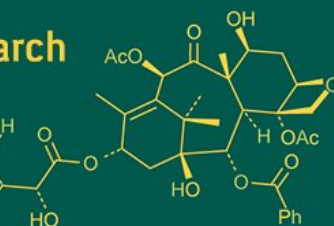
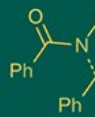


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Occurrence and detection of milk adulterations in Jabalpur: A qualitative study

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Abstract

Milk is a nutritionally important food, providing a rich source of high-quality proteins, lipids, carbohydrates, vitamins and essential minerals necessary for human growth and health maintenance. However, adulteration of milk with various chemical substances remains a significant public health concern. Therefore the present study was undertaken with the objective of detecting the presence of common adulterants in raw milk. A total of 416 milk samples were collected and subjected to qualitative analysis using standard laboratory procedures for the detection of adulterants, including starch, urea, detergent, formalin, hydrogen peroxide and sodium bicarbonate. The results revealed that none of the analyzed samples tested positive for any of the screened adulterants. These findings indicate the absence of the tested adulterants in all examined samples, suggesting that the milk complied with acceptable quality and safety standards. The study highlights the effectiveness of existing quality control and handling practices in the study area and emphasizes the need for continuous monitoring to ensure sustained milk safety and protection of public health.

Keywords: Milk adulteration, raw milk quality, adulterant detection, food safety, public health

Introduction

Milk is an essential component of the human diet and serves as a rich source of nutrients required for growth and maintenance of health. It provides high-quality proteins, fats, carbohydrates, vitamins, and essential minerals (Neumann *et al.*, 2002)^[9]. India is the largest producer of milk globally, contributing approximately 25% of total world milk production, with an estimated output of 250 million tonnes during 2024-25 (NDDB, 2025)^[10]. Among Indian states, Madhya Pradesh ranks third in milk production, with a per capita availability of approximately 490 g/day (NDDB, 2025)^[10].

Despite its nutritional importance, milk is highly susceptible to contamination and adulteration. Various harmful substances, including chemical adulterants, pesticides, insecticides, antibiotic residues, hormones and microorganisms may enter milk through direct or indirect routes, posing significant risks to consumer health (FSSAI, 2011, Banerjee, 2024)^[2, 1]. Adulteration not only reduces the nutritional quality of milk but also compromises its safety and wholesomeness.

According to national surveys on milk adulteration conducted by the Food Safety and Standards Authority of India in 2011, 2012, 2019, and 2022, milk is commonly adulterated with substances such as water, starch, detergents, urea, hydrogen peroxide, formalin, sodium bicarbonate and boric acid. Among these, water has been identified as one of the most prevalent adulterants. The surveys further reported that approximately 31% and 68.9% of milk samples from rural and urban areas, respectively, were found to be adulterated. Additionally, the presence of antibiotic and pesticide residues in milk has been documented. These findings highlight the need for identification of adulteration hotspots to strengthen surveillance and enforcement measures (FSSAI, 2019)^[3].

In view of the potential health hazards posed by milk adulteration, the Food Safety and Standards Authority of India (FSSAI) enforces a zero-tolerance approach towards any form of contamination.

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Accordingly, regular monitoring and systematic assessment of milk quality are crucial to protect consumer health. Hence, the present study aimed to evaluate the presence of common chemical adulterants in raw milk samples using standard laboratory methods.

Materials and Methods

The present study was conducted in the Department of Veterinary Public Health and Epidemiology, College of Veterinary Science and Animal Husbandry, Nanaji Veterinary Science University, Jabalpur, Madhya Pradesh. The investigation was carried out from September 2023 to January 2026 covering different areas of Jabalpur city. A total of 416 raw milk samples were collected randomly from various locations within Jabalpur city using sterile containers (Table-1). Each sample (100-200 ml) was transported under refrigerated conditions (below 5 °C) and processed as soon as possible to maintain sample integrity.

Table 1: Distribution of samples of raw milk collected from different region of Jabalpur city

S. No.	Name of region	Name of areas	Number of samples	Total
1.	Civil Line	Sadar	21	51
		High court	23	
		Rasal chowk	7	
2.	Ranjhi	Kanchghar	21	54
		Gokulpur	15	
		Ranjhi	18	
3.	Bilhari	Bilhari	14	50
		Tilhari	15	
		Gour	21	
4.	Gwarighat	Gorakhpur	18	57
		Rampur	14	
		Gwarighat	25	
5.	Bada fuhara	Vijay Nagar	15	53
		Ranital	7	
		Damoh Naka	11	
		Bada Fuhara	20	
6.	Garha	Garha	29	60
		Dhanwantri Nagar	15	
		Madan Mahal	16	
7.	Adhartal	Suhagi	22	67
		Ghamapur	17	
		Raddi chowk	28	
8.	Medical college	Around Jabalpur	24	24
			Total	416

The collected samples were subjected to qualitative analysis for the detection of common adulterants namely starch, urea, detergent, formalin, hydrogen peroxide and sodium bicarbonate, following standard protocols prescribed by FSSAI (2011) [2]. For starch detection, 5 ml of milk was boiled, cooled to room temperature and a few drops of iodine solution were added. The appearance of a blue color indicated the presence of starch. For urea detection, 5 ml of milk was mixed with a small amount of soybean or arhar powder, followed by the addition of 0.1ml bromothymol blue a color change from red to blue indicated the presence of urea.

