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QUALITATIVE ANALYSIS OF DIFFERENT MILK BRAND IN BAREILLY REGION

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ABSTRACT

In everyday life, milk is an important commodity. It is not only a source of protein of high quality, but also, in addition to other nutrients, a source of calcium and riboflavin. Milk is the product that is most commercially marketed by both local vendors and supermarkets. Because of the rules laid down by the FSSAI, the majority of labelled goods are of sufficient quality in the goods marketed. However, such adulterants are added to local products to increase the yield, which can affect the nutritional quality of the milk. Therefore, to understand the operation, Amul Milk, Mother Dairy Milk, T20milk, Ananda Milk, Cow and Buffalo Milk were the current study aimed at understanding adulteration in 6 selected local milk samples selected. In most milk water content, the adulteration observed mainly in T20 Milk, and Ananda milk was adulterated with some vendors is more, but urea was also observed in few samples. Therefore, the study clearly showed that milk from local vendors had adulterated samples.

KEYWORDS: Adulteration, Milk safety, Detergent in milk, Quality of milk products, Nutrients, Riboflavin

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INTRODUCTION

Milk is a healthy, natural diet and is extensively manufactured in India. More than 67 million cattle and buffaloes, 89 million sheep and goats and 0.2 million camels currently exist. With high yielder genetic dairy animals, India is blessed. Milk farmers produce more than 33 million tonnes of milk without the use of scientific methods [1].

The Economic Survey 2018-19 highlighted that India retains its place as the world's top milk producer, with output of 176.3 million tonnes of milk production in 2017-18, more than 50 percent of the marketable surplus is still managed by the unorganised sector. The survey states: "The marketable surplus is approximately 52 percent of the total milk produced in rural areas". Of this surplus, less than half of the milk sold is managed by an organised sector comprising milk cooperatives and private dairy firms, while the rest is managed by the unorganised sector. India, which accounts for 20% of world demand, ranks first in milk output. Over the years, milk production in India has steadily increased from 55.6 million tonnes in 1991-92 to 176.3 million tonnes in 2017-18, with an annual growth rate of 4.5 percent on average [2].

All year round, milk is made. Milk production, however, is significantly reduced during the summer months due to heat stress, fodder shortage, etc. Milk is transported mainly by middleman, called dodhies, from the point of production to cities. In order to raise volume, such milk is watered. Starch, flour, urea, cane sugar, vegetable oil and so on are added as chemical adulterants to preserve their composition.

Milk is a perishable commodity, so it is likely to be spoiled during transport during the summer months. Therefore, the intermediaries contain chemical preservatives such as penicillin, street-penicillin, formaldehyde, hydrogen peroxide, bi-carbonate sodium, etc. Adulterants / preservatives are health threats that are especially vulnerable to end users, such as children [3].

Ananda Dairy Private Limited

Within its supply network, Ananda has over 5000 villages and more than 2,00,000 dairy farmers from Uttar Pradesh, Haryana, and Punjab. The company's current production capacity is 1,500,000 litres of milk a day, from which dairy farmers obtain more than an average of 8,00,000 litres of milk. In 20 locations across Delhi and the National Capital Region (NCR), Uttarakhand and Uttar Pradesh, Ananda 's approved outlets are present [4].

Ananda currently offers a wide variety of milk and milk products, including, but not limited to, paneer (cottage cheese), ghee (clarified butter), rabri, dahi (yoghurt), lassi, chaach (buttermilk), flavoured yoghurt, flavoured milk, honey drinks, whey drinks, butter, cookies, rusk, matthi, chips, khoya, milk whitener, and creamy milk [5]. Non-dairy products such as tea, maize flakes, boondi, sugar and oats are also produced by the company.

Anik Dairy Pvt. Limited

Anik Spray was one of the most common brands of skimmed milk powder in India, originally produced and later sold to other players by Lipton India. The brand is still active, but due to the fierce competition in the post-1991 liberalisation period, it has lost considerable market share. To ensure immediate lump-free mixing when in contact with water, the milk powder was made from fresh milk. Therefore, it became popular in the Indian kitchen, given the convenience and distinct taste-especially, when used to prepare Chai (Indian milk tea) as an easy replacement to fresh milk [6,7].

