

Adulteration of Milk: A Review

Anisha Francis¹, Twinkle Dhiman², K. Sumana Mounya³

³(M.Tech. in Food Processing Technology, Jawaharlal Nehru Technology University, Kakinada (JNTUK), India)

¹(PhD scholar in Agricultural Processing & Food Engineering, Dept. of Food Processing Engineering, SHUATS, U.P., India)

² (Dietary Research Investigator, Dept. of Hematology, PGIMER-12, Chandigarh, India)

²Corresponding Author: twinkledhiman47@gmail.com

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Abstract: Milk is a good nutritious drink and is eaten for drinking as such, as well as by milk products, by a majority of the population worldwide. The practice of milk adulteration, however, constantly reduces its quality and can introduce hazardous substances into the dairy supply chain which endangers the health of consumers. Various cases of milk adulteration have been reported globally, in which substances such as extraneous water, foreign proteins, whey proteins, melamine and urea, vegetable or animal fats, plus many minor constituents of milk fat were added as possible adulterants in milk and milk products. This article provides some information about adulteration of milk and their detection process.

Keywords: milk, adulteration, milk adulterant, Urea, starch, Common Salt, Sugar

I. Introduction

Milk is a compulsory part of the expectant mom's daily diet as well as growing infants. Due to its unique nutritional value and its important role in human and animal health, milk is very important. In its most easily attackable shape, it has all the substances needed by species. Milk is recommended for young and old people, because of its nutritional value (Reddy *et al.*, 2017).

Milk is defined as the full, fresh, clean, lacteal secretion obtained by complete milking of one or more healthy animals except those obtained within fifteen days before or five days after calving, or such periods as may be necessary to make milk practically colostrum free and contain the minimum specified percentage of milk fat (3.5 percent) and solids not fat (8.5 percent).

Milk has high food value if it is available in its natural form. I provide essential quantities of nutrients such as high quality proteins, fat, carbohydrates, vitamins and minerals than any other single food. In addition to its general need for human health, milk proteins supply certain amino acids that are required for proper adult and infant development. Buffalo and cow's milk contain 7.6 and 4.5% fat, 3.8 and 3.8% protein, 4.9 and 4.9% lactose, 0.78 and 0.72% ash, 17 and 13.9% total solids, respectively (Afzal *et al.*, 2011).

Casein micelles and fat globules give milk most of its physical characteristics, and give milk products such as butter, paneer, curd, cheese, and so on taste and flavor. Milk composition varies considerably with cow breed, lactation stage, feed, year season and many other factors. Some relationships between constituents, however, are very stable, and can be used to show if there has been some tampering with the composition of milk. The Government of India promulgated the 'Prevention of Food Adulteration Act' (PFA Act) in 1954 from the point of view of protecting public health. The Act came into effect on June 1st, 1955. It forbids not only adulterated foods, but also foods tainted with toxicants from being made, marketed and distributed (Rangappa & Achaya 1974).

Air, fat removal, addition of skim milk powder, reconstituted milk, thickening agents such as starch, flour, glucose, urea, salt, chlorine are the characteristics of adulterants commonly contained in milk and milk items. Neutralizers that typically consist of sodium bicarbonate, sodium carbonate, sodium hydroxide, and calcium hydroxide are preservatives. Animal fats, aflatoxins, and vegetable oils are some rare ones.

II. Milk Adulteration

Adulteration is an act by which the quality of food offered for sale is purposely compromised either by combining or substituting inferior substances or by eliminating some important ingredients (Food and Drug Administration, 1995). Adulterated foods are harmful to health because they may contain various toxic chemicals and may be deprived of the nutrients essential for the proper development and growth of the human body. Naturally, pathogenic microorganisms, such as tuberculosis and hepatitis, are found in milk.

Moreover, in the adulteration of milk, Gawalas also have a major role. Milk used for consumption by individuals is adulterated to such a degree that it has very little nutritional value and may even be harmful to public health. Milk dealers can increase their profit margin by diluting three ways, removing useful components such as milk fat that is removed as cream, adding inexpensive substances such as starch to lift the value of total solids to a level that customers can embrace. In our country raw milk is distributed through a traditional method that includes intermediaries called Gawalas. To maximize their benefit, these middlemen (Gawalas) used to adulterate milk.

