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STUDY OF "ADULTERATION IN MILK FROM PROCESSED AND UNPROCESSED MILK SOURCES"

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ABSTRACT

Milk adulteration poses a significant public health issue in India, impacting both the nutritional quality and safetyforconsumers. Hyderabad, a major metropolitanareawith apopulation exceeding10 million, features a varied dairy market that includes both organized pasteurized milk brand sand unregulated local vendorswho sell loose buffalo milk. This research aimed to assess and compare the quality, safety, and adulteration characteristicsofbuffalomilksourcedfromfivedifferentsuppliers:Arogya,Amul,Jersey,Heritage, andlocal vendors. Over the course of one month, a total of 50 milk samples (10 from each source) were collected and analyzed following standardized FSSAI protocols. The physicochemical parameters evaluated included fat, solids-not-fat (SNF), protein, lactose, ash, pH, and freezing point.Additionally, samples were tested for six commonadulterants:water,starch,urea,detergent,formalin,andhydrogenperoxide,utilizingvalid atedrapid detection techniques. Statistical analysis was conducted using one-way ANOVA and correlation tests. The findings indicated that all branded milk samples met FSSAI standards, with fat content ranging from 6.09% to6.52%andSNFvaluesbetween9.21%and9.51%.Incontrast,milkfromlocalvendorsshowedsigni ficantly lowerfat(3.18%)andSNF(7.14%)levels($p<0.001$),failingtocomplywithlegalrequirements.Adulteration was prevalent in local vendor milk, with 100% of samples containing water and detergent, 90% containing starch, and80% containing urea and hydrogenpe roxide. Among the branded samples, only a small percentage of Amul(20%) andHeritage (10%)samplestestedpositivefor detergent. The studyconcludes that packaged milk from organized dairies is nutritionally superior and safer compared to loose milk, highlighting the necessity for ongoing regulatory oversight and increased consumer awareness.

KEYWORDS: Milk adulteration, Hyderabad, Publichealth, Buffalomilk, Local vendors(loosemilk), Packaged milk / Organized dairies, Arogya, Amul, Jersey, Heritage, Physicochemical Analysis.

INTRODUCTION

AboutThe Study

Milkplaysacrucialroleinthe Indianfoodculture,appreciatedforitsnutritionalbenefits,culturalimportance, and religious relevance. India holds the title of the largest milk producer globally, accounting for about 24% of worldwide milk output, with a production level of 239 million metric tonnes in FY24. The availability of milk per person has risen to 471 grams per day, surpassing the global average of 322 grams per day. Water buffaloesareresponsibleformorethan50% of the nation's milk supply, withtheir milkbeinghighinfat (6–8.5%),protein(3.8–4.5%),andminerals, makingitidealfor creatingtraditionaldairyitemslikekhoa,paneer, ghee, and dahi.Food adulteration refers to the intentional or accidental incorporation of inferior or hazardous substances, which degrades the quality and safety of food products. As defined bytheFoodSafetyandStandardsAuthority ofIndia (FSSAI), thispractice negatively impactsthe fundamentalnature andintegrityoffood.A2024study byGarg and Mulla revealed that 70.6%of330 milk sampleswere adulterated,primarily withwater(58.5%), followed by detergent, urea, and neutralizers. Their research further demonstrated that rapid home-based testingkitsachieve nearly 100%specificityand over 80%accuracyin detectingwater anddetergent,serving as reliable screening tools for consumers.

Adulterationofmilk posesserioushealthrisks,includinggastrointestinaldisorders,kidneydisease, cancer, andinseverecases,death.Highdemand, theperishablenatureofmilk,poorqualitycontrol, and lax enforcement make milk particularly vulnerable to adulteration.

According to recent data, almostone-third of milk samples in Indiado not meetquality standards, with adulterationrising to38% in FY25.Theratedropped to 1.68% infiscal 2020due toa decrease in testing due to the pandemic, butitrose again in fiscal 2022 whenabout 50% of samples werefoundto be contaminated with foreign substances.

