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Assessment of Physico-Chemical and Microbiological Quality of Marketed Milk and Its Consumption Trends in Urban Lucknow

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Abstract

The study investigated the physico-chemical and microbiological status of milk being sold in the market, coupled with the milk consumption pattern in urban Lucknow. One hundred milk samples consisting of packaged pasteurised and loose/raw milk samples were collected across various sources of retail. Acid-base parameters like PH, fat, solids-not-fat (SNF), and no specific gravity parameters were analyzed, and microbiological quality was checked by Total Plate Count (TPC), coliform count, yeast and mold count, and Escherichia coli. Adulteration tests were also conducted in order to establish the presence of water, starch, urea, detergents, and neutralizers. The findings were that indeed most of the samples lay within the acceptable limits but a significant percentage was found to vary in SNF, specific gravity and the microbial load implying a dilution, poor handling and storage problem. Some of the samples were identified to be adulterated, thus creating a risk to the health of the consumers. A further analysis of the secondary data showed that urban consumers favoured the packaged pasteurized milk the most, but still a large portion of the market was occupied by the loose/raw milk. Findings identify the sheer necessity of severe quality-related checks and corresponding governmental regulations, as well as consumer education, to make the consumption of milk safe and nutritious in the city.

Keywords: Milk quality, physico-chemical analysis, microbiological safety, adulteration, consumption trends.

1. INTRODUCTION

Milk forms a very important component of Indian diet and milk is not only considered as a major drink, but it is also a very important source of vital nutrients like calcium, protein, vitamin D and B-complex vitamins. It is critical in the development of growth, strengthening bones and teeth, immune system, and overall physiological development of an individual and most especially children and adolescents and the elderly. Milk is an all-pervasive beneficial health food because of which people take milk uniformly and in different forms in the form of raw milk, boiled milk, pasteurized milk, and dairy products such as curd, paneer, butter, and ghee.

There has been a visible increase in the consumption of milk in the urban centers like Lucknow the capital of Uttar Pradesh especially during the last few decades. This rise can be ascribed to the reasons such as urbanization which is increasing with amazing speed, the lifestyle changes, escalated disposable income, and health and nutrition awareness. The packaged milk/milk sold by the local vendors is preferred by households in the urban areas to satisfy their milk needs on daily basis. But with the increased demand, the question of quality and safety of milk marketed has also been raised.

Several studies and media reports have identified the existence of milk adulteration and microbial contamination in different regions of India including the urban markets. The most common among adulterants are water, starch, detergents, urea, and synthetic milk products, with either degenerated intestines or long term toxicity being some of the most severe effects they have on human lives. Also microbial contamination might occur due an inappropriate treatment, poor storage of milk and hygiene factors during their transportation and distribution, thus causing it not to be consumable any more.

That being said, it will be of utmost importance to carry out a critical assessment of both physico-chemical characteristics like pH, fat content, solids-not-fat (SNF), specific gravity and microbiological attributes, like total bacterial count, the presence of coliform and potential pathogens. These determinations give a scientific premise of knowing the quality of milk that is consumed and help in indicating compromised supply chain.

The analysis of the milk consumption trends of the city dwellers can give information about

consumer preferences, knowledge of the quality, reliance on consumption of loose milk and the ideas of milk safety. Such trends are essential in creating populations health policies, consumer literacy programs, and implementation of food safety laws.

1.1. Significance of Monitoring Milk Quality in Urban Settings

As the urbanization process is fast growing at a higher rate where new needs of urban milk consumers are increasing, the suppliers and vendors find themselves prone at every moment towards the aim of satisfying the numbers. In their bid to maintain constant supply and make maximized profits, some of them may compromise on the quality of milk sold. This has contributed to the growing rate of adulteration--a practice that entails the addition of substances such as water, starch, detergents, glucose, urea and even the artificial milk to fill the volume or change the color and thickness of milk. These adulterants, which are cheap and readily available, have the potential to destroy the nutritional content of milk to a great extent and cause high health risks. Consumption of a long term of adulterated milk may cause chronic health problems, like gastrointestinal infections, kidney diseases, metabolic disturbances, and so forth.

Besides the problem of chemical adulteration, the problem of microbial contamination is also a burning question as there is a tendency to transport the milk over long distances to reach the consumer especially in urban markets. Other factors that have contributed to this risk factor include poor refrigeration foods, improper storage, failure to pasteurize food, dirty containers, unhygienic food handling when transporting foods or selling to customers. Foodborne illnesses may arise due to the existence of infectious bacteria such as Escherichia coli, Salmonella, and coliforms, which can cause infection to a person who is prone to becoming susceptible to infections, such as immunocompromised, young children, and the elderly.

