use of hormone and hormone-like substances, growth regulators/ promoters	To enhance size and accelerate maturity of crop
4.	Jam, Jelly, Ketchups, sauces etc.	Use of non permitted artificial color and flavors	Cheaper substitute of permitted additives to make economic gains.
5.	Ketchups, sauces etc.	Arrowroot powder	Arrowroot starch is added to enhance the thickness (consistency) of ketchups and sauces.

This guidebook can help to check common adulterants like artificial colors viz. malachite green, rhodamine B and Erythrosine.

The list of 4 tests for fruit and vegetables described in this guidebook are as follows:

Code	Test
67a	Detection of adulteration with malachite green in green vegetables like bitter gourd, green chilli and others. (Method1)
67b	Detection of adulteration with malachite green in green vegetables like bitter gourd, green chilli and others. (Method2)
68	Detection of adulteration with artificial colorin green peas
69	Detection of adulteration with rhodamine B in sweet potato
70	Detection of adulteration with Erythrosine color in the watermelon pulp

For further understanding of adulteration in fruits and vegetables, it is recommended to utilize the services of FSSAI's mobile food laboratory also known as "Food Safety on Wheels". This unique mobile lab can perform 1 test to check for adulteration in fruits and vegetables.

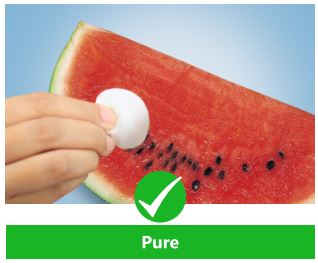
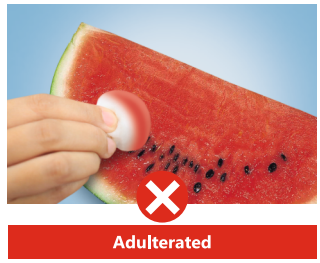
Additionally, some advanced quality parameters viz. total soluble solids, fruit percentage, moisture, acidity and safety parameters such as heavy metals contaminants (lead, copper, cadmium, arsenic etc.), pesticide, mycotoxins, etc. can also be tested. However, such analysis would require a mix of basic as well as high-end analytical equipment's for e.g., ICP-MS, GC-MS/MS, LC-MS/MS etc, respectively. For such analysis, it is recommended to utilize the facilities of any of the FSSAI notified laboratories.

Test 67a	Detection of adulteration with malachite green in green vegetables like bitter gourd, green chilli and others. (Method1)	
Procedure	1. Take a cotton piece soaked in liquid paraffin or vegetable oil (conduct the test with both liquid paraffin and oil separately) 2. Rub the outer green surface of a small part of green vegetable/chilli 3. Observe the color on the cotton	
Observation	No color change observed on the cotton piece	Color of the cotton piece changes to green
Inference	 Pure	 Adulterated
Scientific Explanation	The artificial color is soluble in liquid paraffin or vegetable oil	

Test 67b	Detection of adulteration with malachite green in green vegetables like bitter gourd, green chilli and others. (Method2)	
Procedure	1. Take a small part of the sample and place on a piece of moistened white blotting paper 2. Observe for color on the blotting paper	
Observation	No color change observed on the blotting paper	Blotting paper gives an impression of green color
Inference	 Pure	 Adulterated
Scientific Explanation	Water soluble artificial colors get absorbed on the surface of the moist paper	

Test 68	Detection of adulteration with artificial color on green peas.	
Procedure	1. Take little amount of green peas in a transparent glass 2. Add water to it and mix well 3. Let it stand for half an hour 4. Observe the color of the solution	
Observation	No color observed in the solution	Color of the solution changes to green
Inference	 Pure	 Adulterated
Scientific Explanation	Water soluble artificial colors leach out in the water	

Test 69	Detection of adulteration with rhodamine B in sweet potato.	
Procedure	1. Take a cotton ball soaked in water or vegetable oil (conduct the test with both water and oil separately) 2. Rub the outer red surface of the sweet potato 3. Observe the color of the cotton ball	
Observation	No color change observed on the cotton ball	Cotton ball absorbs the color and changes appearance to reddish violet
Inference	 Pure	 Adulterated
Scientific Explanation	Water or oil soluble artificial colors would solubilize and come out with the cotton surface	

Test 70	Detection of adulteration with Erythrosine color in watermelon pulp	
Procedure	1. Cut the watermelon into two halves 2. Rub a cotton ball on the inner succulent part of the fruit 3. Observe the color on the cotton ball	
Observation	No color change observed on the cotton ball	Cotton ball absorbs the color and changes appearance to red
Inference	 Pure	 Adulterated
Scientific Explanation	Water or oil soluble artificial colors would solubilize and come out with the cotton surface	

6 Salt, Spices & Condiments

Spices are mostly used as flavoring agents in a number of food products and preparations such as curries, bakery products, pickles, processed meats, beverages etc. They enhance the flavor of foods and also disguise or mask the off-flavors in certain foods. Some spices possess antioxidant properties while others are used as preservatives in foods like pickles and chutneys. Spices are obtained from different parts of the plant such as roots, buds, flowers, fruits, barks or seeds. Spices being agricultural commodities are prone to spoilage by insects or microbial attack. Processed spices have several advantages such as convenience, better storage life and ease of transportation. Major spices of India include Black pepper, Cardamom, Ginger, Chilies, Turmeric while minor spices include Cinnamon, Fenugreek, Garlic, Mustard etc.

Due to a shorter shelf life, spice oils or oleoresins are extracted from spices and marketed. Spice oils are obtained by steam distillation (a separation process of temperature sensitive materials) of ground (powdered) spices. Spice oils only contain the aromatic compounds which contribute to the typical smell or aroma of the spice. Oleoresins are obtained by the solvent extraction of ground (powdered) spices. Oleoresins contain the overall flavoring compounds which contribute to both the smell (aroma) as well as the taste of the spice.

A condiment or table sauce is a spice, sauce, or preparation (such as onions) that is added to food to impart a specific flavor, to enhance the flavor, or, in some cultures, to complement the dish.

Spices are high in value and are often sold in ground or powder form, making them a prime target for adulteration. Ground spices are often substituted with fillers, less expensive/low quality spices, flour, corn starch, sawdust etc. Sometimes toxic and potentially carcinogenic dyes are also added to older stocks to enhance their appearance and hide the presence of fillers.

Some common adulterants in spices and condiments are as follows:

S. No.	Spices	Adulterant	Reason
1.	Whole Spices	Dirt, dust, straw, insect,	Presence of extraneous matter (beyond the prescribed limit) indicates deliberate addition to increase the weight of the whole spices in order to make economic gains. Presence of such adulterants also indicates poor hygiene practices followed by the processing unit where whole spices are handled, processed and/or packaged.
2.	Black pepper	Papaya seeds	Papaya seeds are blended with black pepper seeds as cheaper substitutes to make economic gain. Mineral oil coating enhances the appearance of old stock or inferior quality substitutes. This is done to get a better price in market.
		Coated with mineral oil	

S. No.	Spices	Adulterant	Reason
2.		Volatile oil extracted	Oleoresin is a valuable commodity and is sold at a higher price. Black pepper seeds which have been subjected to solvent extraction do not have any smell (aroma) and taste characteristics left. Such spices are called exhausted or spent spices. They can be substituted (partly) with good quality spices to increase the weight and make economic gains.
3.	Cloves and cardamom	Volatile oil extracted (exhausted cloves), Coated with mineral oil	Cloves which have been subjected to solvent extraction do not have any smell (aroma) and taste characteristics left. Such spices are called exhausted or spent spices. They can be substituted (partly) with good quality spices to increase the weight and make economic gains. Mineral oil coating enhances the appearance of old stock or inferior quality substitutes. This is done to get a better price in market.
4.	Mustard seed	Argemone seed	Cheaper substitutes used to increase weight in order to make economic gains.
5.	Powdered spices	Added starch, Powdered bran and sawdust	
6.	Turmeric powder	Colored saw dust	
7.	Turmeric whole	Lead chromate, Metanil Yellow, Chalk powder or yellow soap stone powder	Colors are added to enhance color of old stock or inferior quality substitutes.
8.	Chillies powder	Brick powder, salt powder or talc, powder, Artificial colours, Water soluble coal tar colour, grit, sand, dirt, filth.	Chalk powder or yellow soapstone powder are added to increase weight order to make economic gains.
9.	Asafoetida (Hing)	Soap stone or other earthy material, Starch, Foreign resin.	To increase weight in order to make economic gains.
10.	Ground Spices	Powdered bran and saw dust.	

