

## Determination of physical and chemical parameters, adulteration and hygienic status of raw milk in Thane

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### Abstract

The present study was conducted to evaluate physiochemical parameters of raw milk samples sold in Thane city. Fifty samples of loose buffalo milk were collected from ten selected dairy shop of Thane. Samples were tested separately for fat, solid-non-fat, protein, acidity and specific gravity. Statistical analysis revealed significant variation for fat among different milk samples while other parameters found as per recommended standards. A simple variance analysis (ANOVA) was performed. The result of variance analysis confirmed that there was significant difference between the mean values for parameters of collected milk samples ( $p < 0.05$ ). The analysis concluded that only two samples were adulterated with traces of glucose while other 48 milk samples analyzed were free from adulterants like urea, starch, glucose, sugar, salt and nitrates

**Keywords:** Raw milk, physical and chemical parameters, adulterants.

### Introduction

Milk is the best and cheapest source of nutrition used by all the age group in rural as well as urban areas. Fresh milk is the most common dairy product consumed in our daily life. It is the raw material of all dairy product. It is the only food of young mammals during the early period of its life. Milk also contains antibodies which protect infants against infection. (Mehmood *et al.*, 2010). Milk is a perfect food as it contains all essential nutrients for all physiological function of body system. It is valuable source of calcium, phosphorus and fat soluble vitamins (A, D, E and K) (Kajal *et al.*, 2012). Milk and other dairy products are consumed worldwide and have great commercial importance within the food industry. (Hurley *et al.*, 2006)

The important indicator measured in dairy industry is commercial milk quality which directly depend on the source. Milk must come from healthy animal, be handled hygienically and be free of toxic residues. Therefore raw milk control must be efficient in the farms (Candy *et al.*, 2013) The current process for milk collection from a large number of farmers are time consuming, costly and causes adulteration. (Hossain *et al.*, 2013).

Recently consumer health concerns were developed to the milk properties i.e. SNF, TS, acidity, fat and protein. The presence of these properties in standard ratio is very important (Hossain *et al.*, 2013). Milk quality is directly related to composition and hygiene (Saleem *et al.*, 2015). Adulteration of milk is most serious issue as chemicals which are being used as adulterants may cause health hazard (Soomro *et al.*, 2014). Thus, present study was conducted to evaluate the adulteration, quality and composition of milk sold in Thane city.

### Research Methodology

Fresh milk samples of loose buffalo milk were collected for analysis from the selected dairy shops from following different areas of Thane City in the year 2018: Kopri (S1), Majiwada (S2), Vartak Nagar (S3), Naupada (S4), Vrundavan (S5), Kolshet (S6), Manpada (S7), Vasant Vihar (S8), Patlipada (S9) and Owale (S10). Ten different dairy shops were distributed in two equal groups. Total fifty samples were collected for the period of ten months as five samples monthly from each group. 250ml milk sample was taken from each shop in sterilized

plastic bottle, labelled and immediately brought to the laboratory for analysis. Each sample was tested for physical and chemical parameters, detection of adulterants and hygienic status.

**Physical examination:** Each sample was observed for colour and flavor.

**Chemical composition:** different chemical parameters of milk such as percentage fat and protein were determined using standard procedure according to FSSAI Manual 2015. Determination of the fat content of sample was done by Gerber Method. Protein was determined by Kjeldahls method. Solid-non-fat (SNF) content of milk was determined from corrected lactometer reading (CLR) by the formula:

$$\text{SNF} = \text{CLR}/4 + (0.21 \times \text{Fat } \%) + 0.36$$

**Physiochemical characteristics:** The physiochemical properties like acidity and specific gravity of various milk samples were determined. Acidity in terms of percentage lactic acid was measured by titrimetric analysis. Specific gravity was calculated by lactometer reading by the formula: (Sharma, 2019)

$$\text{Specific gravity} = 1 + \text{CLR} / 1000$$

**Hygienic status:** hygienic status of milk was measured by clot on boiling (COB) test and methylene blue reduction test (MBRT). (Reddy *et al.*, 2018)

**Milk Adulterants:** various milk adulterants like urea, starch, glucose, sugar, salt and nitrates were detected using standard procedure according to FSSAI manual 2015. (Singh *et al.*, 2012)

**Statistical Analysis:** The standard deviations were calculated for comparing milk samples with standard. Descriptive statistics including mean, standard deviation, minimum and maximum values were obtained. Analysis of variance (ANOVA) was done to find statistical difference within the parameters of milk samples.

