

Food Adulteration Testing Manual

(14th Revised Edition – 2019)



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BEGINNINGS

POST INDEPENDENCE, India has been striving to develop and strengthen its industrial base. In this pursuit of “self-sufficiency”, consumers have had to endure use of sub-standard products and services, adulterated foods, short weights and measures, spurious and hazardous drugs, exorbitant prices, endemic shortages leading to black marketing and profiteering, unfulfilled manufacture guarantees and a host of other problems.

In 1960’s exploitation of consumers by manufacturers and service providers was rampant in India with a few monopolistic business houses controlling the industry. In one infamous case, 40 persons suffered dropsy and glaucoma after consuming groundnut oil adulterated with toxic argemone oil. The victims did not get any justice and the culprits escaped without punishment.

This outrage energized 9 women to organize a movement to fight and protect consumer rights by establishing the first consumer organization in India the Consumer Guidance Society of India (CGSI) in 1966 to resist the silent suffering of consumers and their exploitation in all forms. CGSI today has grown in strength and stature 53 since its formation.

Several public minded citizens and illustrious persons have joined their cause down the years. CGSI on date has about 3000 lifetime members spread all over India with all Managing Committee Members and office bearers at helm being unpaid honorary volunteers.

CGSI’S FIGHT FOR LEGAL FRAMEWORK

CGSI was the first consumer organization to demand special Consumer Court for redressal of consumers’ complaints. In 1975, CGSI led a delegation of five consumer organizations from different parts of India to the then Minister for Food and Civil Supplies, Mr. T. A. Pai and demand

for a comprehensive Consumer Protection Act, Special Consumer Courts and a Directorate for implementation of the Act. CGSI’s constant follow-up was instrumental in enacting the “Consumer Protection Act 1986” by the “Government of India”.

CONSUMER ACTIVITIES

1. Consumer Education
2. Holding talks and exhibitions to spread consumer rights awareness among urban poor and rural areas
3. Consumer Complaints Redressal
4. Testing of Consumer Products and
5. Publication of “Keemat” a bi-monthly news magazine now published for over 48 years having articles of general consumer awareness, for CGSI members and public.

CONSUMER EDUCATION IN SCHOOLS/ COLLEGES

CGSI’s Education Committee members had been working with other likeminded educationists to introduce formal Consumer Education in the school curriculum. After two years of meetings and discussions, CGSI efforts bore fruit. In 1994, the Maharashtra Education Board introduced Consumer Education at the (9th) Ninth Standard Level, progressively covering students from the (4th) Forth Standard upwards.

The subjects taught are the Consumer Movement, Rights & Responsibilities of Consumers, the Consumer in the Market Place, Food Adulteration, Weights and Measures, Environment protection, etc. These topics included under the existing subjects like Civics, Economics and Home science, are project-based, and more practical in nature than theoretical or examination oriented.

CONSUMER EDUCATION

CGSI conducts programs and guides consumers in various fields., General Consumer Awareness and

Grievance redressal, Food Adulteration, Soaps and Detergents, Cosmetics, Flavors & Fragrances Property, Telecommunications, Electricity, Energy Conservation, Electrical Appliances, Insurance, Co-operative Housing Societies, Airlines, Surface Transport, Banking, Specialized Finance Subjects, Mutual Funds, etc. Today CGSI programs reach out to more than 20,000 consumers in a year and with the help of increased experts from various fields.

COMPLAINT REDRESSAL

CGSI handles consumer complaints and offers legal guidance to those wishing to file complaints in the Consumer Courts. In cases where there are a larger number of complaints against a party, bringing both sides together to resolve the issue. The CGSI'S Complaints Committee meets at least twice a week.

CGSI has redressed thousands of consumer grievances over the years, with 70-80% success in favor of the consumers. The complaints cover medical/surgical malpractice and negligence; insurance non-payment; sub-standard drugs and medicines; home remedies; defective household appliances; poor quality foods and drinks; misleading advertising claims; and grievances concerning investments, real estate, insurance, telephones, electricity supply, etc.

CGSI counsels over 400 complaints during the year through personal counseling sessions, correctly guiding complainants, sometimes even clearly saying that they do not have a case to fight for without wrongfully leading them on.

PRODUCT TESTING

As early as 1977, CGSI established formal product testing to evaluate quality by drawing samples directly from the market without involving the manufacturers in the testing process. Test results were a revelation for quality control regulatory authorities. It first assessed the safety and performance of domestic pressure stoves and found that two-third of the samples tested failed in safety Parameters.

CGSI sent the results to the government and Indian Standards Institution (ISI) now Bureau of

Indian Standards (BIS), with a demand for mandatory certification. In 1986, with the passing of the Pressure Stoves Quality Control Order, ISI Certification for pressure stoves became mandatory. Subsequently CGSI did tests on electrical appliances and fittings - irons, immersion heaters, culminating in the enactment of the Household Electrical Appliances (Quality Control) Order.