S. No.	Spices	Adulterant	Reason
11.	Cinnamon	Cassia bark	Cassia is usually cheaper in cost than cinnamon and hence is used for adulterating cinnamon.
12.	Cumin seeds	Grass seeds colored with	Cheaper substitute used for part replacement of good quality spice in order to make economic gains.
13.	Green chilli	Malachite green.	To enhance the appearance of old stock or inferior quality substitutes. This is done to get a better price in market.
14.	Saffron	Dried tendrils of maizecob, coloured gelatin fibres and dyeing parts of various wild plants.	Saffron is sold at a premium or high price in market. Part substitution with dried tendrils of maize cob, colored gelatin fibers etc is done to make economic gains.
15.	Coriander powder	Dung powder, Common salt.	Cheaper substitute used for part replacement of good quality spice in order to make economic gains.
16.	Mace of nutmeg tree	mace from a wild species of nutmeg	Cheaper substitute used for part replacement of good quality spice in order to make economic gains.
17.	Curcumin Oleoresins	Synthetic curcumin	
18.	Ginger oleoresin	Addition of capsicum and grains of paradise.	To give increased pungency
19.	Chilli oleoresins	Synthetic saturated acid vanillylamides such as pelargonicvanillylamide.	

*__Note:__ The food laws for salt, spices and condiments have cut-off limits for the following:
1) Organic extraneous matter such as chaff, stems and straw
2) Inorganic extraneous matter such as dust, dirt, stones, lumps of earth

Overall prescribed limit of extraneous matter is at max 1% by weight. Limit for insect damaged matter is also at max 1% by weight. This is to address incidental contamination since whole spices are agricultural commodities which might undergo minimal processing and handling before reaching consumers. In such instances, accidental presence of extraneous matter and insect damaged matter might be found.

This guidebook can help to check seventeen common adulterants like starch, foreign resin and soap stone in hing, papaya seeds in black pepper, saw dust, chalk powder etc.

The list of 25 tests described in this guidebook is as follows :

Code	Test
71a.	Detection of adulteration with foreign resin in Asafoetida (hing) (Method1)
71b.	Detection of adulteration with foreign resin in Asafoetida (hing) (Method2)
72	Detection of adulteration with starch in Asafoetida
73	Detection of adulteration with soap stone or other earthy matter in Asafoetida (hing)
74a.	Detection of adulteration with papaya seeds in Black pepper (Method1)
74b.	Detection of adulteration with papaya seeds in Black pepper (Method2)
75a.	Detection of adulteration with light black berries in Black pepper (Method1)
75b.	Detection of adulteration with light black berries in Black pepper (Method2)
76	Detection of adulteration with artificial/water soluble synthetic colors in Chilli powder
77	Detection of adulteration with saw dust in Chilli powder
78	Detection of adulteration with chalk in Common salt
79	Detection of adulteration with common salt and Iodised salt
80	Detection of adulteration with exhausted cloves in Clove
81	Detection of adulteration with cassia bark in Cinnamon
82	Detection of adulteration with grass seeds colored with charcoal dust in Cumin seeds
83	Detection of adulteration with argemone seeds in Mustard seeds
84	Detection of adulteration with lead chromate in Turmeric whole
85	Detection of adulteration with artificial colour in Turmeric powder
86	Detection of adulteration with yellow clay in Turmeric powder
87	Detection of adulteration with sawdust and powdered bran in powdered spices
88	Detection of adulteration with Added Starch in Powdered spices (Other than Turmeric)
89	Detection of adulteration with dried tendrils of maize cob in Saffron
90	Detection of adulteration with coloured Dried Tendrils of Maize Cob in Saffron
91	Detection of adulteration with Oil Soluble Color in Chilli Powder
92	Detection of adulteration with Metanil yellow in Turmeric Powder
93	Detection of adulteration with Chalk Powder in Turmeric Powder
94	Detection of adulteration with Aniline Dyes in Turmeric Powder
95	Detection of adulteration with Lead Chromate in Turmeric Powder

For further understanding of adulteration in salt, spices and condiments, it is recommended to utilize the services of FSSAI's mobile food laboratory also known as “Food Safety on Wheels”. This unique mobile lab can perform 16 tests to check for adulteration in salt, spices, condiments and related products.

Additionally, some advanced quality parameters viz. moisture, ash, acid insoluble ash, volatile oil, non volatile extracts, crude fibre and safety parameters such as heavy metal contaminants (lead, copper, cadmium, arsenic etc.), pesticide, mycotoxins, etc. can also be tested. However, such analysis would require a mix of basic as well as high-end analytical equipment's for e.g., ICP-MS, GC-MS/MS, LC-MS/MS etc, respectively. For such analysis, it is recommended to utilize the facilities of any of the FSSAI notified laboratories.

Test 71a	Detection of adulteration with foreign resin in Asafoetida (hing) (Method1)	
Procedure	1. Burn small quantity of Asafoetida on a stainless-steel spoon 2. Observe the burning pattern of the flame	
Observation	Burning pattern is similar to camphor	Burning of the sample does not produce a bright flame like camphor
Inference	 Pure	 Adulterated
Scientific Explanation	Asafoetida is a dried resin composed of 10-17% volatile oils. This oil burns with a bright flame.	

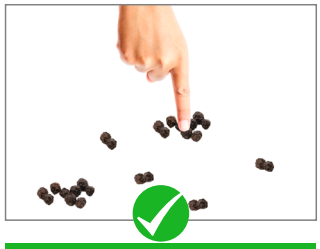
Test 71b	Detection of adulteration with foreign resin in Asafoetida (hing) (Method2)	
Procedure	1. Take a gram of Asafoetida 2. Place in a glass container 3. Add one tea spoon of water and mix thoroughly by shaking 4. Observe the change in solution	
Observation	The solution turns milky white without leaving any sediments at the bottom of glass	Sediments settle at the bottom of the glass
Inference	 Asafetida	 Non-Edible Gum/Resin
Scientific Explanation	Pure Asafoetida is soluble in water.	

Test 72	Detection of adulteration with starch in Asafoetia	
Procedure	1. Add about 1g of Asafoetida sample to a glass of water 2. Add **0.5ml iodine solution** 3. Observe for changes in color	
Observation	No color change observed with the addition of iodine solution	Blue color streaks start to appear after addition of iodine solution
Inference	 Asafoetida	 Starch
Scientific Explanation	Starch produces a blue colored complex with iodine.	

Test 73	Detection of adulteration with soap stone or other earthy matter in Asafoetida (hing)	
Procedure	1. Shake little portion of the sample with lukewarm water and allow to settle 2. Observe for sediments at the bottom of the glass	
Observation	No sediments observed at the bottom of the glass	Sediments settle at the bottom of the glass
Inference	 Pure	 Adulterated
Scientific Explanation	Earthy matter and soapstone are insoluble in the water, while Asafoetida is soluble in water hence, adulterants settle at the bottom.	

Test 74a	Detection of adulteration with papaya seeds in Black Pepper (Method1)	
Procedure	1. Add some amount of black pepper to a glass of water 2. Observe whether the seeds float or settle down	
Observation	Seeds settle at the bottom of the glass	Some or all seeds float on the surface of water
Inference	 Black pepper	 Papaya seeds
Scientific Explanation	Papaya seeds are lighter than black pepper seeds, hence they float on the surface of the water.	

Test 74b	Detection of adulteration with papaya seeds in Black Pepper (Method2)	
Procedure	1. Spread Black Pepper sample on a white paper 2. Observe the appearance of the sample using a magnifying glass	
Observation	Seeds appear brown with a wrinkled surface and characteristic smell and pungent taste.	Seeds appear shrunken with a smooth surface and oval shape. The color is greenish brown or blackish brown.
Inference	 Black pepper	 Papaya seeds

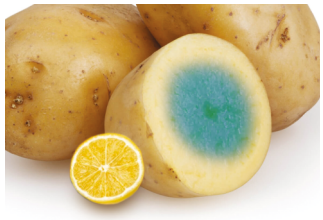
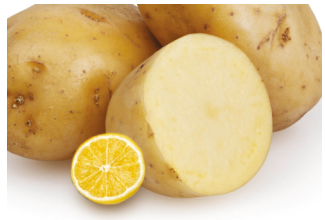
Test 75a	Detection of adulteration with light black berries in Black Pepper (Method1)	
Procedure	1. Press the berries with the help of finger 2. Observe whether the berries break easily or not	
Observation	Black Pepper berries do not break away easily	Light black berries break away easily
Inference	 Black pepper	 Light black berries
Scientific Explanation	"Light berries" means berry that has reached an apparently normal stage of development but the kernel does not exist and hence they break easily on applying slight pressure.	

