

INTRODUCTION

Milk in its natural form has high food value. It supplies nutrients like proteins, fat, carbohydrates, vitamins and minerals in adequate amounts which are available in easily digestible and absorbable form. Due to its high and qualitative nutritive value milk is considered to be the most 'ideal food' for both infants and adults. It supplies body building proteins, bone forming minerals, health giving vitamins, minerals and furnishes energy giving lactose, milk fat and also supplying certain essential fatty acids. Next to egg, milk has high biological value due to its content of essential amino acids. Milk has been recognized as a complete food for man as it acts as a source of essential nutrients required for promoting growth and maintenance of health.

Unfortunately, milk is being very easily adulterated throughout the world. Possible reasons behind it may include-demand and supply gap, perishable nature of milk, low purchasing capability of customer and lack of suitable detection tests (Kamthania *et al.*, 2014). The motivation for food fraud is economic, but the impact is a real public health concern (Singh & Gandhi, 2015). The situation is significantly worse in developing and underdeveloped countries due to the absence of adequate monitoring and lack of proper law enforcement. A national survey in India has revealed that almost 70% of the milk sold and consumed in India is adulterated by contaminants such as detergent and skim milk powder, but impure water is the highest contaminant. According to National Survey on Milk Adulteration conducted by FSSAI (India) in 2011, water is the most common adulterant followed by detergent in milk.

Milk dealers may either dilute the milk or extract valuable components and there after add cheap substances to maintain its compositional parameters. Milk today is being very easily adulterated throughout the world. The situation is significantly worse in developing and underdeveloped countries due to the absence of adequate monitoring and lack of proper law enforcement.

Adulterants are added in milk to increase certain parameters, thereby increasing the milk quality in dishonest way. The composition of milk varies considerably with the breed of cow, stage of lactation, feed, season of the year, and many other factors. However, some relationships between constituents are very stable and can be used to indicate whether any tampering with the milk composition has occurred (Mahmood *et al.*, 2011). A national survey in India has revealed that almost 70% of the milk sold and consumed in India is adulterated by contaminants such as detergent and skim milk powder, but impure water is the highest contaminant. According to National Survey on Milk Adulteration conducted by FSSAI (India) in 2011, water is the most common adulterant followed by detergent in milk. Qualitative detection of adulterants in milk can be easily performed with chemical reactions while quantitative detections are complex and diverse. Type of quantitative detection techniques depend on the nature of adulterants in milk.

The nature of adulterants generally encountered in milk and milk products are water, removal of fat, addition of skim milk powder, reconstituted milk, thickening agents such as starch, flour, glucose, urea, salt, chlorine. Preservatives such as neutralizers which usually consists of sodium bicarbonate, sodium carbonate, sodium hydroxide and calcium hydroxide. Thus, it is obvious that apart from less harmful adulterants, toxic and potentially injurious substances also are being added to milk. Despite food legislation, adulteration remains uncontrolled, furthermore legal steps laid down in the PFA Act are extremely difficult to maintain due to inadequate and untrained man power and laboratory facilities. Such is the state in the country where we are one of the largest nations of milk producers. In the year 2010-2011, India was ranked among the top 5 countries in the world producing 121.8 million tonnes of milk .

Adulterants in milk mainly addition of vegetable protein, milk from different species, addition of whey and watering which are known as economically motivated adulteration (Singh & Gandhi, 2015). These adulterations do not pose any severe health risk. However, some adulterants are too harmful to be overlooked. Some of the major adulterants in milk having serious adverse health effect are urea, formalin, detergents,

ammonium sulphate, boric acid, caustic soda, benzoic acid, salicylic acid, hydrogen peroxide, sugars and melamine.

Some of the adulterants that can be added to milk in order to maintain its freshness and market value which in turn is harmful to the consumer leaving them clueless of what direct effect these adulterants have on them are mentioned below:

Water is an adulterant in milk which is often always added to increase the volume of milk which in turn decreases the nutritive value of milk which if contaminated poses a health risk especially to infants and children.

Milk powder is sometimes added as an adulterant in fresh milk. This is done for economic advantage when a country has milk powder in excess or subsidy is provided for dried powder milk (Guan *et al.*, 2005)

Detergents are added to emulsify and dissolve the oil in water giving a frothy solution, the characteristic white colour of milk. They enhance the cosmetic nature of milk. Detergents cause gastro – intestinal complications.

Urea is added to milk to provide whiteness, increase the consistency of milk and for leveling the contents of solid-not-fat (SNF) as are present in natural milk. The presence of urea in milk overburdens the kidneys as they have to filter out more urea content from the body. Urea is harmful to heart, liver especially for kidneys as the kidneys have to do more work to remove urea from the body (Kandpal *et al.*, 2012). Urea, being a natural constituent of raw milk, has a maximum limit imposed by FSSAI (Food Safety and Standards Authority of India) Act 2006 and PFA (Prevention of Food Adulteration) Rules 1955 which is to be 70 mg/100 ml. Commercial urea is added to milk to increase non-protein nitrogen content (Sharma *et al.*, 2012).

Starch is used to increase solid-not-fat (SNF) and if high amounts of starch are added to milk, this can cause diarrhoea due to the effects of undigested starch in colon. Its

accumulation in the body may prove very fatal for diabetic patients (Singuluri & Sukumaran, 2014). Apart from the starch, wheat flour, arrowroot, rice flours are also added.

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

Carbonates and **bicarbonates** are added to milk which can cause disruption in hormone signaling that regulate development and reproduction (Jha and Matsuoka, 2004).

Formalin, **salicylic acid** and **benzoic acid** act as preservatives and increase the shelf life of the milk (Singh & Gandhi, 2015).

Neutralizers are generally used to mask the pH and acidity values of badly preserved milk passing it off as fresh milk (Faraz *et al.*, 2013).

Sometimes milk fat is replaced by fat from other sources which may also pose a risk to human health. Since milk fat is very expensive, some manufacturers of milk and dairy products remove milk fat for additional financial gain and compensate it by adding non-milk fat such as vegetable oil (e.g., sunflower oil) (Jha and Matsuoka, 2004) .

Ammonia in milk develops regression, loss of acquired speech and sensory disturbances. **Ammonium sulphate** is added to increase the lactometer reading by maintaining the density of diluted milk. Similarly, **melamine** is added to increase protein content falsely (Liu *et al.*, 2012). The ingestion of melamine at levels above the safety limit can induce renal failure and death in infants (Domingo *et al.*, 2014).

Hydrogen Peroxide is added to milk to prolong its freshness, but peroxides damages the gastro intestinal cells which can lead to gastritis and inflammation of the intestine. Hydrogen peroxide disturbs the antioxidants in the body disturbing the natural immunity hence increasing aging.