Because of these issues, proper and periodic physico-chemical and microbiological testing of milk is also not only a matter of regulation but one of national health as well. Regular testing and monitoring assists in early detection of tampering or contamination so as to take immediate corrective action and failing which the poor quality milk may not reach the markets. It is also accredited with enhancing the confidence of the citizens in the chain of supply of diary foods and also promote public regulatory action of food safety laws by the appropriate parties concerned.

2. REVIEW OF LITERATURE

Gupta et al. (2020) completed the investigation on physico-chemical and microbial quality of raw milk bought in Assi part of Varanasi City. The authors documented that despite the fact that some of the samples had complied with the required benchmark, a substantial amount had pH, fat and solids-not-fat (SNF) inconsistencies, meaning they were adulterated and whose handling operations were poor. The microbiological tests showed high total counts of bacteria as well as the presence of coliforms in some of the samples hence reinforcing the dangers of consuming raw milk that has not been pasteurized.

Kapoor et al. (2021) discussed the impact of milk adulteration concerning the health of humans in India. Their results showed that there were a lot of adulterants like urea, detergents, starch, and neutralizers that are found in the milk that has been marketed and these are very hazardous to the health of a person causing gastro-intestinal tract complications as well as long term problems to the kidneys. The research demonstrated that the unawareness of consumers and the insufficient implementation of regulation were the major side to the continuous milk adulteration in India.

Mishra and Singh (2022) used Gyan Milk Products in the Lucknow market to examine their quality and acceptance among the consumers. The analysis demonstrated that the regional dairy brand of Gyan had a high consumer preference because of quality assurance and compliance with the hygienic processing standards. There was also an indication in the findings that the urban consumers in Lucknow were going to trust more in the branded packaged milk products and this implied a slow transition to lose milk sold by the local vendors.

Palsra (2018) examined the issue of milk adulteration and its significance to people in terms

of health in Himachal Pradesh. The research revealed that the issue of adulteration was common and products like starch, detergents, and synthetic milk were among the chemicals to increase the amounts and improve the looks. The author observed that these practices had severe effects to the health of the community especially the weak sections of the society like the children and the old people. The research emphasized the necessity of stringent regulatory monitoring and consumer education to reduce the health impacts of adulterated milk.

3. RESEARCH METHODOLOGY

The methodology outlines the systematic approach adopted for assessing the physico-chemical and microbiological quality of marketed milk and understanding its consumption trends in urban Lucknow. The study combines laboratory-based experimental analysis with descriptive statistical techniques to provide a comprehensive evaluation of milk quality and consumer preferences.

3.1. Research Design

The research paper adheres to an experimental- descriptive type of research design. The experimental techniques were applied in order to determine the quality of milk samples in laboratory conditions whereas the descriptive techniques were utilized to organize and interpret the results in terms of frequencies and percentages of distribution.

3.2. Sample Size and Sampling Technique

The sample size of the study was a sample of 50 milk samples. Various sources of sampling included packaged pasteurized milk, loose / raw milk to have proper representation of the varieties of milk in the market. Purposive random sampling strategy was operationalized so as to identify the variation in the quality of milk in the urban market in Lucknow.

3.3. Data Collection

Data regarding milk consumption patterns were collected from government publications, industry reports, and existing literature.

3.4. Analysis Techniques

Descriptive statistical tools were used in the analysis of results. Proportions and Percentages have been calculated to reflect the changes in physico-chemical figures, microbial loads, adulteration identification, and the consumption patterns. The results were tabulated in frequency-percentage because the results are easy to interpret and understand.

4. DATA ANALYSIS

The present study analyzes the physico-chemical characteristics, microbiological quality, and consumption patterns of marketed milk in urban Lucknow. Laboratory-based observations were recorded to assess key parameters such as pH, fat content, and microbial load, while secondary data provided insights into consumption trends. The results are presented in the form of frequency and percentage tables for better clarity and comparison.

Table 1: pH Range of Marketed Milk Samples

pH Range	Frequency	Percentage (%)
6.4 – 6.5	10	20%
6.6 – 6.7	28	56%
6.8 – 6.9	8	16%
< 6.4	4	8%
Total	50	100%

Table 1 demonstrates a pH value distribution of milk products sold in the commercial area of Lucknow. Most of the samples (56%) ranged between 6.6 and 6.7 which is within the acceptability range of the fresh milk implying that the quality of samples was good. The samples that had a pH of 6.4 6.5 recorded around 20 percent which is a bit lower than the standard thus implying that acidity is about to set in due to microbial activity or lack of proper storage. The fewer samples (16%) were at a pH that was 6.8-6.9 which despite being near to normal could be viewed as less fresh. Interestingly, 8 per cent of the samples recorded low values less than 6.4 which indicated a significant generation of acid and low quality of acid.

