

## IMPACT OF MASTITIS SEVERITY ON MINERAL CONTENTS OF BUFFALO MILK

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This study was planned to determine the effect of mastitis on the mineral contents of buffalo milk. For this purpose, 150 buffaloes were selected randomly having same stage of lactation (third to fourth month post calving) and parity (second to third), from District Jhang, Pakistan. The severity of mastitis was graded as mild, moderate and high by Surf Field Mastitis Test. The milk samples were subjected to wet digestion to determine the levels of mineral contents. The results showed that sodium level increased in mastitic milk from  $38.92 \pm 0.20$  to  $46.60 \pm 0.26$  mg/100 ml. However, a reduction from  $23.08 \pm 0.56$  to  $13.62 \pm 1.33$ ;  $49.45 \pm 0.62$  to  $37.80 \pm 0.50$ ;  $15.78 \pm 0.27$  to  $14.41 \pm 0.18$ ; and  $21.20 \pm 0.39$  to  $20.02 \pm 0.77$  mg/100 ml in potassium, calcium, magnesium and manganese was found due to mastitis. A similar trend was noticed for iron, zinc, and copper, which showed a decrease from  $22.06 \pm 0.36$  to  $18.87 \pm 0.27$ ;  $43.24 \pm 1.02$  to  $37.10 \pm 1.22$  and  $13.18 \pm 0.38$  to  $9.07 \pm 0.22$  mg/100ml, respectively. The results of this study demonstrated that mastitis had a major impact on the minerals contents in milk which can affect quality of milk.

**Keywords:** Mastitis, buffalo milk, mineral contents, severity

### INTRODUCTION

Milk has been recognized as an almost indispensable food for mankind. It contains all the food constituents required in human diet. The composition of milk can vary with the breed, species, feeding regimes, stage of lactation and udder health. The nutritional significance of milk is indicated by the fact that daily consumption of a quart (1.14 litres) of milk furnishes approximately all the fat, calcium (Ca), phosphorus (P), riboflavin, one half of the protein, one third each vitamin A, ascorbic acid and thiamin, and one fourth of calories needed daily by an average individual. Milk is an important source of dietary Ca, which is a key mineral for healthy bone and teeth development in the young ones and an adequate intake is essential for skeletal functioning. The Ca contents of dairy milk are three times that of wheat, greatly exceed that of corn and four times as great as that of human milk (Bilal and Ahmad, 2004). Majority of the Pakistani farmers prefer to keep buffaloes, as high fat percentage in buffalo milk enables them to get higher income because the price of milk is based on fat content and people prefer buffalo milk due to its high fat contents. Buffalo population in Pakistan has been estimated to be 25 million heads, contributing about 74% of the total milk produced in the country. Milk available to our masses is usually lower in food value due to higher prevalence of mastitis in dairy animals (Allore, 1993). Mastitis lowers the milk quality in terms of reduction in certain mineral contents and an increase of sodium contents. Other changes in milk include discoloration and presence of clots, deteriorating the milk quantity and quality (Janota-Bassalik *et al.*, 1978).

According to Tek *et al.* (1998), potassium, sodium and chloride ion contents in milk from normal cows were  $64.11 \pm 2.6$ ,  $32.51 \pm 0.95$  and  $47.05 \pm 2.40$  mg/100 ml, respectively. However, in milk samples from sub-clinical mastitic cows these values were  $39.55 \pm 2.2$ ,  $57.70 \pm 2.05$  and  $86.90 \pm 3.51$  mg/100 ml, respectively. However, there is paucity of information regarding the effects of mastitis on the mineral contents of the buffalo milk. Therefore, the present study was planned to determine the effect of varying degree of mastitis severity on the mineral contents of buffalo milk under Pakistani managemental conditions.

### MATERIALS AND METHODS

This study was conducted to investigate the effect of mastitis severity on mineral contents of buffalo milk. For this purpose, milk samples were collected from 150 buffaloes selected randomly from District Jhang having stage of lactation from third to fourth month post calving and parity from second to third. Out of total 600 quarters, 15 were non-functional (blind teats) and were excluded from the study. Thus, 585 milk samples were available during a study period of three months, for analysis.