CGSI has developed a food adulteration testing kit and a milk adulteration testing kit for use by the lay consumers. Many other products were tested and reports published in the Society's monthly Journal, "Keemat": edible oils, powdered spices, 'surma' (kohl), geysers, clinical thermometers, plastic water bottles, rubber teats, milk, mineral water, breads, soft drinks, bath soaps, fabric detergents, and toothpastes.

PUBLICATIONS

"Keemat" India's first monthly consumer magazine is now in its 48 year of publications. CGSI distributes Keemat to all its members. Keemat is also available as a free download to the public from dedicated CGSI website www.cgsiindia.org. CGSI has produced several Consumer Guides on subjects like Electrical Appliances, Edible Oils, Pesticides, Food, Adulteration, Safety at Home, Safe Blood, etc.

NATIONAL AWARD

In 1991, CGSI received the National Award for Consumer Protection for its 25th year for service to Consumers. CGSI hopes to reach out to increased consumers in the new millennium and to developed newer and more effective methods of serving consumers interest.

CGSI REPRESENTATION IN VARIOUS BODIES

Various Government statutory bodies give representation to CGSI due to its dedicated work force and expertise at its disposal, viz.,

- "Bureau of Indian Standards",
- "Telecom Regulatory Authority of India",
- "Maharashtra Electricity Regulatory Authority of India",

- “Insurance Regulatory and Development Authority of India”,
- “Dept. of Weights & Measures”,
- “Consumer Advisory Committee of various Industries”, etc.,

Lately “Maharashtra State Government” has given representation to CGSI on its prestigious body – “Maharashtra State Consumer Protection Council”.

The Parliamentary Committee on Food, Consumer Affairs and Public Distribution on December 2, 2015 invited CGSI to present its opinion to improve the working and suggest changes to the Consumer Protection Bill 2015. Effective September 2011, the Maharashtra state government has entrusted CGSI to establish, manage and operate the Maharashtra state consumer helpline. Considering CGSI’s experience in consumer rights protection “Maharashtra State Government” has awarded consumer helpline project to since Sept., 2011.

Promote active participation of companies and service providers in resolving consumer disputes Early resolution of complaints Reach out to rural consumers. Capacity building of State level Voluntary Consumer Organizations Provide service in regional language in addition to English language Consumers can call the Toll-free number (1800-22-22-62) or send an e-mail to mah.helpline@gmail.com to seek information, advice or guidance for their day-to-day consumer problems.

Under this project, counselors guide nearly 25,000 aggrieved consumers every year. Maharashtra is among the top two states in terms of number of complains handled amongst nine states conducting consumer helpline project. The main objectives are as follows: Develop a resource center at State level and networking it with the

National Resource Centre, Develop Alternate Consumer Disputes Redressal mechanisms at the State level Resolve maximum number of disputes out of court.

CGSI’s DOCUMENTARY FILM “GRAHAKPAL” ON CONSUMER RIGHTS

CGSI has produced a documentary film “Grahakpal” on consumer rights by roping a few celebrities to spread the message of consumer rights awareness. Screening the film at various seminars conducted by CGSI resulting in the helpline message reaching to numerous viewers every year, majority of the viewers are college and school students who need to be responsible and aware consumers when they enter mainstream after completing their studies.

MEDIATION & COUNSELLING CLINIC

Mr. Girish Bapat, Cabinet Minister for Consumer Protection, Government of Maharashtra and Mr. Arun Deshpande, Chairman, Consumer Welfare Advisory Committee, Maharashtra on 20 October 2015 inaugurated the “Mediation and Conciliation Clinic” that primarily aims to resolve cases pertaining to consumer disputes. CGSI also produced a documentary film “Tareekh ya Tareef” to encourage Mediation and Conciliation.

During the last few years, CGSI is conducting over 2000 seminars on Telecom, Banking, Financial Awareness, Food Safety etc., and with the number of queries and requests increasing steadily and the eagerness to cover more and more consumers, CGSI is conducting educational seminars in other states like Bihar, Jharkhand and Delhi apart from Maharashtra. CGSI has an ambitious target to reach increased consumers through its consumer education programs and make India, a country of aware consumers resulting in flourishing markets with quality products and services.

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IDENTIFYING COMMON FOOD ADULTERANTS

Dr. Sitaram Dixit – Chairman, Consumer Guidance Society of India

Food adulteration is a growing menace that unscrupulous traders and manufacture all over the world indulge in to exploit gullible consumers to make quick and easy money. In all free market societies where legal control is poor or non-existent with respect to monitoring of food quality by authorities, usage of adulterants is common and rampant.