Test 75b	Detection of adulteration with light black berries in Black Pepper (Method2)	
Procedure	1. Float the sample of Black Pepper in Ethyl alcohol (ethanol) 2. Observe whether it floats or sinks down	
Observation	Black Pepper seeds sink and settle at the bottom of the glass	Light black berries float on the surface
Inference	 Black pepper	 Light black berries
Scientific Explanation	"Light berries" means-berry that has reached an apparently normal stage of development but the kernel does not exist hence, they float on the surface.	

Test 76	Detection of adulteration with artificial/water soluble synthetic colors in Chilli powder	
Procedure	1. Sprinkle Chilli powder on the surface of water taken in a glass tumbler 2. Observe for color change in the solution	
Observation	The sample stays on the surface of the water for sometime and gradually settles to the bottom without leaving any color streaks	Colored streaks start descending in the water immediately
Inference	 Pure	 Adulterated

Test 77	Detection of adulteration with saw dust in Chilli powder	
Procedure	1. Add the sample to a glass of water 2. Observe whether the sample settles down or floats	
Observation	The sample gradually settles to the bottom of the glass	Some part of the sample continues to float on the surface
Inference	 Chilli powder	 Saw dust
Scientific Explanation	Saw dust is lighter than Chilli powder hence it floats on the surface.	

Test 78	Detection of adulteration with chalk in common Salt	
Procedure	1. Stir a spoonful of sample of salt in a glass of water 2. Observe for sediments at the bottom of the glass container	
Observation	Sample dissolves completely in water	Solution turns slightly white and some impurities are visible at the bottom of the glass container
Inference	 Common salt	 Chalk
Scientific Explanation	Salt is highly soluble in water while chalk powder is insoluble in the water, hence settles at the bottom or gets partially dissolved resulting in an opaque solution.	

Test 79	Detection of adulteration with common salt in Iodised salt	
Procedure	1. Cut a piece of potato 2. Apply some salt on the cut surface and wait for a minute 3. Add two drops of lemon juice 4. Observe for change in color	
Observation	The color of cut surface turns blue	No change observed in the color
Inference	 Iodised salt	 Common salt
Scientific Explanation	Starch produces a blue colored complex with iodine. In this experiment, potato is the source of starch and Iodized salt is the source of iodine.	

Test 80	Detection of adulteration with exhausted Cloves in Clove	
Procedure	1. Take some water in a glass and place the sample cloves into it 2. Observe for the pattern of settling in the glass	
Observation	Sample settles to the bottom of the glass	Some of the cloves or all of the cloves float at the surface of the water
Inference	 Cloves	 Volatile oil extracted cloves
Scientific Explanation	Exhausted Cloves mean Cloves from which the volatile oil has been extracted by distillation and hence, they become light and float on water.	

Test 81	Detection of adulteration with cassia bark in Cinnamon	
Procedure	1. Take small quantity of Cinnamon on a glass plate 2. Observe the bark	
Observation	Sample is very thin which can be rolled around a pencil or a pen. It has a distinct smell.	Sample comprises of several layers in between the rough outer and inner most smooth layers
Inference	 Cinnamon	 Cassia
Scientific Explanation	Cassia bark is thicker because its outer layer is stripped off. For that reason, cassia sticks curl inward from both sides toward the centre as they dry. Cassia has a hollow tube.	

Test 82	Detection of adulteration with grass seeds colored with charcoal dust in Cumin seeds	
Procedure	1. Rub small amount of cumin seeds on palms 2. Observe the palms for black coloration	
Observation	No color changes observed on the palm	Appearance of black color observed on the palm
Inference	 Pure	 Adulterated
Scientific Explanation	Charcoal is black in colour and used to colour the grass seeds to make it appear like cumin seeds.	

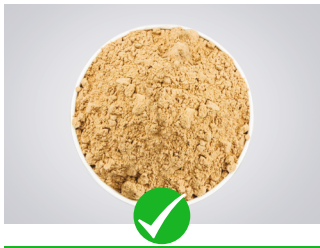
Test 83	Detection of adulteration with argemone seeds in Mustard seeds	
Procedure	1. Take small quantity of Mustard seeds in a glass plate 2. Examine the sample visually	
Observation	The seeds have a smooth outer surface. Once pressed, the seeds have an inner whiter surface.	Seeds have a grainy, rough surface and are black in color. When pressed, the seeds have a white inner surface
Inference	 Mustard seeds	 Argemone seeds

Test 84	Detection of adulteration with Lead chromate in Turmeric (whole)	
Procedure	1. Add small quantity of Turmeric (whole) in a transparent glass of water 2. Observe the color of the solution	
Observation	No color change observed in the solution	Color of the solution changes immediately and the sample also appears bright in color
Inference	 Pure	 Adulterated
Scientific Explanation	Lead chromate is readily soluble in water and hence dissolves to give yellow colored solution immediately.	

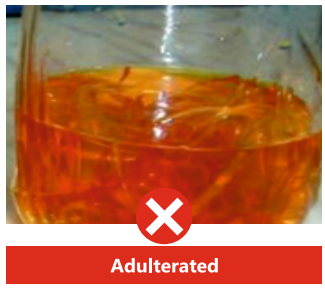
Test 85	Detection of adulteration with artificial color in Turmeric powder	
Procedure	1. Add a teaspoon of turmeric powder in a glass of water 2. Observe the color of the solution	
Observation	Light yellow color observed while the sample settles down in the glass	Strong yellow color observed while the sample settles down in the glass
Inference	 Pure	 Adulterated
Scientific Explanation	Artificial colour is readily soluble in water and hence, dissolves to give yellow coloured solution immediately.	

Test 86	Detection of adulteration with yellow clay in Turmeric powder	
Procedure	1. Add a teaspoon of turmeric powder in a glass of water 2. Mix properly and allow it to stand for sometime	
Observation	Pure turmeric get dissolved in water leaving pale yellow color	The yellow clay will settle down at the bottom
Inference	 Pure	 Adulterated
Scientific Explanation	Clay is insoluble in water, therefore it settles down at bottom	

Test 87	Detection of adulteration with sawdust and powdered bran in powdered spices	
Procedure	1. Sprinkle powdered spices on the water surface 2. Observe whether the sample floats or sinks	
Observation	The sample dissolves in water without leaving any traces of impurities on the surface	Traces of impurities are visible on the surface of the water
Inference	 Pure	 Adulterated
Scientific Explanation	Saw dust and powdered bran are lighter than spices and hence float on the surface of water.	

Test 88	Detection of adulteration with Added Starch in Powdered spices (Other than Turmeric)	
Procedure	1. Add 0.5ml of Iodine solution to the spice powder in a petri dish 2. Observe the development of colour	
Observation	No color change observed on the sample	Color of the sample changes to blue in some parts
Inference	 Pure	 Adulterated
Scientific Explanation	Starch produces a blue-black coloration in presence of Iodine.	

Test 89	Detection of adulteration with dried tendrils of Maize cob in Saffron	
Procedure	1. Take a glass plate/dish and place a small quantity of saffron on it 2. Observe the saffron fragments by placing them between the fingers	
Observation	Sample does not break easily	Sample breaks easily and leaves some color onto the fingers
Inference	 Saffron	 Coloured tendrils

Test 90	Detection of adulteration with colored dried tendrils of Maize cob in Saffron	
Procedure	1. Take a few strands of saffron in a glass jar 2. Add hot water 70-80 °C 3. Observe the diffusion of color	
Observation	Sample continues to release typical saffron color slowly into the water	Sample immediately releases color into the water
Inference	 Pure	 Adulterated
Scientific Explanation	Artificial saffron is prepared by soaking maize cob in sugar and coloring it with coal tar dyes and hence gives out intense color and breaks off easily.	

