Original Article

Estimation of quality of raw milk (open & branded) by milk adulteration testing kit.

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ABSTRACT

Background: Milk is a compulsory part of daily diet for the expectant mothers as well as growing children. Milk is very important due to its special nutritive value and important role for human and animal health. Adulteration is practised either to substitute cheaper ingredients or to impress the buyer to think the product is more valuable or of better quality.

Methods: The present study was conducted by the Department of Community Medicine at HIHT, Dehradun. All the samples of the raw milk (open and branded) supplied by the vendors in 5 Km radius of HIHT . The samples of milk were also collected from the Girls and Boys Hostel Mess and canteen. 500ml of each variety of open milk and 500 ml packet of branded milk were purchased from the milk vendors. The specific gravity of the milk was assessed by lactometer and chemically tested by Adulteration Test Kit supplied by NICE Chemicals Pvt. Ltd. (an ISO 9001 Certified Company).

Results: It was observed that out of 60 samples of milk, only 12 samples (20 %) had specific gravity of 26 and more which is considered as undiluted milk while 48 (80%) had specific gravity of less than 26 clearly indicating the dilution of milk with water. It was also observed that all the milk samples including double toned milk collected from different places showed presence of urea and detergents as common adulterants.

Conclusion: The findings of this study highlights the need to implement improved hygiene practices and to apply effective monitoring throughout the production to delivery chain. Training and education is also needed for all persons who deal with milk production, marketing and processing.

Key words: Adulteration, Detergents, Urea, Specific gravity

Introduction:

Milk is a compulsory part of daily diet for the expectant mothers as well as growing children[1].Milk is very important due to its special nutritive value and important role for human and animal health. It has all the substances needed by organisms in its easiest assimilable form. Due to its nutritive value, milk is recommended to young and old people,

Constituent	Buffalo Milk %	Cow Milk %
1. Water	84.2	86.6
2. Fat	6.6	4.6
3. Protein	3.9	3.4
4. Lactose	5.2	4.9

Milk is produced throughout the year. However, milk production is greatly reduced during summer months due to heat stress and scarcity of fodder and provides temptation for its adulteration to increase its bulk. Adulteration is practised either to substitute cheaper ingredients or to impress the buyer to think the product is more valuable or of better quality. Synthetic milk is prepared by mixing urea, caustic soda, refined oil (cheap cooking oil) and common detergents. Detergents are added to emulsify and dissolve the oil in water giving the frothy solution (foamy appearance), the characteristic white colour of milk.

Refined oil is used as a substitute for milk fat and to provide oily nature. Caustic soda is added to the blended milk to neutralize the acidity, thereby preventing it from turning sour during transport. Urea/ sugar are added for Solid-Not-Fat (SNF), to provide whiteness in milk and natural milk taste. Such artificial milk is harmful for all, but is more dangerous for pregnant women, fetus and persons who are already having heart and kidney problems.

The cost of preparing synthetic milk is less than Rs 3 per litre and it is sold to consumers

at a price ranging between Rs 10 and Rs 15 per litre after blending with natural milk[2].

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Chemical or synthetic milk looks like natural milk as far as physical appearance is concerned, but it is totally different in taste.

Keeping the above facts in view, a study was planned to find out the quality of raw milk among the milk samples being supplied in the HIHT Medical College Campus.

Objectives:

1. To find out whether the sample raw milk (open & branded) has been diluted with water.
2. To estimate the quality of raw milk (open & branded) by milk adulteration testing kit.

Material and Methods:

Study design: Cross-sectional

Methodology:

The present study was conducted by the Department of Community Medicine at HIHT, Dehradun. All the samples of the raw milk (open and branded) supplied by the vendors in 5 Km radius of HIHT (i.e. HIHT campus, Swasthya Pulia, Bhaniawala, Doiwala, and Ranipokhri) were taken up for quality check (the reason being that the milk vendors within 5 Km radius of HIHT are more likely to supply milk in the campus and HIHT residents are also more likely to purchase milk and milk products from these milk vendors). In the HIHT campus, the samples of milk were also collected from the Girls and Boys Hostel Mess, Local canteen and Daily Needs Shop.

For the study, 500ml of each variety of open milk and 500 ml packet of branded milk were purchased from the milk vendors (fixed vendor shops as well as mobile vendors on bicycle /motorcycle etc.) as a customer and collected under all aseptic precautions. These milk samples were coded by the investigators. The specific gravity of the milk was assessed by lactometer (based on Archimedes' Principle) which indicated the amount of water being added to the milk. These milk samples were further subjected to the tests for adulteration using the Milk Adulteration Test Kit supplied by NICE Chemicals Pvt. Ltd. (an ISO 9001 Certified Company) in which the milk samples were chemically tested for the detection of urea, neutralizers, detergents, hydrogen peroxide, sodium chloride and presence of acidity and heat stability. Pre designed laboratory forms were used to collect the laboratory results of the milk samples. All the tests were carried out at the Departmental laboratory of Community Medicine. Filling up the pre-designed proforma, collection of milk samples from the study areas, its coding and quality check were carried out by the investigators.

