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Comparison in the physicochemical properties of Buffaloes milk collected from industrial and non-industrial areas of District Jamshoro Sindh

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Abstract

Milk is one of the most important parts of our diet since it contains all the significant supplements. Milk quality is important parameter for both milk consumers and dairy products. Present study was conducted to compare some the physicochemical properties of buffaloes milk collected from industrial and non-industrial areas of District Jamshoro Sindh. A total of 50 buffaloes milk (BM) samples were obtained from two different sites (n=25) from industrial and (n=25) from the non-industrial areas of Jamshoro. The physicochemical properties such as pH, specific gravity, acidity%, moisture content, total solids (TS), solid-not-fat (SNF), total fat (TF), lactose, total proteins (TP), casein protein and whey proteins were determined in collected milk samples as per reported methods. The conducted research showed that the BM collected from non-industrial areas of Jamshoro had higher level of pH, specific gravity, acidity%, TS, SNF, TF, lactose content, total proteins, casein proteins, whey proteins and low level of moisture content compared to BM collected from industrial areas of Jamshoro. Furthermore it was observed that non-industrial areas buffaloes had significantly higher milk yield (per/day) compared to non-industrial areas buffaloes. A significant correlation was found between the different physicochemical parameters of BM milk collected from both areas. It is concluded that buffaloes milk collected from industrial and non-industrial areas showed the great variation in physicochemical parameters, which may effect on the nutritional and health benefits of milk consumers.

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Introduction

Milk is considered as almost complete diet for human. Buffalo's milk contains all the essential nutrients required for the growth and development. Milk and milk products have been categorized as a major food for infants and school age children (Hinrichs, 2004). Buffalo milk is a natural substance that can be consumed like any other product based on compositional point of view; buffalo milk is richest in fat, total solids, proteins and lactose compared to cow and goat milk (Ménard *et al*., 2010). Based on the chemical composition buffalo milk contains about 82-87% water. Total solids are considered as a major component of buffalo milk after water, TS accounts about 13-17% of total milk components. At normal conditions buffalo milk contain about 7.90% fat, 4.20% proteins and 5.00% lactose (Kunz *et al*., 2000; Verrocchio *et al.,* 2007; Ahmed *et al*., 2008).

Number of studies had shown that milk composition depends on the lactation stage, composition of feed, season and environment of animal (Hang *et al*., 1982; Sharma and Agarwal, 1985; Auldistet *et al*., 1998; Mackle *et al*., 1999). Chemical composition and nutritional values of buffalo's milk may be effected by several factors like feeding system, breed, season and environment (Ahmed *et al*., 2013).

The environmental conditions of Jamshoro industrial area is the point of concern where the emission of industrial waste is continuously contaminating the drinking water and pollute the air as well. That's why the current research work was conducted to compare the physicochemical properties of buffaloes milk collected from industrial and non-industrial areas of District Jamshoro Sindh, Pakistan

Materials and methods

Milk sample collection

For present research work a total of 87 buffaloes milk (BM) samples were obtained from two different sites of Jamshoro (n=45) from industrial and (n=42) from non-industrial areas. All the BM samples were collected from different cattle form during the milking time in clean sterilized plastic type bottles.

Physicochemical analysis of milk samples

All the physicochemical parameters in BM have been analyzed as per reported methods. pH of milk samples was determined by using digital pH meter calibrated with pH 4 and 7 buffers. Titratable acidity, Specific gravity, TS and SNF were analyzed by using standard (AOAC, 2000) reported methods.

Total fat content was analyzed by (Marshall, 1993) reported method. (Triebold, 2000) reported method was used to determine lactose in milk. Total proteins, casein and whey protein in milk samples were determined by (Foley *et al*., 1974) reported method.

Statistical analysis

The data analysis was performed by one way Anova using SPSS software (Version, 22).

Results and discussion

Results of the different physicochemical component of BM collected from both areas of District Jamshoro are reported in Table 1.

The pH in BM collected from industrial area was in the range of 6.13-6-18 compared to 6.21-6.98 BM collected from non-industrial area of Jamshoro. Significantly ($P<0.001$) higher pH was observed in BM collected from non-industrial areas of Jamshoro.

Similar findings were reported by (Khan *et al.,* 2007; Yang *et al.,* 2013). The values of acidity% in BM collected from industrial areas were in the range of 0.11-0.26% compared to 0.13-0.26% in BM collected from non-industrial area of Jamshoro. From the data it was noticed the BM collected from non-industrial areas had higher level of acidity. Almost similar findings were reported by (Khan *et al*., 2007; Mahmood and Usman, 2010). The values of specific gravity in BM milk collected from industrial areas were in the range of 0.76-1.06 compared to 0.91-1.04 in the BM collected from non-industrial areas of Jamshoro. Higher values of specific gravity were noticed in the BM collected from non-industrial areas. Similar results were also reported by (Mansour *et al*., *2012;* Parween *et al.,* 2013; Ramya *et al*., 2016).