Caution: Reagents like Concentrated Hydrochloric acid and Nitric acid will be used to perform the following tests.

Test 91	Detection of adulteration with Oil Soluble Color in Chilli Powder	
Procedure	1. Take 2 g of the sample in a test tube, add **few ml of ether** and shake 2. Decant ether layer into a test tube containing **2 ml of dilute HCl (50%)** and shake 3. Observe the color of lower acid layer	
Observation	No color observed in the lower acid layer	Red color observed in the lower acid layer
Inference	 Pure	 Adulterated
Scientific Explanation	The oil soluble color gets extracted into a separate layer using ether. The commonly used colors give red coloration under acidic conditions.	
Note: For preparation of dilute HCl, add 2ml HCl in 3ml distilled water		

Test 92	Detection of adulteration with Metanil yellow in Turmeric Powder	
Procedure	1. Take 1g turmeric powder in a test tube 2. Add 2 ml of ether 3. Add **0.5ml of concentrated HCl** 4. Observe for any change in color	
Observation	Appearance of pink/violet color which disappears on dilution with water	Appearance of pink/violet color which persists
Inference	 **Pure**	 **Adulterated**
Scientific Explanation	Metanil yellow gets extracted into a separate layer using ether. Metanil yellow gives red color under acidic conditions.	

Test 93	Detection of adulteration with Chalk Powder in Turmeric Powder	
Procedure	1. Take about 1g of turmeric powder in a test tube containing 2-3 ml of water 2. Add **0.5ml of Conc. HCl** 3. Observe for any changes	
Observation	No bubbles observed	Bubbles observed in the test tube
Inference	 **Pure**	 **Adulterated**
Scientific Explanation	Chalk powder is made of Calcium carbonate and reacts with acid to release carbon dioxide, as shown by bubble formation.	

Test 94	Detection of adulteration with Aniline Dyes in Turmeric Powder	
Procedure	1. Take 1g turmeric powder in a test tube 2. Add water to make a suspension 3. Add **1- 2 ml of Ethyl alcohol** 4. Observe for any changes	
Observation	No color change observed	Immediate separation of yellow color in the Ethyl alcohol layer
Inference	 **Pure**	 **Adulterated**
Scientific Explanation	Aniline dyes are miscible in Ethyl alcohol and give intense yellow color upon reaction.	

Test 95	Detection of adulteration with Lead chromate in Turmeric Powder	
Procedure	1. Take 1g of turmeric/chilli powder in a test tube 2. Add 1 ml conc. HCl 3. Observe for any change in color	
Observation	No color change observed	Color changes to a deep red
Inference	 **Pure**	 **Adulterated**
Scientific Explanation	Lead Chromate gives out red color under acidic conditions.	

7 Beverages

Commonly consumed beverages include Tea, Coffee, Cocoa and Carbonated Drinks etc.

Coffee is an evergreen shrub and the coffee flowers produce green berries which turn red when ripe. Coffee processing consists of removing the skin, pulp, parchment and silvery skin. Raw or Green coffee has no flavor. For use as a beverage, it is roasted, powdered and brewed and the extract is consumed as a beverage with or without the addition of milk, sugar and other ingredients. Chicory root is often roasted, ground and blended with coffee to give bitterness and texture to the beverage. Chicory is allowed in coffee-chicory mixture and instant coffee-chicory powder only and not allowed in 100% coffee powder. In such products, chicory content should not exceed 49% by weight.

Tea is an evergreen shrub and the leaves are consumed as a beverage. The most popular form of tea consumed in India is Black tea. Processing of black tea consists of drying of leaves, rolling (to break open the cells), fermentation (to develop the flavor) followed by final drying (to arrest the process of fermentation and reduce the moisture content for safe storage). The finished product is graded into 'leaf' grade and 'broken' grade. Besides these grades, the other waste products include fannings (small pieces of tea) and tea dust. Tea is generally blended before it reaches the consumers. It is at this point, that the chances of adulteration with lower grade tea, other cheaper substitutes and adulterants are high.

Soft drinks are equally popular as a beverage choice. Three main types of soft drinks commonly consumed are carbonated, fruit flavored (still) and sparkling (soda). Some of the ingredients used for manufacturing of soft drinks include sugar, syrups, flavors, colors, fruit juices, water etc. Due to an increased demand, these products are also prone to adulteration.

Common Adulterants:

Among the above-mentioned commodities adulteration is seen in Tea, Coffee, Syrups and Beverages

S. No.	Food Commodity	Adulterant	Reason
1.	Coffee Powder	Cereal Starch	Coffee powder sells at a high price. Cheaper substitutes are added to partly replace good quality coffee powder for the purpose of economic gain.
		Scorched Persimmon stones, clay	
		Powder of date seed	
2.	Tea	Artificially colored or exhausted tea Leather flakes	Cheaper substitutes are added to partly replace good quality tea for the purpose of economic gain. Dyes are added to enhance the color of cheaper substitutes to match the appearance.
3.	Syrups	Coal Tar dye	Added to enhance colour and overall appearance
		Rhodamine B	
		Metanil yellow colour	
4.	Beverages	Metanil yellow	Added to enhance colour and overall appearance
5.	Carbonated beverages/ Lemonade	Mineral oil	

This guidebook can help to check common adulterants like artificial colours viz. malachite green, rhodamine B and Erythrosine. The list of 7 tests those are present in this guidebook are as follows:

Code	Test
96	Detection of adulteration with clay in coffee powder
97	Detection of adulteration with chicory powder in coffee powder
98	Detection of adulteration with scorched persimmon seed powder adulteration in coffee powder
99	Detection of adulteration with cereal starch in Coffee powder
100a	Detection of adulteration with exhausted tea in tea leaves (Method 1)
100b	Detection of adulteration with exhausted tea in tea leaves (Method 2)
101	Detection of adulteration with iron filings in tea leaves
102	Mineral acid in Carbonated beverages/ Vinegar/Lemonade soda

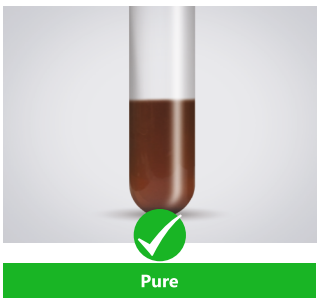
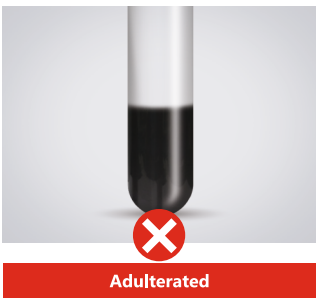
For further understanding of adulteration in beverages, it is recommended to utilize the services of FSSAI's mobile food laboratory also known as "Food Safety on Wheels". This unique mobile lab can perform 2 tests to check for adulteration in beverages and related products.

Additionally, some advanced quality parameters viz. moisture, ash, acid insoluble ashand safety parameters such as heavy metal contaminants (lead, copper, cadmium, arsenic etc.), pesticide, mycotoxins, etc. can also be tested. However, such analysis would require a mix of basic as well as high-end analytical equipment's for e.g., ICP-MS, GC-MS/MS, LC-MS/MS etc, respectively. For such analysis, it is recommended to utilize the facilities of any of the FSSAI notified laboratories.

Test 96	Detection of adulteration with clay in Coffee powder	
Procedure	1. Add ½ teaspoon of coffee powder in a transparent glass of water 2. Stir for a minute and keep it aside for 5 minutes 3. Observe for sediments at bottom of the glass	
Observation	No sediments observed at the bottom of glass	Sediments observed at the bottom of glass
Inference		

Test 97	Detection of adulteration with chicory powder in Coffee powder	
Procedure	1. Take a transparent glass of water 2. Add a teaspoon of coffee powder 3. Observe the solubility pattern	
Observation	Sample floats on the surface of water with gradual/slow dissolution	Sample floats on the surface of water with relatively faster dissolution
Inference	Coffee beans 	Chicory Powder 
Disclaimer: Chicory is allowed in coffee-chicory mixture and instant coffee-chicory powder only and not allowed in 100% coffee powder. Every package containing coffee-chicory mixture and instant coffee-chicory powder, the percentage of chicory shall be mentioned. Also, chicory content should not exceed 49% by weight.		