Every nation on earth has suffered cases of adulteration at one time or other. Government authorities with great efforts have succeeded in reducing the recurrent occurrences; but have not been able to eliminate it.

Only an aware and an informed consumer will be able to eliminate it conclusively by continuous routine monitoring. The dictionary defines food adulteration as an act of intentionally debasing the quality of food offered for sale by either the admixture or substitution of inferior substances or by the removal of some valuable ingredient.

WHAT IS ADULTERATED FOOD?

- a. If the product sold by a vendor is not of the nature, substance or quality demanded by the purchaser or which it purports to be.
- b. If the product offered contains any substance or if it is so processed as to injuriously affect its nature, substance, or quality.
- c. If any inferior or cheaper substance has been substituted wholly or partly in the product, or any natural constituent has been wholly or partly abstracted from it, to affect its quality.
- d. If the product had been prepared, packed, or kept under unsanitary conditions, has become contaminated, injurious to health or is unfit for human consumption.
- e. If the container of the product is composed of any poisonous or deleterious substance which renders its contents injurious to health.
- f. If the product contains any prohibited coloring matter, preservatives, or contains any permitted coloring matter or preservative more than the prescribed limits.
- g. If the quality or purity of the product falls below the prescribed standard, or its constituents are present in proportions other than those prescribed, whether rendering it injurious to health.

To put it in perspective we can say that adulteration is “The act of intentionally debasing the quality of food offered for sale either by the admixture or substitution by inferior substances or by the removal of some valuable ingredient”.

HOW TO TEST FOR FOOD ADULTERANT

The following lists the common items adulterated and simple test methods to identify the adulterants and ascertain the purity of the food product consumed.

We will keep updating this list as and when we come across an easy and effective method to test adulteration.

FOOD ITEM	ADULTERANT	SIMPLE METHOD TO DETECT ADULTERANTS
Sugar Powder	Chalk	<ul style="list-style-type: none"> • Dissolve sugar in a glass of water, chalk, white sand, stone powder will settle down. • Smell of ammonia indicates Urea contamination.
Bura Sugar	Washing Soda	<ul style="list-style-type: none"> • Put some lemon juice, you will observe bubbles are if washing soda is present. • Add 1 ml of Hydrochloric acid (HCl) to a little of Sugar. If you observe effervescence, then washing soda is present. • Dissolve 2 gram of Sugar in water. Dip a red litmus paper in the solution. If washing soda is present, it will turn to blue color.
Gur (Jaggery)	Metanil Yellow color Washing Soda	<ul style="list-style-type: none"> • Add a few drops of HCl to a sample of Gur Appearance of Magenta Red color indicate the presence of Metanil yellow. • While doing the above test for Metanil yellow if you observe effervescence (bubbles), it indicates the presence of washing soda.
Honey	Water Sugar / Jaggery	<ul style="list-style-type: none"> • A cotton wick dipped in pure honey burns when ignited with a matchstick. Presence of water will not allow the honey to burn, and if it does, it will produce a cracking sound. • Take a dry matchstick and dip it in honey. Now try to light the matchstick by striking against the match box. If the matchstick lights up then the honey is pure. If it does not then honey contains sugar water. • Take 5 ml of honey in a porcelain dish. Add aniline chloride solution (3 ml of aniline dissolved in 7 ml of 1:3 HCL) and stir well. Orange red color indicates presence of sugar. • Take 5 ml of honey in a small beaker. Add 5 ml of solvent ether and mix well. Decant the ether layer in a Petri dish and allow the ether to evaporate. Add 2-3 ml of resorcinol (1-gram resorcinol resublimed in 5 ml of concentrated HCl). A cherry red color indicates presence of sugar or jaggery adulteration. • Take blotting paper or a white fabric and pour a spoon of honey. Pure honey will not leave a stain and fabric and paper will not absorb it. • Mix 10 ml of honey with some water and add 2-3 drops of vinegar. Foaming indicated adulteration. • Pure honey on heating caramelizes quickly. If honey foams on heating before caramelizing it indicates adulteration.
Common Salt Iodized or non-iodized test	Chalk	<ul style="list-style-type: none"> • Dissolve in a glass of water, chalk, white sand, soapstone powder will settle down. • Cut a piece of potato and sprinkle salt on the cut portion. After a couple of minutes add a few drops of lemon juice (citric acid). In case of iodized salt, a blue color will appear on the potato surface.

