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DETECTION OF ADULTERATION, CHEMICAL COMPOSITION AND HYGIENIC STATUS OF MILK SUPPLIED TO VARIOUS CANTEENS OF EDUCATIONAL INSTITUTES AND PUBLIC PLACES IN FAISALABAD

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ABSTRACT

This study was designed to elaborate the hygienic status of milk supplied to educational institutions (EI) and public places (PP) in the Faisalabad. A total of sixty samples were collected from the different location and were processed for determination of adulterants, chemical composition and hygienic condition. The results indicated that water was added to 97% and 93% samples from EI and PP respectively. The urea, formalin and cane sugar were detected in 63, 87; 23, 27 and 87, 97 percent samples each from EI and PP, respectively. 3% milk samples from canteens of various public places were found adulterated with hydrogen peroxide. No sample was found to be adulterated with starch, detergents and oil. The tests carried out for evaluating the chemical composition and physio-chemical properties of the milk samples showed the following mean values: Protein%, 1.12±0.09 and 1.33±0.24; Fat%, 2.06±0.11 and 1.40±0.15; Solid-not-fat, 5.10±0.17 and 4.77±0.58; Total solids, 7.18±0.27 and 6.17±0.68; % Acidity, 0.07±0.00 and 0.07±0.00 and average Specific gravity, 1.01±0.00 and 1.01±0.00 from various canteens of EI and PP, respectively. The time for the reduction of Methylene blue dye in milk samples 0-2 Hours, 3% and 17%; 2-6 Hours, 27% and 10%; 6-8 Hours, 23% and 17%; Over 8 Hours, 47% and 56% from various canteens of EI and PP, respectively. The result depicted that samples analysed did not conform legal standards, had poor physical appearance and adulterated with chemicals injurious to health.

Key words: Adulteration, chemical composition, hygienic status, Milk supply, Educational Institutes, Public Places.

INTRODUCTION

Milk is an important source of nutrient required for growth in infants and children and for maintenance of health in adults. Milk is a perfect food, readily digested and absorbed. It is a sole natural food for infants and children. It is chiefly a valuable source of good quality protein, fat, carbohydrates, vitamins and minerals. Protein in diet supply the amino acids required for growth of infants and children. It is also required for maintenance of tissues in adults.

Pakistan is blessed with genetically high yielding dairy animals such as Nili- Ravi Buffaloes and Sahiwal Cows. Currently, there are 36.9 million cattle, 32.7 million buffaloes, 28.4 million sheep, 63.1 million goats and 1.0 million camels producing 47.9 million tones of milk. Per capita availability of liquid milk drinks is 218 liters per annum (Economic Survey, 2011-12) being comparative with world's top most country Finland (183.9 liters), Australia (106.3 liters) and United States (83.9 liters) (Anon., 2012). Buffalo and cow milk contains 7.6, 4.5 % fat, 3.8, 3.8 % protein, 5.1, 4.9 % lactose, 0.78, 0.72 % ash and 17.0, 13.9 % total solids, respectively (Khan *et al*., 2005).

The adulterants/preservatives assume the proportion of health hazards for end consumers, particularly infants (Tipu *et al*., 2007). Suppliers of milk appear to have found three ways to increase their margin from the sale of milk: (i) dilution (ii) extraction of valuable components, i.e. milk fat removed as cream, and (iii) a combination of (i) and (ii) with the addition of cheap (and sometimes potentially harmful) bulking additives, such as low quality flour, to bring the total solids to a level which is acceptable to consumers. Some of the chemicals, adulterants and malpractices results in public health concern and malnutrition.

Normally, the adulteration in food is done either for financial gain or lack of proper hygienic conditions of processing, storing, transportation and marketing. This ultimately leads to the stage that the consumer is either cheated or often becomes victim of diseases. Such types of adulteration are quite common in developing countries. It is equally important for the consumer to know the common adulterants and their effects on health.

According to Pakistan Pure Food Rules there should be 3.5% and 5.0% butter fat and 8.5 and 9.0 % solids-not-fat for cow and buffalo milk, respectively (Farani, 1983). Supply of clean and wholesome milk at canteens of various educational institutes and public places has much importance as the milk supplied is to be consumed by the young and growing students. Therefore a study was planned to determine the chemical composition, hygienic quality and adulteration of that milk supplied.