Anik is interested in the production of milk and milk goods, the trading of agricultural commodities and coal, and in wind power generation. It operates in three divisions: dairy products, including milk, ghee, milk powder and other dairy products; wind power, which includes wind power generation; and other segments, which include coal, agro-commodities and edible oils [7].

Cow Milk

Cow Milk is a white, nutrient-rich liquid food provided by mammalian mammary glands. Before they are able to absorb other food types, it is the main source of nutrition for baby mammals (including humans who are breastfed). There is colostrum in early lactation milk, which brings the antibodies of the mother to her young and can reduce the risk of several diseases. Many other nutrients, including protein and lactose, are found in it. Interspecies consumption of milk is not uncommon, particularly among humans, many of whom consume the milk of other mammals [8].

Buffalo Milk

Buffalo milk varies in richness and structure from cow's milk. Compared with cow's milk, Buffalo milk has lower cholesterol, but more calories and fat. Buffalo milk is eaten in South Asia, with the main producers being India, China and Pakistan. Buffalo milk has higher total solids, making it thicker than cow's milk. Buffalo milk has 100 percent more fat than cow milk, which makes it creamier and thicker due to high activity of peroxidase, buffalo milk can be naturally stored for a longer time. Buffalo milk contains more calcium and less sodium and potassium percentage, making it a better nutritional substitute for infant buffalo milk rich in calcium and phosphorous. India followed by Pakistan is the top producer of buffalo milk. India is the largest producer and consumer of cow and buffalo[9].

Mother Dairy

Mother Dairy tries to take advantage of the resource open to all milk farmers in a number of ways. It is now a National Dairy Development Board (NDDB) subsidiary corporation. Mother Dairy obtains the whole liquid milk requirement from dairy cooperatives. Likewise, Mother Dairy supplies fruits and vegetables from associations of framers / growers. Mother dairy also contributes to the cause of oilseeds grower cooperatives that manufacture / pack the Dhara range of edible oils by undertaking to nationally market al dhara products.

AMUL India Private Limited

The full form of AMUL is Anand Milk Union Limited. It is a cooperative Dairy based in Gujarat’s Anand district. 'The Taste of India' is its tagline.

It has been a major Fast-Moving Consumer Goods (FMCG) company in India over the years. In 1946, under the leadership of then-Dy PM Sardar Vallabhbhai Patel, Mr. Tribhuvandas Patel formed the company. The company is managed by The Gujarat Co-operative Milk Marketing Federation Ltd. (GCMMF). In addition, more than 3.6 million milk farmers across Gujarat are now joint owners of AMUL.

It was due to AMUL the White Revolution successfully spurred in the country. Dr Verghese Kurien joined AMUL in 1949 and is credited with success of AMUL through his marketing techniques. It also has overseas branches. The AMUL pattern was replicated in other states by using certain top down and bottom up approaches. It is the world's largest agriculture dairy development plan [10].

MATERIALS AND METHODS

Materials

AMUL Milk, Mother Dairy Milk, T20milk, Ananda Milk, Cow and Buffalo Milk were purchased from local market of Bareilly Region.

Methods

1) Detection of Table Sugar in Milk Sample

Lactose is the common sugar which is found in milk. The fat content of milk is higher than that of protein. To raise the carbohydrate content of the milk, table sugar like sucrose is added to the milk and thus the milk density would be raised. So the milk can now be adulterated with water, and during the lactometer examination, it will not be detected. Ketose sugar reacts to a red precipitate with resorcinol, signalling the presence of table sugar in the milk. In general, sugar is mixed in the milk to increase its solids, not its fat content, i.e. to increase the lactometer reading of milk, which, if diluted with water, is usually below the usual value. Cane sugar (sucrose) in milk reacts with acidified resorcinol in the laboratory and gives a red colour to the milk.