Paneer, Condensed Milk, Khoya	Starch, mashed potatoes	<ul style="list-style-type: none"> Take a small portion of the product in a test tube add water and boil. Cool to room temperature. Add 1-2 drops Iodine solution. Blue color indicates the presence of starch.
Ice Cream	Washing Powder	<ul style="list-style-type: none"> Put some lemon juice, if we observe bubbles then washing powder is present Add 1 ml of Hydrochloric acid (HCl) to a little of Sugar. If we observe effervescence, then washing powder is present.
Pure Ghee or Butter	<p>Vanaspati</p> <p>Mashed Potato or Sweet Potato</p> <p>Rancid or old Ghee</p> <p>Synthetic coloring matter</p> <p>Coal tar dyes</p>	<ul style="list-style-type: none"> Take one teaspoonful of melted ghee or butter with equal quantity of Conc. Hydrochloric acid in a test tube. Add to it a pinch of cane sugar. Shake well for one minute and let it stand for five minutes. Crimson red color in lower layer shows the presence of Vanaspati. Boil 5 ml sample in a test tube. Cool and add a drop of iodine solution. Blue color indicates the presence of starch. Take 5 ml of molten ghee sample in a stoppered measuring tube. Add 5 ml of HCl. Shake vigorously for 30 seconds. Add 5 ml of 0.1% ether solution of Phloroglucinol. Re-stopper the tube and shake for another 30 seconds. Allow it to stand for 10 minutes. A pink or red color in the lower acid layer indicates rancidity and presence of old ghee. Dissolve 2 grams of Ghee in ether. Divide the portion into two test tubes. Add 1 ml of HCl in one test tube add 1 ml of 10% NaOH solution in the other portion. Shake well and allow standing. Presence of pink color in the acidic solution and /or yellow color in the alkaline solution indicates added coloring materials. Add 5 ml of dilute Hydrochloric Acid or concentrated Sulphuric Acid to 5 ml of molten ghee sample in a test tube. Shake well. Pink color in the case of Sulphuric Acid addition and crimson red color in case of dilute Hydrochloric Acid indicates the presence of coal tar dyes. If addition of HCl does not give crimson red color, add some water. Development of color indicates presence of coal tar color dyes.
Green Vegetables like Peas, Spinach, Capsicum, Chilies, etc.,	Malachite green	<ul style="list-style-type: none"> Take a small part of the sample and place it over a moistened white blotting paper. Color impressions on paper indicates the presence of Malachite green
Sweet Potato	Color	<ul style="list-style-type: none"> Take cotton ball soaked in water and rub the ragi grains with it. The cotton ball will become pink if it contains water soluble color. Do the same test with cotton ball dipped in vegetable oil. Color change will indicate adulteration with oil soluble colorants.

Coffee	Chicory Roasted powdered dates, Tamarind seed powder etc.	<ul style="list-style-type: none"> Gently sprinkle the coffee powder on surface of water in a glass. The coffee floats over the water but chicory begins to sink down within few seconds. Moreover, the falling chicory powder particles leave behind them a trail of color, due to large amount of caramel they contain. Place a small sample on a white filter paper. Spray a 1% sodium carbonate solution. A red color stain on the filter paper will indicate the presence of roasted dates, or tamarind seed powder, etc.
Tea	Tea Colored leaves	<ul style="list-style-type: none"> Rub leaves on white paper, artificial color comes out on paper.
	Used tea	<ul style="list-style-type: none"> Tea leaves sprinkled on wet filter paper. Pink or red spots on paper show color. Spread slaked lime on a white glass plate and then sprinkle some tea leaves on the plate. Shades of red, orange, pink, colors on the slaked lime layer indicates adulteration with coal tar dyes.
	Iron fillings	<ul style="list-style-type: none"> Move a magnet through the sample. Iron will stick to the magnet.
Bajra	Ergot infested	<ul style="list-style-type: none"> Infested Bajra will swell black and float in water.
Ragi	Color	<ul style="list-style-type: none"> Take cotton ball soaked in water and rub the ragi grains with it. The cotton ball will become pink if it contains water soluble color. Do the same test with cotton ball dipped in vegetable oil. Color change will indicate adulteration with oil soluble colorants.
Wheat Flour	Sand / Dirt	<ul style="list-style-type: none"> Shake a small sample with 10 ml CCl₄ and allow standing. Sand will collect at the bottom.
	Barn	<ul style="list-style-type: none"> It will float on water surface.
	Chalk powder	<ul style="list-style-type: none"> Shake the sample with dilute HCl. Effervesce indicates presence of chalk powder.
Sago (Sabudana)	Sand Talcum Powder	<ul style="list-style-type: none"> Burn Sago. If pure, it will swell and burn without leaving any ash. Adulterated Sago will leave behind considerable amount of ash.
Silver Foil	Aluminum Foil	<ul style="list-style-type: none"> On ignition Silver foil burns away completely leaving glistening white spherical ball of the same mass while Aluminum foil will produce a blackish-grey color ash. Take silver leaves in a small beaker and add dilute HCl solution. Appearance of a white turbidity or precipitate indicates silver. If aluminum is present, you will get blackish-grey turbidity, precipitate or fumes.
Saffron	Colored dried tendrils of maize cob	<ul style="list-style-type: none"> Pure saffron will not break easily like artificial. Color dissolves in water and artificial tendrils of saffron will separate. Pure saffron when allowed to dissolve in water will continue to give its color so long as it lasts.

