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DETECTION OF ADULTERANTS AND THEIR EFFECT ON THE QUALITY CHARACTERISTICS OF MARKET MILK

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ABSTRACT

Present study was conducted to investigate the extent of adulteration and its influence on chemical characteristics of market milk sold in the Hyderabad city and its surroundings during the year 2012. Twenty market milk samples from different sale points of Hyderabad city and its surrounding areas and similar number (20) of whole buffalo milk (control) from different dairy farms of the vicinity of Hyderabad were examined at the laboratory of Institute of Food Sciences and Technology/ Department of Animal Product Technology, Sindh Agriculture University, Tandojam. Adulterants like extraneous water, hydrogen peroxide, starch and urea were detected in market milk samples of both areas of Hyderabad city. Extraneous water was found as a main adulterant in all the market milk samples (100%) of both areas. The data revealed that 40% of total market milk samples collected from Hyderabad city were adulterated with hydrogen peroxide, 30% with starch and 25% samples with urea. Among the market milk samples collected from surrounding areas of Hyderabad, 15% samples were adulterated with starch and 10% samples with each hydrogen peroxide and urea. Chemical characteristics like total solids, fat, total protein, casein, lactose and ash contents of market milk were significantly ($P<0.05$) lower than that of control milk. It is concluded from the study that all the market milk samples did not meet the required compositional quality accepted as standard. These adulterants have strong potential to degrade the quality of milk, thus the milk is not suitable for human consumption.

Keywords: Adulteration, chemical characteristics and market milk.

INTRODUCTION

Milk, if present in its natural form has high food value. It supplies nutrients like good quality proteins, fat, carbohydrates, vitamins and minerals in significant amount than any other single food (Neumann *et al*., 2002). Unfortunately, the milk for the consumption for the people of Pakistan is not wholesome, and adulterated to such an extent that there is very less nutritive value in it (Loudon

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and Irvine, 1986). Reason behind this may be an increase in demand of milk which could be due to continuous increase in population or because of hot weather and shortage of fodder. Another factor may be of traditional milk distribution system in the country which involves middlemen. In such condition, to compensate this gap between demand and supply the people adulterate the milk to maximize their profit (Lateef *et al*., 2009). Milk dealers may either dilute the milk or extract valuable components and there after add cheap substances to maintain its compositional parameters. These substances include starch, urea, preservatives like formalin, hydrogen peroxide, boric acid and various antibiotics (Tipu *et al*., 2007). Urea is added for whitening of milk and only few grams of urea are enough to bring milk in its original state (Walker *et al*., 2004). Hydrogen peroxide is used as preservative usually in summer season when environmental temperature is very high. This unethical activity is usually adapted to prevent the financial losses due to the spoilage of milk during its transportation and sale (Naz, 2000). Milk adulteration is not only the problem of Pakistan but some other countries are also suffering from this unethical activity. Therefore present study was designed to observe the extent of adulteration at Hyderabad and its surroundings and their influence on chemical characteristics.

MATERIALS AND METHODS

Study was conducted to observe the extent of adulteration and its influence on the chemical characteristics of market milk sold at Hyderabad city and its surroundings during the summer season 2012. A total of twenty market milk samples were collected randomly from each area and examined at the laboratory of Institute of Food Sciences and Technology/ Department of Animal Product Technology, Sindh Agriculture University, Tandojam. Parallel to market milk, twenty samples of whole buffalo milk (control) were also collected from different dairy farms of Hyderabad and surroundings for comparison purpose.

Analysis

Total solids, casein and ash content of milk samples were examined according to the methods of Association of Official Analytical Chemists (AOAC, 2000). Protein content was determined according to the method of British Standards Institute (BSI, 1990). Fat content of milk was determined by Gerber method as described by James (1995). However, the lactose content was determined by subtracting the sum of percentages of protein, fat and ash contents from the total solids content. Adulterants such as starch, hydrogen peroxide and urea were detected by using milk Adulteration Testing kit (Quality Operation Laboratory, University of Veterinary and Animal Science, Lahore) consisting of reagent bottles for each adulterant. While extraneous water was determined through depression of freezing point and calculated by using following formula:

$$\text{Percent water added} = \frac{\text{Freezing point base} - \text{Observed freezing points}}{\text{Freezing point base}}$$

Data analysis

The data obtained was tabulated and analyzed according to statistical procedure of analysis of variance (ANOVA), and significant differences of the mean were further computed using least significant difference (LSD) at 0.05% level of probability through computerized statistical package i.e. Student Edition of Statistix (SXW), Version 8.1 (Copyright 2005, Analytical Software, USA).