Procedure

- ✓ Pour 10 ml of all milk samples in different test tubes labelled by their respective names and using a pipette add concentrated HCl into the test tubes.
- ✓ This should be done in the fume hood.
- ✓ Now shake the test tubes gently so that the milk samples get precipitated.
- ✓ Weigh 100 mg of Resorcinol and add this to the precipitated milk samples.
- ✓ Then shake the test tubes well.
- ✓ The colour of the milk samples changes to light brown.
- ✓ Now place all test tubes with test tube holder in a water bath at 100 °C for 5 minutes.
- ✓ Then shake the test tubes well.
- ✓ The colour of milk solutions turns red which shows the presence of table sugar in milk.
- ✓ If the colour remains the same, it denotes the absence of table sugar in milk.

2) Detection of Starch in Milk

Milk contains relatively large amount of fat. Addition of carbohydrate to milk increases its solid content. There by reducing the amount of fat present in the milk. Starch is one such component that is added to adulterate milk.

The milk starch detection test uses iodine solution, which adds the milk solution to the blue black colour due to the formation of starch-Iodo complex, in the presence of cereal flour starch such as sangaraha flour (water caltrop) is commonly added to increase milk density (lactometer reading) which decreases if it is adulterated with water. Uncooked starch may be health hazard for consumers, but it is deceiving/ cheating to the end consumers.

In the laboratory, the presence of starch or cereal flour is observed. The chemical test will detect up to 0.01% of the starch in raw milk. In the laboratory, the addition of starch below 0.01% is barely observable.

Procedure

- ✓ Pour 3ml of all milk samples in different test tubes.
- ✓ Now place the test tubes with test tube holders in a water bath at 100° C.
- ✓ After 5 minutes remove the test tubes from the water bath and allow it to cool.
- ✓ Using a dropper, add 2-3 drops of Iodine solution to the test tubes and shake it well.
- ✓ If the colour of milk solution turns yellow, it indicates the absence of starch.
- ✓ Dark blue colour indicates the presence of starch in milk.

3) Detection of Benzoic acid and Salicylic Acid in Milk

Benzoic and Salicylic acid are used as adulterants in milk industries. Reasons to use them as adulterants are:

- To mask the developed acidity in milk
- To enhance shelf life

Excessive amount of benzoic acid and salicylic acid intake can cause diarrhoea, acute stomach pain and decrease in blood pressure.

Procedure

- ✓ Pour 5ml of milk samples in test tubes from different beakers and accordingly label them.
- ✓ Add few drops of conc. Sulphuric acid in milk and shake the test tubes gently.
- ✓ This was done in a fume hood.
- ✓ Observe the precipitation of milk.
- ✓ Now using a dropper, add 0.5% Ferric chloride solution drop by drop and mix this well.
- ✓ A buff colour indicates the presence of benzoic acid.
- ✓ The presence of violet colour depicts the presence of Salicylic acid in milk.

4) Detection of Soap in Milk

To improve the foaming of milk and therefore to provide dense milk, soap is applied to the milk. The addition of such chemicals, particularly related to the stomach and kidneys, can cause health problems.

By adding the indicator of phenolphthalein to the adulterated milk, soap can be detected. If soap is present, a pink colour will be observed as the alkali is neutralised by the milk acidity when the phenolphthalein indicator is applied.

During transportation of milk from rural to urban areas, milkers remove fat and add water in the skimmed milk. This result the milk watery and lack of foams so the milkers add detergent to improve the milky foam formation

Procedure

- ✓ Pour 10ml of milk into the test tubes which are labelled as per the sample name.
- ✓ Then add 10ml of hot water to the milk samples
- ✓ Add 1-2 drops of Phenolphthalein indicator into the test tube and mix them gently.
- ✓ If the colour turns pink, it indicates the presence of soap in the milk.
- ✓ If the colour remains same, it shows the absence of soap in milk.

5) Detection of Formalin in Milk

Milk is processed in the country's rural and suburban areas and is transported to big cities twice a day. Milk usually gets spoiled during the summer months. To keep the milk cold, the milk transporters apply ice blocks and formalin to retain the milk in the tanks. Formalin is highly toxic and carcinogenic, so formalin-added milk is harmful to end users. Formalin is a preservative that can be used for a long time to preserve milk. It is known to cause liver and kidney harm due to its high toxicity. To give a purple coloured ring at the junction of the milk layers, formalin reacts with Sulphuric acid and ferric chloride, suggesting the presence of formalin adulterated in milk. In raw milk, chemical tests will detect a minimum of 0.0001% formalin. Addition of formalin below this level is hardly detectable in the laboratory.