## Results and Discussion:

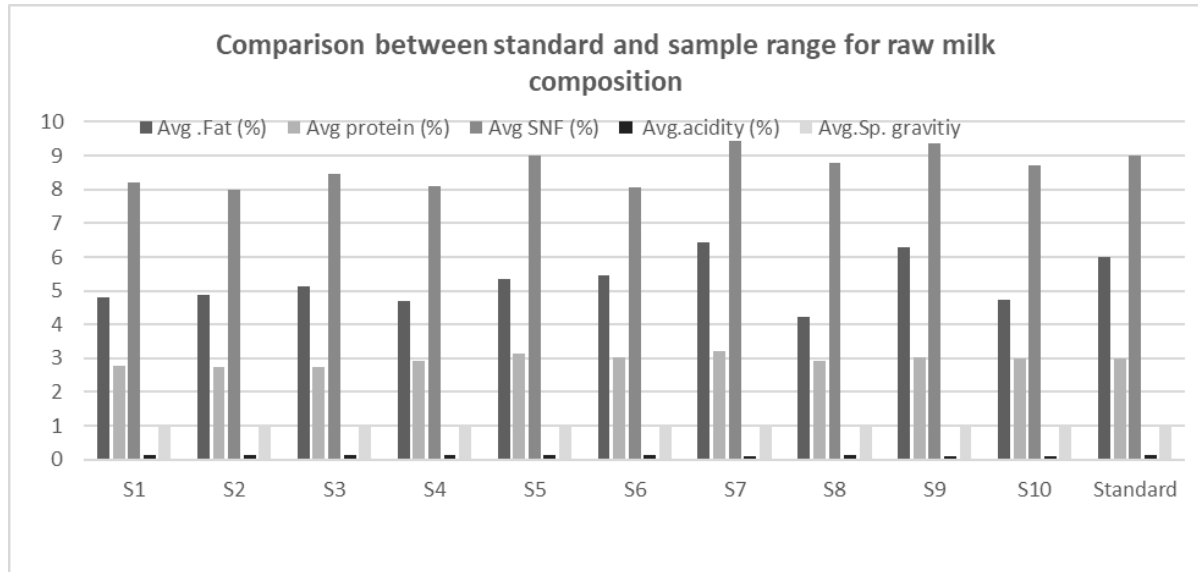
### Physical examination:

**Colour:** The colour of all samples was creamy white.

**Flavour:** The pleasant samples contributed to 78% and good contributed to 22% in flavour category.

### Chemical Composition:

**Fat:** The percentage fat content of milk samples S1 to S10 were  $4.79 \pm 0.89$ ,  $4.88 \pm 0.36$ ,  $5.12 \pm 0.33$ ,  $4.68 \pm 1.40$ ,  $5.34 \pm 0.82$ ,  $5.44 \pm 0.39$ ,  $6.42 \pm 0.68$ ,  $4.22 \pm 0.15$ ,  $6.28 \pm 0.52$ ,  $4.74 \pm 0.83$  respectively (Table 1). It was observed that average value of fat of sample S7 ( $6.42 \pm 0.68$ ) was higher and sample S8 ( $4.22 \pm 0.15$ ) was lower than other milk samples. The fat content of sample S1, S2, S3, S6, S8, S10 were below standard fat level of minimum 6% (figure 2).



**Protein:** The percentage protein of milk samples S1 to S10 were  $2.77 \pm 0.51$ ,  $2.73 \pm 0.06$ ,

$2.75 \pm 0.33$ ,  $2.91 \pm 0.56$ ,  $3.15 \pm 0.61$ ,  $3.04 \pm 0.04$ ,  $3.20 \pm 0.32$ ,  $2.92 \pm 0.08$ ,  $3.04 \pm 0.06$ ,  $3.00 \pm 0.09$  respectively (Table 1). The protein content of sample S5 ( $3.15 \pm 0.61$ ) was higher and sample S2 ( $2.73 \pm 0.06$ ) was lower than protein content of other milk samples. From present study it was observed that protein content of all milk samples was nearest to standard protein level of minimum 3 % (figure 2).

**SNF:** The percentage of Solid-non-fat of milk samples S1 to S10 were  $8.19 \pm 0.79$ ,  $7.99 \pm 0.51$ ,  $8.10 \pm 1.08$ ,  $8.47 \pm 0.29$ ,  $9.02 \pm 0.64$ ,  $8.05 \pm 1.13$ ,  $9.43 \pm 0.20$ ,  $8.77 \pm 0.062$ ,  $9.36 \pm 0.25$ ,  $8.70 \pm 0.33$  respectively (Table 1). The SNF content of sample S5 ( $9.02 \pm 0.64$ ) was higher and sample S2 ( $7.99 \pm 0.51$ ) was lower than SNF of other milk samples. It was observed that the SNF content of all milk samples was within the standard level of 9.0 % (figure 2).

