EFFECT OF SEVERITY OF MASTITIS ON pH AND SPECIFIC GRAVITY OF BUFFALO MILK

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The aim of present study was to determine the effect of severity of mastitis on buffalo milk pH and specific gravity. One hundred and fifty buffaloes were selected randomly having almost same stage of lactation (third to fourth month post calving) and parity (second to third), from Soomorwala, District Jhang. For the determination of milk specific gravity and pH, lactometer and pH meter were used. The severity of mastitis was graded as P1, P2 and P3 by Surf Field Mastitis Test. Specific gravity and pH was 1.032±0.0003 and 6.58±0.03 respectively in 50 negative cases. However, specific gravity decreased from 1.032±0.0003 to 1.028±0.0003 and pH increased from 6.58±0.03 to 7.07±0.01 with the severity of mastitis.
Keywords: Mastitis, specific gravity, pH, buffalo, milk

INTRODUCTION

Milk has been recognized as an almost indispensable food for mankind. It contains all the food constituents required in the human diet. The milk is projected as commodity by the Pakistani people , which is "food for life". It is a fact that milk and wheat constitutes the bulk of the diet of our rural population, as they are the only available and accessible food items for daily consumption there. As a food group, all milk (both milk and milk equivalents) is second only to cereals in level of per capita consumption. By weight all milk makes up nearly one third of all food consumed. (Bilal and Ahmad, 2004). In Pakistan majority of the people prefer buffalo milk due to high fat contents. The annual production of milk in Pakistan is estimated at 28.6 million tons. It is fact that God has granted us the world's finest dairy breed in the form of Nili-Ravi as the major ray of hope for planners, dreaming to make this country self sufficient in animal protein resources but still we are deficient in animal protein. There are many factors responsible for this situation, but mastitis is one of the leading factors in this regard.

Food value of milk depends upon its composition and quality. Specific gravity and pH of milk are one of the best basis to assess the food value of milk for consumers and processors. Milk is a complex colloidal system in which the dispersion medium, water contains salts and sugar in solution. It is therefore heavier than water and its specific gravity is more than a unit. The specific gravity of milk from cows and buffaloes averages 1.032 and 1.033, respectively. The specific gravity of milk is influenced by the proportion of its constituents, each of which has a different specific gravity approximately as follows: fat, 0.93; lactose, 1.66; protein, 1.34; casein, 1.31; salts, 4.12. The average specific gravity of the milk solids other than fat ranges from 1.600 to 1.638 (Eckles, 2001). Specific gravity of milk also depends upon the udder health status of the animal. In mastitic milk, specific gravity reduced due to increased chlorides and decreased lactose contents (Badran et al., 1986; Haggag et al., 1991). Water reaches its maximum specific gravity at 39°F (-0.55°C) where the freezing point of milk is reached.

Freshly drawn milk shows an amphoteric reaction, that is, it turns red litmus blue and blue litmus red. Normal fresh milk has approximately a pH 6.6 to 6.9, which indicates that the milk is slightly acidic. When normal fresh milk is titrated with an alkali solution using phenolphthalein as an indicator, acidity ranges from 0.10 to 0.26 percent. If it is assumed that the acidity is due to lactic acid but real fresh milk contains no lactic acid. The acidity of fresh milk is known to be due to the phosphates of milk, the protein (casein and albumin) and to a slight degree due to the presence of CO_2 and citrates (Bilal and Ahmad, 2004). The pH may serve as the best indicator to assess the udder health status of the animal and food value of the milk. As the severity of mastitis increased, pH value also increased (Haggag et al., 1991), lowering the food value of milk. The milk available to masses in this country is low in quality due to higher incidence of mastitis in dairy animals. The present study was therefore, carried out to determine the effect of mastitis on specific gravity and pH of buffalo milk.

MATERIALS AND METHODS

Milk samples were collected from 150 buffaloes selected randomly from the field, having the same stage of lactation (third to forth month post calving) and parity (second to third). Before collecting the milk samples, teats were thoroughly washed by tap water and first two streams were discarded. Milk samples measuring about one hundred ml were collected from each teat. Two drops of formaline (10%) were added to milk as a preservative and stored at-4°C till further analysis.

