

Performing adulteration analysis of milk samples obtained from National Capital Region (Delhi) of India

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ABSTRACT

Milk is a dairy product that is very nutritious and consumed by most of the population worldwide. However, in order to make more profits, the practice of adulterating milk has become very common. This causes reduction in the milk quality and also introduces chemicals that may be hazardous to the health of the consumers. Adulterants such as water, whey proteins, foreign proteins, vegetable or animal fats and urea have been used globally. This study aimed to detect adulteration in milk samples available across different zones in Delhi. The Urea Test, Neutralizer Test and Butyro-Refractometer Test were performed to detect the various types of adulterants used. Urea is used to increase the whiteness of milk. Neutralizer (caustic soda) is added to milk to delay its curdling. It was observed that all the milk samples were free from urea and animal fat. Addition of neutralizer was observed in some samples of milk.

KEYWORDS: Milk, Adulteration, Delhi, Urea, Neutralizer.

1. INTRODUCTION

Milk when naturally obtained from the udder of a milch animal is very nutritious, as contains optimum amounts of carbohydrates, fats, proteins, vitamins and minerals [1]. It is easy to digest, and readily absorbed by our intestines, and thus is a good food item for infants, children, nursing women and elderly people. Milk proteins also contain certain essential amino acids that are important for the proper growth and development of both adults and infants [2]. However, when adulterated, milk becomes poor in quality and may be hazardous to the consumers.

Adulteration in Milk

Everyone in the chain of food production has an interest in safeguarding food and ensuring that they are safe, genuine and of the best quality, including food producers, retailers, regulators and consumers. Food adulterating has been a practice since Roman times, when it was limited to smaller geographical areas and to only a few food items like dilution of wine with water or with colouring agents [3 and 4]. Adulteration is done in milk to increase the quantity, but the quality is

reduced. An adulterant is a chemical that is not supposed to be found in food items, and their use to contaminate food is illegal. The addition of adulterants to food items either due to lack of proper maintenance or for profit is called adulteration. Although the main reason of adulteration is financial gain, it poses great threat to public health [4]. The United States Pharmacopeia (USP) analyzed twenty five food products that were globally the most prone to adulteration, and found that after olive oil, milk was the most adulterated food ingredient [5].

Milk gets adulterated either due to marketing or for financial gains or due to poor hygiene of processing, storage and transportation environments. Adulteration of milk has been widely reported in many highly populated developing countries such as India, Brazil, Pakistan and China [6-10].

Common Adulterants in milk	Cause	Diseases caused
Water	Diluting with water increases the volume of milk, allowing more profits.	Reduces nutritional value. If water is contaminated, additional health problems are caused.
Urea	Blending with other ingredients to produce synthetic milk with higher protein content for more profit.	Vomiting, nausea and gastritis.
Starch	Increasing thickness and fat in milk artificially for more profit.	Stomach diseases
Detergent	Adding to diluted milk to enhance appearance for more profit. Accidental contamination due to poor maintenance of milk tanks.	This contains sodium which is a slow poison for people suffering from heart ailments and hypertension.
Caustic Soda	To avoid curdling and to increase the shelf life of milk.	Affects people suffering from heart ailments and hypertension. Damages the mucosal lining of the oesophagus, especially in kids
Cane Sugar	Increasing solid contents of milk.	Decreases the nutritious value of the milk
Formalin/ Melamine	Adding to milk to increase the protein content artificially, for more profit.	Causes liver damage
Oil	Replacing milk fats with vegetable oil for profit.	Enhances creamy texture of the milk but is very harmful for consumption
Other synthetic compounds Neutralizers(carbonates/bicarbonates)	Decreasing costs by masking the acidity values and pH of poorly preserved milk to sell it off as fresh.	Impair various organs of the body, cause cancer and heart problems, and sometimes may lead to death.

Table 1.1: Common Adulterants in Milk

The adulterants may also have deleterious effects on the health of consumers, especially infants (Table 1.1). Milk suppliers mainly use three ways to increase their profits from the sale of milk, which are dilution, extraction, or a combination of both dilution and extraction of valuable constituents. Milk fat may be removed or milk may be added with cheap and potentially harmful bulking additives like poor quality flour, to bring the total solids in the milk to a level accepted by

consumers. Most adulterants, chemicals and malpractices cause malnutrition and raise concerns on public health [11].