Milk adulteration, poor hygiene, malpractices, lack of preservation technology, refrigeration facilities and sanitation conditions are the key causes of losses in milk quantity and poor quality. Milk adulteration is achieved to increase its thickness, then adding starch and other reconstituted milk powders to increase its viscosity. Often used to improve the shelf-life of filthy milk ice and other chemicals such as hydrogen peroxide, carbonates, bicarbonates, antibiotics, caustic soda and even the most deadly chemical formalin. Urea adulterated milk is very dangerous to the children, as it accelerates the puberty process (Bania *et al.*, 2001).

Some adulterants, such as detergents, are used to boost the cosmetic character of milk. When water is applied to milk, its foamy appearance diminishes, so artificial detergents are applied to it to give milk a foamy appearance. To whiten the milk, hair removal powders and urea are applied to give it a genuine look. Just a few grammes of urea is adequate to get milk back to its original state. During the summer season, hydrogen peroxide is typically used to preserve milk when the ambient temperature is very high. This unethical practise is commonly modified to avoid financial losses due to milk spoilage during the transport and selling of milk.

Common adulterants of milk

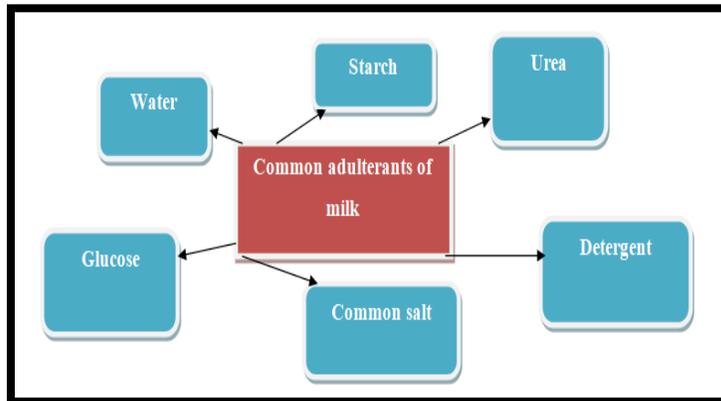


Figure: 1 Common adulterants of milk

III. Typical Adulterants and Their Health Hazards On Humans

Water

Water is the most widely added adulterant to increase milk production, which in turn reduces milk's nutritional value. But it is a major health issue for the milk consuming population if polluted water is applied to milk.

Urea

Urea is added to milk to give whiteness, to increase milk quality, to increase nonprotein nitrogen content and content of solid-not-fat (SNF) as present in natural milk for leveling. To prepare synthetic milk, urea is also used. Acidity, indigestion, ulcers and cancers are associated with health hazards. Urea is harmful to the heart, particularly to the liver for the kidneys, because the kidneys have to do more work to extract urea from their bodies.

Melamine

To wrongly raise the protein content melamine is added to the milk and milk powder. It causes the kidneys to Failure and in extreme cases deaths.

Detergents

To emulsify and dissolve the oil in water, detergents are added that give a frothy solution, the characteristic white colour of milk. They improve milk's cosmetic character. Gastro-intestinal complications are caused by detergents.

Peroxides of hydrogen (H₂O₂)

To prolong its freshness, hydrogen peroxide is applied to the milk, but peroxides harm the gastrointestinal cells which can lead to gastritis and intestinal inflammation. H₂O₂ disturbs the body's antioxidants, disrupting the normal immunity and thereby growing ageing.

Starch

Starch is used to raise solid-not-fat (SNF), and if large levels of starch are added to milk, the effects of undigested starch in the colon may cause diarrhoea. His body build-up can be very lethal for diabetic patients. Besides starch, wheat flour, arrowroot, and rice flours are also added (**Reddy et al., 2017**).

Chlorine

After adding water chlorine is applied to compensate for the density of the diluted milk. Chlorinated milk can cause arterial clogging and cause heart attacks. The acid base balance in the body and even the blood pH are disrupted by chloride in the milk.

Sugar

Generally sugar is mixed in the milk to increase the solids not fat content of milk to increase the lactometer reading of milk, which was already diluted with water.

Neutralizers

In synthetic milk, NaOH is often used to neutralise the acidic effect. In India synthetic milk is a common problem that is prepared by adding urea, caustic soda, refined oil and common detergents. For those suffering from hypertension and heart ailments, caustic soda contains sodium and serves as a slow poison. Caustic soda deprives the body of the use of lysine, an essential amino acid in milk which grows babies need. Such artificial milk is unsafe to all, but harms pregnant women more (**Bhatt et al., 2008**).

Food colours

Often several food colouring agents are introduced to enhance appearance and have dangerous health effects.

Milk powder

The milk powder is often introduced in fresh milk as an adulterant. This is achieved for economic gain when a nation has surplus milk powder or dried powder milk is provided with subsidies.

