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Buffalo Milk Adulteration in South Punjab (Pakistan) -A Public Health Hazard

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ABSTRACT

Milk is a complex mixture enriched with nutrients, minerals and vitamins which are considered crucial for normal growth and functioning of vital organs. Consumers are quite interested in buffalo milk composition due to its direct relation with human health. The study was performed to investigate the effects of seasonal variation on buffalo milk composition and level of milk adulteration in Southern Punjab region of Pakistan. A total of 100 buffalo milk samples (50 samples/season) were collected and were examined from January to June 2022.All milk samples were transferred to Milk Analysis Laboratory Punjab Food Authority, Multan. Milk composition and milk adulteration were checked by using Lacto scan and Latte adulteratization kit (Milk adulteration analyzer). Data was analyzed by independent t-test. The results revealed that milk composition (Fat, protein, solid not fat) showed significant ($P<0.05$) difference in winter and summer seasons. Analysis of milk adulteration showed that milk samples were adulterated with skim milk, urea, detergent, and starch. Strict quality control measures are required to stop buffalo milk adulteration, a major threat to public health.

Keywords: Buffalo Milk; Urea; Detergent; Fat; Protein

Introduction

Buffalo milk, one of the substantial known human foods, provides many nutrients such as carbohydrates, fats, proteins, vitamins, minerals, and other important components (Yasmin et al., 2012). Buffalo milk is popular in Pakistan and other south Asian countries. Buffalo milk is unique due to less cholesterol, high fat, content more calories that add to its health benefits. Moreover, it is a good diet for developing healthy bones, maintaining dental health, and preventing cardiovascular disorders. Buffalo milk is thick and creamy in consistency therefore suitable for manufacturing traditional dairy products including yogurt, cottage cheese (paneer) and traditional milk products like ghee and khoa (Haque [1]). According to authors, shorter summers (hence shorter periods of pasture grazing) in the Nordic countries could explain CLA differences between the Nordic and other European countries. However, it was not known if such changes would occur under tropical conditions with the traditional feeding system of Sindh, (Pakistan), where animals are fed on forages throughout the year, except in winter and late spring when shortage of green forage occurs, and ruminants are fed crops by product along with available green fodder. Pakistan ranks as the 5th largest producer of milk in the world with over 26 million buffaloes, 56 million sheep, 24 million of each cattle and goats. Buffaloes are the major milk producing animal, accounting for about 75% of all milk produced. They are concentrated in irrigation areas and long rivers, as are the human population.

Goat and ewe milk are not proceeded for commercial purposes in Sindh (Pakistan), and these animals are mostly reared for meat purpose, while milking is a secondary function, which provide extra source of income to poor farmers (Sarwar et al., 2002). However, data on milk fatty acid composition from ruminant species from Pakistan is scarce. Milk adulteration became a global concern after breakthrough of melamine adulteration in Chinese infant milk formula. Worldwide, it is a terrible situation that milk is being very easily adulterated and the situation is significantly worse in underdeveloped countries due

to lack of adequate monitoring and absence of proper law enforcement (Xin [2]). Dairy Milk adulteration is a socioeconomic issue in developing countries. The act of adding adulterants makes it unfit for human consumption and dairy products fail to meet the legal standards. It brings not only brings unfavorable consequences in terms of major economic losses for the processing industry, but also a major health hazards for the consumers from infants to adults worldwide. The consumption of adulterated milk causes several critical health disorders including dysentery, colon ulcers, nephrosis, disturbance of cardiovascular system (Hanford [3]). In Pakistan limited studies are available on level of dairy milk adulteration, a major public health hazard. Limited studies have been conducted on buffalo milk composition variation in different seasons but none in south Punjab where summer season lasts for long duration and winter lasts for short period.

The first objective of the study was to estimate variation in composition of buffalo milk. The second objective was to know about adulterant types used in buffalo milk supplied for human consumption in South Punjab region of the country.

Methodology

A total of 100 milk samples were collected by convenience sampling method from various cities in southern Punjab. Milk samples were collected in two seasons. Winter(n=50) sampling was conducted from December to March and summer(n=50) sampling was conducted from April to June from same cities. Milk samples were collected from dairy farms(n=40), local vendors(n=30), and commercial chillers(n=30). The raw milk samples were collected from homogenized milk into sterilized Falcon tubes to avoid any type of contamination. All milk samples were labelled and placed in ice filled cooler box. The samples were transported to the Milk Testing Laboratory Punjab Food Authority, Multan and preserved at 4-8°C until analysis. For estimation of milk fat, protein, lactose, and total solids Lactoscan milk analyzer was used (Miltonic Ltd.series7035, Bulgaria). For detection of adulterants (starch, urea, hypochlorite, pulverized soap, formalin, sugar, skim milk, boric acid and detergent) user friendly Latte Adulterazione kit was used according to the manufacturer's protocol. The data generated was entered in software SPSS and independent t test was applied to find significant difference in milk composition.

