

**Research Article****DETECTION OF VARIOUS CHEMICALS IN LOCALLY AVAILABLE OPEN MILK SAMPLES IN DEAR ISMAIL KHAN, PAKISTAN****Ayisha Aslam¹| Rubina Naz¹| Shakeeb Ullah²| Adamu Abdul Abubakar³| Muhammad Shuaib Khan²| Sadaf Javaria⁵| Saifur Rehman^{2*}| Atabo Shaibu Mohammed⁴| Aisha Siddiqua²| Muhammad Inamullah Malik²| Ahmed Saeed²**

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ABSTRACT:

Background: Milk is very nutrient-dense. However, milk is readily contaminated during production, processing, and storage, endangering the health of users. The identification of dangerous chemicals in milk is crucial. The present study aimed to highlight the problem of milk pollution by observing milk samples at district Dera Ismail Khan.

Materials and Methods: To achieve the objective, a total of 60 milk samples were gathered by stratifying the district into two distinct geographical distributions: within the city and beyond the city boundaries, based on population density. Different analytical techniques were used for the quick detection of dangerous chemicals or the targeted verification of milk validity.

Results: According to quantitative data, the average levels of fat, lactose, added water, temperature, freezing point, pH, and conductivity of the milk are statistically the same ($p > 0.05$). However, the average content of SNF, density, salts, and protein are statistically different ($p < 0.05$). The qualitative findings revealed the presence of sodium chloride and sorbitol in minimal quantities, while a majority of the samples exhibited adulteration with formalin.

Conclusion: The study's findings led to the conclusion that milk sold both within and outside of the region of D.I. Khan had been adulterated with sodium chloride, sorbitol, and formalin to produce distinctive hues. Control and elimination of this problem may require the application of efficient preventative measures and mitigating strategies.

KEYWORDS:

Milk; qualitative and quantitative analysis; Formalin; Dera Ismail Khan; Pakistan

1| INTRODUCTION

Milk is a highly nutritious dietary source due to its abundant content of protein, vital fatty acids, minerals, and vitamins. Milk is essential for the development and health of people of all ages. It serves as an inexpensive and readily accessible means to obtain excellent protein. Milk and milk products have had a history of contamination and adulteration¹. Therefore, it is necessary to find a solution to the problem of tainted milk and milk products, which can be achieved through the creation of novel techniques and methodologies for determining the presence or absence of specific adulterants in milk and milk products that are harmful chemicals and cause very dangerous

disease in humans. Adulterated food produces health problems i.e. eyes problem, heart diseases and renal issues. Due to its necessary constituents like Lactose, Milk Fat, Proteins, Minerals and Vitamins, milk is considered highly predictable. Ancient documentation signifies that if countries utilize to procure maximum calories from food and food stuffs to be extra educated and competent of possessing sound organization. To fulfill the nutritional needs of neonates all mammalian females produced milk. Milk is the basic source in human feed in all over the world; milk is the basic source of iron and nourishment including magnesium, protein carbohydrate, fatty acids, phosphorus, and calcium. It is also a complete diet itself².

Milk possesses the highest nutritive importance in its innate form because it is a good supplier of fats, milk proteins (provides amino acids required for the appropriate development of infants and adults), minerals, vitamins and carbohydrates. It is simply absorbed and digestible food and hence it is particularly essential for nursing women, infants, elderly people and children³. The features of contaminants/adulterants usually present in food and foodstuffs are removal of fat, reconstituted milk, water, thickening agents and addition of skim milk powder just like flour, urea, starch, glucose, chlorine, urea and salt. Neutralizers like sodium carbonate, calcium hydroxide, sodium hydroxide and sodium bicarbonate. Other types of adulterants are vegetable oil, aglatoxin and animal fats⁴.