Milk is produced throughout the year. However, milk production is greatly reduced during summer months due to heat stress and scarcity of fodder etc. Milk is transported from point of production to cities mainly

through middlemen called "dodhies". Such milk is watered/ skimmed to increase profit. To maintain its composition, starch, flour, urea, cane sugar, vegetable oil, etc., are added as adulterants. Milk is a perishable commodity so during summer months, it is likely to be spoiled during transportation. The middlemen therefore add chemical preservatives such as penicillin, strepto-penicillin, formaldehyde, hydrogen peroxide, sodium bi-carbonate, etc. The major problem in the fluid milk supply system in Pakistan from the consumer point of view is not only adulteration but also dirty adulteration. Public consume fluid milk which has been adulterated and diluted to an extent that there is very little nutritive value left in it, resulting, to a great extent, to general public health concerns and malnutrition.

Keeping in view the above facts, the present study was conducted to achieve the following objectives:

1. To determine the chemical composition of the milk available in local market.
2. To check the hygienic status of market milk.
3. To detect various adulterants in market milk.

MATERIALS AND METHODS

Sixty samples were collected, one sample about 250 ml of unprocessed market milk each per week from the canteens of the following educational institutes and public places located in various localities of Faisalabad city for six weeks.

1) University of Agriculture, Faisalabad.
2) Govt. College University, Faisalabad.
3) Madina University, Faisalabad.
4) Punjab Medical College, Faisalabad.
5) Government College Samanabad, Faisalabad.
6) Railway Station, Faisalabad.
7) General Bus Stand, Faisalabad.
8) Taj Mahal Cinema, Faisalabad.
9) Chiniot Bazaar, Faisalabad.
10) Ghulam Muhammad Abad, Faisalabad.

Each sample was collected in sterilized glass bottle with cap, labelled, kept in icebox and immediately brought to the dairy laboratory, Department of Livestock Management, University of Agriculture, Faisalabad for analysis. Supply of milk to these canteens were in real unhygienic conditions, in mixed form (cattle/buffalo/ sheep/goat), mainly by kacha and pakka dhodhies (milk men), and there was no temperature control. Every sample was divided in five parts: one for physical examination, second for chemical composition, third for physio-chemical properties, forth for hygienic status and fifth for detection of various adulterants. The following analysis was carried out.

Physical Examination: Each sample was observed for general appearance (presence of dirt), odour (mild and cowey), colour (yellow and bloody), consistency (thin or watery), and sediments were observed physically (Khan *et al*., 2005).

Chemical Composition: Parameter like percent protein, fat, total solids, SNF of milk was determined by using standard procedures. Protein% was measured by titration method, fat% by Gerber's method while SNF and total solids by Fleischmann's formula (Khan *et al*., 2005).

Physio- chemical Properties: Acidity and average specific gravity of milk was determined by using standard procedures (Khan *et al*., 2005).

Hygienic Status: Hygienic status of milk was measured by using Methylene Blue Reduction Test (A.O.A.C., 1997).

Milk Adulterants: Various milk adulterants like water, starch, urea, formalin, hydrogen peroxide, detergents, oil and cane sugar was detected by using standard procedures (Tipu *et al*., 2007).

Statistical Analysis: Data collected on different parameters was analyzed statistically by using Fisher's analysis of variance technique using MINITAB (2000) software on computer. Least significant difference (LSD) test at 0.05 probability levels was used to compare the differences among the treatment's means (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Physical Examination: Results of present study (Table 1) showed that 67% of the milk samples from canteens of both educational institutes and public places had unclear general appearance; 60% and 64% showed very mild while 7% and 3% had cowey odour; 13% and 0% samples had light yellow while 7% and 0% showed bloody colour; 80% and 87% samples had thin consistency and 70% and 67% samples had sediments in it, from various canteens of educational institutes and public places, respectively. All this may be considered as hindrances to accept such milk for human consumption.

The results for physical examination of milk clearly showed that the milk sold at these canteens was extensively put to the malpractices such as skimming and adulteration with water that probably carried out during the handling of milk starting from milking till it reached the canteens/end consumers. Thus the milk marketed at these canteens cannot, in all fairness, be considered, as 'Milk' in its real shape. It had abnormal colour, odour, thin consistency and its general appearance was poor due to the dirt/sedimentation present in it.