Results

In the present study, change in milk composition during extreme weather conditions of South Punjab region were investigated. Data shows that fat content of milk samples was significantly ($P<0.05$) different in winter and summer seasons. Milk protein content was also significantly($P<0.05$) different in winter and summer season. Milk lactose content was non significantly ($P>0.05$) different in winter and summer seasons. Milk total solids content showed significant ($P<0.05$) difference in winter and summer season as shown in Table 1. In the present study data from dairy farms showed no milk adulteration in winter and summer season in South Punjab region. Milk samples acquired from local vendors showed use of skim milk followed by detergent as adulterants were high both in winter (52.5%;33.33%) and summer (72%;31.33%) seasons. Milk samples acquired from commercial chillers showed use of skim milk followed by starch as adulterants were high both in winter (60%; 33.33%) and summer season (60%; 33.33%). The use of urea as milk adulterant was found in summer (28.3%) in buffalo milk samples as shown in Table 2.

Table 1: Buffalo milk composition in winter and summer seasons.

Season	Winter (n=50)	Summer (n=50)	P-value
Fat	5.48±0.350	4.50±0.351	0.000
Protein	3.66±0.440	3.32±0.387	0.000
Lactose	3.82±0.508	3.75±0.494	0.459
Total Solids	13.60±1.11	12.10±1.17	0.032

Note: P≤0.05 (*shows that value is significant)

Table 2: Buffalo milk adulteration in winter and summer seasons.

Season	Winter Season			Summer Season		
Adulterants	Dairy Farms (n=20)	Middleman (n=15)	Commercial Chillers (n=15)	Dairy Farms (n=20)	Middleman (n=15)	Commercial Chillers (n=15)
Starch test	-ve	+ve (5)	+ve (5)	-ve	+ve (5)	+ve (5)
Urea test	-ve	+ve (2)	-ve	-ve	+ve (2)	+ve (4)
Hypochlorite Test	-ve	-ve	-ve	-ve	-ve	-ve
Pulverized soap test	-ve	-ve	-ve	-ve	-ve	-ve
Formalin test	-ve	-ve	-ve	-ve	-ve	-ve
Sodium chloride test	-ve	-ve	-ve	-ve	-ve	-ve
Hydrogen peroxide test	-ve	-ve	-ve	-ve	-ve	-ve
Sugar test	-ve	-ve	-ve	-ve	-ve	-ve
Skim milk test	-ve	+ve (8)	+ve (9)	-ve	+ve(11)	+ve (9)
Boric acid test	-ve	-ve	-ve	-ve	-ve	-ve
Detergent Test	-ve	+ve (4)	+ve (3)	-ve	+ve(5)	+ve (2)
Adulterant free	-ve (20)	-ve (4)	-ve (4)	-ve(20)	-ve (2)	+ve(15)

Discussion

Out of total dairy milk produced in Pakistan, buffalo contributes about 68 %, followed by other dairy animals. Due to the high fat contents of buffalo milk, it is the most preferred by people among other dairy products. In the present study buffalo milk samples showed difference in fat, protein, and total solids contents in winter and summer seasons. Saadi, et al. (2019) finding is in line with our study and show significant difference ($p<0.001$) with highest percentage of fat 4.48 % in milk in winter while values decrease to 2.95% in summer. The decrease in fat in summer may be due to the length of light compared to dark. The higher the ratio between light and dark the lower the proportion of fat due to increased prolactin secretion whose concentration in plasma is higher in summer than in winter (Ozrenck [4]). As for the effect of nutrition the basis in the composition of fat depended on the composition of acetate in the rumen. Food such as grain feeding that reduces acetate production will also reduce fat concentration in milk produced during the summer (Vildirim and Cimen, 2009). Percentage of protein was highest in milk produced from cows, which fed on concentrated feeds in the winter and amounted to 3.46% and decreased to 2.93% for the milk of cows that fed on herbs in the summer, and attributed the reason for high protein in the winter to the diet content high in protein while in the summer the nutrition was low in protein content (Colombari [5]). The low percentage of fiber in cattle (concentrated feed) resulted in increased protein content in milk produced. On the contrary, when they fed on green the protein decreased (Petitclerc, et al. 2000). Significant differences were found in the percentage of total solids, as the proportion of fat increased the proportion of total solids (Pavel [6]). The freezing point and lactose sugar showed no significant difference. Difference in milk composition in both seasons might be due to change in feed and water consumption by buffaloes (Afzal [7,8]). In the present study buffalo milk adulteration was observed in both seasons. Skim milk powder was the most used adulterant for thickening of milk in the study area as reported in literature (Azad [9]). Urea added in buffalo milk to increase non protein nitrogen content. Urea adulteration has carcinogenic effects on human health. Starch is used as a thickening agent in milk. Starch adulteration can cause diarrhea and its accumulation in the body might be fatal for diabetic patients (Yadav [10]). Detergents are added to emulsify and dissolve the oil in water to give frothy solution, a desired characteristic of milk. Consumption of adulterated milk leads to kidney failure, gastritis, and intestinal inflammation (Rennie [11-14]).

Conclusion

People living in developing countries like Pakistan, which is already far behind in delivering health services, are deprived of pure healthy buffalo milk. The adulterated milk is of low quality and responsible for introducing hazardous substances leading to serious health hazards in consumers. Therefore, it is need of the hour to devise an efficient and reliable quality control system that will regularly monitor the activities of malpractices in the dairy industry. It is the responsibility of the government to formulate an effective strategy to ensure the access of fresh and quality raw milk to people so that infants and adults both can enjoy a healthy life by having pure natural milk. General public awareness, effective monitoring measures and regulatory system for quality control of milk and dairy products can play a crucial role in minimizing milk adulteration.

Declaration of Conflicting Interests

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