Table1: Health Effects of Common Milk Adulterants

Adulterant	Motivation for Addition	Reported Health Effects	References
Water	Increasevolume	Diarrheal diseases non-potable; nutrition	ChoudharySharma, 2024
Starch	Restore viscosity after dilution	Diarrhea; fatal for diabetic patients	Garg&Mulla,2024
Urea	Artificiallyincrease protein content	Nephrotoxicity;renal failure; disorders gastrointestinal	Ibrahimetal.,2025
Detergent	Create froth; neutralize acidity	Gastroenteritis; intestinal inflammation	Garg&Mulla,2024
Formalin	Preservative (carcinogenic)	Cancer; abdominal pain; kidney failure	Choudhary & Sharma, 2024
HydrogenPeroxide	Preservative; whitening	Gastritis; esophageal burns	Pengetal.,2020

Hyderabad, the capital of Telangana, features a dual dairy market: an organized sector consisting of brands like Amul, Heritage, Jersey, and Arogya, which provide processed and monitored milk, and an unorganized sector comprised of local vendors who sell loose, frequently unprocessed milk. Research conducted by Sudharshan et al. (2019) within the Greater Hyderabad Municipal Corporation (GHMC) revealed significant adulteration in vendor-supplied milk. The most prevalent additives identified included water (90%), starch (73.33%), skim milk powder(73.33%),sugar(46.67%),neutralizers (14%),urea(11%), ammoniumsulfate (6%),soap(5%),anddetergent(1%). While past research has documented extensive milk adulteration in Hyderabad, there is a lack of studies directly comparing major branded buffalo milk with locally sold loose milk using consistent analytical methodsandtimeframes.Thisstudyaimstofillthatvoidbyassessingwhetherthepremiumpriceof brandedpackagedmilkisreflectedinitsqualityandsafety.Furthermore,a2025consumerawareness surveybyUnnisa et al. involving 418 Hyderabad residents revealed that, despite 77.5% of respondents being aware of food adulteration, many remained uninformed about specific adulterants and their associated health risks; meanwhile, 69.9% of participants cited economic profit as the main driver for such practices.

Research Questions

1. Dothefivemilksources(Arogya,Amul,Jersey,Heritage,localvendor)meettheFSSAIlegalstandardsfor buffalo milk fat (≥6%) and SNF (≥9%)?
2. Whatarethetypesandfrequenciesofadulterantspresentinmilkfromeachsource?3.Isthereastatistically significant difference in the physicochemical parameters between branded and local vendor milk?
3. Can the freezing point of milk reliably detect water adulteration, or is it confounded by other adulterants like urea?
4. Isthereanassociationbetweendetergentadulterationandgastrointestinaldiseasesamong consumers?

Objectives of the Study

Primary Objective

* To evaluate the physicochemical properties—including fat, solids-not-fat (SNF), protein, lactose, ash, pH, and freezing point—of buffalo milk sourced from Arogya, Amul, Jersey, Heritage, and a local vendor in Hyderabad.

Secondary Objectives

* To identify common milk adulterants, such as water, starch, urea, detergents/neutralizers, formalin, and hydrogen peroxide, using standardized analytical techniques.
* TodeterminethelevelofcompliancewithFSSAIregulatory standards.
* To compare the quality and safety profiles of branded processed milk against locally sourced unprocessed milk.
* Toassesstheefficacyofrapid,home-basedtestingmethodsfordetectingcommon adulterants.

Scope

This study assesses the physicochemical properties—specifically fat, solids-not-fat (SNF), protein, lactose, ash, pH, and freezing point—along with the presence of six common adulterants (water, starch, urea, detergents/neutralizers, formalin, and hydrogen peroxide) in buffalo milk. The analysis included four commercialbrands(Arogya,Amul,Jersey,andHeritage)andonelocalvendorinHyderabad,utilizingatotal of 50 samples (10 per source) collected over a one-month period.

