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Detection of extraneous water adulteration and physico-chemical quality of market milk collected from different areas of Parbhani

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ABSTRACT : Present work was performed to detect extraneous water adulteration in market milk samples collected from four different areas of Parbhani city and to study their effect on physico-chemical quality milk. Milk samples were evaluated for added water, compositional parameters and physic-chemical properties. The results emerged from the study shows that compositional parameters *viz.*, water, total solids, solids not fat, protein, fat, lactose content of milk sample collected from different areas of Parbhani city did not differ significantly, but salt content in milk sample shows significant difference. Similar significant difference was found in physico-chemical properties *i.e.* acidity and pH of different area milk sample. However freezing point and density of milk sample did not differ significantly. Water adulteration was observed in 36, 76, 64, 32 per cent market milk samples of A, B, C, D areas in Parbhani city, respectively. Addition of extraneous water in milk sample of area A significantly differ (P<0.05) from C and D areas of Parbhani city and influence on the physico-chemical quality of milk.

KEY WORDS : Market milk, Water addition, Quality of different areas milk, Compositional parameters, Physico-chemical properties

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INTRODUCTION

Milk is perfect and balanced food, having high biological value in nature which is compulsory part of diet for the expectant mothers as well as growing children (Javaid *et al.*, 2009). Milk is defined as the whole, fresh, clean, lacteal secretion obtained by complete milking of one or more healthy animals excluding that obtained fifteen days before or five days after calving, such periods as may be necessary to render milk practically colostrums free and containing the minimum prescribed percentage of milk fat 3.5 and solids not fat 8.5 (Goff and Hill, 1993). Milk is considered as nature's single most complete food as it contains all the nutrients necessary for health in right proportion. Chemically milk is complex mixture of fat, protein, carbohydrate, minerals, and other miscellaneous constituents, which are dispersed in water and make it a complete diet. According to Ramesh (2006) milk contains water-87.67 per cent, milk solids -12.7 per cent, SNF- 9.7 per cent, protein - 3.40 per cent, milk sugar or lactose- 4.90 per cent and ash-0.70 per cent, but composition of milk varies with species of animal, genetic and environment factors, as buffalo and cow milk contains total solids- 17 per cent and 13.9 per cent, fat-7.6 per cent and 4.5 per cent, protein- 3.8 per cent and 3.8 per cent, lactose- 4.9 per cent and 4.9 per cent, respectively (Khan *et al.*, 2005). Dairy product quality starts at the farm; good dairy products can only be made from good quality raw milk, so milk should have normal composition. Milk quality is directly related to its composition and hygiene.

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Milk is a product of biological evolution obtained from different species of animal which contributes about 24 per cent of milk from indigenous cows, 55 per cent from buffalo and 21 per cent from cross bred cows (Sunjay, 2012). Buffalo is the most valuable animal and is preferred more than the cow's milk, as buffalo milk has a richer taste due to its contents of milk fat, protein, lactose, total dry matter, vitamin and minerals than cow milk. But during scarcity of milk availability water is the most common adulterant found in milk to increase volume of milk. As milk is directly related with the health of consumer and its adulteration may leads to serious health hazards, for this reason present study is planned to observe the extent of water adulteration in market milk samples collected from four different areas of Parbhani city and its influence on the physical characteristics of market milk.

MATERIAL AND METHODS

A total of Hundred raw milk samples were collected from four areas (A, B, C, D) of Parbhani city located in Maharashtra state *i.e.* 25 milk samples from each area. Two hundred and fifty milliliter (250 ml) of market milk samples were collected in the morning under aseptic conditions and transferred in sterile bottles to laboratory in cold chain 4°C and then they were analyzed. Collected milk samples were analyzed for added water, fat, protein, lactose and solid not fat, freezing point and density by using milk analyzer Lacto scan SL (manufactured by-Milkotronic Ltd., Bulgaria) as per the manufacturer's instructions. Before analyzing milk samples were mixed gently 4-5 times to avoid any air enclosure in the milk and milk analyzer kept in the recess position. Approximately 25 ml of milk samples were taken in the sample tube which was put in the sample holder one at a time. As the starting button activated, the milk analyzer sucks the milk, makes the measurements, and returns the milk in the sample-tube. The specified results after the measurement displayed on the digital indicator (IED display). Analysis of milk samples for its total solids content was done as per the method AOAC, 2000. Acidity of milk samples was determined according to the method of AOAC, 1990. A digital pH meter (model -920 LMPH- 12) was calibrated using buffers solution of pH 7.0 and 4.0 prior to use. Then the pH of milk samples was measured.

