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Detection of harmful adulterants in milk supplied to Delhi, India

Brototi Roy*, Jyoti Singh, Sonali Sunsunwal, Gunjan Dayal, Binduma Yadav, Chitra Bhardwaj and Ankita Teotia

Zoology Department, Maitreyi College, Chanakyapuri, Delhi 110 021, India

Milk adulteration is a serious problem in developing countries. It cheats the consumers and poses a serious threat to their health. The present qualitative analysis was undertaken to study the presence of adulterants in milk supplied to Delhi and adjoining regions (Faridabad, Gurgaon and Noida). A comparative analysis was carried out for the extent of different adulterants present in both packaged and locally available milk samples. Seventy five milk samples were tested for the presence of neutralizers, skimmed milk powder, urea, detergent and ammonium sulphate. Most milk samples collected from Delhi and adjoining regions tested positive for neutralizers and skimmed milk powder. In addition, some samples also tested positive for detergent, urea and ammonium sulphate. Considerable number of unpackaged milk samples showed presence of ammonium sulphate and detergents compared to packaged ones. Surprisingly, urea was present only in packaged samples.

Keywords: Adulteration, ammonium sulphate, detergent, neutralizer, skimmed milk powder, urea.

MILK is a rich source of nutrients required for proper growth and maintenance of body¹. These nutrients are in readily assimilable form and can be easily absorbed. Milk and milk products form a significant part of our diet and a substantial amount of our food expenditures goes on milk and other dairy products. India is the largest milk producer in the world with an output of 160 million tonnes (MT) recorded in 2015–16 (ref. 2). At the same time, it remains the largest milk consumer as well. The consumption of milk far outweighs its production in India. According to the National Dairy Development Board (NDDB), estimated demand for milk in India would be 200 MT by 2021–22 (ref. 2). To overcome the growing demand, adulteration of milk has become more and more prevalent in India. The opaque and fluid nature of milk makes it highly vulnerable to adulteration, further affecting the dairy products.

Milk adulteration is a significant problem in all developing countries and third world nations^{3–8}. There have been reports of adulteration from all parts of India^{9–15}. Recently, a report indicated that 25% of the milk samples tested in Maharashtra (India) did not comply with the

*For correspondence. (e-mail: brototiroy@gmail.com)

standards set by the Food Safety Standards Authority of India (FSSAI). The samples were found laced with sugar, oil and milk powder¹⁶. Also, in 2013, Gahlawat *et al.*¹⁷ found starch in milk supplied to different regions of Delhi.

People use different types of adulterants to get different kinds of benefits. The most common practice of adulteration is the addition of water to milk by suppliers to increase its volume so as to meet the ever increasing demand. Dilution with contaminated water not only reduces the nutritional value of milk but also causes serious health problems. Addition of water changes the specific gravity of milk which can be detected by lactometer¹⁸. Therefore, to compensate for specific gravity, different types of adulterants such as, salt, chemical substances and sugars are added. Sometimes natural milk is adulterated with low valued ingredients like water, whey, etc. and is known as 'economic adulteration'. The common adulterants found in milk are starch, chlorine, hydrated lime, sodium carbonate, formalin and ammonium sulphate. To meet the milk deficit, synthetic milk is prepared by mixing urea, caustic soda, refined oil and common detergents. Apart from ethical and economical issues, determination of milk adulteration is important for preventing health hazards like gastrointestinal disorders, renal and skin disease, eye and heart problem, and cancer^{13,19,20}. With new techniques available for detection of different kinds of milk adulterants, the milk suppliers have also become clever in employing complex methods of adulterations, thus, evolving several new adulterants. The present study was undertaken to qualitatively assess milk samples supplied in different regions of Delhi and its neighbouring states to determine the presence of some of the most hazardous adulterants. In addition, a comparison was also made between packaged and unpackaged milk samples.

Seventy-five milk samples (packaged and unpackaged) were randomly collected from different regions of Delhi, Noida, Gurgaon and Faridabad in 50 ml Tarsons tube under aseptic conditions. Care was taken to collect an approximately equal number of packaged and unpackaged samples from each region. These were coded and qualitatively tested for adulterants, such as neutralizers, skimmed milk powder (SMP), urea, detergents and ammonium sulphate, using milk adulteration kit of HIMEDIA Laboratories, Mumbai. Each test was carried out in duplicates and at room temperature (25°C).