Table 1. Results of the physicochemical parameters of buffaloes milk (BM) collected from industrial and non-industrial areas of Jamshoro. Min, minimum. Max, maximum. SD, standard Deviation.

	Industrial area			Non-industrial area			
Parameter	Min	Max	Mean± SD	Min	Max	Mean± SD	P-value
pH	6.13	6.81	6.455±0.168	6.21	6.98	6.772±0.256	<0.001
Acidity%	0.11	0.26	0.168±0.041	0.13	0.26	0.162±0.043	0.08
Sp. Gravity	0.76	1.06	1.028±0.054	0.91	1.04	1.032±0.032	0.09
Moisture%	84.98	87.32	85.758±0.592	83.01	85.95	83.624±0.583	<0.001
T.S%	12.68	15.02	14.242±0.546	14.04	16.99	16.385±0.617	<0.001
SNF%	7.38	9.92	8.624±0.758	9.31	11.40	9.939±0.505	<0.001
T.F%	4.38	6.32	5.585±0.43	5.85	6.99	6.607±0.369	<0.01
Lactose%	3.28	4.80	3.720±0.282	4.43	4.88	4.632±0.134	<0.01
T. P%	3.36	4.81	3.895±0.277	4.18	4.82	4.308±0.147	0.04
Casein%	2.68	3.84	3.116±0.221	3.34	3.85	3.526±0.118	0.6
Whey proteins%	0.19	0.96	0.759±0.32	0.36	0.96	0.865±0.95	0.5

Moisture content in the BM collected from industrial areas was in the range of 84.98-87.32% compared to 83.01-85.95% in BM collected from non-industrial areas. Significantly (P<0.001) higher level of moisture% was found in the BM collected from industrial areas. Difference in moisture content in BM may be due to residual status, fat content and body size of buffaloes.

Table 2. Pearson correlation between the milk parameters collected from industrial area.

Parameter	Moisture	TS	SNF	TF	TP	Lactose
Moisture	1					
TS	-1.000**	1				
SNF	-.847**	.847**	1			
TF	-.259	.259	-.112	1		
TP	-.199	.199	.140	.012	1	
Lactose	-.150	.065	.039*	.234	-.160	1

** Correlation is significant at 0.01 levels, * Correlation is significant at 0.05 levels.

The total solid (TS) in BM collected from industrial areas were in the range of 12.68- 15.02 % compared to 14.04-16.99% in BM collected from non-industrial areas of Jamshoro. Significantly (P<0.001) higher values of TS were found in the BM collected from non-industrial area. Results of TS from present study were in the line of (Ahmed *et al.,* 2007; Han *et al.,* 2007). While lower than the (Hayam *et al.*, 2017).

The solid-not-fat (SNF) level in the BM collected from industrial areas ranged between 7.38-9.92% compared to 9.31-11.40% in BM collected from non-industrial areas of Jamshoro. Significantly (P<0.001) increased level of SNF were determined in BM collected from non-industrial areas. Variation in the SNF may be due to number of lactation and composition of diet (Sodi *et al.*, 2008). Findings of present study were in the line of (Meena *et al.*, 2007; Misra *et al.*, 2008) and lower than the (Ramya *et al.*, 2016).

The total fat (TF) level in the BM collected from industrial areas ranged between 4.38-6.32% compared to 5.85-6.99% in BM collected from non-industrial areas of Jamshoro. Significantly (P<0.01) higher level of TF was found in BM collected from

non-industrial areas. Normally milk fat of buffaloes varies from 4.4 to 8.9% (Faruque, 1996). The results of total fat from present study were within the ranges reported by (Mishra *et al.*, 2008; Yadav *et al.*, 2013; Nivedita *et al.*, 2018). Various studies like had reported higher values of total fat in buffaloes milk. (Enb *et al.*, 2009; Menard *et al.*, 2010; Balusami *et al.*, 2015).

Table 3. Pearson correlation between the milk parameters collected from non-industrial area.

Parameter	Moisture	TS	SNF	TF	TP	Lactose
Moisture	1					
TS	-.324**	1				
SNF	-.412**	-.023	1			
TF	-.229	.391*	-.403*	1		
TP	-.005	.270	-.059	-.221	1	
Lactose	-.150	.065	.039	.234	-.160	1

** Correlation is significant at 0.01 levels, * Correlation is significant at 0.05 levels.

Data concerning the lactose showed that BM milk collected from industrial areas was ranged between 3.28-4.80% compared to 4.43-4.88% in BM collected from non-industrial areas of Jamshoro. Significantly (P<0.01) higher level of lactose was determined in the BM collected from non-industrial areas of Jamshoro. Results of the lactose content from the present study were lower than the (Abo El-Nor *et al.*, 2007; Abou Donia *et al.*, 2010; Menard *et al.*, 2010) who found the higher values of lactose in buffaloes milk.