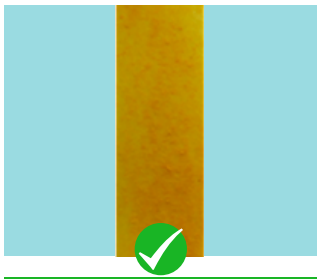
Test 98	Detection of adulteration with scorched persimmon seed powder adulteration in coffee powder	
Procedure	1. Dissolve1 teaspoon of coffee powder in 5ml water 2. Pour 3ml of **2% of aqueous solution of sodium carbonate** slowly and carefully 3. Observe for change in color	
Observation	No color change observed	Solution turns red
Inference		
Note- For preparation of 2% Sodium Carbonate, add 1g Sodium Carbonate in 50ml distilled water		

Test 99	Detection of adulteration with cereal starch in Coffee powder	
Procedure	1. Take 2g of coffee powder in a 100ml beaker 2. Add 40ml water and boil, cool and allow it to settle 3. Transfer the supernatant solution to the test tube 4. Add 3 ml of 0.1N potassium permanganate solution and 10ml of HCl (1:1) to decolorize the mixture. 5. Add few drops of iodine solution 6. Observe the change in color	
Observation	No color change observed	Solution turns bluish black
Inference		
Scientific Explanation	Amylose in starch is responsible for the formation of a deep blue color in the presence of iodine.	

Test 100a	Detection of adulteration with exhausted tea in tea leaves (Method 1)	
Procedure	1. Take a filter paper and spread few tea leaves 2. Sprinkle with water to wet the filter paper 3. Wash the filter paper under tap water and observe the stains against light 4. Observe for staining of the filter paper	
Observation	No staining observed on the filter paper	Blackish brown colored staining observed on filter paper
Inference		

Test 100b	Detection of adulteration with exhausted tea in tea leaves (Method 2)	
Procedure	1. Take small amount of tea leaves/ dust and place it in the centre of a filter paper 2. Add water drop by drop at the heap of the tea leaves/ dust 3. Observe for color streaks on the filter paper	
Observation	No color streaks observed on the filter paper	Blackish brown colored streaks observed on the filter paper
Inference	If the tea is adulterated with a coloured tea, water will dissolve the added colour and leave streak of colour in the filter paper 	
Scientific Explanation	The color is water soluble and gets dissolved in the water leaving a streak on the filter paper	

Test 101	Detection of adulteration with iron filings in tea leaves	
Procedure	1. Take a small quantity of tea leaves on a glass plate 2. Move the magnet through the tea leaves 3. Observe the magnet	
Observation	No iron fillings observed on the magnet	Iron filings observed on the magnet
Inference	 Pure	 Adulterated
Scientific Explanation	Iron displays magnetic properties and therefore can be easily detected with a bar magnet	

Test 102	Mineral acid in Carbonated beverages/ Vinegar/Lemonade soda	
Procedure	1. Take 5-10 ml of vinegar or beverage in a test tube 2. Dip the **Metanil yellow paper** 3. Observe color change of indicator paper	
Observation	No color change observed on the indicator paper	Color of the indicator paper changes to violet
Inference	 Pure milk	 Adulterated milk
Scientific Explanation	Carbonated beverages, vinegar and lemonade soda has pH more than 2.5. The Metanil yellow paper strip gives a violet color in case of beverage sample adulterated with Mineral acid since the pH drops below 2.5	

Annexures

Annexure I

GENERAL SAFETY GUIDELINES

Personal Protective Equipment (PPE):

- Use appropriate personal protective equipment during all times in the laboratory.
- All individuals working in the chemical laboratory must wear aprons (laboratory coats) and shoes all the time.
- Use safety goggles while handling any chemicals in the laboratory.
- Use nitrile gloves and mask while handling solvents and solid chemicals.
- Use acid/alkali gloves while handling acid and alkali.
- Use heat resistant gloves while heating/boiling or handling hot glassware.

General laboratory operations:

- No equipment should be kept next to the door as this prevents complete opening of the door.
- All unwanted chemicals and glassware should be removed from work table immediately.
- Work table and floor should be cleaned after each stage of an experiment and after spillage.
- Broken glass pieces should be removed and swept up immediately.
- All the reagents (acids, solvents etc.) should be labelled and kept properly at their places.
- Avoid naked wires running across the laboratory floor.
- Each equipment should be placed at its specified place.
- The first aid box should be placed at designated place for easy access.
- The samples for analysis should be kept in their designated places.

General laboratory personal protective equipment

Handling of chemicals and solvents:

- All chemicals should be handled with care.
- Spills on hand, or other parts of body, should be immediately cleaned/washed thoroughly.
- The acid spill should be continuously washed with cold running water at least till the burning sensation ceases. Immediately consult a physician.
- Transferring or weighing of chemicals should be done with a spatula.
- Do not breathechemical vapors or gases.
- Do not attempt to smell during the course of a reaction.
- Do not pipette by mouth, instead, use appropriate rubber bulbs.
- Do not store dangerous chemicals on high shelves.
- Handle organic solvents away from the open flames, if any.
- Heating of acids should be carried out in the fume hood/cabinet only.
- Dilution of acid should be done by carefully pouring acid in water and not vice-versa.
- All solvents should be regarded as flammable.
- Turn off all naked flames while using solvents.
- Used solvents should be disposed carefully.

Handling glassware and apparatus:

- Examine all glassware for defects before any experiment; do not use cracked or badly chipped glassware.
- The damaged glassware should be carefully discarded and replaced appropriately.
- Always remove chemicals from glassware before washing.
- Handle the reagent bottles carefully-use appropriate trays to carry from one point to another.
- Never leave any reagent bottles, measuring cylinder etc. standing on the edge of the work table where it can easily be knocked over.
- Do not setup apparatus near the edge of the work table.

Guideline for Teachers:

- Procure the required adulterants and food products to prepare positive adulterated samples for demonstration.
- General supervision is required when the kit is used by School Children.
- Customize the demonstration content in accordance to the class/grade .

Annexure II

HAZARD PICTOGRAM

S.No.	Pictogram	Hazard Description
1.		**Health Hazard** • Cancer causing • Short, or, long term exposure could cause serious long-term health effects
2.		**Medium Health Hazard: EXCLAMATORY MARK!** • Irritant (Skin, Eye) • Narcotic effect • Respiratory tract irritant
3.		**Acute Health Hazard: CORROSIVE** • May cause burns to skin and damage to eyes • May corrode metals • Avoid skin & eye contact • Avoid breathing vapors
4.		**Acute Health Hazard: SKULLS & BONES** • Indicates life-threatening effects, in some cases even after limited exposure • Any form of ingestion, inhalation and skin contact should be avoided
5.		**Physical Hazard: FLAME** • Flammable &combustible • Flammable when exposed to heat, fire, spark, or • May give off flammable gases upon reacting with water
6.		**Physical Hazard: BOMB** • Explosive &self-reactive • May explode as consequence of fire, heat, shock, or friction
7.		**Physical Hazard: FLAME OVER CIRCLE** • Oxidizers • May burn in absence of air • Can intensify fires in combustible materials
8.		**Environmental Hazard:** • Indicates substance that are toxic to aquatic organisms, or may cause long lasting environmental effect • These should be disposed-off responsibly

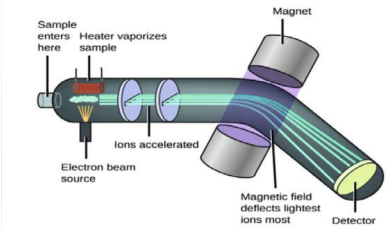
Annexure III

Major equipment available in a food testing laboratory and their applications

What is Mass Spectrometer (MS)?

A **mass spectrometer** produces charged particles (ions) from the chemical substances that are to be analyzed. The **mass spectrometer** then uses electric and magnetic fields to measure the **mass** ("weight") of the charged particles

How does it work?



1. Small quantity of food sample is vaporized inside the MS
2. Electron gun ionizes molecules in the food sample
3. Positive ions accelerate while passing through electric field
4. Positive ions deflect while passing through magnetic field
5. Ions hit a charged plate producing a complex stick pattern

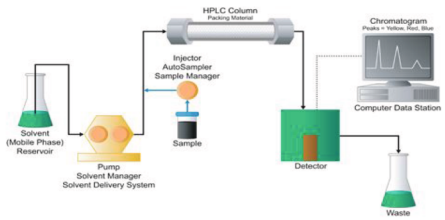
Where is it used?