Milk adulteration has been a persistent problem in India and other developing countries like Pakistan and Bangladesh^{3,6,10}. A study conducted by FSSAI in 33 states across India found that milk was adulterated with detergent, fat and even urea, besides the age-old practice of dilution with water. Shockingly, 68.4% of samples from across the country were found contaminated with various adulterants. Among the different states tested, Goa and Puducherry were the only states where milk

samples conformed to required standards. In contrast, West Bengal, Jharkhand, Bihar, Odisha and Mizoram were the worst where 100% of randomly collected milk samples were adulterated. Delhi also fared badly in this survey. Seventy per cent of milk samples collected from Delhi was adulterated²¹. Also, it was reported by FSSAI that 33.4% of packaged milk and 66.6% of unpackaged milk sold by milkmen were adulterated¹⁰. In our study, milk from different regions of Delhi and adjoining states were found to be adulterated with neutralizers, urea, SMP, detergents and ammonium sulphate. In addition, we also found that packaged and unpackaged milk was equally contaminated.

Neutralizers are usually added to prevent curdling thus, increasing the shelf life of milk. They could be added in the form of caustic soda, sodium bicarbonate, sodium carbonate, etc. All milk samples collected from different regions were adulterated with neutralizers (Figure 1). Highest percentage of neutralizers was found in samples collected from east Delhi, whereas only 10% of the samples collected from Gurgaon and Faridabad contained neutralizers. Neutralizers were slightly more in case of packaged samples compared to unpackaged ones (Figure 2). In many regions of Pakistan and India, milk was reported to contain caustic soda, sodium carbonate and sodium bicarbonate to neutralize its pH and acidity^{3,5,15,22}. Excessive amount of neutralizers like carbonates and bicarbonates disrupt hormonal signals and affect development and reproduction²³.

SMP was also present in all milk samples (Figure 3). Its addition to pure milk is an offence according to law. Cheap SMP is usually added to increase the SNF (solid not fat) value of diluted milk. Thus, 30% of samples from Gurgaon contained SMP whereas only 10% or less than 10% of samples from other regions contained SMP. As in the case of neutralizers, percentage of SMP was found higher in packaged samples than unpackaged ones.

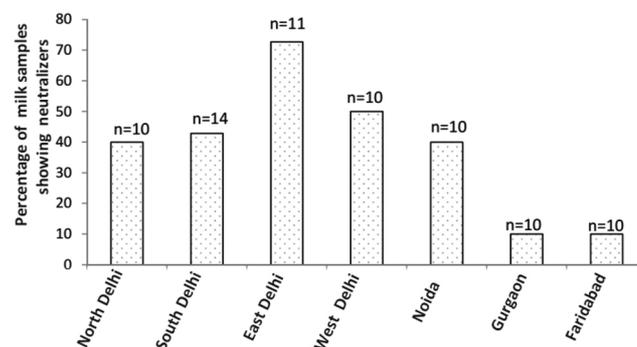


Figure 1. Percentage of milk samples from Delhi and NCR showing neutralizers. Seventy five samples obtained from different regions were tested for the adulterant. *n* denotes the number of samples from each region. The number of samples that tested positive was calculated as percentage of the total number of samples (*n*) analysed from that region.

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Recently, FSSAI conducted a national snapshot survey and reported that 44.69% of samples were adulterated with SMP²⁴. Also, 80% of samples in Hyderabad (India) were adulterated with SMP (ref. 15). Detergent was

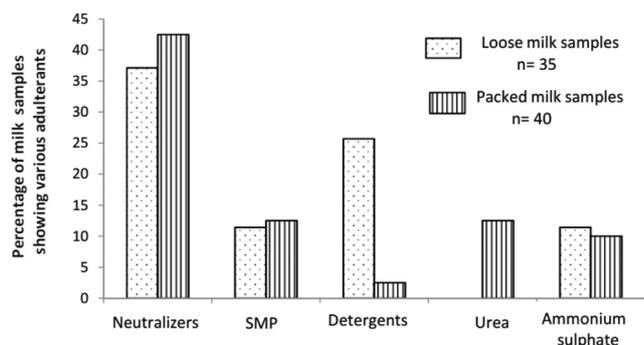


Figure 2. Percentage of unpackaged and branded milk samples from Delhi and NCR showing various adulterants. Seventy five samples obtained from different regions were tested for the adulterant. *n* denotes the number of samples from each region. The number of samples that tested positive was calculated as percentage of the total number of samples (*n*) analysed from that region.