Before collecting the milk samples, teats were thoroughly washed by tap water and first two streaks were discarded. A total of 100 ml milk sample was collected from each teat. Two drops of formaline (10%) were added in milk as preservative and stored at  $-4^{\circ}\text{C}$  till further analysis. Surf Field Mastitis Test was conducted following the directions of Muhammad *et al.*

(1995) for grading the severity of mastitis. Grading was done as: No visible change in appearance, negative; mild severity, P1; moderate severity, P2 and high severity, P3.

Milk samples were subjected to wet digestion to evaluate electrolytes and trace elements (Richards, 1968). For this purpose, one ml of milk sample was taken into a 100 ml conical flask and 10 ml of concentrated nitric acid was added. The contents of the flask were heated for 20-30 minutes. After cooling, 5 ml perchloric acid was added. The contents of the flasks were heated again till volume was reduced to 2-3 ml. The contents were diluted upto 10 ml by adding redistilled water. The digested and diluted sample solution was used for the estimation of electrolytes and trace elements. Sodium and Potassium concentrations were estimated by flame photometer. Zinc, iron, calcium, manganese, copper and magnesium were determined by atomic absorption spectrophotometer.

### Statistical analysis

The mean values ( $\pm$  SE) of milk mineral contents in respect to various groups of mastitis grade (negative, P1, P2, P3), side of quarters (right and left) and

from  $40.30 \pm 0.24$  mg/100ml in mild cases to  $46.60 \pm 0.26$  mg/100 ml in severe cases ( $P < 0.01$ ). However, minimum contents of  $38.92 \pm 0.20$  mg/100 ml was found in normal milk, indicating that sodium contents of milk increased due to mastitis resulting in salty taste of milk. However, potassium, calcium and iron contents decreased due to the mastitis as compared to non-mastitic milk ( $P < 0.01$ ). Maximum potassium concentration was found in control ( $23.08 \pm 0.56$  mg/100ml) and minimum in P3 ( $13.62 \pm 1.33$  mg/100ml). Same pattern was noticed in case of calcium and iron. In normal milk, calcium and iron concentrations were maximum ( $49.45 \pm 0.62$  and  $22.06 \pm 0.36$  mg/100ml, respectively), but these value were minimum;  $37.80 \pm 0.50$  for calcium and  $18.87 \pm 0.27$  mg/100 ml for iron in case of severe mastitis. Similarly, maximum magnesium ( $15.78 \pm 0.27$  mg/100 ml), manganese ( $21.20 \pm 0.23$  mg/100 ml), zinc ( $43.24 \pm 1.02$  mg/100 ml) and copper ( $13.18 \pm 0.38$  mg/100 ml) contents were found in control. With severity of mastitis the above values decreased in milk (Table 1). Statistical analysis indicated a significant difference in mineral contents of milk, except magnesium, due to the severity of mastitis. However, non significant