Results

Table I: Source of collection and type of milk

Source of collection	Cow	Buffalo	Mixed	Double toned
Bhaniawala	12	8	10	-
Local shop (HIHT) and Daily Needs	-	-	-	6
Ranipokhri	-	2	6	-
Doiwala	-	2	2	-
HIHT Campus	12	-	-	-
Total	24	12	18	6

Table I shows the type and source from where the milk samples were collected. Cow's milk was collected from 24 places while buffalo's and mixed milk (of cow's and buffalo's) was collected from 12 and 18 places respectively. Double toned milk was collected from 2 sites.

Table 2 Milk quality according to specific gravity

Type of Milk	Specific gravity < 26	Specific Gravity = 26
Cow's	18	06
Buffalo's	12	00
Mixed (Cow's and Buffalo's)	16	02
Double Toned Milk	02	04

It was observed that out of 60 samples of milk, only 12 samples (20 %) had specific gravity of 26 and more which is considered as undiluted milk while 48 (80%) had specific gravity of less than 26 clearly indicating the dilution of milk with water. The maximum diluted milk which had specific gravity of 12 was being sold by twenty milk vendors whereas the best milk which had specific gravity of 32 was being sold only by two vendors (Table 2).

Table 3: Quality of milk according to place, type and presence/absence of chemicals

Place	Type	No. of sample	Urea	Detergents	Neutralizer	H_2O_2	NaCl	Stabilizer
Bhaniyawala	Cow	12	Yes	Yes	Nil	Nil	Nil	Upto 0.14
	Buffalo	8	Yes	Yes	Nil	Nil	Nil	Upto 0.14
	Mixed	10	Yes	Yes	Nil	Nil	Nil	Upto 0.14
HIHT	Cow	12	Yes	Yes	Nil	Nil	Nil	Upto 0.14
	Double Tone	6	Yes	Yes	Nil	Nil	Nil	Upto 0.14
Ranipokhri	Buffalo	2	Yes	Yes	Nil	Nil	Nil	Upto 0.14
	Mixed	6	Yes	Yes	Nil	Nil	Nil	Upto 0.14
Doiwala	Buffalo	2	Yes	Yes	Nil	Nil	Nil	Upto 0.14
	Mixed	2	Yes	Yes	Nil	Nil	Nil	Upto 0.14

Table 3 shows the quality of milk according to presence / absence of chemicals present in them. All the milk samples including double toned milk collected from different places showed presence of urea and detergents as common adulterants. However, the other adulterants namely H_2O_2, Neutralizer, NaCl and stabilizer were not detected in any of the milk samples.

Discussion:

The National Survey on Milk Adulteration 2011[2], a first-of-its-kind snap shot survey on milk by the Food Safety and Standards Authority of India (FSSAI)[3], was conducted to ascertain the quality of milk and to check the contaminants in milk, especially liquid milk, throughout the country. 1791 Samples were collected from 28 states and five union territories. The worst performers were Bihar, Chhattisgarh, Odisha, West Bengal, Mizoram, Jharkhand and Daman & Diu. Results revealed that 1226 (68.4%) milk samples failed to match the set standards. 88% of milk samples each in Uttarakhand and Uttar Pradesh Failed to match the standards. The problems were more pronounced in the milk sold loose as compared to the packaged milk. Samples collected from rural areas fared better with only 30 per cent non-compliance as compared to urban centres.

This Nationwide Survey also revealed that water was the most common adulterant in milk. Nearly 70 per cent of milk samples did not conform to the set standards. Of the total non-compliant samples, the highest, nearly 46 per cent, belonged to the category of Solid Not Fat (SNF), and this was due to dilution of milk with water. The present study also revealed that 80% of the milk samples were adulterated with water (either intentionally or accidentally).Grace et al[4], while studying milk safety in North East India, also found that adulteration with water was present in milk from all dairies and there was considerable variation in adulteration with water (from 2% to 20%).

Water is the most common adulterant in milk which is often added to increase the quantity of milk by scrupulous milk dealers to earn easy money. Addition of water to milk reduces the nutritive value of milk, and if contaminated, it poses a health risk to consumers. Contaminated water can cause infective diarrhea in children which may hamper their growth and

development besides providing them fewer calories. Water used for diluting milk is usually obtained from an unsafe inexpensive source of water supply and can be contaminated with pesticides, heavy metals and other micro-organisms. If such samples of milk are consumed as milk, ice creams or other milk products it poses a serious risk to its consumers affecting their overall health.