Adulterants causes' very harmful effect on human beings such as diseases of the skin, intestine, kidney, head and stomach, by using such type of milk and milk product which consist of adulterants for long time death may be happen⁵. For example, according to Dr. M. P Sharma, Head of Internal Medicine at Rockland Hospital, if urea is added in milk, it could be causes gastritis, nausea and vomiting. Formalin also produces very dangerous disease in children particularly for pregnant women which has very harmful effect on fetus. These adulterants or contaminants create kidney or heart issues especially caustic soda act as a slow poison those people who are affliction from heart ailments and hypertension as well as urea is normally damaging kidneys. To determine if milk is adulterated or not, qualitative tests are performed on it. The goal of this research was to determine the quantity and quality of milk components in the context of adulterants to indicate the presence or absence of certain substances, such as chemicals. So, the appropriate steps can be taken by the governing body on an ongoing basis to preserve the quality of the milk and make it safe for use.

2 | MATERIAL AND METHODS

2.1 | STUDY AREA AND SAMPLING

The present investigation was carried out in the district of Dera Ismail Khan to ascertain the presence of several chemical substances in unpasteurized milk. Target population was the milk shops, tea cafes and hotels. A random sample was observed containing inside and outside geographical area already classified and a standard part staged as normal status. A total of 60 samples (30 from inside and 30 from outside the city) were collected aseptically in 5 ml screw-capped, clean, sterilized bottles in the morning from randomly selected local milk vendors. Three samples each from buffalo, sheep, and camels were also collected as controls. The samples were shifted and preserved using standard protocols at FVAS Gomal University and Civil Veterinary Hospital D.I. Khan.

2.2 | ANALYSIS OF SAMPLES

The samples were subject to various physico-chemical analyses for various adulterants. The adulteration tests (urea test, hydrogen peroxide test, sorbitol test, sodium chloride test, and formalin test) were done using the Chemical Adulteration Kit designated by FVAS Gomal University. Milk quality tests (Fat, SNF, Density, Lactose, Salts, Protein, Added Water, Temperature Sample, Freezing point, Phand Conductivity) were done using a milk analyzer at the Testing Laboratory of the Civil Veterinary Hospital, D.I. Khan.

2.3 | STATISTICAL ANALYSIS

Qualitative statistic aspect of study. A descriptive qualitative and quantitative or mixed study analysis was performed on a well-defined sampling plan. Data matrix was formulated in SPSS v.20, IBM released. The tabulated value or results of replication were performed thrice.

3 | RESULTS

A comprehensive analysis was conducted on a sample size of 60 milk samples to identify and detect a range of chemical adulterants. The designated regions encompass the inside and outside of the city, specifically those designated for the supply of milk.

Table 1 Summary of milk samples used for the detection of adulterants.

Adulterants	Inside the city		Outside the city		Standard	
	Present	Absent	Present	Absent	Present	Absent
Urea	0	30	0	30	0	03
Hydrogen Peroxide	0	30	0	30	0	03
Sorbitol	06	24	15	15	0	03
Sodium Chloride	0	30	1	29	0	03
Formalin	07	23	16	14	0	03

According to the data presented in Table 1, the milk samples were found to include formalin (38%), sorbitol (35%), and sodium chloride (1.67%), while urea and hydrogen peroxide (H₂O₂) were absent in all of the samples.

Table 2 Statistical analysis of Fat, SNF, density, lactose, salts, proteins, added water, temperature, freezing point, pH and conductivity of Milk.

Milk Content	City status	N	Mean	Std. Deviation	Std. Error Mean	p-value
Fat	Inside city	30	3.9857	1.58979	.29025	0.198
	Outside city	30	4.4580	1.13566	.20734	
SNF	Inside the city	30	6.7303	1.49740	.27339	0.004
	Outside the city	30	6.0387	1.20176	.21941	
Density	Inside the city	30	25.3137	6.31931	1.15374	0.004
	Outside the city	30	21.1397	4.32456	.78955	
Lactose	Inside the city	30	3.1127	.81621	.14902	0.06
	Outside the city	30	2.7593	.62298	.11374	
Salt	Inside the city	30	.5043	.17059	.03115	0.02
	Outside the city	30	.4207	.08698	.01588	
Protein	Inside the city	30	3.0823	.80448	.14688	0.007
	Outside the city	30	2.5893	.54679	.09983	
Added water	Inside the city	30	26.5083	19.70339	3.59733	0.485
	Outside the city	30	29.8093	16.57110	3.02546	
Temperature Sample	Inside the city	30	26.5900	5.55228	1.01370	0.26
	Outside the city	30	28.0000	3.98212	.72703	
Freezing Point	Inside the city	30	-.4188	.14058	.02567	0.5
	Outside the city	30	-.3951	.16374	.02989	
pH	Inside the city	30	6.4050	.46755	.08536	0.42
	Outside the city	30	6.2623	.85241	.15563	
Conductivity	Inside the city	30	4.5770	1.70934	.31208	0.315
	Outside the city	30	4.1723	1.36095	.24847	