**Table 1. Average milk minerals contents (mg/100 ml) as affected by severity of mastitis in buffaloes**

| Groups  | Sodium                     | Potassium                  | Calcium                    | Iron                       | Magnesium           | Manganese                   | Zinc                       | Copper                     |
|---------|----------------------------|----------------------------|----------------------------|----------------------------|---------------------|-----------------------------|----------------------------|----------------------------|
| Control | 38.92<br>$\pm 0.20$ (d)    | 23.08<br>$\pm 0.56$<br>(a) | 49.45<br>$\pm 0.62$ (a)    | 22.06<br>$\pm 0.36$<br>(a) | 15.78<br>$\pm 0.27$ | 21.20<br>$\pm 0.39$<br>(ab) | 43.24<br>$\pm 1.02$<br>(a) | 13.18<br>$\pm 0.38$<br>(a) |
| P1      | 40.30<br>$\pm 0.24$<br>(c) | 18.74<br>$\pm 0.73$<br>(b) | 46.15<br>$\pm 0.44$<br>(b) | 19.46<br>$\pm 0.32$<br>(b) | 14.92<br>$\pm 0.22$ | 19.56<br>$\pm 0.69$<br>(b)  | 41.34<br>$\pm 0.78$ (b)    | 12.57<br>$\pm 0.28$ (b)    |
| P2      | 44.42<br>$\pm 0.23$ (b)    | 16.96<br>$\pm 0.90$<br>(b) | 39.66<br>$\pm 0.98$ (c)    | 18.00<br>$\pm 0.28$<br>(d) | 14.77<br>$\pm 0.23$ | 22.11<br>$\pm 0.67$<br>(a)  | 40.91<br>$\pm 2.16$<br>(b) | 9.40<br>$\pm 0.37$<br>(c)  |
| P3      | 46.60<br>$\pm 0.26$<br>(a) | 13.62<br>$\pm 1.33$<br>(c) | 37.80<br>$\pm 0.50$<br>(d) | 18.87<br>$\pm 0.27$<br>(c) | 14.41<br>$\pm 0.18$ | 20.02<br>$\pm 0.77$<br>(b)  | 37.10<br>$\pm 1.22$<br>(c) | 9.07<br>$\pm 0.22$<br>(c)  |

P1 = Mild severity P2 = Moderate severity P3 = High severity

Values with different letters within a column differ significantly ( $P < 0.01$ )

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 techniques (Steel and Torrie, 1980). Means were compared by Least Significant Difference Test (Montgomery, 1997).

## RESULTS AND DISCUSSION

The data regarding various milk mineral concentrations as affected by severity of mastitis are presented in Table 1. Sodium contents in mastitic milk increased

differences were found in sodium, potassium, iron and copper contents but significant differences were found in calcium, magnesium, manganese and zinc contents between left/right and fore/rear quarters (Table 2).

The results of the present study are in line with those of Janota-Bassalik *et al.* (1978), who found that mastitis increased milk sodium contents from 402 mg to as much as 2270 mg per litre, and decreased potassium contents from 1649 to 522 mg/100 ml. Similarly, Grigorian *et al.* (1982), Banga *et al.* (1989), Charjan-ku *et al.* (2000) and Rawdat and Omaina (2000) reported an increase in sodium contents and decrease in potassium, calcium, iron, magnesium,

Table 2. F values of various milk minerals as affected by severity of mastitis in buffaloes

| Source of variations | F Value              |                      |                      |                      |                      |                      |                       |                      |
|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|----------------------|
|                      | Sodium               | Potassium            | Calcium              | Iron                 | Magnesium            | Manganese            | Zinc                  | Copper               |
| Grading (G)          | 8.0554**             | 21.2655**            | 82.7249**            | 40.8350**            | 2.1850 <sup>NS</sup> | 3.2848*              | 81.7249**             | 38.8250**            |
| Side (S)             | 1.1725 <sup>NS</sup> | 0.1499 <sup>NS</sup> | 0.6890 <sup>NS</sup> | 0.0011 <sup>NS</sup> | 0.0640 <sup>NS</sup> | 1.1826 <sup>NS</sup> | 0.5980 <sup>NS</sup>  | 0.0011 <sup>NS</sup> |
| G × S                | 1.8740 <sup>NS</sup> | 9.7507**             | 0.4346 <sup>NS</sup> | 2.1416 <sup>NS</sup> | 0.0647 <sup>NS</sup> | 0.8744 <sup>NS</sup> | 0.4346 <sup>NS</sup>  | 2.1416 <sup>NS</sup> |
| Front & Rear (FR)    | 0.1554 <sup>NS</sup> | 0.2245 <sup>NS</sup> | 8.2692*              | 0.4228 <sup>NS</sup> | 7.9614**             | 8.3164**             | 8.2692**              | 0.4128 <sup>NS</sup> |
| G × FR               | 2.0675 <sup>NS</sup> | 0.3236 <sup>NS</sup> | 12.5407**            | 1.0281 <sup>NS</sup> | 1.3624 <sup>NS</sup> | 0.0321 <sup>NS</sup> | 12.5207 <sup>NS</sup> | 1.0281 <sup>NS</sup> |
| S × FR               | 0.1185 <sup>NS</sup> | 2.0118 <sup>NS</sup> | 0.1754 <sup>NS</sup> | 0.0066 <sup>NS</sup> | 0.9884 <sup>NS</sup> | 0.1137 <sup>NS</sup> | 0.1754 <sup>NS</sup>  | 0.0066 <sup>NS</sup> |
| G × S × FR           | 0.4031 <sup>NS</sup> | 3.0939*              | 1.2856 <sup>NS</sup> | 1.4280 <sup>NS</sup> | 0.4709 <sup>NS</sup> | 0.5867 <sup>NS</sup> | 1.2756 <sup>NS</sup>  | 1.4128 <sup>NS</sup> |