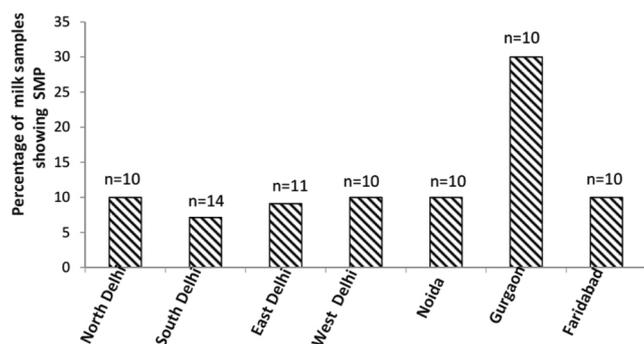


Figure 3. Percentage of milk samples from Delhi and NCR showing skimmed milk powder. Seventy five samples collected from different areas were tested for the adulterant. *n* denotes the number of samples from each region. The number of samples that tested positive was calculated as percentage of the total number of samples (*n*) analysed from that region.

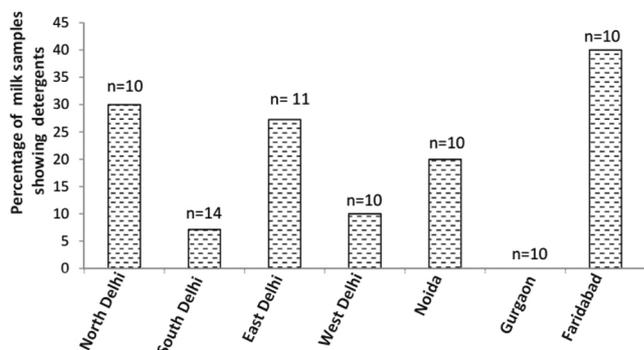


Figure 4. Percentage of milk samples from Delhi and NCR showing detergents. Seventy five samples collected from different areas were tested for the adulterant. *n* denotes the number of samples from each region. The number of samples that tested positive was calculated as percentage of the total number of samples (*n*) analysed from that region.

another major hazardous adulterant found in samples collected from all regions except Gurgaon. Faridabad had the maximum percentage (40%) of contamination by detergents (Figure 4). Interestingly, more unpackaged samples contained this adulterant compared to packaged milk. Detergents have also been previously reported in milk samples of other regions such as Dehradun¹³ and Hyderabad¹⁵. In a nationwide study conducted by FSSAI in 2012, almost 8.4% of the samples were found to be adulterated with detergents. Adulteration with detergents is usually an incidental contamination which is due to negligence. Improper washing and cleaning of utensils that are used for milk collection by milkman generally leads to appreciable amount of detergents in milk. However, at times it is intentionally used to emulsify and dissolve the oil in water giving a frothy solution and the characteristic white colour of milk. Detergents are also usually added to increase the SNF value of milk. Studies have reported that consumption of milk adulterated with detergents leads to food poisoning and gastrointestinal complications. In addition, some detergents contained dioxane, a carcinogenic agent²⁵. The concentration of urea in natural milk ranges from 0.2 to 0.7 g/l. Adulterated milk contains almost twenty times its natural concentration²⁶. Urea is added to increase the consistency and whiteness of milk. Its presence overburdens the kidneys and is very harmful and may even lead to renal failure¹³. It also leads to problems related to eyesight, headache and diarrhoea in children²⁰. Urea is also reported to cause increase in facial hair of women and children¹⁹. In a study carried out in Hyderabad¹⁵, 60% of the samples showed presence of urea. In a similar study in Dehradun¹³, shockingly 100% of the samples, unpackaged or packaged, were adulterated with urea. In the present study, only 10% of the samples from Gurgaon had detectable quantity of urea and it was absent in samples from Delhi, Faridabad and Noida (Figure 5). Surprisingly, urea was present only in the packaged samples obtained from Gurgaon (Figure 2). This can be seen in the light of a finding that Amul Dairy had detected urea in 18 milk samples that were supplied by Bhalej village milk co-operative. The milk co-operative collected milk from 1500 villagers and sent it to Amul Dairy for packaging and marketing²⁷.