Chemical Composition: The results of chemical composition of milk (Table 2) revealed that the average protein content were 1.12±0.09, 1.33±0.24 and ranged from 0.92 to 1.47 and 0.89 to 2.23 percent from various

canteens of educational institutes and public places, respectively that not matched with representative value of protein in normal cow/buffalo milk which is 3.8% as reported by Khan *et al*. (2005). Such a low protein value surely resulted from mega adulteration practices of milk with water. Thus the end consumers (young students and other peoples especially passengers) are being deprived of a highly valuable and nutritive ingredient protein of milk. The mean values for fat content in milk samples collected from canteens of various educational institutes and public places, respectively were 2.06±0.11, 1.40±0.15 and ranged from 1.81 to 2.43 and 0.93 to 1.77. These values were quiet lower than the legal milk standard in vogue (5% for butter fat) and much lower than the average fat content in cow milk (4.5 %) and buffalo milk (7.6%) as reported by Khan *et al*. (2005). This points out the extent to which skimming / watering of the milk marketed at canteens of educational institutions is being malpracticed. The mean values for SNF contents as observed in the present study were 5.10±0.17, 4.77±0.58 and ranged from 4.55 to 5.52 and 3.69 to 6.75 from various canteens of educational institutes and public places, respectively. The SNF content as observed in this study was even less than the legal standard of SNF content (9%) in milk (Farani, 1983). The mean values for total solids as observed in the present study were 7.18±0.27, 6.17±0.68 and ranged from 6.41 to 7.96 and 4.77 to 8.52 from various canteens of educational institutes and public places, respectively. These values were found to be much lower when compared than those of normal values for buffalo and cow milk (17.0 % and 13.9 %) as reported by Khan *et al*. (2005).

Results of present study are in line with that of Mustafa (1990), Khan *et al*. (1991), Mustafa *et al*. (1991), Khan *et al*. (1999), Javaid *et al*. (2009) and Lateef *et al*. (2009) that milk sold at these places was extensively put to malpractices such as skimming and adulteration with water, which are probably carried out during the handling of milk starting from milking till it reaches the consumers and milk was diffused on the basis of experience and they do not use any measuring or metering device.

Keeping in view the current milk analysis the universally accepted statement that milk is a perfect food is not applicable to the milk obtained from canteens of various educational institutes and public places in the city of Faisalabad. It is very unfortunate that the public are forced to consume that milky coloured fluid which has lost its wholesomeness and nutritive value due to skimming and adulteration.

Physio-chemical Properties: Average specific gravity as observed in the present study was 1.01±0.00, 1.01±0.00 and ranged from 1.02 to 1.02 and 1.01 to 1.03 from various canteens of educational institutes and public places, respectively. The average specific gravity value was found to be much lower when compared than that of normal specific gravity values for buffalo and cow milk (1.033 and 1.032). Percent acidity values of milk sold at canteens of various educational institutes and public places were 0.07±0.009, 0.07±0.00 and ranged from 0.04-0.09 and 0.05-0.09. The value obtained in this study was almost similar to those in freshly obtained normal cow's milk. The milk samples obtained from canteens had already been put to intensive heat treatment in form of boiling, as a result the acidity remained very low and shelf quality of milk was increased (Table 3).

Hygienic Status: Only 3% and 17% milk samples were such in which the dye got decolorized up to two hours. The dye was reduced within 2-6 hours and 6-8 hours in 27%, 10% and 23%, 17% milk samples while in 47% and 56% of milk samples from various canteens of educational institutes and public places, respectively the methylene blue reduction did not take place till the end of 8 hours. The results revealed that 47% and 56% of the samples from canteens of educational institutes and public places were found to be of reasonable hygienic quality (Table 4). Results of present study are in agreement with those of Memon (2000), Gran *et al*. (2002), and Gilani (2008). The Methylene blue reduction test results has shown that apparently the hygienic quality of milk samples collected from canteens of various educational institutions and public places fall in good to excellent category, this could be due to excessive boiling and in some cases keeping milk continuously on low fire. It may not be fair to conclude that the milk obtained from these canteens generally meets the normal standards.

Adulteration: Results of adulterants (Table 3.5) showed that 97% and 93% of the milk samples collected from canteens of educational institutes and public places showed water addition in them. Urea adulteration was present in 63% and 87% samples; Formalin adulteration was present in 23% and 27% samples while 87% and 97% samples showed cane sugar adulteration from various canteens of educational institutes and public places, respectively. While hydrogen peroxide adulteration was found in 3% milk samples from various canteens of public places. No sample was found to be adulterated with starch, detergent and oil from canteens of both the places.

Results obtained from this study are in accordance with the results of Haasnoot *et al*. (2001), Cataldi *et al*. (2003), Mabrook and Petty (2003), Jha and Matsuoka (2004), Renny *et al*. (2005), Borin *et al*. (2006), Luykx *et al*. (2007), Sengar (2007) and Lateef *et al*. (2009). It is also concluded that milk sold at various canteens of educational institutes and public places were extensively put to malpractices such as skimming and adulteration with water (Khan *et al*. 1991, Mustafa *et al*. 1991, Khan *et al*. 1999 and Lateef *et al*. 2009).