\*\*Significant at  $P \leq 0.01$ ;\*Significant at  $P \leq 0.05$ ;

NS = Non-significant

manganese, zinc and copper contents in mastitic milk. They further found that extent of change in above minerals depended upon the severity of mastitis. The probable reason for this change in mineral contents in mastitic milk may be the breakdown of the secretory epithelium, causing blood constituents to appear directly into the milk by passing between the cells due to breakdown of the junctional complexes that normally hold the secretory cells together. The above justification was also supported by Larson (1985), who pointed out that infection of the mammary glands with microorganisms that produce mastitis can have a profound effect on the synthesis of milk and its composition. In severe mastitis, with breakdown of secretory epithelium, blood components can appear in milk, resulting in high amounts of sodium and reduction of other minerals.

On the basis of the present study, it can be concluded that severity of mastitis lowered the food value of milk in terms of reduction in potassium, calcium, iron, magnesium, manganese, zinc and copper contents and an increase in sodium level.

## REFERENCES

- Allore, H.G. 1993. A review of the incidence of the mastitis in buffaloes and cows. *Pakistan Vet. J.*, 13: 1-7.
- Banga, H.S., P.P. Gupta and R. Singh. 1989. Changes in minerals and electrolytes in milk and udder tissues during experimental mycoplasmal mastitis in sheep. *Indian J. Anim. Sci.*, 59(5): 555-557.
- 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 Vet. J.*, 77(12):1066-1068.
- Grigorian, A.S., A.O. Manasian, A.S. Grigoryan and A.O. Manasian. 1982. The contents of trace elements in sub-clinical mastitis milk. *Proc. 21<sup>st</sup> Intern. Dairy Cong.*, New York, USA, 1(1):30.
- Janota-Bassalik, L., M. Zajac and M. Wojtaszkiewicz. 1978. Changes in content of major and trace elements and lactose in the milk of cows with an experimental udder infection. *Zeszyty-Problemy-Postepow-Nauk-Rolniczych*, 20(7):615.
- Larson, B.L. 1985. *Lactation*. The Iowa State University Press, Ames, Iowa, USA.
- Montgomery, D.C. 1997. *Design and Analysis of Experiments*. John Wiley 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*. *Pakistan J. Food. Sci.*, 5:91-93.
- Rawdat, A.M. and N.M. Omaila. 2000. Some biochemical changes in serum and milk of mastitic buffaloes. *Egyptian J. Agri. Res.*, 78(4):1737-1747.
- Richards, L.A. 1968. *Diagnosis and Improvement of Saline and Alkaline Soils*. 1<sup>st</sup> Ed., Agri. Hand Book. No. 60, IBH, Pub. Co., New Delhi, India.
- Steel, R.G.D. and J.H. Torrie. 1980. *Principles and Procedures of Statistics. A Biometrical Approach*, McGraw Hill, Publ. Co. Inc., New York, USA.
- Tek, C., M.R. Kilicarslan, S.C. Konuk, A. Sabunca, K. Gurbulak and A. Senunver. 1998. Variations in K, Na and Cl in milk from cows with sub-clinical mastitis. *Veteriner-Fakultesi-Dergisi-Istanbul*, 24(2):321-328.