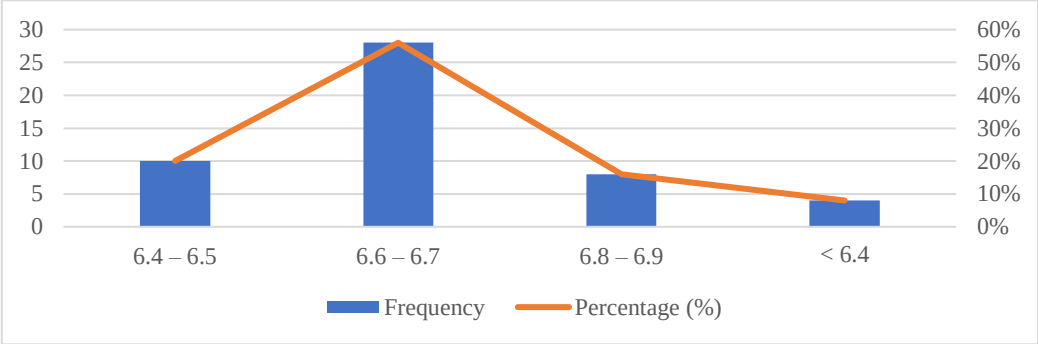

Figure 1: Graphical presentation of pH Range of Marketed Milk Samples

Figure 1 illustrates Most milk samples (56%) had a pH of 6.6–6.7, within the normal range, indicating good quality. However, 20% showed slightly lower pH (6.4–6.5) and 8% were below 6.4, suggesting acidity and possible spoilage. About 16% had a higher pH (6.8–6.9), indicating reduced freshness.

Table 2: Fat Content of Marketed Milk Samples

Fat Content (%)	Frequency	Percentage (%)
< 3.0	8	16%
3.0 – 3.5	22	44%
3.6 – 4.0	14	28%
> 4.0	6	12%
Total	50	100%

Table 2 demonstrates that almost half of the samples (44%) contained fat that was in between 3.0-3.5%, which is a normal range when applied to toned milk. The range here was 3.6-4.0 % fat or about 28 % of the latter were 12 % with over 4.0 % fat, in other words, richer milk. But, 16 percent of samples were found to contain less than 3.0% Fat posing a likelihood of being diluted or of low quality. In general, samples were acceptable according to the fat content standard but some sample indicated the compromised quality.

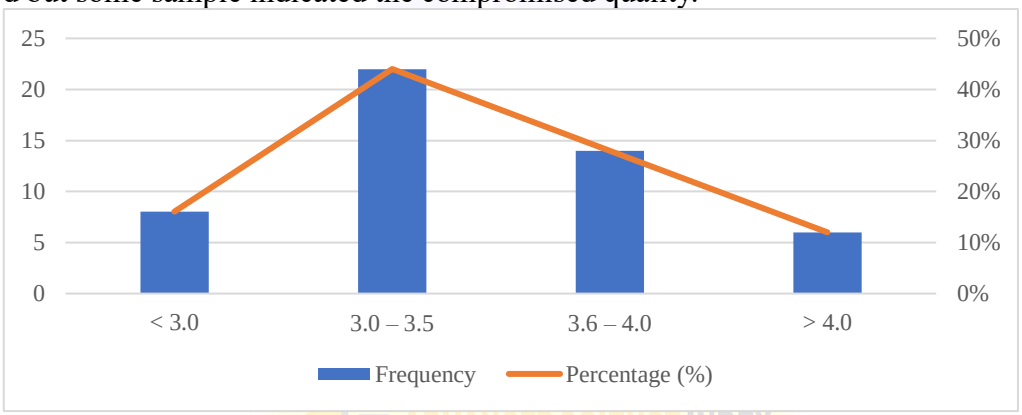

Figure 2: Graphical presentation of Fat Content of Marketed Milk Samples

Figure 2 shows most samples (44%) had fat between 3.0–3.5%, while 28% and 12% showed higher fat content, indicating good quality. About 16% were below 3.0%, suggesting dilution or inferior quality.

Table 3: Microbial Quality (Total Plate Count)

TPC Range (cfu/ml)	Frequency	Percentage (%)
< 20,000	12	24%
20,001 – 50,000	16	32%
50,001 – 1,00,000	14	28%
> 1,00,000	8	16%
Total	50	100%

Table 3 illustrates Nearly one-third of samples (32%) had TPC within the acceptable range (20,001–50,000 cfu/ml), while 24% showed very low counts, indicating freshness. However,

28% exceeded 50,000 and 16% crossed 1,00,000 cfu/ml, reflecting microbial contamination and poor hygiene in handling.