Water :

Amount of water present in milk samples was calculated by using following formula :

Water (%) = 100 – Total solids

Statistical analysis :

Data obtained during the study analyzed by analysis of variance using Completely Randomized Design (CRD) as suggested by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Compositional parameters :

Data obtained from chemical analysis of market milk collected from different areas of from four areas of Parbhani city are presented in Table 1. Statistical analysis of chemical composition reported that water, total solids, solid not fat, fat, protein, lactose content of milk samples did not differ significantly. The values for total solids (12.56 %), SNF (6.87 %) content was lower in C area market milk sample than other area milk sample, while highest T.S. SNF content *i.e.* 15.78 per cent, 8.25 per cent, respectively found in area A milk sample of Parbhani city. Milk sample of B and D area contains total solids 13.26 per cent and 13.98 per cent, while SNF 7.72 per cent and 7.14 per cent, respectively. Whereas Lateef *et al.* (2009) observed lower observations for total solids 6.54±0.20 per cent and solid not fat content 4.98±0.26 per cent in milk supplied to canteens of various Hospitals in Faisalabad city. Contrarily Higher water content was noted in C area milk sample (87.94 %), followed by B area (86.23 %), D area (84.92 %), A area (84.21 %). Similarly Mohammad *et al.* (2007) recorded maximum water content in s5 (84.8 %) followed by s3 (84.6 %) while minimum in s1 followed by s2. Ali Ibrahim *et al.* (2012) noted average moisture content 87.6 per cent in cow's dairy farms samples.

Maximum value of fat (7.5 %) was recorded in A area milk sample followed by D area milk sample (6.83 %), B area milk sample (6.53 %) then by C area milk sample (6.24 %) which was

Table 1 : Chemical composition different areas milk sample of Parbhani city

Collection of milk samples	Compositional parameters (%)						
	Water	Total solids	Solid not fat	Fat	Protein	Lactose	Salt
A	84.21	15.78	8.25	7.5	3.02	4.52	0.69[b]
B	86.23	13.76	7.23	6.53	2.55	3.96	0.60[b]
C	87.4	12.56	6.87	6.24	2.82	3.95	12.54[a]
D	84.92	13.98	7.14	6.83	2.61	3.91	13.98[a]
S.E. ±	NS	NS	NS	NS	NS	NS	0.90
C.D.	NS	NS	NS	NS	NS	NS	2.72

NS= Non-significant

minimum in four area of Parbhani city. Results are in agreement with Zeki *et al.* (2013) observed fat percentage (7.04±0.84 %). Shaikh *et al.* (2013) also noted significantly ($p<0.05$) lower average fat content of Hyderabad and its surrounding areas market milk than that of control milk.

With regard to protein content, A area milk sample found with higher protein 3.02 per cent while the lowest protein content 2.55 per cent was recorded in B area, while in C and D area milk sample of Parbhani city it was noted 2.82 per cent and in 2.61 per cent, respectively. Results are in close agreement with Lingathurai *et al.* (2009) who found slightly higher (3.77 %) protein content. Tanim Jabid Hossain *et al.* (2010) recorded 3.07-3.57 per cent protein content of the raw milk. Lingathurai *et al.* (2009) found slightly higher (3.77 %) protein content. Lower values of protein content in milk samples of Parbhani city may result due to addition water/ mixing of cow milk with buffalo milk.

Lactose content was observed in declining trend from area A to D showing 4.52 per cent lactose content in A area milk sample while 3.96, 3.95, 3.91 per cent lactose in B, C, D area milk sample of Parbhani city, respectively. Shaikh *et al.* (2013) observed slightly higher lactose content than our results *i.e.* 4.9 per cent in milk samples. However, Muhammad *et al.* (2010) recorded the average values for lactose were 2.87±0.27 per cent and noted that average value for lactose content was significantly lower than the value given in the manual of united states public health services.

Salt content in milk sample of A and B area did not differ significantly; similar non-significant difference was noted in C and D area milk sample of Parbhani city. But the highest level of salt noted in both C and D area milk sample of Parbhani city. Variation in salt content of different area milk sample may be due to stage of lactation/ may be the effect of geographic area.

The compositional parameters of milk sample collected from four areas of Parbhani city did not reach to the buffalo milk standards. The variation in value of compositional parameters from buffalo milk standards may due to addition of water/skimming/ mixing of cow milk with buffalo milk.

