Original Article

Quality assessment of milk available to the consumers in Faisalabad

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Abstract

The aim of this study was to determine the physio-chemical composition in milk samples sold in urban, peri-urban and rural areas of District, Faisalabad. For this purpose, samples were taken in sterilized and labeled glass bottles. A total of 144 samples (250 ml each) were collected in the morning from urban, peri-urban and rural areas (48 samples from each area; 12 samples / week). The sampling sites were Satiyana, Samundari, Narwala and Sarghoda Road. The results for the physical examination on the basis of locality, the general appearance odour, color were non-significant while consistency (Water: 4.2, 25.0 and 41.7; Normal: 95.8, 75.0 and 58.3) and sedimentation (Sediments present: 16.7, 41.7 and 43.8%) were significant (P=0.001) but time had non-significant effect for all parameters. The results for chemical composition on the basis of locality, the fat (4.83, 3.88 and 3.53%), protein (3.65, 3.21 and 2.97%), lactose (5.33, 4.71 and 4.29%), solids not fat (9.78, 8.62 and 7.79%) and total solids (14.59, 12.51 and 11.29) were significant; freezing point (-0518, -0.416 and -0.412 C) and specific gravity (1.0269, 1.0242 and 1.0227) (P<0.001) were also significant.

Key words: Milk, physio-chemical, consumers, Faisalabad

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INTRODUCTION

Milk is the best source of nutrients in human diet, as it is easily digested and absorbed. It is used in all age groups of rural as well as urban areas. It provides proteins, fats, vitamins and minerals. Milk is also an ideal food for pregnant women, infants and children. It contains about 87.4% water and 12.6% total solids (3.7fat, 8.9% solids-not-fat). It has 3.4, 4.8, 0.7% proteins, lactose and minerals, respectively (Chandan, 1997). Fresh milk is slightly sweet in taste. However, when exposed to air or sun light, sweetness becomes volatile and disappears. Annually, Pakistan produces 48 million tons of milk and mostly it comes from rural areas. Buffalo produces 61.6% of total milk produced while the share of cattle is 34.9%. The contribution of sheep, goats and camel is 0.08, 1.6 and 1.72%, respectively. Punjab province produces 49% of total milk production. Pakistan ranks fourth among the milk producing countries of the world after United States, Russia and India. However, milk production, collection, processing and distribution system in Pakistan is traditional and under developed. Moreover, due to lack of modern and hygienic facilities, the milk quality is not optimum for the health of consumers. Due to less number of processing plants, only 3% milk is processed out of total milk produced in Pakistan (FAO, 2002).

Research on chemical composition of milk based on its nutritional importance in the human diet and the legal and marketing requirements governing its sale. Legally minimum standard of 3.5 and 5.0% butter fat and 8.5 and 9.0% solids-not-fat for cow and buffalo milk respectively, is being enforced in the Punjab, Pakistan. One of the objectives of this food act is to assist the detection of milk adulteration which is common problem in many developing countries including Pakistan. High prices of processed and packed milk as compared to raw milk have compelled majority of the people to purchase raw milk from milkmen “gowalas”, milk shops and canteens. The milk sellers and producers, being illiterate, do not observe the necessary hygienic precautions in the production and handling of milk, thus rendering it unwholesome for human consumption. Before it reaches the consumer, milk often passes through one or more middlemen, who being unscrupulous and ignorant of the importance of hygienic milk

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handling, keep it persistently exposed to environmental contamination. Some of the unscrupulous middlemen also resort to adulteration of milk by adding unclean water presumably to adjust specific gravity of milk changed due to cream separation. Unhealthy practices in the production and handling of product not only lower its nutrient value but also make it unfit for human use (Mustafa, 1990).

Milk available to the consumers is normally undesirable in terms of physical appearance and chemical composition that are considered the basis for quality assessment. The present study was therefore planed to study varing physical and chemical aspect of milk sold in different areas of Faisalabad.

MATERIALS AND METHODS

. A study was conducted to determine the physio-chemical composition in milk samples sold in urban, peri-urban and rural areas of the ,Faisalabad district. Samples collected during the course of study were analyzed in the Dairy Laboratory, Department of Livestock Management, University of Agriculture, Faisalabad.