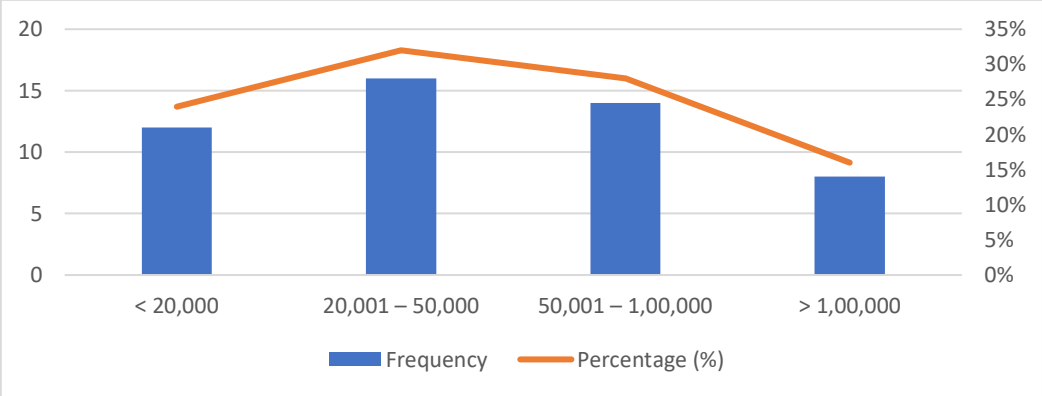

Figure 3: Graphical presentation of Microbial Quality (Total Plate Count)

Figure 3 shows while 56% of samples were within acceptable limits, 44% exceeded them, indicating microbial contamination in a significant share of milk.

Table 4: Consumption Pattern of Milk in Urban Lucknow

Type of Milk/Product	Frequency	Percentage (%)
Packaged Milk	45	45%
Loose/Raw Milk	30	30%
Toned/Double Toned Milk	15	15%
Other Milk Products	10	10%
Total	100	100%

Table 4 displays the consumption pattern reveals that the most favoured product was packaged milk which recorded an observed share of 45, a sign the consumer preference was highly inclined to branded milk or processed milk and in all probability this was favoured by the consumers due to the perceived safety and quality assurance as well as ease of use. Loose/raw milk continued to take up a relatively high amount (30%), and this provides major indication that the traditional supply chains are still being aligned- probably due to price sensitivity or familiar preferences. There was less uptake of toned /double toned milk (15%) and other milk variants (10%) which could be a result of low awareness and availability and consumer confidence on the variants.

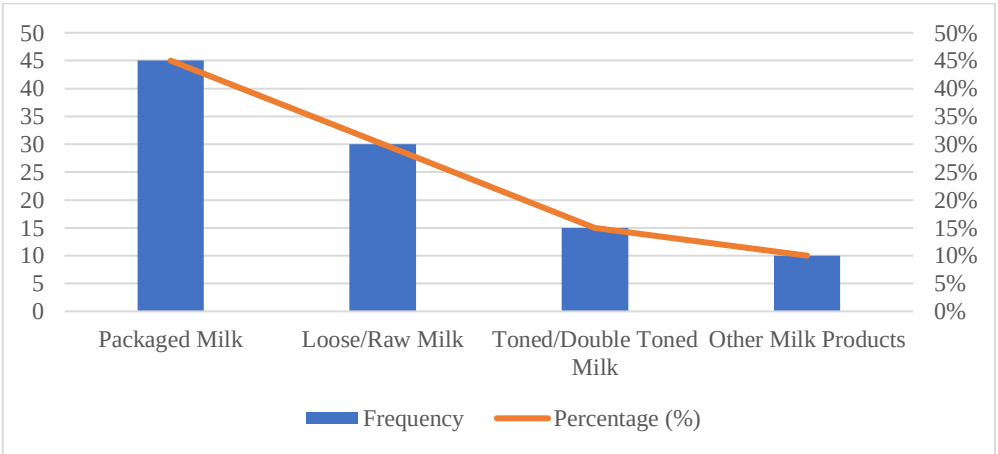

Figure 4: Graphical presentation of Consumption Pattern of Milk in Urban Lucknow

Figure 4 shows Packaged milk was most preferred (45%), followed by loose/raw milk (30%), while toned milk (15%) and other products (10%) had lower consumption.

5. CONCLUSION

A large number of changes in the physico-chemical and microbiological quality of the marketed milk in urban Lucknow is noted in the study. Although most of the samples recorded appropriate standards regarding the level of pH and fat content, solids-not-fat, and specific gravity were recorded to be different implying the likelihood of its dilution and compromise of

its quality. Similar results were found when the microbiological analysis was conducted as a significant number of samples were confirmed to go above the allowed standards which points to shortcomings in hygiene handling as well the hygienic means of storage. In some, adulteration tests also provided confirmation of the presence of contaminants like water, starch and urea which would be hazardous to the people who eat it. Packaged pasteurized milk ranked at the top with most people preferring it but there remained a high percentage share of loose/raw milk on the urban part. In sum, the conclusions make it clear that stricter quality control requirements, better regulation, and awareness among they will have to be raised to guarantee the presence of both safe and nutritious milk in the city.

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