Surf Field Mastitis Test (SFMT) as described by Muhammad (1995) was used for grading the severity of mastitis and was performed at the animal site. Grading was done as: No visible change in appearance, negative; mild clumping, P1; Rapid/moderate clumping, P2 and Rapid/heavy clumping, P3. Milk specific gravity was determined according to the method described by David (1977). For this purpose, milk samples having temperature between 50-70 °F were thoroughly mixed and poured into a high glass cylinder. Lactometer was lowered slowly into the milk and when it becomes stationary, noted the scale reading on the lactometer. Laboratory thermometer was used to record the milk temperature. In case the temperature was above or below the standard (60°F), LR was corrected according to the following:

i) Add 0.1 for each degree above 60 °F in LR

ii) Subtract 0.1 for each degree below 60°F in LR

Finally, following formula was used to determine the specific gravity

1+CLR/1000

Digital pH meter was used to determine the pH of milk.

Statistical Analysis

The mean values (±SE) of milk specific gravity and pH in respect of various groups i.e. mastitis grade (control, P1, P2, P3), side of quarters (right and left) and location of quarters (front and rear) were computed. In order to ascertain the magnitude of variation in these parameters among various groups, the data were analyzed by using two-way analysis of variance technique (Steel and Torrie, 1980). Means were compared by Duncan Multiple Range Test (Montgomery, 1997).

RESULTS AND DISCUSSION

Milk specific gravity decreased due to mastitis (Table 1). The severity of mastitis significantly lowered the specific gravity (Table 2). Mean milk specific gravity was 1.032±0.0003 in negative quarters, but 1.03 ± 0.0003, 1.030 ± 0.0003, 1.028 ± 0.0003 in P1, P2 and P3 quarters respectively. Statistical analysis indicated a significance difference in specific gravity due to severity of mastitis. However, a non-significant difference was found between left/right, fore/rear quarters (Table2). The findings of this study are in line with those of Bardan et al (1986) and Haggag et al (1991) who pointed out that specific gravity lowers with severity of mastitis. It may be attributed to increase in chloride and decrease in lactose contents as specific gravity is positively correlated with lactose and negatively correlated with chloride contents. On the other hand, pH increased due to mastitis (Table 3). Mean milk pH was 6.58±0.03 in negative quarters which increased to 6.77±0.02, 7.01±0.01 and 7.07±0.01 in P1, P2, P3 quarters respectively. Statistical analysis indicated a highly significant difference in pH due to severity of mastitis (Table 4). However, non-significant difference was found between left/right, fore/rear quarters. The results of the present study are in agreement with Haggag *et al.* (1991) and Horvath *et al* (1980) who showed that with severity of mastitis pH of the samples increased. Similarly, Charjan *et al.* (2000) reported that milk pH increased @ of 0.13 per unit increase in CMT score and pH could serve as the best indicator to asses the condition of udder health in dairy animals. The probable reason of pH increase due to severity of mastitis may be attributed to the lowered acidity as has been found in mastitic milk. The lowered acidity in mastitic milk is due to reduction in lactose contents as the lactic acid formation is minimum in this case.

CONCLUSION

On the basis of this study it was found that food value of milk could be improved by controlling the mastitis in buffaloes, a major dairy animal in Pakistan.

REFERENCES

Badran, A.E., M.A. Sharaby and G.A. Hassan. 1986. Susceptibility of cows and buffaloes to Mastitis infection. II. Milk quality and mastitis infection. Indian Veterinary J. 63: (12): 107-1022.

Bilal, M.Q. and A. Ahmad. 2004. Dairy Hygiene and Disease Prevention. Usman and Bilal Printing Linkers, Faisalabad, Pakistan

Charjan-Ku, P.Y., N.S. Mangle, D.R. Kalorey and S.V. Kuralkar. 2000. Changes in milk pH and the levels of Na and K in whey associated with udder health status of cow. Indian Veterinary J. 77(12): 1066-1068.

Table 1. Mean milk specific gravity concentration of normal and mastitic buffaloes.