Collection of samples

Samples were collected from urban, peri-urban, and rural areas of the Faisalabad district. Samples were taken in sterilized and labelled glass bottles having metallic lid, and were kept in ice box and brought to the laboratory for analysis. A total of 144 samples (250 ml each) were collected in the morning from urban, peri-urban and rural areas (48 samples from each area; 12 samples / week). The sampling sites were Satiyana, Samundari, Narwala and Sarghoda road.

Physical Examination

Each sample was observed for general appearance, odour, consistency, colour and sediment (Eckles *et al.*, 1986).

Chemical Composition

Milk components like percent protein, lactose, fat, solids-not-fat (SNF) and freezing point were determined by using lacto-scope compact (Delta instrument, Netherland).

The percent of total solids (TS) and solids not fat (SNF) in milk were calculated by the method described by Eckles *et al.* (1986).The specific gravity of milk samples were determined by using standard procedure as described by khan *et al*. (2005).

Data collected were allotted a definite score for data entry in software (statistical analysis) and further analysis.

RESULTS AND DISCUSSION

Physical Examination

The effect of localities and time on the general appearance was non-significant. However, a little variation was found in samples collected from different localities (Table I).

Study results indicated that 77.1, 81.3 and 81.3% milk samples collected from rural, peri-urban and urban areas were clear while 22.9, 18.8 and 18.8%, respectively were dirty. Milk sold in rural areas was not so poor in general appearance and this might be due to the filthy atmosphere, unhygienic milking and handling. These results are in accordance with Lateef *et al.* (2009), who analyzed milk samples collected from the canteens of various hospitals in Faisalabad city and found that 66.66% samples had dirt while remaining were clear. Javaid *et al*. (2009) collected 125 milk samples (25 from each source) from five marketing agencies *i.e.,* direct seller (DF), milk collection center (MCC), milk vendor shop (MVS), hotel (HT) and buffalo dairy farm (BDF) which was considered as control. They concluded that all the attributes of physical quality of milk supplied through four agencies were significantly lower than DF milk, most probably due to adulteration. Odour of milk is affected by many factors such as concentrate feeds and fodders fed to dairy animals, heat and light treatment, lipolysis, microbial changes (Palo, 1985) and their passage to milk through blood or the absorbing capacity of milk from atmosphere. The odour disappears when milk is allowed to stand for a few hours or following cooling and aeration immediately after milking (Eckles *et al.*, 1986).

The effect of localities and time on odour was non-significant. However, a trend of increased coweyodour was found in rural milk samples. In the present study, 64.6% rural, 79.2% peri-urban and 85.4% urban milk samples had normal odour; 29.2% rural, 18.8% pei-urban and 12.5% urban milk samples showed very mild, odour while 6.3% rural, 2.1% peri-urban and 2.1% urban milk samples had coweyodour. On overall basis, out of total 144 samples, 76.4% were found normal, 20.1% had very mild odour and 3.5% had coweyodour. A

trend of increased coweyodourin the samples collected from rural areas again reflected the use of unhygienic housing and milking practices, which can be improved by providing good housing, adopting hygienic measures at milking time and following recommended milking management techniques. Week wise variation in odour was also non-significant, as the milk samples collected during different weeks had similar intensity of odour. These results are in accordance with Lateef *et al.* (2009), who concluded that 63.33% samples had very mild, 23.33% samples had normal and 13.33% had coweyodour. The results of present study are also in line with Faraz (2009). In the studies conducted in Pakistan for odour measurements, traditional methods were used. Biolatto *et al*. (2007) worked on same parameter *i.e.*, odour characteristics by using E-nose approach or SPME-GC analysis which can be used as an alternative technique to the traditional methods of odour measurement.

