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Milk Adulteration Analysis in Various Regions of Ludhiana District, Punjab, India

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Abstract

The present study aimed at evaluating the adulteration in milk samples of different regions of Ludhiana, the Industrial hub of Punjab and the Manchester of India. The presence of chemical adulterants was analysed by standard methods to test the milk samples collected from six areas of Ludhiana city: Civil Lines, adjoining areas of Bus Stand, Chandigarh Road, Haibowal, Ferozepur Road and Hambran Road. All the areas of study tested negative for starch, ammonium compounds, formalin, detergent and urea whereas 86.66% adulteration was found for water followed by salt (23.33%) and acidity (6.66%). The present work provided an insight into the quality of milk consumed in the areas of study and such monitoring is pivotal for generating awareness at the level of consumer.

Keywords: Adulteration, milk samples, analysis, awareness

Introduction

Milk adulteration is defined as an act of intentionally degrading the quality of the food product and milk product to increase the sale either by mixing or substitution of low-grade substances or by the removal of some precious ingredients. [1] Adulterated food is hazardous for health as it may contain various toxic chemicals and may be deprived of nutrients required for proper growth and development of human body.[2] Milk consists of nutrients, which are needed for proper growth and maintenance of body. Milk and its products are major part of the diet and a large amount of our food expenditures goes on milk and other milk products. Milk is transported from the point of production to consumers and processing plants by middlemen. They may adulterate milk to increase their profit margin by several chemicals like urea, starch, flour, cane sugar, vegetable oils, detergents etc. [3] There are many preservatives like formalin and some antibiotics which are added in milk to enhance its shelf life. [4] These adulterants, preservatives and drugs in milk cause very serious health problems and various diseases.[5] It is, therefore, important to protect the consumer by ensuring that adequate control measures are in place and that the food analyst has suitable methods for the detection of milk adulteration. As per FSSAI, despite the laws governing the quality and sale of milk existing in India for decades, the adulteration of milk has not been checked completely.[3] The present study was conducted with the objective of observing the adulteration in milk samples procured from different localities of Ludhiana city.

Materials and Methods:- Thirty raw milk samples of open milk and branded milk (cow milk/buffalo milk/ packet milk) were purchased from different local vendors from six areas (Area 1 - Area 6) of Ludhiana (Punjab, India) city viz. Civil Lines, Bus stand adjoining areas (with in 3 kms), Chandigarh Road, Haibowal, Ferozepur Road and Hambran Road (Table 1). These samples were subjected to adulteration analysis for the presence of chemical adulterants viz. salt, acidity, starch, ammonia, formalin, detergent, urea and water. Samples for analysis were collected in sterilized glass bottles with stopper of 500 ml capacity. Samples were labelled as S1 to S30 (Table 2) along with in house hand milked sample as control. The milk adulteration analysis was carried out within one hour of collection.

Table 1 : Areas of Milk Sample Collection

Sr.No.	Sample ID	Locality
1	Area 1	Civil Lines
2	Area 2	Adjoining areas of Bus Stand (With In 3 KMs)
3	Area 3	Chandigarh Road
4	Area 4	Haibowal
5	Area 5	Ferozepur Road
6	Area 6	Hambran Road

Water test:- Water is an adulterant which is often added to increase the volume of milk which in turn decreases the nutritive value of milk and if contaminated poses a health risk especially to infants and children.[6] Any addition of water to milk disturbs its specific gravity.[7] The specific gravity of the milk, indicating the amount of water being added to the milk was assessed by using lactometer. As specific gravity decreases with increase of temperature, therefore corrected lactometer reading (CLR) was obtained using the method of Sharma, 2019 and used while calculating the specific gravity of milk samples.[8]

Salt test:- Common salt (Sodium Chloride) is added to increase solid-not-fat (SNF) content in milk . [9,10] Salt detection was done using silver nitrate and potassium chromate solutions followed by observing the colour change.[11]

Starch test:- Addition of starch in milk increases its solid content and masks adulteration. It reduces the nutritive value of milk. Starch accumulation in the body can cause diarrhea.[10] Accumulated starch in the body may prove very fatal for diabetic patients.[6] Starch detection was done following the method given by Bureau of Indian Standards. [12]

Acidity test:- The value of Titrable Acidity (TA) as an indicator of raw milk quality has been challenged recently, because milk is refrigerated within minutes after it leaves the cow until it reaches the consumer. TA appears to be a valid method of evaluating raw milk quality even though it can be influenced by the protein content. TA is a rapid test indicating raw milk quality and provides an indirect measure of the acid content in milk. Generally, as milk acid content increases, TA value increase. Milk acid content is increased by the bacteria that convert lactose to lactic acid. TA has been used for many years to indicate whether milk has undergone bacterial degradation (acid production) or temperature abuse or is aged.[13] Titrable Acidity was measured using phenolphthalein indicator. [14]