Limitations

* Thesamplesize(n=50)maynotberepresentativeofallproductionbatches.

* The inclusion of only one local vendor limits the ability to generalize findings across all milk vendors in Hyderabad.

* Thestudydidnotaccountforseasonalfluctuationsinmilkcompositionoradulteration patterns.

* The use of rapid test kits provided only qualitative or semi-quantitative data, without subsequent confirmatory instrumental analysis.

* The interpretation of freezing point data may be complicated by the presence of multiple, simultaneous adulterants.

MATERIALS AND METHODS

Study Design and Area

This cross-sectional, comparative analytical study was conducted in Hyderabad, Telangana, India (17.3850° N,78.4867°E). To ensure consistent storage andtransport conditions, milksampleswerecollected fromfive locations within a 15-km radius, including Gachibowli, Ameerpet, and Secunderabad.

Sample Collection and Handling

- **SourcesofMilk Samples**

Table2: Characteristics of Milk Sources.

Source	Type	Description	Claimed fat%
Arogya	Processed,packaged	Telangana State cooperative;pasteurized,homogenized	6.5%
Amul	Processed,packaged	GCMMF;”TasteofIndia”pasteurized buffalo milk	6.0%
Jersey	Processed,packaged	VijayaDairy;pasteurized,ISO22000 certified	6.0%
Heritage	Processed,packaged	HeritageFoods(private);pasteurized	6.0%
Localvendor	Unprocessed,loose	Single lomg-standing vendor in Ameerpet;open steel can,no refrigeration	Notspecified

Sampling Protocol

- Samplesize:10samples persource→total50samples
- Collectionperiod:January15 –February15,2026(onemonth,twiceweekly)
- Volumepersample:500mLinsterile,screw-cappedcontainers
- Transport:Ice-packedcoolerboxes,deliveredwithin2 hours

- Storage:Refrigeratedat4°C;analysiswithin48 hours

PhysicochemicalAnalysisofMilk

Allphysicochemicalevaluationswereconductedinstrictaccordancewiththe*FSSAIManualofMethodsof Analysis of Milk and Milk Products (2021)*, alongside relevant BIS/ISO standards. The FSSAI framework encompassesover127standardizedanalyticalprotocolsapplicabletodiversedairymatrices,includingliquid milk, cream, dahi, yogurt, and cheese

1. Determination of Fat Content (Gerber Method)

Principle: The Gerber method relies on the acid-digestion of milk proteins through the application of concentrated sulfuric acid. Iso-amyl alcohol is utilized to facilitate the clean separation of the lipid phase. Following this, high-speed centrifugation is employed to isolate the fat, the percentage of which is subsequently determined via direct visual reading from a calibrated butyrometer.

Procedure

* Add10mLofsulfuricacid (specificgravity1.820–1.825) toaGerber tube.
*Carefullyadd10.75mLofthemilksamplewithoutmixing.
*Add1mLofiso-amylalcohol.
*Centrifugethemixtureat1100rpmfor5minutes at 65°C.
*Readthefatpercentagedirectlyfromthebutyrometer scale.
*Precision:+_0.05%

2. DeterminationofSolids-Not-Fat(SNF)

* **Principle:** SNF is calculated using Fleig's formula, which incorporates the lactometer reading and fatcontent.
* Formula:SNF(%)=(Correctedlactometerreading÷4)+ (0.2×Fat%)+ 0.14
* Note:Lactometerreadingswerecorrectedto20°Cpriortocalculation.

3. DeterminationofTotalProtein(KjeldahlMethod)

* **Principle:**TheKjeldahlmethodestimatestotalnitrogencontent.Organicnitrogenisconvertedinto ammonium sulfate through sulfuric acid digestion, followed by distillation and titration.
* Calculation:%Protein=%Nitrogen×6.38(milkproteinconversionfactor)

4. LactoseDetermination(FehlingTitration)

***Principle:**Lactosewithindeproteinizedmilkreduces Fehling'ssolutionuponheating.Thetitrationendpoint is identified using a methylene blue indicator.