The main aim for this malpractice is to increase profits by either gains in volume or extended shelf life. However, adulteration of milk is a potential threat to both human health and the economy [12 and 13]. The oldest and simplest way of adulteration of milk is by adding water to increase its volume. In addition to water, other substances are also added to milk, such as whey, preservatives such as hydrogen peroxide (H_2O_2), stabilizing agents, nitric acid, urea and acidity regulators such as sodium hydroxide (NaOH) [13 and 14]. This study was undertaken to detect the presence of adulteration, if any, in milk samples available across different zones in Delhi.

2. MATERIALS AND METHODS

1. Neutralizer Test: In test tubes, 2 mL of the milk samples were taken. 2 mL ethanol (90%) was added to milk sample. One drop of 1% Rosalic acid solution was added and mixed properly. Appearance of rose red pink indicated the presence of neutralizer.

2. Urea Test: 2 mL of milk sample was mixed with 2 mL of 1.6% DMAB reagent. The control milk sample containing no added urea showed a slight yellow color. Distinct yellow color was observed for positive test.

3. Butyro-Refractometer (BR) Reading: Water was circulated from constant water bath through Butyro- Refractometer till the thermometer at Abbe's Refractometer showed constant temperature of $40^{\circ}C$. 2 drops of standard fluid were placed on the surface of lower prism. The prism was closed and instrument was allowed to stand for a few minutes before reading was taken so that the temperature of the sample and instrument was same. It was observed that the instrument was standardized. The prism was washed with cleaning mixture and 1-2 drops of sample was placed on lower prism and reading was taken at constant temperature. BR reading range 40- 43 indicated genuine milk.

3. RESULTS AND DISCUSSIONS

Milk is the best and easy source of nutrients like body building protein, bone forming minerals, health giving vitamins and energy giving fats and lactose. To increase the economic value of milk and milk products, these are adulterated in different ways like adding water to increase the amount and starch is added to give thickness and so on.

3.1. Urea and Neutralizer

Urea is generally added to milk to increase its SNF content and whitening of milk. All the 90 milk samples tested in the present study for urea as an adulterant were found to be free from urea (Table 3.1 and Figure 3.1).

On testing for neutralizer, a total of 14 samples (15.5%) out of 90 samples tested showed the presence of neutralizer. None of the freshly collected milk samples at source had neutralizer as an adulterant. Out of 30 packaged milk samples, 5 (16.6%) were detected positive for neutralizer. In case of loose milk samples collected from vendors, 9 (30%) out of 30 samples were found to be adulterated with caustic soda.

Other workers also reported presence of urea and neutralizer in the milk samples tested in their studies [9, 14-17]. These chemicals are used as cheap preservatives to increase the shelf life of milk. Neutralizers generally used to hide the pH and acidity values of badly preserved milk, thus passing it off as fresh milk [6].

Type of milk	Source	Region	Urea	Neutralizer		Adulterated With Neutralizer	Genuine	Total
			Negative	Negative	Positive			
			Count	Count	Count			
Fresh Loose	Buffalo	East	10	10	0	0	10	10
		North	10	10	0	0	10	10
		South	10	10	0	0	10	10
Loose	Buffalo	East	5	3	2	2 (40%)	3 (60%)	5
		North	5	4	1	1 (20%)	4 (80%)	5
		South	5	5	0	0	5	5
	Cow	East	5	3	2	2 (40%)	3 (60%)	5
		North	5	3	2	2 (40%)	3 (60%)	5
		South	5	3	2	2 (40%)	3 (60%)	5
Poly Packaged	Full cream milk	East	5	3	2	2 (40%)	3 (60%)	5
		North	5	4	1	1 (20%)	4 (80%)	5
		South	5	5	0	0	5	5
	Toned milk	East	5	4	1	1 (20%)	4 (80%)	5
		North	5	4	1	1 (20%)	4 (80%)	5
		South	5	5	0	0	5	5
Total			90	76	14	14 (15.5%)	76 (84.4%)	90