Localities and week wise variation in colour of milk samples showed non-significant variation and trend of white colour decreased in urban milk samples. However, a little variation was found in colour of milk samples collected during different weeks

The results of the study showed that 83.3% rural, 75.0% peri-urban, and 70.8% urban milk samples had white coloured milk, while 16.7% rural, 25.0% peri-urban and 29.2% urban milk samples had light yellow coloured milk. On overall basis, 76.4% milk sample had white colour and 23.6% had light yellow colour, indicating an adulteration in terms of watering, skimming and mixing of cow milk with buffalo milk. The decreased trend in white colour of milk from rural to urban areas might be due to the increased adulteration in urban areas. The results of present study agree with Lateef *et al.* (2009) and Faraz (2009). Milk ranges in colour from bluish-white to golden yellow, depending on the breed of animal, the amount of fat and solids present and kind of feed. In large quantities, milk appears entirely opaque while in thin layers it is slightly transparent. Milk from which the fat has been removed, or milk which is low in fat percentage, shows a bluish tint. The white colour of milk is due to the reflection of light by the dispersed fat globules, the calcium caseinate and colloidal phosphate. The yellow colour of milk is due to the carotene pigment associated with xanthophyll which is found in green plants and greenish yellow colour is due to the riboflavin pigment. These pigments are produced by different bacteria, known as chromogenic microorganisms (Srivastava, 2002).

The effect of locality on the consistency of milk samples was significant (P=0.001). The samples collected from rural area had normal consistency as compared toperi-urban and urban areas. Thin/watery consistency was less in rural area's samples and more in urban and peri-urban areas. The time (weeks) had no significant effect on consistency as milk samples collected during different weeks had similar consistency. The results of the study showed that 95.8% rural, 75.0% peri-urban and 58.3% urban milk samples had normal consistency, while 4.2% rural, 25.0% peri-urban and 41.7% urban milk samples had thin/watery consistency. This shows that the samples collected from rural area has higher percentages of normal consistency than peri-urban and urban areas. This might be due to less adulteration of water, as most of the samples from rural areas were collected directly from the producers. It indicates that producer's majority have lowest attitude and watering is done at middlemen level. The quality of milk can be improved by excluding/minimizing the middle men from the marketing chain. The justification was also supported by Lateef *et al.* (2009). The effect of locality on sedimentation was significant (P<0.01). The milk samples collected from rural area had less sediments than peri-urban and urban areas. However, week wise variation was non-significant. The results of the study showed that 83.3% rural, 58.3% peri-urban and 56.3% urban milk samples had no sediments, while 16.7% rural, 41.70% peri-urban and 43.8% urban milk samples were positive for the presence of sediments. The milk samples collected from rural area had less sedimentation than peri-urban and urban areas. On overall basis, 66% milk samples were found positive for sedimentation indicating careless attitude during milking and handling. This shows that the milk sold at rural areas is more pure. The results of this study are in line with those of Lateef *et al.* (2009) and Faraz (2009).

Chemical Composition

Milk samples collected from the rural, per-urban and urban areas of Faisalabad were analysed for biochemical constituents *viz*., fat, protein, lactose, SNF, freezing point, total solid and specific gravity. The results are shown in

Table II. The effect of locality on milk fat was significant (P<0.001). The results of the present study showed that milk samples collected from rural, peri-urban and urban areas had 4.83, 3.88 and 3.53% fat, respectively. The milk samples collected from rural areas had higher percentage which shows that milk from rural areas is less subjected to mal-practices *i.e.,* skimming and watering. Fat samples analyzed in previous studies by Mohammad *et al*. (2007) and Han *et al*. (2007) had 6.98-7.35% and 7.59% fat, respectively. In comparison to above findings, the fat percentage found in the present study is very close to the legal standard and thus it is a clear indication of less skimming by local milk dealers in Faisalabad. These results are not in accordance with those of Khan *et al*. (1991), Mustafa *et al*. (1991) and Khan *et al*. (1999), who worked on the milk sold at various canteens of hospitals in Faisalabad and Peshawar city. Their results showed that the milk at these places was extensively put to malpractices such as skimming and adulteration with water (Table I).

Table I: The effect of locality and time on physical properties of milk samples collected from rural, peri-urban and urban areas of Faisalabad.