***Calculation:**%Lactose=(Titrevalue×Factor×Dilution)÷Sampleweight

5. DeterminationofAshContent(GravimetricMethod)

***Principle:**Ash content corresponds to the total mineral residue remaining after the complete combustion of organic matter.

***Procedure**

* Weigh10gofthemilksampleintoasilicacrucible.
* Evaporatethesampleandcharit.
* Incineratethecharred samplein amufflefurnaceat550°C untilawhiteorgrey ashisachieved.
* Weightheresulting residue.

***Calculation**

%Ash=(Weightofash÷Weightofsample)× 100

6. MeasurementofpH

***Equipment:**CalibrateddigitalpHmeter(EutechpH700).

*Calibration:The device is calibrated at 25°C using standard buffer solutions with pH levels of 4.0, 7.0, and 9.2.

***Procedure:**Followingcalibration,milksamplesare analyzeddirectly,andthepHvaluesarerecorded.

DeterminationofFreezingPoint(CryoscopyMethod)

***Equipment:**AdvancedInstruments4D3Cryoscope

7. Calibration Standards:

* Sodiumchloridesolutions:−0.408°C,−0.512°C,−0.621°C

Procedure

* Themilksampleissupercooledtoaround−3°C.
* Icecrystallizationisinitiated(seeding).
* Thetemperatureincreaseismonitoreduntilequilibriumisachieved.

* Thefreezingpointisrecordedin°C.

Interpretation: Afreezingpointhigherthan−0.530°Csuggestspotentialwateradulteration.

- **Detection of Milk Adulterants**

All analyses for adulterants were conducted in triplicate to ensure accuracy. Positive findings were verified through repeated testing. Rapid qualitative methods were also utilized due to their established accuracy (>80%) in screening for common adulterants.

1. DetectionofAddedWater(Lactometer Test)

Principle: Thedilutionofmilkdecreasesitsdensity,whichinfluenceslactometerreadings.

Procedure

* Alactometerreadingwastakenat 20°C.
* Thevalues werecomparedagainstthestandardbuffalomilkrange(28–32°Clactometerscale).
* Lowerreadingsindicatedtheadditionofwater.

2. DetectionofStarch(Iodine Test)

*****Reagent:**0.1N iodinesolution

*****Procedure**

* A5mLmilksamplewas collected.
* 2–3dropsofiodinesolutionwereintroduced.
* Theemergenceofbluecolorationsignifies thepresenceofstarch.

3. DetectionofUrea(p-DimethylaminobenzaldehydeTest) Reagent Preparation:

* Dissolve2 g of p-DMAB in 100 mLof 95% ethanol.
* Add10mLofconcentratedHCl.

Procedure

* Mix5mLofthemilksamplewith1mLofthereagent.
* Ayellowcolorationobservedafter5minutesindicatesthepresenceof urea.

4. DetectionofDetergent/Neutralizer(MethyleneBlueTest)

*****Reagent:**Preparea0.5%methylenebluesolution.

Procedure:

* Combine10mLofthemilksamplewith0.5mLofmethyleneblue.
* Add1mLofconcentrated H_2SO_4.
* Thedisappearanceofthebluecolorindicatesthepresenceofdetergent.

5. DetectionofFormalin(Hehner'sTest)

Reagents

* ConcentratedH_2SO_4
* 10%$FeCl_3$solution

Procedure

* Take5mLofthemilksample.
* Carefullyadd5mLofconcentratedH_2SO_4 alongthewallofthetube.
* Add0.5 mLof $FeCl_3$.
* Theformationofavioletringattheinterfaceindicates thepresenceofformalin.

6. DetectionofHydrogenPeroxide(KI–StarchTest) Reagents:

* 10%potassiumiodide(KI)
* 1%starch solution

Procedure

* Take5mLofthemilksample.
* Add5drops ofKIand5drops ofstarchsolution.
* Thedevelopmentofbluecolorationindicates thepresenceofhydrogenperoxide.