Common Spices & Spices Powder	Color Powdered Barn, Saw dust	<ul style="list-style-type: none"> • Extract the Spice sample with Petroleum Ether. Add 13N Sulphuric Acid Solution (88 ml of Concentrated Sulphuric acid diluted with 250 ml of distilled water). Appearance of red color that persists even upon adding distilled water indicates the presence of artificial color. If the red color completely disappears on adding distilled water, the sample is free of color adulteration. • Sprinkle some powder on the surface of water in a glass beaker. Barn & sawdust will float.
Red Chilli Powder	Brick Powder	<ul style="list-style-type: none"> • Brick powder settles fast chilli powder settles slowly when put in water.
	Red Color dye	<ul style="list-style-type: none"> • Sprinkle some Chilli powder on the surface of water in a glass beaker. Artificial colorants will descend as colored streaks.
	Sudan red III color	<ul style="list-style-type: none"> • Take 1 g of suspected chilli powder in a test-tube, add 2 ml of hexane to it, and shake well. Allow it to settle. Decant the clear solution into another test tube. Add 2 ml of acetonitrile reagent in water (7:3) and shake well. The appearance of a red color in the lower aceto-nitrile layer indicates the presence of Sudan red III.
Turmeric Powder	Metanil Yellow	<ul style="list-style-type: none"> • Add a few drops of HCl to turmeric in water. Instantly the solution will turn to violet color. When the color persists when diluted with water indicates the presence of Metanil yellow.
	Other aniline dyes	<ul style="list-style-type: none"> • Take some turmeric powder in a test-tube and add water to make a solution. Add 1-2 ml of rectified spirit. Immediate separation of yellow color in the rectified spirit will indicate presence of dyes.
Asafetida Hing	Soap Stone or earthy matter	<ul style="list-style-type: none"> • Shake a little portion of sample with water and allow settling. Soap stone or earthy matter will settle down at the bottom.
	Other resin Colophon residue obtained after the distillation of turpentine oil.	<ul style="list-style-type: none"> • Powder a gram of asafetida and take it in a test-tube. Add one teaspoon of water. Mix thoroughly by shaking. Milky white solution with no sediments represents pure asafetida.
		<ul style="list-style-type: none"> • Further, a small amount of powdered asafetida, taken in a spoon and burnt on a gas flame, burns with a bright flame like camphor, which is an indication of pure asafetida. • Take 1 g of asafetida, powder it thoroughly, and take it in a test-tube. Add some rectified spirit and filter/ decant the solution. Take 5 ml of filtrate and add few drops of ferric chloride (6%) solution. Olive green color shows the presence of adulteration with other resins.

Cinnamon Bark	Cassia Bark	<ul style="list-style-type: none"> Cinnamon bark is very thin and we can roll it around a pencil or pen. It also has a distinct smell. Cassia bark is very thick and stiff and we cannot roll it. Cassia bark comprises of several layers in between the rough outer and inner most, smooth layers. On examination of the bark closely, can also make a clear distinction.
Cloves	Exhausted or De-oiled Cloves	<ul style="list-style-type: none"> Using the magnifying glass, observe the individually spread cloves closely. We can identify exhausted cloves by its small size and shrunken appearance. The characteristic pungent taste of genuine cloves is less pronounced in exhausted de-oiled cloves.
Cumin / Jeera	Grass seeds colored with charcoal	<ul style="list-style-type: none"> Rub the cumin seeds on your palm. If palm turns black, it indicates adulteration with charcoal.
Black Pepper	Papaya Seeds, Immature pepper	<ul style="list-style-type: none"> Float the sample in alcohol. The mature black pepper berries will sink, while papaya seeds and light black pepper float.
Mustard	Argemone Seeds	<ul style="list-style-type: none"> Argemone seeds have rough surface & on pressing is white inside. Mustard is yellow inside
Vegetable Oil	Castor Oil	<ul style="list-style-type: none"> Take 1 ml Oil in a dry test tube. Add 10 ml of acidified petroleum ether. Shake vigorously for 2 minutes. Add 1-2 drops of ammonium molybdate reagent (Dissolve 1 gm ammonium molybdate in 100 ml of Conc. Sulphuric Acid). Turbidity indicates adulteration with castor oil.
	Karanja Oil	<ul style="list-style-type: none"> Take a 1 ml of Oil in a test tube. Add few drops of antimony trichloride solution in chloroform, mix well. Appearance of a canary yellow or orange color indicates presence of Karanja oil
	Mineral Oil	<ul style="list-style-type: none"> Take 2 ml sample in a test-tube and add 2 ml of alcoholic potash to it. Warm the sample on a low flame burner for about 10 min and add water to it. Appearance of turbidity shows presence of Mineral Oil.
	Argemone Oil (In Mustard Oil)	<ul style="list-style-type: none"> Take oil in a transparent glass test tube. Add a few drops of nitric acid. Shake vigorously and heat for 2-3 minutes. Appearance of red color indicated adulteration
	Colors	<ul style="list-style-type: none"> Take 5 ml of oil in a test tube. Add equal quantity of concentrated hydrochloric acid. Shake gently and allow it to stand for 5 minutes. Color if present will separate out in the acidic upper layer in the test tube.