Milk Samples		Localities				Time (Weeks)					
		Rural	Peri-Urban	Urban	*P*	1	2	3	4	*P*	Control Sample
General Appearance (%)	Clear	77.1	81.3	81.3	NS*	75.0	88.9	75.0	80.6	NS	100.0
	Dirty	22.9	18.8	18.8		25.0	11.1	25.0	19.4		--------
Odour (%)	Normal	64.6	79.2	85.4	NS	77.8	77.8	75.0	75.0	NS	100.0
	Very Mild	29.2	18.8	12.5		16.7	16.7	25.0	22.2		--------
	Cowey	6.3	2.1	2.1		5.6	5.6	0.0	2.8		--------
Colour (%)	Milk White	83.3	75.0	70.8	NS	86.1	83.3	69.4	66.7	NS	100.0
	Light Yellow	16.7	25.0	29.2		13.9	16.7	30.6	33.3		---------
Consistency (%)	Normal	95.8	75.0	58.3	=0.001	77.8	75.0	69.4	83.3	NS	100.0
	Thin/ Watery	4.2	25.0	41.7		22.2	25.0	30.6	16.7		---------
Sediments	No	83.3	58.3	56.3	<0.05	58.3	77.8	69.4	58.3	NS	100.0
	Yes	16.7	41.7	43.8		41.7	22.2	30.6	41.7		---------

* Non-significant

Week wise variation in fat% was not significant. However, a little variation in the percentages of fat was found during different weeks. The effect of interaction of week and location on fat was also significant (P<0.05). The effect of locality on the percentage of milk protein was significant (P<0.001). The study results indicated that milk protein was maximum (3.65%) in samples collected from rural areas followed by peri-urban (3.21%) and urban (2.97%). The probable reason of low protein contents in milk samples collected from peri-urban and urban areas may be the boiling of milk that denatures the protein. Protein percentage of milk collected from rural area is close to protein values (3.8%) obtained by Mohammad *et al*. (2007) and lower than the protein percentage (4.86%) reported by Han *et al*. (2007).

The protein percentage of milk samples from all areas of study was higher than the protein value (2.23%) reported by Faraz (2009), who obtained milk samples from hospitals, educational institutions and public places in

Faisalabad city. Comparatively more protein contents in the present study might be due to variation in collection sites as in this study milk were collected from those spots from where household consumer's purchased the milk. However, week wise variation was not significant as very mild variation in the percentage of protein was foundduring different weeks. The effect interaction of location and week on protein was non-significant. Lactose is a disaccharide and made up of two simple sugars, glucose and galactose. Most of the glucose and galactose are derived from the blood glucose in the synthesis of lactose. The concentration of glucose in blood plasma is very low in comparison with the lactose concentration of milk. The glucose and galactose fractions are important for developing brain (Anonymous, 1988). Lactose has the ability to suppress protein putrefaction in the intestine and thereby retard growth of several pathogens.

The locality had a significant (P<0.001) effect on lactose percentage of milk samples. Maximum lactose contents (5.33%) were found in milk samples collected from rural areas while minimum (2.43%) in those collected from urban areas. These results are in accordance with the results of Han *et al*.(2007), who reported 4.74% lactose in milk samples. The effect of time (weeks for the collection of milk sample) on the percentage of lactose was non-significant as a little variation in the percentages of lactose was found during different weeks. The interaction of both location and week was non-significant.

The effect of locality on the percentage of SNF was significant (P<0.001). The percentage of SNF was higher in the milk samples collected from rural areas as compared to the peri-urban and urban areas. The effect of time (weeks for the collection of milk sample) on the percentage of SNF was non-significant. However, some variation in the percentage of SNF was found during different weeks. The interaction of location and week was also non-significant.

The results of the present study showed 9.78, 8.62 and 7.79% SNF in rural, periurban and urban milk samples, respectively. The percentage of SNF was higher (P<0.01) in the milk samples collected from rural areas as compared to the peri-urban areas and urban areas. SNF refers to the total solids excluding fat in milk; the proteins, mineral matter, sugar, etc., together make the SNF. On the basis of legal milk standards, 9% SNF for buffalo and 8% for cow milk, the SNF percentage observed in the present study for rural and peri-urban areas is very close to the minimum legal standard. These results do not agree with those of Lateef *et al*. (2009) and Faraz (2009), who reported very low SNF values. The relatively low percentage of SNF in urban milk samples is a clear indicator of mal-practices like skimming and adulteration. The results of Khan *et al*. (1991), Mustafa *et al*. (1991) and Khan *et al*. (1999) differs from present study. They reported very low SNF %age in milk samples and blamed this to skimming and adulteration with water.