Detection of Ammonium compounds:- Ammonium compounds are used as adulterant to increase solid-not-fat content.[10] Ammonium sulphate is added to increase the lactometer reading by maintaining the density of diluted milk .[15, 9] Detection of ammonium compounds was done using Nessler's reagent. [11]

Formalin:- Formalin (40%) is poisonous though it can preserve milk for a long time. Formalin is used as adulterant for preservation of milk [10, 15]. Detection of formalin was done by Hehner's test with concentrated sulphuric acid as the reagent using FSSAI manual of analysis of milk and milk products. [11]

Detergent:- 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. Detergents are added to emulsify and dissolve the oil in water giving a frothy solution, which is the desired characteristic of milk. [6,9] Presence of detergents in the milk

samples was tested using methylene blue and chloroform following FSSAI manual of methods of analysis of foods, milk and milk products. [11]

Urea:- Urea is added as adulterant in milk to increase solid-not-fat content. Presence of urea was detected using p-dimethyl amino benzaldehyde (DMAB) method. [10]

Results

Triplicate samples were taken of the milk subjected to adulteration analysis. The results of six areas are summarized in Table 2, figs. 1 and 2. Among all the samples, 8 (26.6%) samples were positive for adulteration. Out of the 30 samples studied from six different regions, only four samples (13.33%) had specific gravity between 1.030 and 1.034. All other samples (86.66%) (fig.2) had specific gravity less than 1.030, an indication of the addition of water in milk. The maximum diluted milk had specific gravity of 1.023 as compared to control having specific gravity of 1.031. Salt was detected in 7 samples with 23.33% (fig.2). Highest number of positive samples were noted in Area 5 where three out of five samples were positive for salt adulteration followed by Area 2 where two samples were observed positive. No sample from area 4 and area 6 showed salt adulteration (Table 2; Fig. 1). The range of milk acidity for good quality of milk is 0.10-0.17% LA (Lactic Acid). [14] Two samples from Area 1 (6.66%) (fig.2) were found to be acidic having acidity value 0.176% and 0.2% LA. Acidity value of all other samples were found to be in range. As evident from Table 2, Starch, ammonium compounds, formalin, detergent and urea were not detected in studied samples.

Table 2 : Results Obtained from Adulterant Analysis through Standard Methods [7,12,11,10,15]

Area / Locality	Sample Number	Results Based on Specific gravity	Salt	Acidity	Starch	Amonia	Formalin	Detergent	Urea
Area 1	S1	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S2	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S3	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S4	Diluted	Negative	**Positive**	Negative	Negative	Negative	Negative	Negative
	S5	Diluted	**Positive**	**Positive**	Negative	Negative	Negative	Negative	Negative
Area 2	S6	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S7	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S8	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S9	Diluted	**Positive**	Negative	Negative	Negative	Negative	Negative	Negative
	S10	Diluted	**Positive**	Negative	Negative	Negative	Negative	Negative	Negative
Area 3	S11	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S12	**Undiluted**	**Positive**	Negative	Negative	Negative	Negative	Negative	Negative
	S13	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S14	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S15	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Area 4	S16	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S17	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S18	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S19	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S20	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Area 5	S21	Diluted	**Positive**	Negative	Negative	Negative	Negative	Negative	Negative
	S22	**Undiluted**	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S23	Diluted	**Positive**	Negative	Negative	Negative	Negative	Negative	Negative
	S24	Diluted	**Positive**	Negative	Negative	Negative	Negative	Negative	Negative
	S25	**Undiluted**	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Area 6	S26	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S27	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S28	**Undiluted**	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S29	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative
	S30	Diluted	Negative	Negative	Negative	Negative	Negative	Negative	Negative