RESULTS

Table 3: Detailed Physicochemical Parameters (Mean ± SD, n=10 per source) *Significantly different from all branded sources. ($p < 0.001$, ANOVA)

Parameter	Arogya	Amul	Jersey	Heritage	Local vendors	FSSAI Standards
Fat%	6.52±0.15	6.31± 0.10	6.23± 0.18	6.09± 0.12	3.18±0.45*	≥6.0
SNF%	9.51±0.08	9.43± 0.12	9.32± 0.10	9.21± 0.09	7.14±0.32*	≥9.0
Protein%	4.21±0.12	4.12± 0.10	4.03 0.14	3.94± 0.11	2.51±0.28*	≥4.0
Lactose%	4.91±0.07	4.82±	4.81±	4.73±	4.18±0.15*	-

		0.09	0.11	0.08		
Ash%	0.72±0.01	0.71± 0.02	0.70± 0.01	0.66± 0.02	0.42±0.03*	-
Ph	0.72±0.01	6.79± 0.04	6.71± 0.06	6.64± 0.07	6.51±0.12	-
Freezing point(Celcius)	-0.533±0.02	-0.522± 0.02	-0.531± 0.01	-0.524± 0.02	-0.851± 0.15*	-0.530to 0.570

Key Observation: AllbrandedmilksamplesmetandsurpassedtheFSSAI-mandated minimum fatcontent of 6.0%. Among the branded samples, Arogya had the highest fat content (6.52%), whereas Heritage had the lowest (6.09%), though both values fell within the acceptable range.

Thelocalvendor'smilkhadonly3.18%fat,whichis47%belowthelegalminimum,showingclearnon-compliance.

Thesolids-not-fat(SNF)contentofthelocalvendor'smilkwas7.14%,falling21%shortoftheFSSAI minimum standard, indicating potential dilution or substandard milk quality.

Thelocalvendor'smilkhadaproteincontentof2.51%,about37%belowtheFSSAI'sminimumrequirement of 4.0%, indicating poorer nutritional value.

The freezing point of the local vendor's milk (−0.851 °C) was significantly lower than expected, suggesting an unusual composition that could point to adulteration or changes in its components.

Incidence of Adulterants

Table4: Frequency of Positive Samples for Each Adulterant.(n=10per source)

Adulterant	Arogya	Amul	Jersey	Heritage	Local vendor
Water	0	0	0	0	10(100%)
Starch	0	0	0	0	9(90%)
Urea	0	0	0	0	8(80%)
Detergent	0	2(20%)	0	1(10%)	10(100%)
Formalin	0	0	0	0	0
Hydregen Peroxide	0	0	0	0	8(80%)

Interpretation

Local vendor milk: All of the examined samples had a high level of adulteration. Water and detergent were presentinal l10samples, showing consistent contamination and dilution. Furthermore, noformalin was found in any of the milk samples from the local vendor, and 9 samples tested positive for starch and 8 samples contained urea and hydrogen peroxide.

Branded milk: Interms of theseadulterants,thebrandedmilksamples demonstrated nodetectablepresence of water, starch, urea, formalin, or hydrogen peroxide**, indicating good overall quality. Nevertheless, detergent was found in two Amul samples and one Heritage sample, suggesting isolated cases of potential contamination that call for additional research.

Brand-wiseCompliancewithFSSAIStandards

Table-5: ComplianceStatus(Fat+SNF+Protein+NoProhibited Adulterants.)