Phyisco-chemical properties of milk :

Significant difference ($P<0.05$) was noted in B area milk sample for per cent acidity and pH value; however, per cent acidity and pH value of A, C and D area milk samples did not differ significantly. Highest acidity (0.173 %) and pH 6.90 noted in C area milk sample, lower values for acidity (0.154 %) and pH 6.72 was observed in B area milk sample. It was observed from results that the values of for titrable acidity were in the range of 0.15- 0.17 per cent. Results are in close agreement with Javaid *et al*. (2009) who found titrable acidity of market milk as 0.13, 0.15 and 0.17 per cent. Whereas, Lateef *et al*. (2009) reported 0.07 per cet titrable acidity in market milk sample. Correlation between per cent acidity and pH value of milk sample shows inverse relation, it means as pH increases per cent acidity decrease and vice versa. But all the pH values of milk were observed slightly higher than normal. The higher pH observed in market milk samples was may be due to the extensive use of preservatives and other adulterants in market milk. Similarly, Javaid *et al.* (2009) observed remarkable differences among the mean pH values (6.54, 6.53, 6.65 and 6.66) of several milk samples.

Addition of extraneous water in milk sample of A area significantly differ ($P<0.05$) from other C & D areas of Parbhani city, while water addition in milk samples of B area did not differ significantly from the milk sample of A as well as C and D area of Parbhani city (Table 2). Extraneous water addition in market milk samples was observed in declining trend from area D to area A milk sample of Parbhani city. it means extraneous water adulteration was maximum in D (19.98 %), area followed by C area (17.33 %), B (11.75 %) area, A area (1.56 %) of Parbhani city. Prevalence study shows water adulteration in 36, 76, 64, 32 per cent market milk samples of A, B, C, D areas in Parbhani city, respectively. The present findings are in close agreement with Tasci (2011) found 30 per cent milk samples with added water in Turkey. Similarly Joshi (2012) noted water adulteration in 52.2 per cent raw milk sample of Parbhani. Contrarily Lateef *et al*. (2009), who observed extraneous water 93.33 per cent in all the samples studied. The mean extraneous water in market milk samples was higher than control milk samples. Water is the main adulterant which was frequently used for adulteration of milk in various countries of the world to increase the quantity of milk. But its addition not only reduces the nutritional value of milk but contaminated water may also pose a health risk to consumer. Many times milk dealers also add dirty ice to increase

Table 2 : Extent of extraneous water adulteration in market milk of Parbhani city and its effect on physico-chemical properties.

Collection of milk samples	Physico-chemical properties				Water adulteration	
	pH	Acidity (%)	Density g mL^{-1}	FP (^{0}c)	Water addition (%)	Prevalence (% milk sample)
A	6.74^{b}	0.169^{a}	1026	- 0.556	1.55^{b}	36
B	6.90^{a}	0.154^{b}	1023	- 0.477	11.75^{ab}	76
C	6.72^{b}	0.173^{a}	1022	- 0.467	17.33^{a}	64
D	6.81^{ab}	0.162^{ab}	1022	- 0.453	19.98^{a}	32
S.E. ±	0.04	0.005	NS	NS	4.81	
C.D.	0.12	0.011	NS	NS	14.43	

NS= Non-signficant

the shelf life of milk which is also one of the reasons of elevated level of extraneous water in milk samples.

The freezing point of milk samples collected from different areas of Parbhani city did not differ significantly. Freezing point of milk sample declining from area A to area D milk sample. Addition of extraneous water in milk will have adverse effect on freezing point and nutritional quality. Increase in water adulteration has negative effect on the FP of milk sample. Freezing point of milk sample in A area found - 0.556, in B area - 0.477, in C area - 0.467 and in D area - 0.453. Similarly Dehinenet *et al*. (2013) noted negative effect of water adulteration (addition) on freezing point of milk sample. The results are in close agreement with Ghulam *et al*. (2014) revealed no significant difference (P>0.05) in average freezing point of milk sold by MP, MC, MM, P and DS.

Density of different area milk saple also shows non-significant difference. Area A milk sample shows highest density 1026 g mL^{-1} while lowest 1022 g mL^{-1} was in D area milk sample of Parbhani city. It is noticeable from the table that as water adulteration in milk increases the density of milk sample decreases and *vice versa*. Density of all area milk samples did not reaches to the standards Similar rates of density were reported as average 1.026-1.032 g/cm^3 Javaid *et al*. (2009). Whereas Walstra *et al*. (2006) observed 1029 g mL^{-1} density of milk of fresh whole milk. Values for density of milk sample correlated with percentage of added water and observed that extraneous water addition reduce the density of milk.

Conclusion :

The water was the most common adulterant found in majority of market milk samples which affect quality of milk samples as well as contaminated water increases risk of health hazard to consumers.

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