**Acidity:** acidity in terms of percentage lactic acid of milk samples S1 to S10 were

$0.127 \pm 0.007$ ,  $0.126 \pm 0.006$ ,  $0.129 \pm 0.006$ ,  $0.127 \pm 0.009$ ,  $0.124 \pm 0.007$ ,  $0.118 \pm 0.007$ ,  $0.116 \pm 0.015$ ,  $0.120 \pm 0.018$ ,  $0.114 \pm 0.012$ ,  $0.113 \pm 0.013$  respectively (Table 1). The acidity of sample S4 ( $0.127 \pm 0.009$ ) was higher and sample S6 ( $0.118 \pm 0.007$ ) was lower than acidity of other milk samples. The titratable acidity of milk typically varies from 0.12 to 0.19 %. It was observed that acidity of all milk samples was within the standard range (figure 2)

**Specific Gravity:** Specific gravity of milk sample S1 to S10 were  $1.027 \pm 0.002$ ,

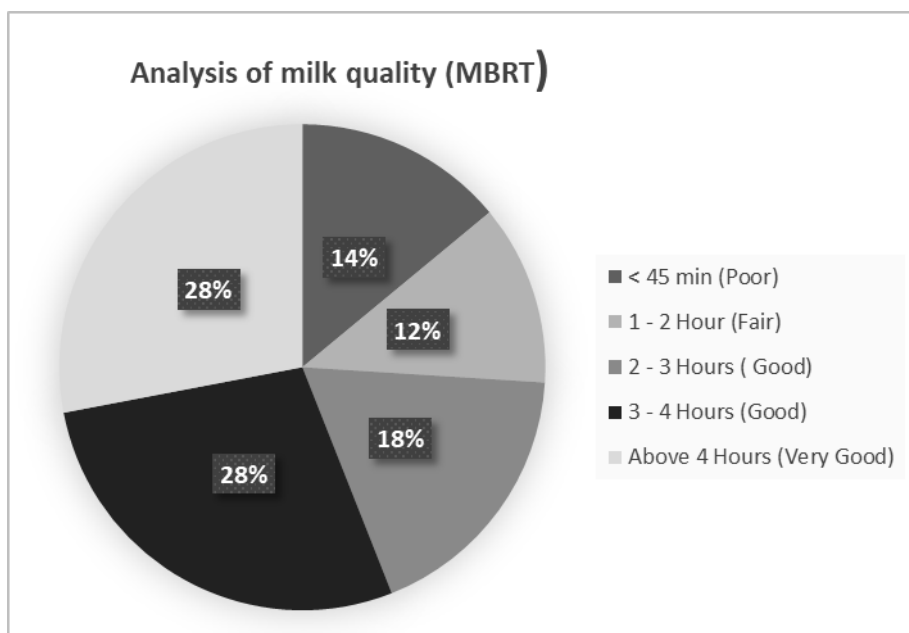
$1.027 \pm 0.002$ ,  $1.028 \pm 0.001$ ,  $1.027 \pm 0.002$ ,  $1.028 \pm 0.003$ ,  $1.025 \pm 0.004$ ,  $1.031 \pm 0.001$ ,  $1.030 \pm 0.000$ ,  $1.031 \pm 0.000$ ,  $1.030 \pm 0.001$  respectively (Table 1). It was found that the specific gravity of sample S7 ( $1.031 \pm 0.001$ ) was higher and sample S6 ( $1.025 \pm 0.004$ ) was lower than specific gravity of other milk samples. The specific gravity of buffalo milk ranges from 1.030 -1.032. From present study it was observed that specific gravity of all milk samples was very close to standard range (figure 2)

### Hygienic Status:

**COB (Clot on Boiling) Test:** Result of COB test showed that all fifty samples found negative for clot on boiling test indicating all the samples are of good quality.

**MBRT (Methylene Blue Reduction Test):** In 14 % samples the dye got decolorized in less than 45 mins. indicating very poor quality of milk, in 12% samples dye was reduced in 1 to 2

hrs. indicating fair quality of milk, in 18% samples dye was reduced in 2 to 3 hrs. indicating good quality, in 28% samples dye was reduced in 3 to 4 hrs. showing good quality of milk samples and 28% samples were found to be of very good quality as dye was reduced in more than 4 hrs. (figure 1)



**Adulterants:** All samples were tested for adulterants like urea, starch, glucose, sugar, salt and nitrates. The result showed that glucose adulteration was present in two samples while other 48 samples were found negative for adulteration of urea, starch, glucose, sugar, salt and nitrates.