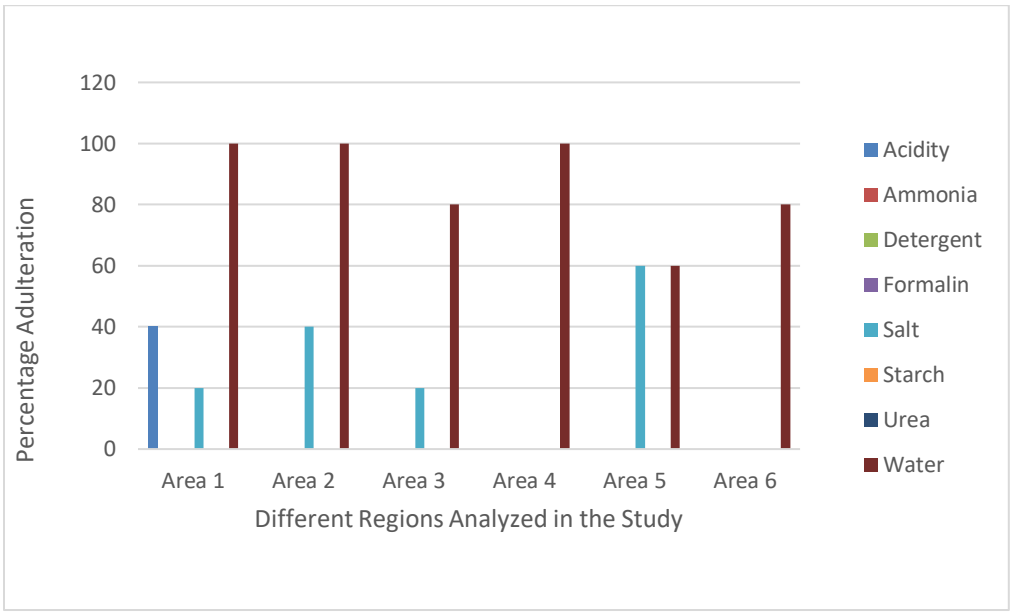

Figure 1: Results of Milk Adulteration analysis in different study areas

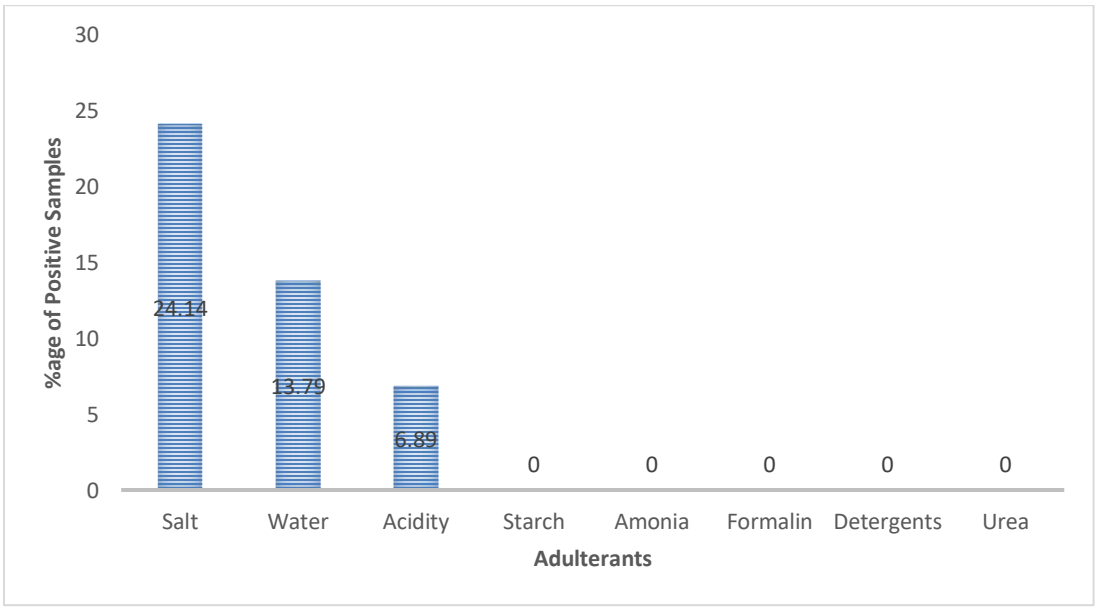

Figure 2: %age of Adulterants analyzed in Milk Samples

Discussion

All the samples tested negative for Starch, ammonium compounds, formalin, detergent and urea. The extent of adulteration was highest for water (86.66%) followed by salt and acidity i.e. 23.33% and 6.66% respectively. This explains that these adulterants were used to increase the volume of milk or to increase solid-not-fat content in milk or is an indicator of improper storage of the milk. Sodium chloride is used as cheap preservative which increase the shelf life of fresh milk.[6] Water has been found as the most common adulterant in milk.[16] Adulteration of milk by addition of water may introduce chemical or microbial health hazards and reduce the nutritional and processing quality, palatability and marketing value of the milk.[17,18] Adulteration with acidity is done to correct the pH of milk. [19,20]

Conclusion

From the above study it is evident that the tested milk samples were adulterated with water, salt and acidity; water being the most common adulterant. As the population is increasing, therefore inadequate supply coupled with financial gain is considered to be the major reason for milk adulteration. Easy detection methods at the consumer level should be made accessible for periodically monitoring the quality of milk. Awareness and Access to information is pivotal to overcome this issue. Further work is needed to find out any association between various morbidities amongst the people and milk adulteration to draw attention of concerned authorities.

Conflicts of interest

There are no conflicts of interest.

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