- Detection of food contaminants and environmental toxins
- Pesticide residue analysis
- Protein identification
- Drinking water testing

What is High Performance Liquid Chromatography (HPLC) ?

High performance liquid chromatography (HPLC) is utilized for separation and quantification of components in a mixture that has been dissolved in a solvent called the 'mobile phase'.

How does it work?



Simple Schematic Representation of HPLC System

1. Food sample (liquid form) is injected into the HPLC sampling port
2. Mobile phase (solvent) carries the sample to HPLC column under pressure
3. Column (stationary phase) is the site for chromatographic separation
4. Detector measures the separated components coming out from the column at different speeds
5. Computer is used to compare the chromatogram/pattern versus a standard

Where is it used?

- Vitamin content & nutritional analysis
- Detection of adulterants & contaminants
- Detection of spoilage indicators
- Detection of food additives

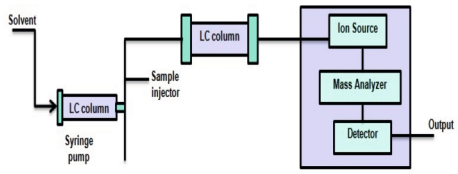
Annexure III

Major equipment available in a food testing laboratory and their applications

What is Liquid Chromatography- Mass Spectrometry (LC-MS) ?

Liquid chromatography- Mass Spectrometry (LC-MS) is an analytical technique which combines the separation power of HPLC and detection power of Mass Spectrometry

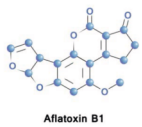
How does it work?



Simple Schematic Representation of LC-MS System

1. Food sample (liquid form) is injected into the LC sampling port
2. Mobile phase (solvent) carries the sample to LC column under pressure
3. Column (stationary phase) is the site for chromatographic separation
4. Interface between LC and MS allows for transition from high pressure to high vacuum conditions
5. Ionization of the sample is followed by sorting & detection under influence of electric and magnetic fields

Where is it used?



Aflatoxin B1

Detection of Aflatoxins

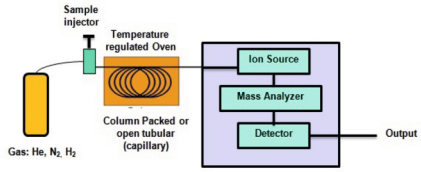
Detection of Food colorants

Detection of Veterinary Drug Residues such as Antibiotics

What is Gas Chromatography- Mass Spectrometry (GC-MS) ?

Gas chromatography- Mass Spectrometry (GC-MS) is an analytical technique which combines the separation power of HPLC and detection power of Mass Spectrometry

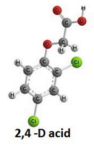
How does it work?



Simple Schematic Representation of GC-MS System

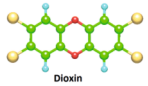
1. Food sample (liquid form) is injected into the GC sampling port and volatilized
2. Mobile phase (carrier gas) carries the sample to LC column under pressure
3. Column (stationary phase) is the site for chromatographic separation
4. Interface between GC and MS allows for transition from high pressure to high vacuum conditions
5. Ionization of the sample is followed by sorting & detection under influence of electric and magnetic fields

Where is it used?



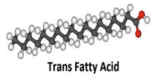
2,4 -D acid

Detection of Pesticides



Dioxin

Detection of environmental pollutants



Trans Fatty Acid

Detection of Trans Fatty Acid

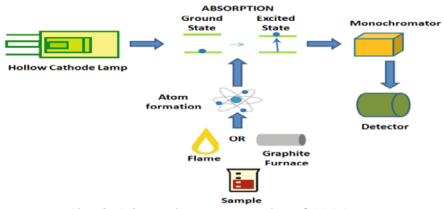
Annexure III

Major equipment available in a food testing laboratory and their applications

What is Atomic Absorption Spectroscopy (AAS) ?

Atomic Absorption Spectroscopy (AAS) is an analytical technique which is based on absorption of light by free metallic ions.

How does it work?



Simple Schematic Representation of AAS System

1. Food sample (liquid form) is introduced into the carrier stream into a nebulizer as mist
2. Desolvation and vaporization of ions or atoms in a sample by high-temperature source such as a flame or graphite furnace
3. Monochromator is used to select the specific wavelength of light which is absorbed by the sample, and to exclude other wavelengths
4. Detector convert the light signal into an electrical signal proportional to the light intensity
5. The calibration curve of standard solutions concentration vs absorbance is plotted. The unknown concentration of the element is then calculated from the calibration curve

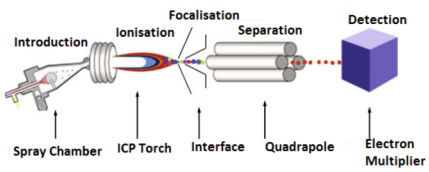
Where is it used?

Detection of essential minerals (K, Ca, Mg, Na), trace minerals (Cu. Cr, Fe, Mn, Se, Zn etc. and Toxic elements(Hg, Pb, As, Cd etc.) in food and water

What is Inductively Coupled Plasma- Mass Spectrometry (ICP-MS) ?

Inductively Coupled Plasma- Mass Spectrometry (ICP-MS) is an analytical technique that detects ions distinguished by their mass-to-charge ratio (m/z value). It is based on ions moving under influence of electrical or magnetic field

How does it work?



Simple Schematic Representation of ICP-MS System

1. Liquid sample converted into a fine aerosol of sample is introduced into the plasma via a combination of nebulizer, spray chamber, and torch
2. Plasma ion source decomposes sample matrix and form ions. Ion lenses focuses ions and remove photons and neutrals.
3. Reaction cell removes spectral interferences (polyatomic ions)
4. Quadrupole MS separates ions by m/z- unit mass resolution
5. Detector detects ions and transfer counts to the data system

Where is it used?

Detection of essential minerals (K, Ca, Mg, Na), trace minerals (Cu, Cr, Fe, Mn, Se, Zn etc.) and Toxic elements(Hg, Pb, As, Cd etc.) in food and water

Advantage over AAS

- Wide Elemental Coverage
- Extremely Low Detection Limits
- Fast Analysis times (all elements at once)
- Simple Spectra
- High Throughput & Productivity
- Isotopic Information

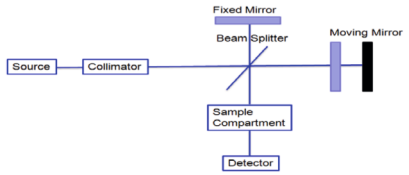
Annexure III

Major equipment available in a food testing laboratory and their applications

What is Fourier Transform Infrared Spectrometry (FTIR) ?

Fourier-transform infrared spectroscopy (FTIR) is a technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid or gas. An FTIR spectrometer simultaneously collects high-spectral-resolution data over a wide spectral range.

How does it work?



Simple Schematic Representation of FTIR System

1. Infrared energy is emitted from a source. This beam passes through an opening which controls the amount of energy presented to the sample
2. The beam enters the interferometer modifies the light in a special way to allow for subsequent processing of the data
3. The beam enters the sample compartment where it is transmitted through or reflected off of the surface of the sample. Some specific frequencies of energy, which are unique characteristic of the sample, are absorbed
4. The beam finally passes to the detector for final measurement.
5. The computer processes all the data to infer what the absorption is at each wavelength and generates a spectrum corresponding to the data using the Fourier Transform technique.

Where is it used?

Milk Analyser- Fat, Protein, Lactose and adulterants

Fats & Oils- Degree of unsaturation

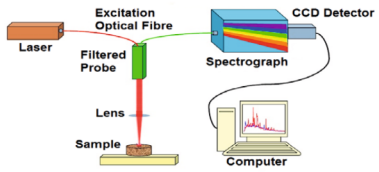
Aroma & Flavor in spices and other food products

Analysis of Packaging material

What is Raman Spectroscopy ?

Raman spectroscopy is a spectroscopic technique based on inelastic scattering of monochromatic light, usually from a laser source. Inelastic scattering means that the frequency of photons in monochromatic light changes upon interaction with a sample

How does it work?