Pulses viz., Yellow Dals, Besan powder, etc.	Metanil Yellow or Lead Chromate or Kesari Dal (Lathyrus Sativus)	<ul style="list-style-type: none"> • Extract the color with luke warm water from the sample of pulses. Add drops of HCl. A pink color indicates presence of Metanil yellow / Lead Chromate and other dyes. • Add 50 ml of dilute HCl and cook the dal for about 15 minutes. If pink color develops it indicates the presence of Kesari Dal.
Vinegar	Mineral Acid	<ul style="list-style-type: none"> • Dip a Metanil yellow indicator paper in vinegar. If the paper turns pink it indicates adulteration of vinegar with mineral acid.
Supari Powder	Saw dust Artificial Colors	<ul style="list-style-type: none"> • Sprinkle some powder on the surface of water in a glass beaker. Sawdust will float. Artificial colorants will show up as colored streaks.
Apple	Wax	<ul style="list-style-type: none"> • Scratch the surface with a knife. Wax will peel off.

Among all foods, milk adulteration is the most common one, being very easy and lucrative. Simple addition of water to milk adulterates it. Addition of water to pure milk, changes its physical and nutritional constituents. Using inferior quality impure water in adulteration of milk, increases the chances of infection and disease due to microbial contamination on its consumption.

Impure water reduces the keeping quality of milk and so adulterators add artificial harmful preservatives to improve the shelf life of the adulterated product. Pure milk spoils on keeping at room temperature within a day and an adulterated one stays fresh for a much longer time.

Consumers can easily recognize simple water addition the milk becomes thin and watery. To prevent easy identification adulterators, add various chemical agents to thicken the product so that adulterated milk resembles the consistency of pure milk.

To know more about milk adulteration and means to identify, please refer “Test Yourself – Adulteration in Milk” by Dr. Sitaram Dixit, Chairman – Consumer Guidance Society of India (CGSI).

TEST YOURSELF – DETECT ADULTERATION IN MILK

Dr. Sitaram Dixit – Chairman, Consumer Guidance Society of India

Although many known methods for detection of adulteration in milk, exists, the methods compiled below are not only simple and rapid but also very sensitive to detect milk adulteration. Consumers can easily carry out these tests using simple laboratory apparatus, common chemicals available in the market. CGSI's milk adulteration testing kit (launched in 2006) uses these methods.

Find below the method to prepare the milk adulteration testing reagents and protocol.

REAGENTS REQUIRED.

1. Concentrated Hydrochloric acid. (1:1)
2. Concentrated Sulphuric acid. (1:1)
3. Concentrated Nitric acid. (1:1)
4. Citric acid. (Concentrated Solution)
5. Ammonia Solution: (1:1)
6. Phosphomolybdic acid. 1% (w/v) water.
7. Resorcinol (White flakes)
8. (N/10) hydrochloric acid standard.
9. Rosolic Acid: 1% (w/v) in alcohol.
10. Phenolphthalein Indicator: 1% (w/v) alcohol.
11. Para phenylene diamine: 1% (w/v) alcohol.
12. Iodine solution: 1% iodine in 10% Potassium Iodide Solution (w/v)
13. Vanadium Pentoxide Reagent: 1% (w/v) in 6% (w/v) sulphuric acid solution.
14. Barford Reagent: Dissolve 24 gm of Copper acetate in 450 ml of boiling distilled water. Add 25 ml of 8.5 % (w/v) acetic acid solution, shake, cool to room temperature and make up to 500 ml. After sedimentation filter the reagent and store in dark colored bottle.
15. Para-dimethyl amino benzaldehyde reagent: 16% (w/v) in 10% (w/v) hydrochloric acid.
16. Urease solution: (20 mg / ml).
17. Bromothymol blue: 0.5% (w/v) in water.
18. Barium Chloride: 5% (w/v) in water.
19. Sodium hydroxide: 2% (w/v) in water.
20. Sodium hypochlorite: 2% (w/v) in water.
21. Phenol solution: 5% (w/v) solution in water.
22. Silver nitrate reagent: 0.8% (w/v) in water
23. Potassium dichromate: 1% (w/v) in water.
24. Bromocresol purple: 0.5% (w/v) in water.
25. Ferric Chloride: 0.5% (w/v) in water.
26. Turmeric Paper.
27. Lactometer, test tubes, droppers, gas burner, measuring cylinders, beakers, bottles, etc.