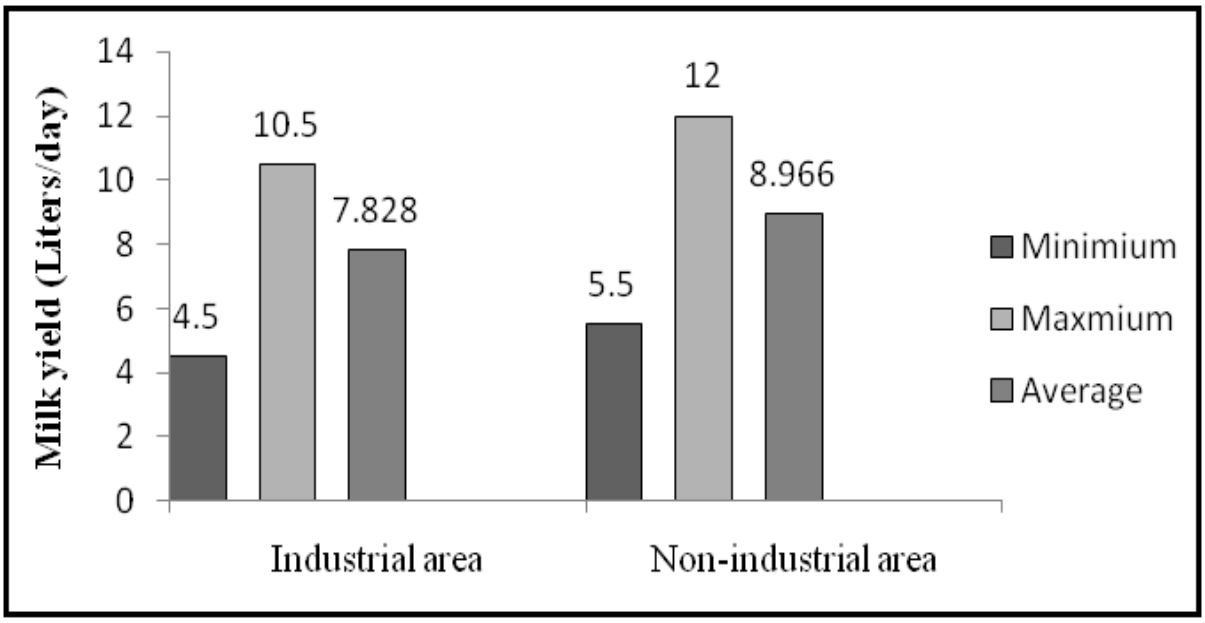

Fig. 1. Average milk yield in buffaloes from both areas of Jamshoro.

Proteins are heterogeneous component of milk, divided into casein and whey protein fractions. Data concerning the Total protein (T.P) showed that BM milk collected from industrial areas was ranged between 3.36-4.81% compared to 4.18-4.82% in BM collected from non-industrial areas of Jamshoro. Significantly (P<0.01) higher level of lactose was determined in the BM collected from non-industrial areas of Jamshoro.

Results of total proteins from present study are with the agreement with the previous studies (Mahmood *et al.*, 2010; Guetouache *et al.*, 2014; Hayam *et al.*, 2017).

Casein is the valuable component of milk, while the proportion of whey proteins is relatively low compared to casein. Casein and whey proteins in BM collected from industrial areas were in the range of 2.68-3.84% and 0.19-0.96% compared to 3.34-3.86% and 0.36-0.96% in BM collected from non-industrial areas. From the results it was observed that casein and whey proteins were higher in the BM collected from non-industrial areas. Due to the number of biological values and multi-functional properties whey proteins are considered as major part of milk food (jara *et al*., 2011; Tavares *et al*., 2013).

Milk Yield (Liters/day)

Milk yield in buffaloes from industrial and non-industrial areas of Jamshoro is given in Figure 1. Significantly ($P<0.01$) higher milk yield had been observed in non-industrial areas buffaloes compared to industrial areas buffaloes. Milk yield in buffaloes depend on the animal health, breed, feeding system and environment (Zhag Rongchang, 1983).Variation in milk yield among the buffaloes may be due to environmental impact on the health and performance of buffaloes from industrial area of District Jamshoro.

Correlation between the milk parameters

The most interesting part of this study was correlation between the physicochemical parameters of buffaloes milk collected from industrial and non-industrial areas of District Jamshoro Table 2 and 3. Significant very high negative and positive correlations were found between the Moisture- TS, SNF-Moisture, SNF-TS and lactose- SNF, lactose-SNF and TF-SNF in the BM collected from industrial and non-industrial areas of District Jamshoro.

Conclusion

The present research work showed that the buffalo's milk collected from non-industrial areas of District Jamshoro had more favorable milk composition compared to buffaloes milk collected from industrial areas of District Jamshoro. Significant variation in physicochemical parameters of milk indicates some environmental effects on buffalo's health and performance. Further investigation should be carried out on to examine the composition and contamination of buffaloes fodder and water.

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