The Specific Gravity of milk can also be lowered (indicating dilution) if it is aerated, e.g., by shaking during transport. According to Arimi et al (2005)[5] and Kivaria et al (2006)[6], 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. Ellis and Goodacre (2006)[7] reported that the practice of adulteration of milk by adding water is more common during the dry season when milk is scarce and market demand is high.

The same FSSAI Survey also revealed that most Indians are consuming detergents and other contaminants through milk and all of the 250 (20.4%) milk samples collected from the non-conforming Eastern States contained detergent. Surprisingly in the present study, all (100%) of the milk samples were adulterated with detergent. According to Dr R.S. Khanna, Managing Director, Rajasthan Cooperative Dairy Federation, in a survey of more than 200 villages in a Rajasthan district, adulterated milk with vegetable fat, detergents, urea, salt and other elements were found in about 41 villages. Nirma washing powder allegedly, was the preferred detergent adulterant. Detergents are added to emulsify and dissolve the oil in water giving the frothy solution, the characteristic white colour of milk.

The same Nation-wide research[2] observed that due to lack of hygiene and sanitation in milk handling and packaging, detergents (used for cleansing) are not removed (indicating poor cleaning of milk containers) and find their way into the milk. Many a time, detergents (cheap country made soap) are deliberately added to milk to increase the foamy touch, viscosity and thickness of milk so that it may resemble natural milk. The survey report notes that the consumption of milk with detergents is hazardous to health (FSSAI Survey). The Indian Council of Medical Research[8], in one of its reports, states detergents cause food poisoning and gastro-intestinal complications. The use of unclean milking and transport equipments also contribute to the poor hygienic quality of milk[9].

Urea is added to milk to provide whiteness, increase the consistency of milk and for levelling the contents of Solid-Not-Fat (SNF) as are present in the natural milk. Presence of urea in milk overburdens the kidneys as they have to do more work to throw out urea contents from the body. This may lead to renal failure in some cases. It also results in swollen limbs and impaired vision. Besides, urea is also harmful for the heart and liver. Strikingly, in the present study all (100%) of the milk samples were adulterated with urea. The most probable reason for presence of urea in all the samples of milk may be due to the fact that the fodder being consumed by the cattle would be containing fertiliser/ herbicide/pesticide residues which are being indiscriminately used nowadays for increasing the yield of crops and urea is one of the active ingredients of most of the fertilisers/herbicides/pesticides. Thus, urea gradually finds its way in the milk secretion of the animals consuming this fodder. An unpublished research study by an IIT Scholar had also found endosulphan (a pesticide) in the human breast milk.

Other adulterants viz H_2O_2, Neutralizer, NaCl and stabilizer were not present in any of the milk samples in the present study.

Conclusion and Recommendations:

All the milk samples, irrespective of the site, contained urea and detergents whereas 80 % of milk samples were diluted with water. It is therefore recommended that the residents of medical college campus should be made aware of the hazards of consuming such milk samples. A community based in depth study with highly specific milk testing kit should be carried in this area to further reveal any other contaminants present in milk sample.

As per Section 40 and 42 of the Food Safety and Standards Act, 2006 and Section 2.2.4 of the Food Safety and Standards Rules, 2011, purchasers can get food (milk also) analysed.

If one suspects adulteration in milk, one should shift source of supply immediately and lodge a complaint with the Food Safety Officer of their district or Food Safety Commissioner of their State/Union Territory. The milk sample can also be analysed at home by following:

1. Put one drop of milk on polished vertical surface. The drop of pure milk either stops or flows slowly leaving a white trail behind it, whereas milk adulterated with water will flow immediately without leaving any mark.

2. Take 5 ml of milk in a test tube and add 2 drops of bromocresol blue solution. Appearance of blue colour after 10 minutes indicates presence of urea.

The address of Food Safety Commissioner of all States and Union Territories and Public Health Laboratories are available on the website of the Food Safety Authority of India (FSSAI):www.fssai.gov.in.

Address of Food Safety Commissioner of all States and Union Territories and Public Health Laboratories can be obtained from following toll free numbers:

- 1800-11-4000 of National Consumer Helpline
- 1800-11-2100 of FSSA

The findings of this study highlight the need to implement improved hygiene practices and to apply effective monitoring throughout the production to delivery chain. Training and education is also needed for all persons who deal with milk production, marketing and processing.

Further research and extension is urgently needed to characterize critical quality points and hazards in order to ensure that good quality dairy products are produced and consumed.

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