Note: It is noteworthy that formalin more than 1% in milk is undetectable by this test.

Procedure

- ✓ Pour 2ml of milk in the labelled test tubes.
- ✓ To this, add 2ml of 90% Sulphuric acid containing Ferric chloride using a glass pipette (this step to be done in fume hood).
- ✓ A purple violet ring formed at the junction, indicates the presence of Formalin in the milk.

6) Detection of Micro-organisms in Milk

Milk can, along with some potentially beneficial microbes, contain some harmful micro-organisms such as bacteria. Microbiological milk analysis is conducted to assess the degree of bacterial contamination in milk and to understand the chemical changes that are caused by microbial activity in milk. Pasteurization is performed to destroy certain dangerous bacteria. If milk pasteurisation is not carried out correctly, there will be a higher number of bacteria in the milk. In order to detect the presence of bacteria in milk, the methylene blue reduction test is used.

This test operates on the theory that, in the presence of bacteria, the methylene blue indicator is present in an oxidised form, leading to a reduction of this indicator over a comparatively short period of time. In a short period of time, the blue colour produced by adding the indicator to the milk would shift to white, indicating the presence of bacteria in the milk and thus denoting improper pasteurisation. A positive test results in the ability of viable bacteria to decolorize milk within 30 minutes. Milk is found to be unsatisfactory. The test results in a negative test if the milk is not decolorized within 30 minutes. The milk is considered of good quality. Four levels of quality can be distinguished:

- Excellent - when no reduction of blue colour for up to 8 hours
- Good - no decolouration in 6-1/2 to 7-1/2 hours
- Fair - decolouration in 2-1/2 to 6 hours
- Poor - decolouration in less than 2 hours

Procedure

- ✓ Pour 10ml of milk from the respective beakers into the labelled test tubes.
- ✓ Add 8-10 drops of Methylene blue into the test tubes containing milk and mix them well.
- ✓ The colour of milk solution turns blue.
- ✓ Close the test tubes using cotton plugs and keep it in incubator for 30 minutes at 37 degree Celsius.
- ✓ If the Blue coloured milk solution turns white immediately, it indicates the presence of microorganism.
- ✓ If the colour remains the same, it indicates a fewer number of microbes in the sample.

7) Detection of Urea in Milk

Urea is a normal milk constituent and forms a significant part of milk's non-protein nitrogen. The concentration of urea in milk within the herd is variable. The amount of urea in natural milk ranges between 20 mg/100 ml and 70 mg/100 ml. The urea content in milk above 70 mg/100 ml, however, shows milk containing 'added urea. Urea is usually applied to increase the SNF value in the preparation of synthetic milk. Up to a minimum level of 0.05 percent, the chemical test will detect urea in raw milk. The addition of urea below 0.05 in the laboratory is barely observable.

Procedure

- ✓ Pour 2ml of milk sample in different test tubes and label them accordingly.
- ✓ Add 1ml of urea to each of the test tubes.
- ✓ If urea is present, the milk colour will change into yellow.
- ✓ And absence of urea in the milk sample indicates with an off white color change.

8) Clot on Boiling Test

The Clot on Boiling (C.O.B) is easy and fast. This is one of the old checks for milk that is too acidic (pH<5.8) or irregular (e.g. mastitis or colostral milk). If a milk sample fails the test, the milk may contain bacteria producing acids or acids or abnormally high protein levels, such as in colostrums. Milk is maintained as such at room temperature, the acidity called as formed acidity will be increased. If acidity is increased to more than 0.2%, heat treatment induces coagulation, which is the result of calcium caseinate salt dissociation. The heat stability of incoming raw milk for further processing must therefore be understood. It is a qualitative acidity determination method in milk, we infer from the test name that we depend on the formation or presence of clots in the milk sample, so if acidity is 0.25 percent and more, the milk will be clotted. Such clotted milk is converted into curd or heat-treated clot during milk processing, so that such milk must be rejected.