I. DETECTION OF NEUTRALIZERS

Adulterators add prohibited neutralizers like hydrated lime, sodium hydroxide, sodium carbonate or sodium bicarbonate to milk to prevent spoilage.

Rosolic acid test (Soda Test)

Take 5 ml of milk in a test tube and add 5 ml alcohol followed by 2-3 drops of rosolic acid. If the color of milk changes to pinkish red, we infer adulteration of milk with sodium carbonate / sodium bicarbonate and so unfit for human consumption. (Please note that this test will be effective only if the neutralizers are present in milk. In case the added neutralizers nullify due the naturally developed acidity in milk, then this test will be negative. One needs to test, the alkalinity of milk for presence of soda ash.)

Alkalinity Test

Take 20 ml of milk in a silica crucible and evaporate the water. Burn the contents in a muffle furnace at 550°C. Disperse the ash in 10 ml distilled water and titrate it against decinormal (N/10) hydrochloric acid using phenolphthalein indicator. If the titer value exceeds 1.2 ml, it can conclude that the milk contains neutralizers and adulterated.

II. TEST FOR DETECTION OF HYDROGEN PEROXIDE

- Take 5 ml milk in a test tube. Add 3 drops of Para phenylene diamine and shake well. Change in color of the milk to blue confirms adulteration of milk with hydrogen peroxide.
- To 10 ml of milk sample in a test tube add 10-15 drops of Vanadium Pentoxide reagent and mix. The development of pink or red color indicates presence of hydrogen peroxide.

III. TEST FOR DETECTION OF FORMALIN

Poisonous Formalin (40%) preserves milk for a long time.

Take 10 ml of milk in a test tube. Add 5 ml conc. sulphuric acid (containing traces of Ferric Chloride) through the sides of the test tube

without shaking. If a violet or blue ring appears at the intersection of the two layers, it shows the presence of formalin. Note violet coloration usually does not appear when relatively large quantities of formaldehyde are present.

IV. TEST FOR DETECTION OF CANE SUGAR IN MILK

Generally, mixing cane sugar in milk increases the % solids content of milk i.e., to increase the lactometer reading of milk, diluted with water.

Take 10 ml of milk in a test tube. Add 5 ml of hydrochloric acid along with 0.1 g of resorcinol. Shake the test tube well and place it in a boiling water bath for 5 min. Appearance of red color indicates the presence of added cane sugar.

V. TEST FOR DETECTION OF STARCH

Addition of starch increases the SNF (Solid–Not–Fat) content of milk. Adding wheat flour, arrowroot, rice flour, etc., also increases SNF.

Take 3 ml milk in a test tube and boil it thoroughly. Cool the milk to room temperature. Add 2 to 3 drops of 1% iodine solution. Change of color to blue indicates addition and adulteration of milk with starch.

VI. TEST FOR DETECTION OF GLUCOSE

Adding (poor quality) glucose as an adulterant to milk increases the lactometer reading.

Take 3 ml of milk in a test tube. Add 3 ml Barford's reagent and mix it thoroughly. Keep the test tube in a boiling water bath for 3 min and then cool it for 2 min by immersing it in tap water without disturbance. Add 1 ml of phosphomolybdic acid and shake. If blue color is visible, then glucose is present in milk.

VII. TEST FOR DETECTION OF UREA

Adulterators add urea in the preparation of synthetic milk to raise the SNF value.

- Mix 5 ml of milk with 5 ml Para dimethyl amino benzaldehyde reagent. If the solution

turns distinct yellow in color, then the given sample of milk contains urea. (**Note:** Control, normal milk may show a faint yellow due to presence of natural urea.)

- Take 5 ml of milk in a test tube. Add 0.2 ml of fresh urease (20 mg / ml). Shake well at room temperature. Add 0.1 ml of bromothymol blue solution. Appearance of blue color after 10 – 15 min indicates the adulteration milk with urea.

VIII. TEST FOR DETECTION OF AMMONIUM SULPHATE

The presence of sulphate in milk increases the lactometer reading.