RESULTS AND DISCUSSION

Results presented in Table 1 show that the extent of adulteration in the market milk samples collected from Hyderabad city was more than that of the surrounding areas of Hyderabad, which agrees with the findings of Bhatt *et al.* (2008), who observed elevated adulteration practice in urban area than in rural area. Adulteration of extraneous water remained 100% (20 numbers) which was similar with the findings of Lateef *et al. (*2009), who reported adulteration of water in 93.33% of milk samples. Hydrogen peroxide was detected in 40% and 10% of the milk samples examined in each area of Hyderabad city and surroundings, respectively. This was added to increase the shelf life of milk. Starch was detected in 30% of milk samples of Hyderabad city and 15% of the samples taken from surroundings of Hyderabad. Starch content in milk samples was also observed. Urea remained 25% in city samples and 10% in the milk samples collected from surrounding areas. The results related to urea are in line with the work reported by Bhatt *et al.* (2008), who determined 16, 24, 35 and 12% of urea adulteration in milk samples of different urban areas, however, in rural areas urea remained 9, 8, 16 and 4 %. The pH value observed in market milk samples was higher than control milk samples. Similarly, Javaid *et al*. (2009) observed remarkable differences among urban and rural area milk. In present study, chemicals like hydrogen peroxide was possibly added to increase the shelf life of milk, while starch was probably added to increase the viscosity of milk.

Table 1. Adulterants observed in market milk samples of Hyderabad city and its surrounding areas.

Adulterants	Market milk samples			
	Hyderabad city		Surrounding areas of Hyderabad	
	Number (n=20)	%	Number (n=20)	%
Extraneous water	20	100	20	100
Hydrogen peroxide	8	40	2	10
Starch	6	30	3	15
Urea	5	25	2	10

Fig.1 reveals that the average total solid contents in market milk samples of Hyderabad and its surrounding areas were 13.56± 0.1 and 13.8±0.4 %, respectively, which seems to be significantly ($P< 0.05$) lower than that of control milk (17.35±0.1%). This was probably due to the presence of extraneous water in

market milk as addition of water to milk decreases the concentration of all the nutrients. Among the market milk samples, the milk from the surrounding areas of Hyderabad contained more total solids (13.8±0.4%), compared to that of milk obtained from the sale points of Hyderabad city (13.56± 0.1%), the differences among them were not significant (P>0.05). Present results were in line with study conducted by Ahmad (2009) who reported that none of the milk samples found to be with in the average standard range of total solid content.

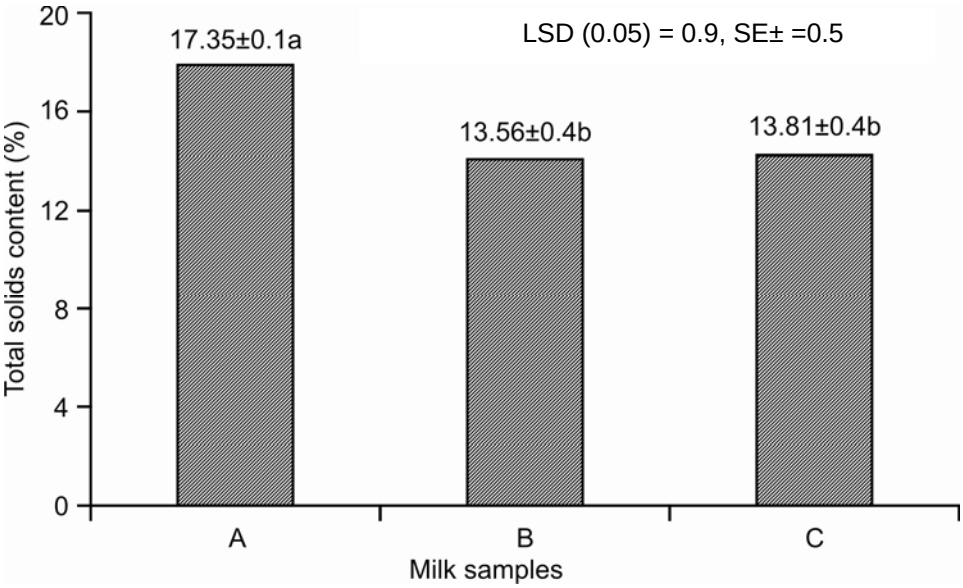

Figure 1. Total solids content (%) of (A) Whole buffalo milk i.e. Control (B) Market milk collected from Hyderabad city (C) Market milk collected from surrounding areas of Hyderabad city.