Procedure

- ✓ Take 5ml of milk samples in different test tubes.
- ✓ Put all test tubes in water bath for 5 minutes.
- ✓ Remove the tubes from water bath without shaking.
- ✓ Note any acid smell or precipitated particles on the sides of the test tubes.
- ✓ Sample showing precipitated particles are recorded as positive C.O.B. test. Such milk is rejected on the platform.

9) Alcohol Test

For fresh milk, the alcohol test is used to show if it will coagulate for thermal processing. This test is particularly important for pasteurised milk, evaporated milk and milk powder processing. This test is more sensitive than the boiling coagulation (COB) test. It is based on the

propensity of milk to stabilise as a result of disruption of the milk 's mineral balance. When alcohol is added, milk with a highly established acidity, or with calcium and magnesium compounds greater than natural, can coagulate. A positive test can also result in an increased level of albumin (colostrum milk) and salt concentrate (mastitis). In the dairy industry, depending on the form and use of milk, three different concentrations of ethanol solution are usually used for the examination. There are 68% v / v, 65% v / v and 60 percent v / v.

Milk that passes the 68 percent ethanol test is known as superior quality milk. The raw milk should pass a 68 percent ethanol test for the production of milk powder. For the development of pasteurised polybag milk, Dairy usually considered 60 percent ethanol test negative raw milk because it did not have to undergo intensive heat treatment as in the case of pasteurised milk. At the processing units, milk that does not even pass the 60% ethanol test is refused.

Procedure

- ✓ Take 5ml of milk sample in different test tubes.
- ✓ Add equal quantity of 68% ethyl alcohol.
- ✓ Mix the contents of the test tubes by inverting several times.
- ✓ Examine the tube and note any coagulation.
- ✓ If coagulation has occurred fine particles of curd will be visible on the inside surface, presence of flake or curd denotes positive alcohol test.
- ✓ Such samples are rejected.

RESULTS

1) Detection of Table Sugar in Milk Sample

Important sugar was observed in some of the milk samples. The negative and positive lab tests for the identification of table sugar in different milk samples are shown in **Figure 1**.

Table 1: Detection of Table Sugar in Milk Sample

S. No.	Milk Sample	Result
1	AMUL	Negative
2	T20	Negative
3	Anik	Negative
4	Mother dairy	Negative
5	Cow milk	Negative
6	Buffalo milk	Negative

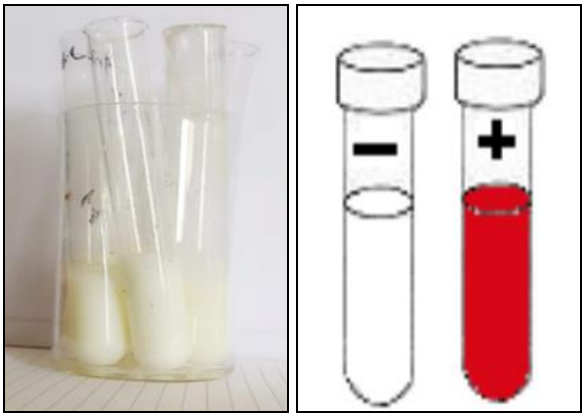

Figure 1: Table Sugar Lab Test

2) Detection of Starch in Milk Sample

No starch is found in any of the sample.

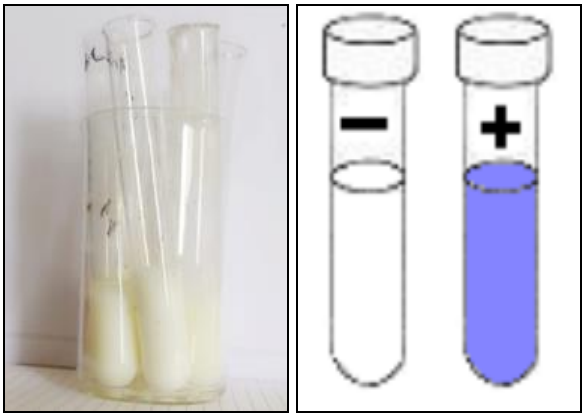

Figure 2: Starch Lab Test Result

Table 2: Detection of Starch in Milk Sample

S. No.	Milk Sample	Result
1	AMUL	Negative
2	T20	Negative
3	Anik	Negative
4	Mother dairy	Negative
5	Cow milk	Negative
6	Buffalo milk	Negative

3) Detection of Benzoic and Salicylic Acid in Milk Sample

Buff colour formation shows the presence of benzoic acid as in AMUL and yellow precipitate formation shows the presence of salicylic acid as in T20 Ananda Ananda.