Groups	Right		Left		Overall mean
	Front	Rear	Front	Rear	
Control	1.032 ± 0.001	1.031 ± 0.001	1.032 ± 0.001	1.031 ± 0.001	1.032 ± 0.0003
P1	1.031 ± 0.001	1.029 ± 0.001	1.030 ± 0.001	1.030 ± 0.001	1.031 ± 0.0003
P2	1.029 ± 0.001	1.030 ± 0.001	1.029 ± 0.001	1.028 ± 0.001	1.030 ± 0.0004
P3	1.028 ± 0.001	1.029 ± 0.001	1.028 ± 0.001	1.028 ± 0.001	1.028 ± 0.0003

P1 = Positive one (mild clumping); P2 = Positive two (moderate clumping); P3 = Positive three (heavy clumping)

Table 2. Analysis of variance of milk specific gravity in mastitic buffaloes.

Source of variations	Degree of freedom	Sum of squares	Mean sum of squares	F-value
Grading (G)	3	0.000	0.000	26.3830**
Side (S)	1	0.000	0.000	0.6261^{NS}
G × S	3	0.000	0.000	1.4400^{NS}
Front & Rear (FR)	1	0.000	0.000	0.0063^{NS}
G × FR	3	0.000	0.000	2.7652*
S × FR	1	0.000	0.000	0.0563^{NS}
G × S × FR	3	0.000	0.000	0.8118^{NS}
Error	144	0.001	0.000	
Total	159	0.001		

**Significant at P≤0.01; *Significant at P≤0.05; NS = Non-significant.

Table 3. Mean milk pH concentration of normal and mastitic buffaloes.

Groups	Right		Left		Overall mean
	Front	Rear	Front	Rear	
Control	6.54 ± 0.11	6.56 ± 0.03	6.68 ± 0.24	6.54 ± 0.02	6.58 ± 0.03
P1	6.72 ± 0.03	6.77 ± 0.24	6.79 ± 0.12	6.78 ± 0.03	6.77 ± 0.02
P2	7.00 ± 0.04	7.04 ± 0.07	7.02 ± 0.02	6.99 ± 0.02	7.01 ± 0.01
P3	7.00 ± 0.01	7.07 ± 0.02	7.00 ± 0.02	7.04 ± 0.03	7.07 ± 0.01

P1 = Positive one (mild clumping); P2 = Positive two (moderate clumping); P3 = Positive three (heavy clumping)

Table 4. Analysis of variance of milk pH in mastitic buffaloes.

Source of variations	Degree of freedom	Sum of squares	Mean sum of squares	F-Value
Grading (G)	3	6.280	2.093	154.1676**
Side (S)	1	0.009	0.009	0.6628^{NS}
G × S	3	0.038	0.013	0.9246^{NS}
Front & Rear (FR)	1	0.012	0.012	0.8513^{NS}
G × FR	3	0.042	0.014	0.0343^{NS}
S × FR	1	0.067	0.067	4.9519*
G × S × FR	3	0.041	0.014	0.9948
Error	144	1.955	0.014	
Total	159	8.444		

**Significant at P≤0.01; *Significant at P≤0.05; NS = Non-significant

David, C.L. 1977. Laboratory Guide in Dairy Chemistry Practical. FAO Regional Dairy Development and Training Center for Asia and the Pacific. Dairy Training and Research Institute, Univ. Philippines, Los Bamos College, Langnene.

Echles, C.H., B.C. Willes and M. Harold. 2001. Milk and Milk Products. New Dehli, India.

Haggag, H.F., L.F. Hamzawi, G.A. Mahran and M.M. Ali. 1991. Physico-chemical properties of colostrum and clinical and sub-clinical mastitic buffalo milk. Egyptian J. Dairy Sci., 19(1): 55-63.

Horvath, G.A., I.H. Mohammed, J. Varga, G. Szemeredi and L. Quarini. 1980. Effect of sub-clinical mastitis on milk composition. Magyar Allatorvosok Lapja. 35(9): 615-619.

Montgomery, D.C. 1997. Design and Analysis of Experiments. John Wieley and Sons, New York, USA.

Muhammad, G., M. Athar, A. Shakoor, M.Z. Khan, F. Rehman and M.T. Ahmad. 1995. Surf Field Mastitis Test: An inexpensive new tool for evaluation of wholesomeness of fresh milk. Pak. J. Food. Sci. 5: 91-93.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and Procedures of Statistics. A Biometrical Approach, McGraw Book, Publ. Co. Inc., New York, USA.

David, C.L. 1977. Laboratory Guide in Dairy Chemistry Practical. FAO Regional Dairy Development and Training Center for Asia and the Pacific. Dairy Training and Research Institute, Univ. Philippines, Los Bamos College, Langnene.