The average fat content of market milk at Hyderabad and its surrounding areas remained 5.28 ± 0.2 and 5.45±0.2%, respectively which was significantly (P< 0.05) lower than that of control milk (6.48 ± 0.07). While among the market milk samples the fat content of milk obtained from the surrounding areas of Hyderabad city seems to be higher (5.45±0.2%), compared to that of milk samples obtained from the sale points of Hyderabad city (5.28±0.2%), however, the differences among them were statistically not significant (P>0.05) (Fig. 2). The values of average fat content observed in present study were relatively lower than average fat content in buffalo milk (7.6%) as reported by Khan *et al*. (2005). This seems to be due to several malpractices such as skimming and dilution of milk by milk dealers.

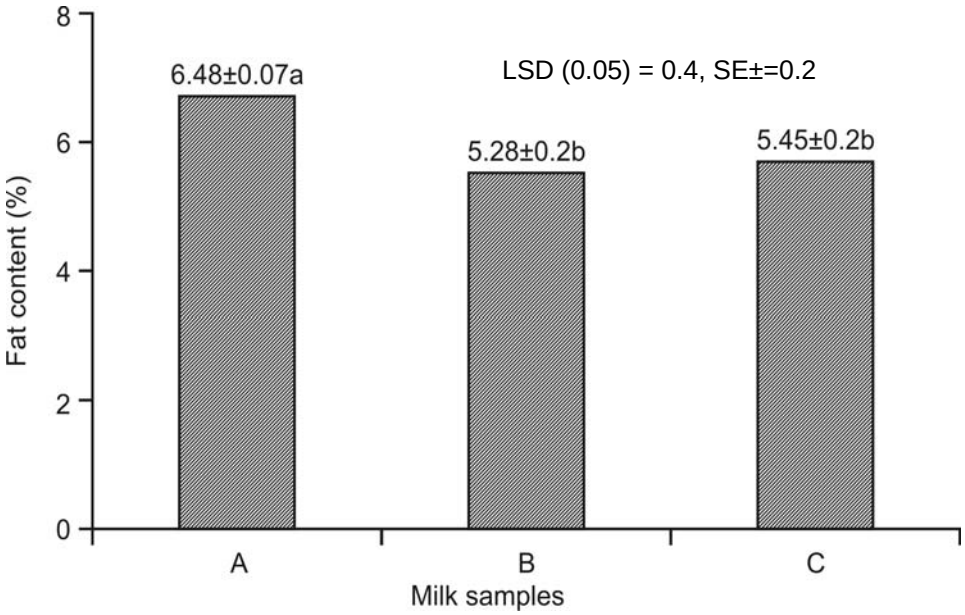

Figure 2. Average fat content (%) of (A) Whole buffalo milk i.e. Control (B) Market milk collected from Hyderabad city (C) Market milk collected from surrounding areas of Hyderabad city.

Results presented in Fig. 3 reveal that market milk samples of surrounding areas were better in protein content (3.18±0.09%), compared to that of milk sold at Hyderabad city (i.e. 3.09±0.09%). However, the differences among the samples were statistically non-significant (P> 0.05). Moreover, the protein content of milk sold at both areas was comparatively lower (P< 0.05) than that of control milk (3.65±0.02%). Present findings regarding the protein content indicated that the milk samples collected from surrounding areas of Hyderabad city seemed to be impure and could be adulterated with extraneous water. However, milk sold at Hyderabad city and its surroundings was still better in protein content than that of sold in some other parts of the country (Mustafa *et al.,* 1991).

The average casein content of market milk samples of Hyderabad city and its surrounding areas was 2.25± 0.09 and 2.30±0.09 %, respectively that was also significantly lower (P< 0.05) than that of control milk (2.61±0.06%) samples. Among the market milk, the casein content of milk samples collected from the surrounding areas of Hyderabad city was higher (2.30±0.09%), compared to milk samples collected from sale points of Hyderabad city (Fig. 4). It was recorded relatively higher (3.2%) in the findings of Ahmed (2009).