Brand	Fat≥6%	SNF ≥9%	Protein≥4%	No Prohibited Adulterants	OverallCompliance
Arogya	Yes	Yes	Yes	Yes	Compliant
Amul	Yes	Yes	Yes	No(detergent in 2/10)	Non-Compliant(adulterated)
Jersey	Yes	Yes	Yes	Yes	Compliant
Heritage	Yes	Yes	No(3.94%)	No	Non-Compliant
Local Vendor	No	No	No	No	Non-Compliant(adulterated)

Interpretation

Arogya and Jersey were completely compliant, fulfilling all nutritional requirements (protein, fat, and SNF) with no adulterants found, demonstrating high-quality milk and efficient quality control.Despite meeting the nutritional standards, Amulwas non-compliant because 2 of 10 samples contained detergent, indicating potential contamination or adulte ration during distributionorcollection.Detergentwasfoundin1outof10samples,indicatinglowerqualityandpote ntialcontamination,andprotein content (3.94%) was below the necessary threshold (≥4%), making Heritage non-compliant.The milk from the local seller was the least compliant; it contained many adulterants and failed all nutritional requirements. Theresultsshowsubstantialdilutionandadulteration,makingitthemostdangerousmilksourceamo ngthose examined.

Over all interpretation

Only2ofthe5examinedmilksources(40%)exceededacceptablequalitycriteriaandweretotallyfree ofthe identified adulterants. Itisconcerning to find detergent insamples ofbrandedmilk (Amuland Heritage)since it could be a sign of adulteration or contamination during handling, transit, or milk collection rather than at the processing facility. Local vendor milk, on the other hand, had the highest degree of adulteration, with several adulterants found in almost every sample. These results demonstrate the higher safety concerns connectedto milkfromthe unorganizedsector,whereregulatoryoversight andquality control arefrequently lacking.

Correlation Analysis

Table6:Pearson'sCorrelationCoefficientsBetweenParameters.(AllSamplesCombined)

Parameter Pair	Correlation Coefficient(r)	p-value	Interpretation
Fatvs. SNF	0.942	<0.001	Strong positive correlation
Fatvs. Protein	0.931	<0.001	Strong positive correlation
SNFvs. Protein	0.958	<0.001	Strong positive correlation
Freezingpointvs. Urea	-0.876	<0.001	Strong negative correlation
Fat vs. Water addition	-0.893	<0.001	Strong negative correlation

ThePearson'scorrelationcoefficientsuncovertheunderlyingconnectionsbetweenthephysicalandchemical characteristics of all the milk samples, offering insights into the nature of adulteration.

Key Observations

Fatvs. SNF(r =0.942, p<0.001)

Interpretation: This indicates a strong positive correlation. Inpure, undiluted milk, fatand SNF(whichconsists of protein and lactose) are correlated positively as they both stem from the same mammary secretion. Milk that has higher yields and quality will typically exhibit increased levels of both components. This robust correlation demonstrates that the differences in these elements among the tested samples mainly arise from naturalcompositionalvariationsratherthanintricate,selectivealterations ofonecomponent.Nevertheless,if both components are consistently low, it suggests simple dilution with water.

Fatvs.Protein (r=0.931,p <0.001)

A**strongpositivecorrelation**wasidentifiedbetweenthelevelsoffatandprotein.Sampleswithelevated fatcontentalso generally exhibited increasedprotein levels. Thisassociation mirrors theinherent composition of milk and suggests that dilution methods, like adding water, result in a simultaneous decrease of both fat and protein. The correlation is **extremely statistically significant (p < 0.001)**.

SNFvs.Protein (r=0.958,p < 0.001)

Interpretation: This correlation represents the strongest observed link. It is biologically inherent, as protein makesupapproximately38-40%oftheSNFincow'smilk. Thenearlyperfectcorrelation(r=0.958)suggests that the SNF analysis was precise and that the SNF value was not artificially increased by the inclusion of non-proteinnitrogenous compoundslikeurea, whichcould disruptthis natural relationship acrossthed ataset. Thisalignswiththemethodsofadulteration:whenureaisintroducedtoelevatetheapparentSNFreadi ng(as determined by lactometer), it does not enhance the actual protein content.The significant SNF–protein association indicates that the main factor influencing milk composition was water dilution rather than urea adulteration.

Freezing point and urea showed a strong negative correlation ($r = -0.876$, $p < 0.001$). In line with water dilution followed by urea addition to make up for decreased SNF, this implies that samples with higher urea levels also had freezing points that were closer to 0°C. The correlation suggests that the most common type of adulteration was probably water adulteration.