Low valued Milk

By combining lower valued milk with higher valued milk, milk is adulterated. Goat milk, for example, is frequently adulterated with cow milk for greater benefit. It has been found that the health risks associated with this activity are not well described, but from a commercial and ethical perspective this is a major problem in the food industry (**Jha and Matsuoka 2004**).

Whey

The addition of liquid-whey to raise the amount of milk is a very common procedure. Low-priced rennet whey sometimes blends with liquid milk and milk powder. Whey, the strong rennet whey is commonly found in milk. The addition of solid rennet whey to UHT milk causes blood pressure to decrease. For greater benefit, some businessmen use inexpensive muriatic acid to prepare whey, which causes severe health problems.

Preservatives

Micro-organism production spoils the milk and spoiled milk isn't good for health. The milk can be protected for a long time by boric acid, formalin, sodium carbonate (Na₂CO₃), sodium bicarbonate (NaHCO₃), salicylic acid, benzoic acid, sodium azides and toxic effects that can lead to death. It induces stomach pain, diarrhoea, vomiting and other symptoms associated with poisoning.

Non-Milk Proteins & fats

Milk, milk powder and other milk products are often adulterated by low-priced non-milk proteins such as soy, peas and soluble wheat proteins. Whey powder from bovine rennet is often mixed with milk powder. Milk fat is also augmented by other sources of fat which can also pose a risk to human health. Since milk fat is very expensive, some manufacturers of dairy and milk products exclude milk fat for additional financial gain and make up for it by adding non-milk fat, such as vegetable oil.

Detection of Milk Adulteration: Various milk adulterants and the method used to detect those adulterants are presented.

Table No.3 Detection of different edible adulterants in milk

Adulterant	Procedure	Observation
Sugar	Take a taste of 10 ml of milk in a test tube. Add just 5 ml of conc. HCl and resorcinol at 0.1 g. Place the test tube in a bath of water for 5 minutes.	A red colour appearance suggests that added sugar is present
Starch	Test 3 ml of milk in a test tube. Cool it to room temperature after stirring thoroughly. Add 1 percent iodine solution with 2 to 3 drops	A blue colour appearance suggests the presence of starch .
Glucose	Take a taste of 1 ml of milk in a test tube. Apply 1 ml of Barford 's updated reagent. Heat the mixture in a bath of boiling water for precisely 3 minutes. Refrigerate easily under tap water. Shake well and apply 1ml of phosphomolybdic acid.	The sudden presence of a deep blue colour suggests that glucose is present
Common salt	Take a sample of 5 ml of milk into a test tube. Add 1 ml solution of 0.1 N silver nitrate. Mix the contents thoroughly and apply 10 % potassium chromate solution of 0.5 ml	The yellow colour appearance suggests the presence of added salts, while the brick red colour shows the milk free from added salt.
Buffalo milk	1/10 Dilute the milk. On the middle of a glass slide, place a drop of diluted milk. Now placed a drop of the Hansa test serum (duly preserved) on the milk drop and mix with a glass rod or clean tooth pick	Within half a minute, curdy particles form in milk that contains buffalo milk.
Skim milk powder	Add nitric acid drop by drop in to the test milk sample	The development of orange colour, it indicates the milk is adulterated with skim milk powder. Samples without skim milk powder shows yellow color.

Source: (Pappas et al., 2008)

IV. Conclusion

Normally, adulteration in milk is present in its most crude Hey, shape. Sometimes, banned substances are added or occasionally added. Milk has been completely replaced by synthetic milk. This is, this is, For financial advantage, over. Yet, several times, carelessness and carelessness are the absence of hygienic manufacturing, storage, transportation conditions and adulteration is caused by marketing. Such kinds In developed nations, adulteration is very normal. Or countries that are backward. However, milk adulteration is a serious concern. Also, issues in developing countries. In those nations, advanced techniques are used to adulterate milk and need sophisticated approaches to identification. Consumers are either tricked or, by drinking adulterated milk, often

become victims of diseases. To ensure adulterant-free milk for consumption, quality control tests for milk are a significant feature. Some of the common diseases caused by the ingestion of adulterated milk are hypertension, kidney disease, skin, eye, heart disease and cancer. To adulterate milk, hundreds of different techniques are being implemented. And the technique of detection ranges from basic visual inspection to complex biological systems. This paper offers a summary of the various elements used in the adulteration of milk, the adulteration technique, and an in-depth analysis of the electrical methods adopted for the adulteration of milk. The paper is intended to help researchers get an overall understanding of the adulteration of milk and its methods of detection.

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