Note: Values in parentheses represent percentage

Table 3.1: Adulterants in Milk Samples

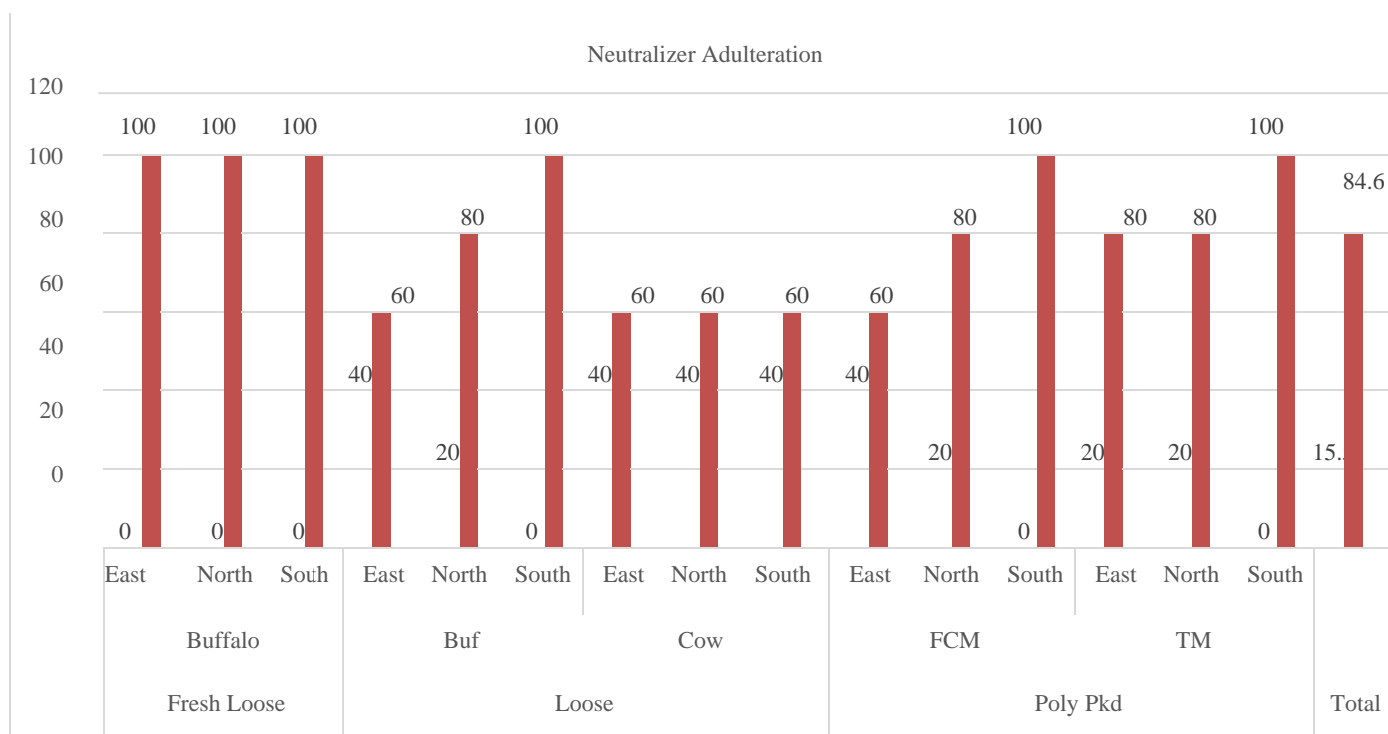


Fig 3.1: Neutralizer Adulteration in Milk Samples (zone-wise) (FCM-Full Cream Milk, TM-Toned Milk)

Type of Milk	Milk BR reading (required)	<40	40-43	>43	Non-Confirming	Genuine	Total
Full cream	40-43	0	15	0	0 (0%)	15 (100%)	15 (100%)
Toned	40-43	0	15	0	0 (0%)	15 (100%)	15 (100%)
Loose cow milk	40-43	0	15	0	0 (0%)	15 (100%)	15 (100%)
Loose Buffalo milk	40-43	0	15	0	0 (0%)	15 (100%)	15 (100%)
Fresh Loose milk	40-43	0	30	0	0 (0%)	30 (100%)	30 (100%)
Total		0	90	0	0 (0%)	90 (100%)	90 (100%)

Note: Values in parentheses represent percentage

Table 3.2: BR Readings of the Milk Samples

3.2. BR reading

With the help of BR reading, the adulteration in milk and milk products with animal fat or oil is usually detected. All the 90 milk samples were found to show readings within the required limit for Butyro-Refractometer, indicating absence of any animal fat or oil adulteration in milk samples (Table 3.2). Similar reports were also obtained by other investigators [18 and 19].

4. CONCLUSIONS

Adulteration of milk is a widely followed process by manufacturers to increase their profits. However, it is a hazard for the consumers, as some of the adulterants are dangerous chemicals. Milk samples were tested in the laboratory to check the quality of milk based on content of adulterants. Surprisingly, all the milk samples were free from urea. However, in neutralizer test, 5 (16.6%) out of 30 packaged milk samples and 9 (30%) out of 30 samples from vendors were detected positive for caustic soda which is added to neutralize the acidity and curdling of milk. From the results, it can be concluded that all the samples of milk were free from urea and animal fat. Addition of neutralizer was observed in some samples of milk.

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