Table 3: Detection of Benzoic and Salicylic Acid in Milk Sample

S. No.	Milk Sample	Benzoic acid	Salicylic acid
1	AMUL	Negative	Positive
2	T20	Positive	Negative
3	Anik	Negative	Negative
4	Mother dairy	Negative	Negative
5	Cow milk	Negative	Negative
6	Buffalo milk	Negative	Negative

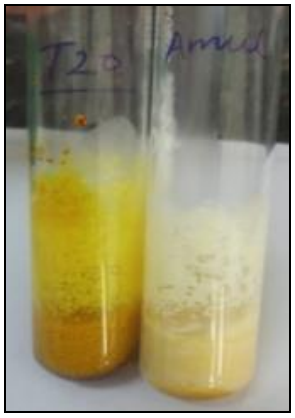

Figure 3: AMUL shows buff colour due to presence of Benzoic Acid & T20 shows yellow colour due to Salicylic Acid

4) Detection of Soap in Milk Sample

Pink colour indicates the presence of soap in AMUL milk sample. Other milk samples give negative test for presence of soap and is free from soap and other detergents.

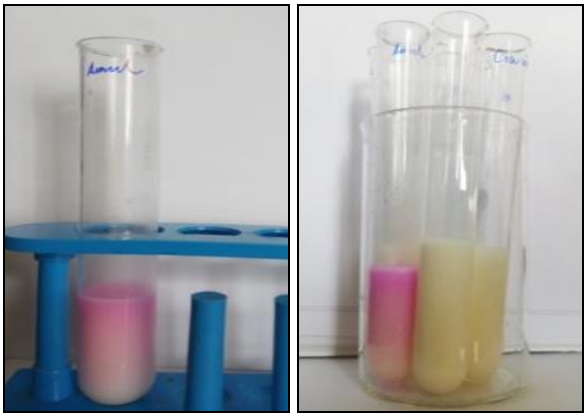

Figure 4: AMUL Sample Showing Positive Comparison of Different Milk Samples

Table 4: Detection of Soap in Milk Sample

S. No.	Milk Sample	Result
1	AMUL	Positive
2	T20	Negative
3	Anik	Negative
4	Mother dairy	Negative
5	Cow milk	Negative
6	Buffalo milk	Negative

5) Detection of Formalin in Milk Sample

T20 milk sample confirms the presence of formalin.

Table 5: Detection of Formalin in Milk Sample

S. No.	Milk Sample	Result
1	AMUL	Negative
2	T20	Positive
3	Anik	Negative
4	Mother dairy	Negative
5	Cow milk	Negative
6	Buffalo milk	Negative

Figure 5: Formalin Lab Test Seen in T20 Milk Sample

6) Detection of Microorganism in Milk Sample

AMUL & Anik milk samples confirmed the presence of high level of microbes while T20 milk sample depicted low level of microbial content in it.

Figure 6: T20 Milk Sample T20 & Other Milk Samples

Table 6: Detection of Microorganism in Milk Sample

S. No.	Milk Sample	Result
1	AMUL	Excellent
2	T20	Poor
3	Anik	Excellent
4	Mother dairy	Good
5	Cow milk	Fair
6	Buffalo milk	Good

7) Detection of Urea in Milk

T20 milk sample confirmed the presence of urea in it.

Table 7: Detection of Urea in Milk

S. No.	Milk Sample	Result
1	AMUL	Negative
2	T20	Positive
3	Anik	Negative
4	Mother dairy	Negative
5	Cow milk	Negative
6	Buffalo milk	Negative

Figure 7: T20 Milk Sample T20 in Comparison with Other Milk Sample

8) Clot on Boiling Test

AMUL milk sample got clotted on boiling.