WaterAddition vs. Fat(r= -0.893,p < 0.001)

Wateradditionandfatcontentshowedastrongnegativecorrelation.Becauseofdilution,thefatleveld roppedasthepercentageofadditionalwaterincreased.Thisdemonstratesthatasignificantfactorinth esubparquality of non-compliant milk samples was

Overall Observation

Accordingtothecorrelationstudy,themainkindofadulterationinthenon-compliantmilksampleswaswater dilution. As is typical of dilution, the high positive correlations between fat, SNF, and protein ($r > 0.93$) demonstrate that these quality metrics declined proportionately. The employment of urea to disguise the effects of water addition by maintaining the apparent SNF level is further shown by the substantial negative connectionbetweenfreezingpointandurea(r= −0.876).Overall,ourresultsshowthat adulterationmethods had a major impact on milk quality, with urea acting as a secondary masking agent and water dilution as the primary adulteration technique.

DISCUSSION

The analysis reveals a distinct difference in quality between milk from local vendors and packaged milk brands. Strong quality control was demonstrated by the fact that all branded samples satisfied regulatory requirementsforfat, SNF,andproteinwithminimalvariation.

Thisisconsistentwith**FSSAI2022**studies thatindicateorganized dairieshavehighlevels ofcompliance. Localvendormilk, ontheotherhand,wasunfitfordairyprocessing duetoitslowfat (3.18%),SNF(7.14%),andprotein(2.51%)content.Theseresultsprovidecompellingevidencethat unstructuredmilk ismorelikely to be adulterated (Garg and Mulla, 2024).

The Milk from the Local Vendor: A Mix of Adulterants

Water (100%), flour (90%), detergent (100%), urea (80%), and hydrogen peroxide (80%) were among the several adulterants found in local milk. This suggests intentional multi-step adulteration using water for dilution, starch for density adjustment, urea for protein inflation, detergent for froth, and $H2O_2$ for preservation.

FSSAI (2026) and **Sudharshan et al. (2019) are two national and regional studies that have documented similar patterns. The high concentration of hydrogen peroxide, which is much over permissible limits and poses major health concerns, is especially worrisome. This is a condensed, academic-tightened version.

BrandedMilkDetergent:ACautionarySign

Detergent was found in 10% of Heritage samples and 20% of Amul samples, indicating that contamination may have occurred during handling or collection rather than processing. Previous research has connected gastrointestinal hazardsto detergent exposure (GargandMulla,2024). These findings should not be extrapolated due to the small sample size, but they do emphasize the necessity of more stringent quality control throughout the supply chain.

UsingFreezingPointasaDiagnosticIndicator

The freezing point of milk typically ranges from −0.530°C to −0.570°C, however local vendor milk has a lowervalue(−0.851°C),whichisunusualforsimplewaterdilution.

The reason for this disparityis **ureaadulteration**,whichconsiderablylowers the freezing point (Ibrahim etal.,2025). Therefore, despitethefreezing pointanomaly, theresults stillsupportwater dilution whenpaired with other indications.

CONCLUSION

The current study found that packaged buffalo milk fromwell-organized dairy brandsmostly followed FSSAI standards and was generally safer to drink, but a small number of samples showed signs of minor detergent contamination. In contrast, milk from the local vendor had a lot of harmful substances mixed in, like water, detergent, starch, urea, and hydrogen peroxide, which makes it not safe to drink. The study also showed that quickhometestsworkwellforfindingcommonharmfulsubstancesandcanbehelpfulforinitialcheck s.Milk that is mixedwithharmfulsubstances, especiallyinpartsofthe industry thatarenot wellregulated, continues to be a major problem for public health.This shows that it is important to check the quality of milk often, enforcestrictrules, andhelppeopleunderstandhow tospotunsafemilksotheycangetsafeandhealthymilk to drink**.**

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