- Take 5 ml of hot milk in a test tube. Add a suitable acid for e.g. citric acid and separate the whey obtained by filtration. Take the whey in another test tube and add 0.5 ml of 5% barium chloride. Appearance of precipitate indicates the presence of ammonium sulphate.
- Take 5 ml of milk add 2.5 ml of 2% sodium hydroxide, 2.5 ml of 2% sodium hypochlorite and 2.5 ml of 5% phenol solution. Heat for 20 seconds in boiling water bath. If bluish color turns to deep blue it indicates the presence of ammonium sulphate, however in case it turns to pink it shows that the sample is free from Ammonium sulphate.

IX. TEST FOR DETECTION OF SALT

Addition of salt in milk is mainly resorted to increase the corrected lactometer reading.

Take 5 ml of silver nitrate reagent in a test tube. Add 2-3 drops of potassium dichromate reagent. Add 1 ml of milk in the above test tube and mix thoroughly. If the contents of the test tube turn yellow in color, then milk contains salt. If it turns to chocolate or reddish brown in color, the milk sample is free from salt.

X. TEST FOR DETECTION OF SOAP

Take 10 ml of milk in a test tube and dilute it with equal quantity of hot water. Add 1 – 2 drops of phenolphthalein indicator. Development of pink color indicates soap adulteration of milk.

XI. TEST OF DETERGENTS IN MILK

Take 5 ml of milk in a test tube and add 1-2 drops of bromocresol purple solution. Mix well. Appearance of violet color indicates the presence of detergent in milk. Unadulterated milk will show a very faint violet coloration.

XII. DETECTION OF WATER IN MILK

Lactometer reading detects adulteration of milk with water. Take raw milk in a long-stemmed wide mouth bottle or a measuring cylinder. Place the lactometer in it taking care to see that the lactometer does not touch the sides of the bottle or the measuring cylinder. Note down the reading at the surface of milk sample taken. Also note the temperature of the milk sample.

Although we can check the adulteration of milk with water by lactometer reading, other adulterations above too affect the lactometer reading. Hence, we usually adopt the freezing point (FP) depression method, recognized by AOAC as a confirmatory test.

$$\text{Added water (in \%)} = \frac{(\text{Normal FP} - \text{Observed FP}) \times 100}{\text{Normal freezing point}}$$

Normal freezing point of milk is -0.55°C with a tolerance level of 3%, i.e., equivalent to specifying a minimum freezing point depression for authentic milk of -0.55°C .

XIII. DETECTION OF SKIM MILK POWDER

If the addition of nitric acid drop by drop in to the test milk sample results in the development of orange color, it indicates adulteration of milk with skim milk powder. Samples without skim milk powder shows yellow color.

XIV. TEST FOR DETECTION OF BENZOIC AND SALICYLIC ACID

Take 5 ml of milk in a test tube. Add 3-4 drops of concentrated sulphuric acid. Add 0.5% ferric chloride solution drop by drop and mix well. Development of buff color indicates presence of

benzoic acid and violet color indicates presence of salicylic acid.

XV. DETECTION OF BORAX AND BORIC ACID IN MILK

Take 5 ml milk in a test tube. Add 1 ml of concentrated hydrochloric acid and mix well. Dip the tip of turmeric paper into the acidified milk and dry in a watch glass at 100°C or over a small flame. If the turmeric paper turns red, it indicates the presence of borax or boric acid. Add a drop of ammonia solution on the turmeric paper and if the red color changes to green, it confirms the presence of boric acid.

The following two adulteration tests are difficult to carry out by consumers as they require sophisticated equipment's and only an expert analyst can conduct the same. We mention it here only for consumer information and for better understanding.

XVI. DETECTION OF VEGETABLE FAT

The characteristic feature of milk is in its fatty acid composition, which mainly consists of short chain fatty acids such as butyric, caproic, caprylic acid; whereas the vegetable fats consist mainly of long chain fatty acids and hence adulteration of vegetable fat in milk can be easily found out by analyzing the fatty acid profile by gas chromatography.

XVII. DETECTION OF BUFFALO MILK IN COW MILK

Hansa test detects the presence of buffalo milk in cow milk. It is based on immunological assay.

Dilute 1 ml of milk with 4 ml of water and then treat it with 1 ml of antiserum. The characteristic precipitation reaction indicates the presence of buffalo milk in the sample taken.

(We develop the antiserum by injecting buffalo milk proteins into rabbits).

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- Council for Fair Business Practices, Bombay Chamber of Commerce and Industry
- Indian Soap & Toiletries Makers Association
- Mission basis workshops organized by Government of Maharashtra, as a precursor to the finalization of the Food Safety & Standards Act 2006

Formulated the popular CGSI 'Food & Milk Adulteration Testing Kit' for consumer use to test adulteration



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