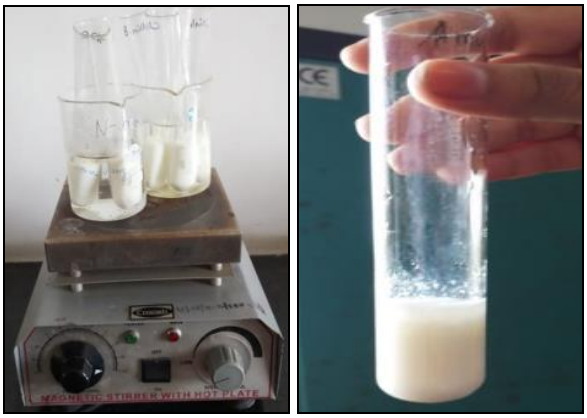

Figure 8: Samples Kept on Boiling over Water Bath Amul Milk Sample got Clotted

Table 8: Clot on Boiling Test

S. No.	Milk Sample	Result
1	AMUL	Positive
2	T20	Negative
3	Anik	Negative
4	Mother dairy	Negative
5	Cow milk	Negative
6	Buffalo milk	Negative

9) Alcohol Test

Buffalo Milk Sample shown the positive sample as it gets coagulated. So, we discarded that sample and the further experiments were performed on new sample. Coagulation occurred in Buffalo milk sample on addition of alcohol.

Table 9: Alcohol Test

S. No.	Milk Sample	Result
1	AMUL	Negative
2	T20	Negative
3	Anik	Negative
4	Mother dairy	Negative
5	Cow milk	Negative
6	Buffalo milk	Positive

Figure 9: Buffalo Milk Confirm the Presence of Alcohol

DISCUSSION

Milk can, along with some potentially beneficial microbes, contain some harmful micro-organisms such as bacteria. Microbiological milk analysis is conducted to assess the degree of bacterial contamination in milk and to understand the chemical changes that are caused by microbial activity in milk. To kill such damaging bacteria, pasteurisation is finished. If pasteurization of milk is not carried out properly there will be presence of larger count of bacteria in the milk.

To improve the foaming of milk and therefore to provide dense milk, soap is applied to the milk. The addition of such chemicals, particularly related to the stomach and kidneys, can cause health problems. By adding the indicator of phenolphthalein to the adulterated milk, soap can be detected. In the food industry, acids such as Benzoic acid and Salicylic acid are commonly used as a preservative. To conserve and thus increase the shelf life of milk, it is added to milk to. Formalin is a preservative and can preserve milk for long period of time. Due to its high toxicity, it is considered to cause liver and kidney damage.

Therefore, to understand the operation, AMUL Milk, Mother Dairy Milk, T20milk, Ananda Milk, Cow and Buffalo Milk were the current study aimed at understanding adulteration in 6 selected local milk samples selected. In most milk water content, the adulteration observed mainly in T20 milk, and Ananda milk was adulterated with some vendors is more, but urea was also observed in few samples. Therefore, the study clearly showed the fact that MILK from local vendors had adulterated samples.

CONCLUSION

It is evident from the above analysis that the so collected milk samples were adulterated with common adulterants such as water, urea, detergent and starch, water being the most common adulterant, the milk samples collected were found to contain excess water, starch and detergent, the T20 and Ananda Milk samples were found to have not only excess water but also urea and detergent added, the T20 s samples were found to have not only excess water but also urea and detergent added. It was therefore found that all the samples of milk and milk products so collected had varying proportions of common adulterants that could affect human health, so a regulatory body should regularly verify the existence of these harmful ingredients in these products.

In its most crude form, adulteration in milk is usually present. Prohibited substances are also added or the milk is often entirely replaced with synthetic milk. For financial benefit, this is achieved. But also adulteration is caused by carelessness and lack of hygienic condition of manufacturing, storage, transportation and marketing. In developing countries or backward nations, such forms of adulteration are very common. But milk adulteration is a serious concern in developed countries also. In these countries advanced methods are adopted to adulterate milk and need Milk.

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CONFLICT OF INTEREST

None

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