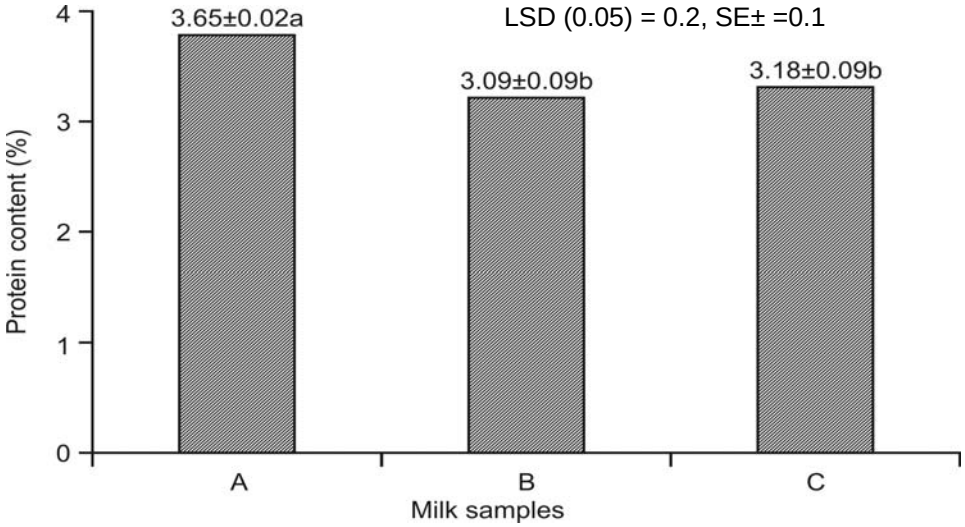

Figure 3. Average protein content (%) of (A) Whole buffalo milk i.e. Control (B) Market milk collected from Hyderabad city (C) Market milk collected from surrounding areas of Hyderabad city.

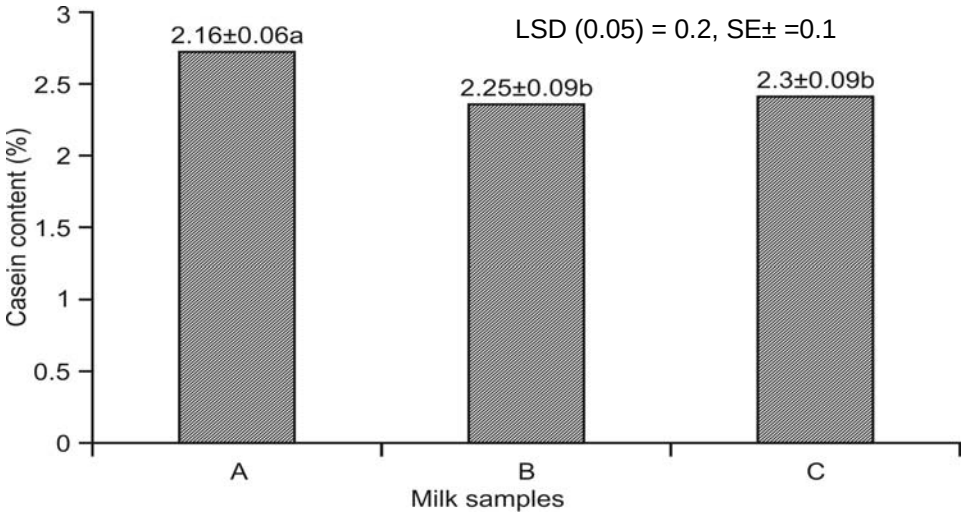

Figure 4. Average casein content (%) of (A) Whole buffalo milk i.e. Control (B) Market milk collected from Hyderabad city (C) Market milk collected from surrounding areas of Hyderabad city.