**Table 1. Parameters of milk samples (Mean  $\pm$  SD)**

Sample	Fat %	Protein %	SNF %	Acidity %	Sp. Gravity
S1	4.79 $\pm$ 0.89	2.77 $\pm$ 0.51	8.19 $\pm$ 0.79	0.127 $\pm$ 0.007	1.027 $\pm$ 0.002
S2	4.88 $\pm$ 0.36	2.73 $\pm$ 0.06	7.99 $\pm$ 0.51	0.126 $\pm$ 0.006	1.027 $\pm$ 0.002
S3	5.12 $\pm$ 0.33	2.75 $\pm$ 0.33	8.47 $\pm$ 0.29	0.129 $\pm$ 0.006	1.028 $\pm$ 0.001
S4	4.68 $\pm$ 1.40	2.91 $\pm$ 0.56	8.10 $\pm$ 1.08	0.127 $\pm$ 0.009	1.027 $\pm$ 0.002
S5	5.34 $\pm$ 0.82	3.15 $\pm$ 0.61	9.02 $\pm$ 0.64	0.124 $\pm$ 0.007	1.028 $\pm$ 0.003
S6	5.44 $\pm$ 0.39	3.04 $\pm$ 0.04	8.05 $\pm$ 1.13	0.118 $\pm$ 0.007	1.025 $\pm$ 0.004
S7	6.42 $\pm$ 0.68	3.20 $\pm$ 0.32	9.43 $\pm$ 0.20	0.116 $\pm$ 0.015	1.031 $\pm$ 0.001
S8	4.22 $\pm$ 0.15	2.92 $\pm$ 0.08	8.77 $\pm$ 0.062	0.120 $\pm$ 0.018	1.030 $\pm$ 0.000
S9	6.28 $\pm$ 0.52	3.04 $\pm$ 0.06	9.36 $\pm$ 0.25	0.114 $\pm$ 0.012	1.031 $\pm$ 0.000

S10	4.74 ±0.83	3.00 ± 0.09	8.70 ± 0.33	0.113 ± 0.013	1.030 ± 0.001
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ANOVA

Source of Variation	SS	Df	MS	F	P-value	F crit
Rows	2.788467227	9	0.30983	2.492052	0.02501	2.152607
Columns	467.6099414	4	116.9025	940.2814	7.21E-36	2.633532
Error	4.475776674	36	0.124327			
Total	474.8741853	49				

The variance analysis is showed in Table 2. Results of the analysis of variance confirm that the variability of certain chemical parameters of milk was significant ( $p < 0.05$ )

**Table 2. Variance analysis of chemical parameters of milk**

Anova: Two-Factor Without Replication				
SUMMARY	Count	Sum	Average	Variance
S1	5	16.90554	3.381108	10.41459
S2	5	16.76344	3.352688	10.03036
S3	5	17.49524	3.499048	11.33097
S4	5	16.84214	3.368428	10.08532
S5	5	18.65724	3.731448	12.79141
S6	5	17.6795	3.5359	10.56392
S7	5	20.19114	4.038228	14.96448
S8	5	17.0623	3.41246	11.52677
S9	5	19.8253	3.96506	14.70475
S10	5	17.5856	3.51712	11.60886
Avg. Fat	10	51.91	5.191	0.494499
Avg. protein	10	29.504	2.9504	0.026827
Avg. SNF	10	86.0956	8.60956	0.285774
Avg. acidity	10	1.2132	0.12132	3.51E-05
Avg.Sp.gr	10	10.28464	1.028464	3.29E-06

**Conclusion:**

The statistical analysis showed that sample S5, S7 and S9 were found superior for higher milk protein, fat and SNF. Except fat, other parameters of different milk samples found as per recommended standards. COB test and MBRT test concluded that quality of milk samples was good. Variance analysis for milk samples revealed that there is significant difference between the mean values of collected milk samples ( $p < 0.05$ ). Except two samples, other milk samples were free the adulterants like urea, starch, glucose, sugar, salt and nitrates.

**Acknowledgement:**

The authors are thankful to the Principal, Management, Head- Department of Chemistry, Vartak college and The Principal of Dnyanasadhana college for encouragement during the process of carrying out this work.

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