Table 2 presents the findings of the study, indicating a significant difference in the SNF, density, salt, lactose, and protein content of milk obtained from locations within and outside the city. This conclusion is supported by a p-value below the threshold of 0.05. There was no discernible distinction observed in the remaining content of the milk, as shown by the p-value exceeding 0.05.

4 | DISCUSSIONS

Milk possesses a high concentration of essential elements, rendering it a comprehensive source of nourishment on a worldwide scale. This attribute is attributed to its nutritionally dense composition. Consequently, milk and its derivative products are susceptible to adulteration⁶. Using milk adulterants in food processing is widely regarded as an unreliable practice. These adulterants are found to have many detrimental impacts on human health, including the potential to induce severe diseases and diminish the nutritious content of milk⁷. The presence of adulterants in milk was identified through the observation of color variations resulting from chemical interactions with various reagents. These reactions exhibit validity solely within a limited range of concentrations and lack precision⁸. There are a total of 11 substances that have been identified as potential adulterants for milk and other liquid meals. Like Hydrogen peroxide, sucrose, carbonate, bicarbonate and formaldehyde etc⁹.

In the present investigation, a qualitative analytical method was employed to identify the presence of adulterants in milk. According to Aparnathi et al.¹⁰ it has been observed that processing methods, such as sterilization, have a substantial impact on the results of qualitative tests. Different analytical procedures have been devised to detect the presence of adulterants in milk, while certain traders continue to employ novel techniques to adulterate milk with less expensive substances¹¹. In the present investigation, the presence of sorbitol and sodium chloride as adulterants in milk was observed. It is worth noting that these substances are considered edible. However, the presence of formalin in milk poses a significant risk to human health due to its potential to cause cancer. Recent studies have shown that milk is intentionally adulterated with a variety of substances, including urea, sorbitol, water, sucrose, salt, and detergent, all of which are adulterants¹¹. According to Azad and Ahmed, certain edible components are included as adulterants to improve the flavor of milk⁸.

In the present study, formaldehyde was detected in most of the samples. According to Aparnathi et al.¹⁰ and Kamthania et al.¹², the consumption of a minimal quantity of formaldehyde is improbable to result in any immediate impact. The consumption of a substantial quantity of a substance can result in acute toxicity, leading to many adverse effects such as intense abdominal pain, vomiting, unconsciousness, kidney injury, and potentially fatal outcomes. The primary health issue associated with formaldehyde pertains to its carcinogenic properties. Various chemicals, such as formaldehyde, sodium hypochlorite, NaOH, and H₂O₂, are employed in order to prolong the longevity of milk¹³. The visual characteristics of milk can be enhanced through the incorporation of other substances, such as colorants, detergents, and soaps, which were likewise detected in certain samples.

5 | CONCLUSIONS

Adulterants are intentionally incorporated into items to regulate the equilibrium between supply and demand, hence ensuring their availability for use. Milk, a consumable product, is frequently subject to adulteration through the addition of diverse substances including salts and chemicals such as formalin, sorbitol, sodium chloride, and water. The presence of adulterants in milk has reduced its quality, rendering it potentially harmful for human use. Based on qualitative research, it can be inferred that milk obtained from both urban and rural areas is found to be adulterated. Consequently, it is imperative to enforce regulatory measures in accordance with the legislation.

CONFLICT OF INTEREST

All authors declare no conflict of interest.

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