The effect of locality on the freezing point was significant (P<0.001). The results showed that the freezing points for samples collected from rural, peri-urban and urban areas were -0.518, -0.416 and -0.412, respectively which showed that it was lower for the milk samples collected from rural areas as compared to the peri-urban areas; and it was lower for the peri-urban areas as compared to the urban areas. The effect of time (week for the collection of milk sample) on the freezing point was not significant. The interaction between weeks and location was also non-significant.

By addition of 1 percent (by volume) of water to milk, the freezing point rises approximately 0.0099°F (0.0055°C). Hence, the raised freezing point for urban areas indicates the increased malpractice of water adulteration. This indication was also supported by Khan *et al*. (1991), Mustafa *et al*. (1991) and Khan *et al*. (1999).

The effect of locality on the percentage of total solids was significant (P<0.001). The results of the present study showed 14.59, 12.51 and 11.29% total solids in rural, peri-urban and urban milk samples, respectively. The percentage of total solids was higher in the milk samples collected from rural areas as compared to the peri-urban and urban areas (P<0.01). Peri-urban areas milk samples had higher percentage of total solids than urban areas milk samples. The values for TS of the present study are lower as compared to the normal values for buffalo (17%) and cow (13.9%) milk as reported by Khan *et al*. (2005). Taking 13.9% as a standard value, the milk from rural areas only falls in the category of pure milk. The results of present study for TS value are lower than the value (18.44%) reported by Han *et al*. (2007) and are higher than the value (6.54%) reported by Lateef *et al*. (2009). The difference in TS

values might be attributed to variation in localities and time periods. Results of present study is in line with (11.35%) Mehaia *et al*. (1995) and (11.15%) Antunac *et al*. (2001) that are very close in peri-urban and urban areas value and Zhang *et al*. (2008) who shows 14.3% TS value that is very close to the rural areas value. However, there was a continuous decreasing trend in total solids of milk samples from week 1 to week 3 and a slight increase in week 4. Statistically this variation was non-significant. The interaction between the location and weeks was non-significant.

The effect of locality on the specific gravity was significant (P<0.001). The specific gravity was higher in the milk samples collected from rural areas as compared to the peri-urban areas; and it was higher for the peri-urban areas as compared to the urban areas. The effect of time (weeks for the collection of milk sample) on the specific gravity was not significant. However, a little variation in the specific gravity was found during different weeks. The interaction between the weeks and location was non-significant (Table II).

Table II: The effect of location and time on chemical composition of milk samples collected from rural, Peri-urban and urban areas of Faisalabad at different weeks.

Parameters	Locations			s.e.d	P	Time (Weeks)				s.e.d	P
	Rural	Peri-urban	Urban			1	2	3	4		
Fat (%)	4.83	3.88	3.53	1.61	<0.001	4.24	4.01	3.95	4.10	1.31	NS
Protein (%)	3.65	3.21	2.97	1.02	<0.001	3.39	3.23	3.22	3.26	0.84	NS
Lactose (%)	5.33	4.71	4.29	1.24	<0.001	4.93	4.69	4.71	4.77	1.13	NS
Solid fat (%)	9.78	8.62	7.79	2.48	<0.001	9.02	8.56	8.60	8.74	2.02	NS
Freezing point (°C)	-0.52	-0.42	-0.41	0.14	<0.001	-0.48	-0.46	-0.46	-0.46	-0.11	NS
Total solids (%)	14.59	12.51	11.29	3.85	<0.001	13.26	12.65	12.45	12.83	3.14	NS
Specific gravity	1.03	1.02	1.02	0.001	<0.05	1.03	1.02	1.02	1.02	0.007	NS

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