Different adulterants present in the milk like water, urea, formalin, hydrogen peroxide and cane sugar threatened the wholesomeness of milk. It is very unfortunate that the students in educational institutes and public at public places especially passengers are enforced to consume that milky coloured fluid which is extensively put to adulteration. It did not meet the legal standard and requirements.

Table 1: Physical Examination of Milk Samples Collected from Canteens of Various Educational Institutes and Public Places:

Examination	Educational Institutes			Public Places		
General Appearance	33% clear	67% dirty	-	33% clear	67% dirty	-
Odour	33% normal	60% very mild	7% cowey	33% normal	64% very mild	3% cowey
Colour	80% milk white	13% light yellow	7% bloody	100% milk white	0% light yellow	0% bloody
Consistency	20% normal	80% thin/ watery	-	13% normal	87% thin/ watery	-
Sediment	30% no sediment	70% yes	-	33% no sediment	67% yes	-

Table 2: Chemical Composition of Milk Samples Collected from Canteens of Various Educational Institutes and Public Places:

Constituents	Milk from Canteens of Educational Institutes		Milk from Canteens of Public Places	
	Mean ± SE (%)	Range (%)	Mean ± SE (%)	Range (%)
Protein	1.12±0.094	0.92-1.47	1.33±0.24	0.89-2.23
Fat	2.06±0.112	1.81-2.43	1.40±0.15	0.93-1.77
Solid-not-fat	5.10±0.174	4.55-5.52	4.77±0.58	3.69-6.75
Total Solids	7.18±0.270	6.41-7.96	6.17±0.68	4.77-8.52

Table 3: Physio-chemical Properties of Milk Samples Collected from Canteens of Various Educational Institutes and Public Places:

Constituents	Milk from Canteens of Educational Institutes		Milk from Canteens of Public Places	
	Mean ± SE (%)	Range (%)	Mean ± SE (%)	Range (%)
Acidity	0.07±0.009	0.04-0.09	0.07±0.00	0.05-0.09
Specific Gravity	1.01±0.000	1.02-1.02	1.01±0.00	1.01-1.03

Table 4: Percentage of Milk Samples Collected from Canteens of Various Educational Institutes and Public Places that Reduced Methylene Blue Dye at Various Time Intervals:

Type of Milk	Reduction Time			
	0-2 Hours	2-6 Hours	6-8 Hours	Over 8 Hours
Milk Samples from Canteens of Educational Institutes	3%	27%	23%	47%
Milk Samples from Canteens of Public Places	17%	10 %	17%	56%

Table 5: Adulteration of Milk Samples Collected from Canteens of Various Educational Institutes and Public Places:

Adulterants	Milk Samples from Canteens of Educational Institutes		Milk Samples from Canteens of Public Places	
	Absent	Present	Absent	Present
Water	3%	97%	7%	93%
Starch	100%	0%	100%	0%
Urea	37%	63%	13%	87%
Formalin	77%	23%	73%	27%
H2O2	100%	0%	97%	3%
Detergents	100%	0%	100%	0%
Oil	100%	0%	100%	0%
Cane Sugar	13%	87%	3%	97%

Milk is considered as wholesome diet for infants, children as well as for adults. But the results obtained from this study are totally opposite to this statement. It was shocked to check the status of milk sold

at various canteens of educational institutes and public places. At these places instead of the wholesome milk a white watery fluid named as milk was available to the end consumers having bad odour, colour, thin consistency, very poor nutritive value and was extensively put to adulteration. Different adulterants like water, urea, formalin, hydrogen peroxide and cane sugar were present in milk. It is very unfortunate that the patients in hospitals, students in educational institutes and other people especially passengers at various public places are enforced to consume that milky coloured fluid which is extensively put to adulteration. It is not fair to conclude that the milk sold at all these places, in general, meets the legal standards. Probably everyone involved in the milk marketing chain diluted milk to some extent directly or indirectly but very intentionally.

Conclusion: The results of the physical examination, chemical composition, physio-chemical properties and milk adulteration clearly showed that the milk sold at these places was extensively put to the malpractices such as skimming and adulteration of milk with water, urea, formalin, hydrogen peroxide and cane sugar which was carried out during the handling of milk starting from milking till the receiving by end consumer. Thus the milk marketed at these places could not be considered as "Milk" in its real sense as it was only white milky watery fluid instead of wholesome milk. Probably everyone involved in the milk marketing chain diluted milk to some extent directly or indirectly but very intentionally. In spite of the fact that methylene blue reduction test have shown that apparently the hygienic quality of milk samples obtained from various canteens was satisfactory (due to excessive boiling) but it is not fair to conclude that the milk sold at these places, in general, met the minimum legal standards of normal milk.

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