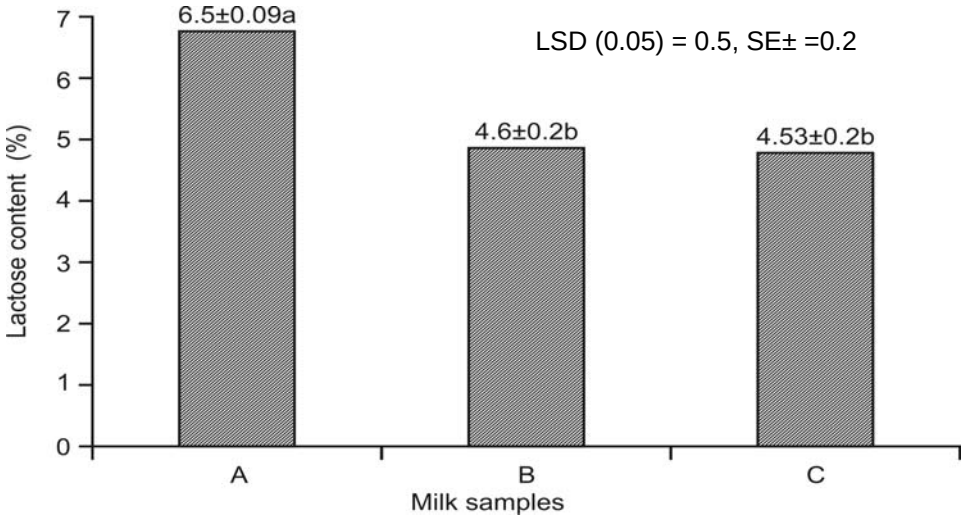

Figure 5 Average lactose content (%) of (A) Whole buffalo milk i.e. Control (B) Market milk collected from Hyderabad city (C) Market milk collected from surrounding areas of Hyderabad city.

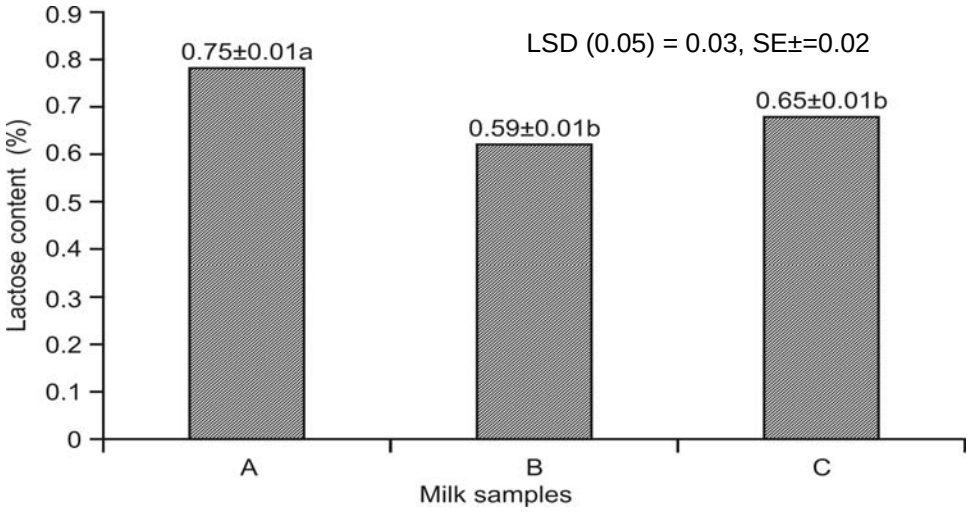

Figure 6. Average ash content (%) of (A) Whole buffalo milk i.e. Control (B) Market milk collected from Hyderabad city (C) Market milk collected from surrounding areas of Hyderabad city.

Fig. 5 shows that the average lactose content of milk sold at Hyderabad city (4.60± 0.2%) was relatively similar (P> 0.05) to that of sold at surrounding areas of Hyderabad (4.53±0.2%). However, the milk at both of these areas was significantly lower (P<0.05) in lactose, compared to that of control milk (6.47±0.09%). The findings of present study regarding the lactose content of market milk are relatively in line with the findings of Khan *et al*. (2005), who observed 4.9% lactose in milk samples. It could be incurred from present results of market milk being sold at both sale points of Hyderabad city and its surrounding areas are impure.

The average ash content of market milk taken from Hyderabad city and its surroundings was 0.59±0.01 and 0.65±0.01%, respectively, it was also significantly lower (P< 0.05) than that of control milk (0.75±0.01%). Whilst, among the market milk samples the ash content of milk samples collected from the surrounding areas of city was significantly higher (0.65±0.01%) (P<0.05) than that of milk samples obtained from both sale points of the city (Fig. 6). It is also noticeable that average ash content of control milk examined in the present study is relatively in accordance with that of reported by Khan *et al*. (1999). In market milk samples ash content was relatively similar to that observed (0.57%) by Mustafa *et al.* (1991) in canteen milk samples.

CONCLUSION

Study concludes that milk dealers of Hyderabad city and its surrounding areas adulterate milk to overcome the gap between demand and supply. They add water and adulterants like starch and urea to maintain its compositional parameters and milk preservatives, like hydrogen peroxide to increase shelf life of milk. It can also be concluded that adulteration of extraneous water, hydrogen peroxide, starch and urea alter the physico-chemical characteristics of market milk or exhibit strong influence in impairing the quality of market milk.

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