Simple Schematic Representation of Raman Spectroscopy System

1. Sample is illuminated with a monochromatic laser beam. The beam is passed to the sample through mirror or lenses
2. Most of the light is elastically scattered called the Rayleigh scatter while a small is inelastically scattered called the Raman scatter. A lens system focuses the exciting light onto or into the sample and collects the resulting Raman scattered light.
3. The scattered light is collected by fibre optics. collected scattered light must then be spectrally filtered to remove the Rayleigh scattered component
4. A CCD detector captures the light, resulting in the Raman spectrum
5. The collected Raman light is spectrally analysed to get the result

Where is it used?

- Determination of fat / oil composition
- Adulteration of oil
- Detection and Identification of bacteria and other micro-organisms
- Surface enhanced Raman Spectroscopy (SERS) detection of pesticides in foods
- Analysis of Carotenoides
- Detection of Melamine in milk
- Structural characterization of grains, crops etc.

Annexure IV

MOBILE FOOD TESTING LABORATORY (FOOD SAFETY ON WHEELS)

"Food Safety on Wheels" are 'Mobile' food testing laboratories. Apart from conducting simple tests for common adulterants in milk, water, edible oil and other items of food of daily consumption, these mobile units are also being used to

- Build awareness around food safety, hygiene
- Promote healthy eating habits in citizens at large
- Conduct training and certification programme for food handlers and supervisors in food businesses, particularly petty food businesses

In addition, these mobile units are supporting the frontline workers in the states to enhance their outreach and conduct surveillance activities even in far-flung areas.

For further understanding of adulteration in commonly consumed food products, it is recommended to utilize the services of FSSAI's mobile food laboratory. The list of tests that can be performed by the mobile laboratory are tabulated below:

S.No.	Category	Test for Adulterants
1.	Milk and Milk Products	Added Water by glass plate method
		Added Water by Lactometer method
		Added Starch and cereal flours
		Cellulose
		Added cane Sugar
		Added Glucose
		Maltodextrin/ DextrinAdded Urea
		Ammonium Sulphates
		Added sulphates
		Sodium Chloride

S.No.	Category	Test for Adulterants
1.	Milk and Milk Products	Vanaspati in milk
		Nitrates
		Neutralizers
		Detergents
		Pulverised soaps
		Skimmed milk Powder
		Gelatin
		Added preservatives - Formalin, Hydrogen Peroxides, Benzoic and Sodium benzoate, Salicyclic acid, Mercuric chloride
		Alkaline phosphatase test
		Turbidity Test
		Added colours - Metanil yellow, Annato, Coal tar dyes
		Thickeners in milk products - Starch, mashed potato, cereal flours, gelatine, blotting paper
		Vanaspati in Ghee
2.	Fats, Oils, and Fat Emulsions	Rancidity
		Argemone oil
		Cotton seed oil
		Mineral Oil
		Castor oil
		Karanjia oil
		Cyanide in edible oil
		Mobile oil (Lube)
		Adulteration in coconut oil
3.	Salt, Spices, and Condiments	Detection of adulteration with Lead Salts in Turmeric Powder
		Detection of adulteration with Lead Chromate in Turmeric Powder
		Detection of adulteration with Metanil Yellow in Turmeric Powder
		Detection of adulteration with Aniline Dyes in Turmeric Powder
		Detection of adulteration with Chalk Powder in Turmeric Powder
		Detection of adulteration with Brick Powder in Chilli Powder
		Detection of adulteration with Added Color in Chilli, Turmeric and Other Curry Powders

S.No.	Category	Test for Adulterants
3.	Salt, Spices, and Condiments	Detection of adulteration with Oil Soluble Color in Chili Powder
		Detection of adulteration with Sudan Dye III in Chilli Powder
		Detection of adulteration with Rhodamine B in Chilli Powder
		Detection of adulteration with Papaya Seeds in Black Pepper
		Detection of adulteration with Common Salt in Coriander Powder
		Detection of adulteration with Chalk in Asafoetida
		Detection of adulteration with Colophon Residue in Asafoetida
		Detection of adulteration with Foreign Resins in Asafoedita
		Detection of adulteration with Dried Tendrils of Maize Cob in Saffron
4.	Other Foods	Detection of adulteration with Chalk Powder and Washing Soda in Sugar, Bura Sugar
		Detection of adulteration with Artificial Invert Sugar Syrup in Honey (Fieh's Test)
		Detection of adulteration with Artificial Invert Sugar Syrup in Honey if Fieh's Test Is Positive
		Detection of adulteration with Chalk Powder and Washing Soda in Wheat flour
		Detection of adulteration with Metanil Yellow in pulses and Sella Rice
		Detection of adulteration with Lead chromate in Pulses
		Detection of adulteration with Sand and Dirt in Wheat and Other Flours
		Detection of adulteration with Boric Acid in Maida and Rice Flour
		Detection of adulteration with Malachite green in green vegetables using liquid Paraffin
		Detection of adulteration with Artificially Coloured Tea Dust Mixed with Genuine Tea or Used Tea Leaves
		Detection of adulteration with Mineral Acid in Vinegar/ Carbonated Beverages

The following equipment present in FSW can be used to perform on-the-spot testing:

S.No.	Equipment	Test
1.	Digital Multi-Parameter Hand Held Meter	pH, Conductivity, TDS (Total Dissolved Solids) and Salt
2.	Digital refractometer-Portable	Total soluble solids
3.	Rapid Milk screening Apparatus-Milkoscreen	Fat, SNF, Protein Adulterants - added water urea, sucrose, maltodextrin, ammonium sulphate and abnormality (if any other adulterant is present, it alerts as abnormal milk)

The other rapid test kits like pathogen detection kit, pesticides kit, antibiotic kits etc. can also be placed in FSW to do on spot testing.

Annexure V

State-wise list of nodal officers for Mobile Food Testing Laboratory

S.No.	State/UT	Name and contact details of Nodal Officer
1.	Andaman & Nicobar	**Mr. N. R. Nair** District Food Safety Officer & Designated Officer (Food Safety), DC's Office, South Andaman- 744102 Phone No. 09434297929 E-mail: anicfs2013@gmail.com, dcandaman2016@gmail.com
2.	Arunachal Pradesh	**Mr. Lokam Mangha** Assistant Food Controller, Food Safety Unit, Directorte of Health Services, Naharlagun–791110, Papum Pare (Arunachal Pradesh) Mobile No.: 09436288339 E-mail: arunachalfoodsafety@yahoo.co.in
3.	Assam	**Mr. Anupam Gogoi** Food Analyst State Public Health Laboratory, Bamunimaidam, Guwahati-21, Assam Mobile No.: 08473882511 E-mail: foodanalyst@sphlassam.org
4.	Bihar	**Dr. Mahendra Pratap Singh** In charge-Food Analyst, Combined Food & Drugs Laboratory, Agamkuan, Patna- 800007 Mobile No: 9430030897 E-mail: mpratap19@gmail.com
5.	Chandigarh	**Mr. Sukhwinder Singh** Designated Officer, Department of Food Safety & Standards, Govt. Multispecialty Hospital, Sector-16, Chandigarh Phone: 09779036660 Email: s.shukhwinder@gmail.com
6.	Chandigarh	**Dr. Ashwani Kumar Dewagan** Assistant Commissioner Office of the controller, Food and Drug Administration, 4th Floor, Block -01, IndrawatiBhawan, Naya Raipur - 492002, Chhattisgarh Mobile No: 09300850010 Email: drashwanidewangan@gmail.com

S.No.	State/UT	Name and contact details of Nodal Officer
7.	Dadra and Nagar Haveli	**Dr. V.K. Das** Director (DO) ShriVinobaBhave Civil Hospital, Dadra and Nagar Haveli, Silvassa Phone no: 0260-2642940, 09904405701 Email: vkdas511@gmail.com
8.	Delhi	**Mr. V. D. Joshi** Chemist, Food Laboratory, Department of Food Safety, Govt, Of NCT Of Delhi, A-20 Lawrence Road, Industrial Area, New Delhi-110035 Phone: 09899016859 Email: foodlabpfa@gmail.com
9.	Goa	**Mr. Chandrakant Kambli** Senior Scientific Officer/ Food Analyst, Food and Drug Laboratory, Bambolim, Goa- 403202 Mobile no.: 08322459229 Email: off-dfda.goa@nic.in, jyotijs27@yahoo.co.in
10.	Gujarat	**Mrs. D. R Chauhan** Deputy Commissioner (Food) Office of the Commissioner, Food and Drug Administration, Dr. Jivraj Mehta V Bhawan, Block no. 8, 1st Floor, Gandhinagar-382010, Gujarat Mobile no.: 08866532270 Email: comfdca@gujarat.gov.in
11.	Haryana	**Ms. Manisha Bora** Public Analyst, State food excise and water testing lab, Chandigarh Sector -11D, Chandigarh, Haryana Mobile no.: 09467404827 Email: haryanafda@gmail.com
12.	Himachal Pradesh	**Mr. L. D. Thakur** Designated Officer, Directorate of Health Safety and Regulation, Government of Himachal Pradesh, Block -6, SDA Complex, Kasumpti, Shimla-171009 Mobile No: 09418484412, 9816084412, Email: ldthakurdo@gmail.com