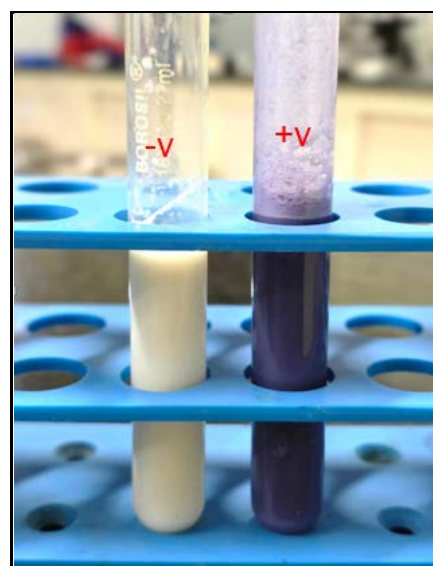
To detect detergent, 5 ml of milk was treated with 0.1ml of 0.5% bromocresol purple solution and the development of a violet color indicated a positive result. For formalin detection, 5 ml of milk was carefully layered with 5ml concentrated sulphuric acid containing a trace amount of

0.5ml of 1% ferric chloride without shaking the formation of a purple ring at the junction indicated the presence of formalin. For hydrogen peroxide detection, 10 ml of milk was treated with a few drops of 2% para-phenylenediamine hydrochloride solution and the appearance of a blue color indicated a positive result.

For the detection of sodium bicarbonate, 5 ml of milk was mixed with 10ml of alcohol and rosolic acid solution and the development of a pink color indicated the presence of sodium bicarbonate. These procedures were used to qualitatively assess the presence or absence of adulterants in the collected raw milk samples.



Milk adulterants in raw milk



Starch milk adulteration test

Results and Discussion

Milk is a nutrient-rich food essential for human growth and maintenance of health. Owing to its high nutritional value, cost and demand milk is often subjected to adulteration through the addition of various physical and chemical substances to increase volume, enhance shelf life or mask poor quality. Such adulteration not only reduces the nutritional value of milk but may also render it unsafe for consumption (Khomane *et al.*, 2024) [7] thereby posing significant risks to human health. Common adulterants reported in milk include water (the most prevalent), sodium carbonate, sodium bicarbonate, caustic soda, formalin, urea, detergents, ammonium sulphate, boric acid, benzoic acid, salicylic acid, hydrogen peroxide, starch, sugar, melamine, skimmed milk powder, reconstituted milk, rice flour, vegetable oil, animal fat and whey powder.

In the present study, none of the analyzed milk samples tested positive for the screened adulterants, namely starch, urea, detergent, formalin, hydrogen peroxide, and sodium bicarbonate. These findings indicate that the milk samples collected from the study area were free from the tested adulterants suggesting that the milk quality was maintained from production to consumption.

The absence of adulterants in the present study may be attributed to adequate milk production in the Jabalpur region throughout the year. The area is characterized by a substantial population of milch animals particularly buffaloes and the presence of large dairy farms which contribute to consistent and sufficient milk supply. This reduces the likelihood of adulteration practices aimed at increasing volume or shelf life.

The findings of the present study are in agreement with reports of the Food Safety and Standards Authority of India (FSSAI), which documented a relatively low prevalence of milk adulteration in recent surveys (FSSAI, 2019; FSSAI, 2022)^[3,4]. Similar observations have been reported in recent studies highlighting improved monitoring and regulatory enforcement in the dairy sector (Banerjee, 2024)^[1]. However, earlier reports and some regional studies have documented significantly higher levels of milk adulteration, with water being the most common adulterant (Garg *et al.*, 2024; Ibrahim *et al.*, 2023; Kumar *et al.*, 2015)^[5,6,8].

Overall, the results of the present study highlight improved milk quality and effective regulatory and management practices in the study area. Nevertheless, continuous monitoring and strict enforcement of food safety standards remain essential to sustain milk quality and safeguard public health.

Conclusion

The present study revealed that all raw milk samples were free from the tested adulterants, indicating good quality and safety. This suggests minimal adulteration in the study area from production to consumption. The findings may be attributed to adequate milk production and effective dairy management practices in the region. The results are consistent with recent reports indicating reduced milk adulteration. However, considering potential health risks, continuous monitoring of milk quality remains essential. Strict implementation of food safety regulations is necessary to ensure sustained consumer protection.

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