Ammonium sulphate is also a fertilizer-like urea commonly available and used by unscrupulous vendors to increase the lactometer reading of milk diluted with water. Ammonium sulphate was present in a considerable number of milk samples collected from Delhi and adjoining regions. Thirty per cent of samples from Gurgaon and approximately 10% of the samples from North Delhi and Faridabad were adulterated with ammonium sulphate whereas East Delhi and Noida showed less than 10% and 20% of adulteration respectively (Figure 6). Relatively large number of unpackaged samples procured from vendors tested positive for ammonium sulphate compared

to packaged samples. Similar adulteration has been reported in Kolkata and its suburban areas of West Bengal²⁸, different areas of Gandhinagar in Gujarat²⁹ and in Anantapur, Andhra Pradesh³⁰. It is to be noted that ammonium sulphate in excessive quantities can lead to coronary disease, gastrointestinal irritation with nausea, vomiting and diarrhoea^{31,32}.

The present study once again brings to light the persistent problem of milk adulteration. Milk adulteration affects majority of people especially children, old aged and infirm people and pregnant women. There is an urgent need to deal with this issue to curb its menace. The Prevention of Food Adulteration Act, 1954 and Rules need to be strictly enforced. The surveillance mechanism of Food and Drug Administration needs to be toughened. However, effective results can only be obtained by generating awareness among consumers related to adulteration and the legal course they can take against the traders. In

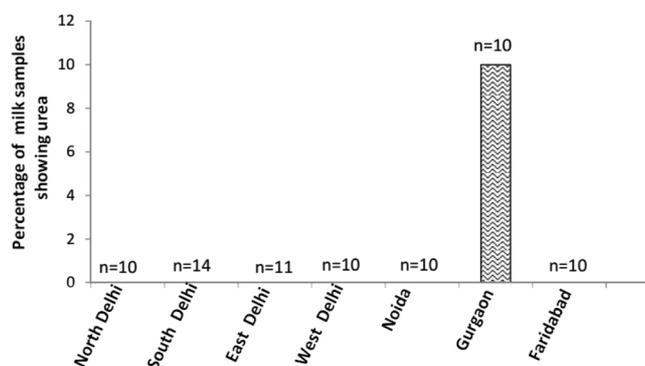


Figure 5. Percentage of milk samples from Delhi and NCR showing urea. Seventy five samples obtained from different regions were tested for the adulterant. *n* denotes the number of samples from each region. The number of samples that tested positive was calculated as percentage of the total number of samples (*n*) analysed from that region.

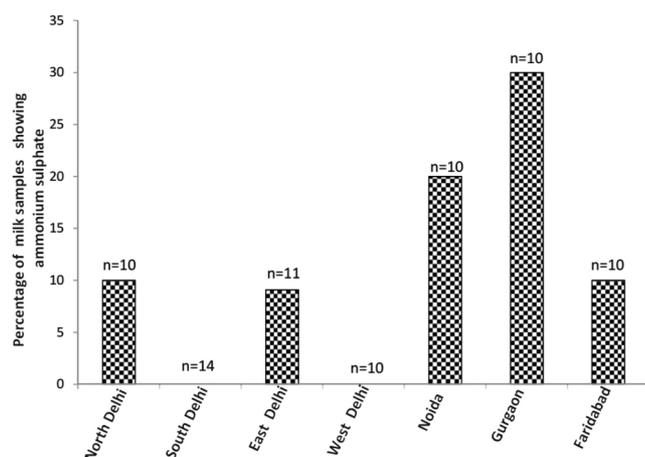


Figure 6. Percentage of milk samples from Delhi and NCR showing ammonium sulphate. Seventy five samples collected from different regions were tested for the adulterant. *n* denotes the number of samples from each region. The number of samples that tested positive was calculated as percentage of the total number of samples (*n*) analysed from that region.

addition, milkmen need to be educated regarding the standards of food safety and hygiene they should maintain. Nevertheless, the most important aspect of adulteration is the gap between supply and demand of milk that has to be somehow narrowed to effectively curb this.

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