S.No.	State/UT	Name and contact details of Nodal Officer
13.	Jammu and Kashmir	**Mr. Khursheed Ahmad** Assistant Commissioner Food Safety (HQ), Drugs & Food Control Organisation, State Food Health Authority, Patoli-Mangotrian, Jammu-180007 Mobile no.: 07006674094 Email: controllerdrugsfoodjk@gmail.com
14.	Jharkhand	**Mr. Chaturbhuj Meena** Food Analyst, State Food & Drug Laboratory, Namkum, Ranchi Tata Road, Ranchi – 834010 Mobile No: 09826444913 Email: chaturbhujmeena2@gmail.com
15.	Karnataka	**Mrs. Sharada. M.** Chief Food Analyst, State Food Laboratory, Public Health Institute, Sheshadri Road, Bangalore-01 Mobile no: 09845993072 Email: cfafoodlab@gmail.com
16.	Kerala	**Mr. S.T. Thankachan** Chief Government Analyst, Office of the commissioner of food Safety, Thycaud, Thiruvananthapuram- 695014 Mobile no. 08943346180 Email: uranium56@gmail.com foodsafetykerala@gmail.com
17.	Madhya Pradesh	**Mr. Brijesh Saxena** Joint Controller, Food and drugs Admn., Idgah Hills, Bhopal, Madhya Pradesh Phone No. : 07552665036 Email: fda.bhopal@gmail.com
18.	Maharashtra	**Ms. Sangita Raghvendra Thakur** Assistant Director Food and Drug Administration, M.S. Survey No. 341, Bandra Kurla Complex, Bandra(E), Mumbai- 400051 Mobile No: 09870166900 Email : sangitathakur333@gmail.com, jcfoodhq18@gmail.com

S.No.	State/UT	Name and contact details of Nodal Officer
19.	Manipur	**Mr. Chabungbam Sanjaoba Meitei** State Public Health Laboratory, R&D Wing Complex, Lamphel, Manipur – 795004 Phone No: 09436689674 Email: Sanajaoba1568@gmail.com
20.	Meghalaya	**Mr. S N Sangma** Joint Commissioner Food Safety, Health Complex, Laitumkhrah, Shillong-793003 (Meghalaya) Phone/ Fax No: 09436112117 Email : sangma.dcfs@gmail.com
21.	Nagaland	**Ms. Khrukutolu Veswuh** Food Analyst State Public Health Laboratory, Merhuliesta Colony, Near CMO Office, Kohima, Nagaland Mobile No: 09436005608 Email: sphl_pfa@rediffmail.com, fssanaga@gmail.com
22.	Odisha	**Mr. Nihar Ranjan Das** Analytical Chemist State Public Health Laboratory, In front of Ram Mandir, Convent Square, Bhubaneswar – 751001 Mobile No. : 09437281975 Email: foodsafetyodisha@gmail.com
23.	Puducherry	**Dr. S.D. Balakrishnan** Biochemist of the Dept. of Food & Drugs testing, Indira nagar, Gorimedu, Puducherry – 605006 Mobile no.: 09443214269 Email: sd.balakrishnan@gmail.com
24.	Punjab	**Dr. Anoop Kumar** Deputy Director food safety, o/o Commissioner, Food & Drugs Administration, Near Civil Hospital, Kharar, Punjab Mobile no.: 09814430158 Email: foodpunjab22@gmail.com

S.No.	State/UT	Name and contact details of Nodal Officer
25.	Rajasthan	**Mr. Pankaj Kumar** Office of chief Food Analyst, State Central Food Laboratory, Jaipur, MandirMarg, Sethi Colony, Jaipur-302004 Mobile no.: 09352002483 E-mail: chief.public.analyst@gmail.com, pankajphl063@gmail.com, fssa.2006@yahoo.com
26.	Sikkim	**Mr. N.R. Gurung** Joint Director State Food Laboratory, HC, HS & Family Welfare Department, Government of Sikkim, Singtam - 737134, Sikkim Mobile No: 09434024311 E-mail: nawaratnagurung@gmail.com nawaratnagurung@ymail.com
27.	Tamil Nadu	**Dr. K. Vanaja** Director& Additional Commissioner (Food Safety) Office of the Commissioner of Food Safety, 5th Floor DMS campus, 359, Anna Salai, Chennai- 600006 Mobile no. 09444224898 Email: vanajaraj62@gmail.com
28.	Tripura	**Dr. Karunamay Nath** Food Analyst Regional Food Laboratory, Pt. Nehru Complex, Gurkhabasti, Agartala - 799006 Mobile No: 09436458179/09436457390 Email : drknathfoodanalyst@gmail.com
29.	Telangana	**Dr. Shankar** Director FAC, Institute of Preventive Medicine, PH Labs & food (Health), Narayanaguda, Hyderabad-29 Mobile no : 9849905227, 9949197435 Email: prlsecy_hmfw@telangana.gov.in telanganacfs@gmail.com
30.	Uttarakhand	**Mr. R. S. Rawat** Designated officer, O/o D.G. Health Office, Dehradun, Uttarakhand Phone: 09412677141 Email: commis.fssauk@gmail.com

Note: The list of FSSAI notified Laboratories is available on FSSAI website Link: https://fssai.gov.in/home/food-testing/Orders—Notice.html

S.No.	State/UT	Name and contact details of Nodal Officer
31.	Uttar Pradesh	**Mr. V.K. Verma** Assistant Commissioner (Food) Food Safety and drugs Administration, Government of Uttar Pradesh, Sector-C, Aliganj, Lucknow, Uttar Pradesh-226021 Mobile No: 09415480511 Email: fdaupgov@gmail.com
32.	West Bengal	**Ms. Sarmishtha Mukhopadhyay** Food Analyst, Health department, KMC, Central Laboratory (Food), 1A Hogg Street, Kolkata – 700087, West Bengal Mobile No: 9830137201 Email: foodanalyst.kmc@gmail.com, foodanalyst@kmcgovt.in

Note: The updated list of nodal officers of FSW and FSSAI notified Laboratories is available on FSSAI website
Link: https://fssai.gov.in/home/food-testing/Orders—Notice.html

Ensuring Safe & Quality Food through

'Robust Food Testing'

FOOD NOTIFIED / RECOGNIZED FOOD LABORATORY

- Can perform all the tests as per regulations/ standards
- All safety & regulatory parameters as prescribed in the Regulations
- Equipped with State of Art Modern Equipment
- 141 Notified Food Laboratories
- 19 Referral Laboratories
- 13 National Reference laboratory for Method development

FOOD SAFETY ON WHEELS

- More than 100 Tests for in all Food Categories
- Used for Testing, Training & Awareness
- Basic chemicals & small equipment available
- Free / Minimal testing charges

FOOD SAFETY MAGIC BOX

- 100 Tests for in 07 Food Categories
- Contains basic chemicals & small instruments (Lactometer & Magnet)
- Acid/Alkali Solution required in some tests
- Minimal cost involved

DART

- 44 Tests for in 7 Food Categories
- Quick, East & Safe
- No chemicals/equipment required
- No cost involved
- An effort to empower citizens and build trust in the foods

fssai

FOOD SAFETY AND STANDARDS AUTHORITY OF INDIA

Inspiring Trust, Assuring Safe & Nutritious Food

Ministry of Health and Family Welfare, Government of India

CONTACT US

For more information, visit our website www.fssai.gov.in/snfathome

Write to us at snfathome@fssai.gov.in with your suggestions and queries

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