BIOCHEMICAL PROFILE OF MILK : A COMPARATIVE STUDY OF HEALTH AND MASTIC BOUFFALOES

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ABSTRACT

A study carried out to compare the compositional quality of milk from healthy and mastitic buffaloes revealed mean ± S.E. content of sodium, potassium, chloride, protein, lactose and SNF in milk of healthy quarters as 40.00±1.19 mg/dl, 102.00±0.06 mg/dl, 0.126±0.006 per cent, 3.33±0.03 gm/dl, 5.92±0.01 gm/dl and 8.77±0.05 gm/dl, respectively. The milk from clinically infected quarters showed 85.00, 36.50 and 10.51 per cent higher (P<0.01) levels of sodium, chloride and protein; the actual values being 74±1.66 mg/dl, 0.172±0.012 per cent and 3.68±0.02 gm/dl, respectively. The levels of potassium (65.00±2.40 mg/dl), lactose (3.80±0.02 gm/dl) and SNF (8.36±0.02 gm/dl) in milk from mastitic quarters revealed significant (P<0.01) decrease of 36.27, 35.81 and 4.67 per cent as compared to the corresponding levels in milk from healthy buffaloes.

INTRODUCTION

The very essence of dairying is the efficient production of wholesome raw milk that provides consumers with dairy products of high quality. But, it is well known that mastitis, the inflammation of mammary glands usually causes a depression in yield and alters significantly the biochemical composition of milk which in turn influences greatly the processing and keeping quality of milk and milk products (Murno et al., 1984, Needs et al., 1988 and Auldist et al., 1995). Although considerable data is available in this context for cows, very limited information is available on the effects of mastitis in dairy herd on the biochemical composition of milk from buffaloes. This investigation was carried out to obtain more complete and quantitative information on biochemical composition of milk from buffaloes and to determine how the mastitis affects the compositional quality of milk.

MATERIAL AND METHODS

Animals: Study involved 27 healthy and 21 clinically mastitic Murrah buffaloes. Animals were distributed over different parities with a lactation stage varying from 2-7 months post-calving. The healthy animals in this trial were kept at an organised farm. while, the mastitic buffaloes comprised of individual animals presented for treatment at veterinary clinics of Punjab Agricultural University. The identification of healthy and mastitic quarters was done by carrying out physical examination of milk and udder, and subjecting milk samples to Sodium Lauryl Sulphate test (SLST) a modified CMT described by Pandit and Mehta (1969) and culturing. A quarter was considered to be mastitic when milk and/or udder showed apparent abnormalities and found positive for Sodium Lauryl Sulphate test and microbial isolation.

Collection and analysis of milk samples: The individual quarters were examined for mastitis by Sodium Lauryl Sulphate as a animal side test and 15-20 ml of quarter foremilk samples were collected in sterilized and labelled test tubes taking all the possible aseptic precautions. The milk samples were brought to the laboratory and evaluated for bacterial cultural studies by standard microbial procedures described by National Mastitis Council (Brown et al., 1969).

The estimation of chloride content was done as per the standard volumetric procedure.

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described in ICAR’s Manual in Dairy Chemistry (1979). The analysis of milk samples for fat, protein, lactose and SNF contents was carried out at Milkoscan. A portion of milk sample was stored at -20°C till concentration of Na⁺ and K⁺ was assessed on flame photometer (Lindsay and Norvell 1969). The data was analysed statistically by using student’s t-test at 1.0 and 5.0 per cent level of significance (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

Sodium, potassium and chloride: The Na⁺ and K⁺ content of milk from healthy quarters were measured to be 40±1.19 mg/dl and 102±0.06 mg/dl, respectively. This corroborates well with the findings of Singh (1990) who observed the mean Na⁺ and K⁺ contents in buffalo milk to be 43.40 mg/dl and 103.35 mg/dl, respectively. Similarly, Grigorov et al. (1962) reported sodium content in milk from healthy buffaloes to be 47.7 mg/dl. Thus, the milk from buffalo like that of cattle was characterised by a high concentration of K⁺ and a low concentration of Na⁺. This finding is consistent with the proposition of Linzell and Peaker (1971), who based on an experimental study with mammary tissue from guinea pigs found that the normal secretion of Na⁺ and K⁺ was controlled by active pumping system on the basal and lateral membranes of the mammary epithelial cells. These pumps operate so that Na⁺ is pumped out of the secretory cell (into the extra-cellular fluids) and K⁺ is pumped in the opposite direction. The K⁺ : Na⁺ ratio in the intracellular fluid is about 3:1 while it reversed in the extra-cellular fluid to 1:3 as in the blood. These ions are directed in the milk from intracellular fluid rather than by leakage of extra-cellular fluid and thus milk is electrically positive as that of intracellular fluid.

The average chloride content of milk from healthy quarters of buffaloes was observed to be 0.126±0.006 per cent. Results are in agreement with the findings of Badran et al. (1986) and Mann (1999) who reported mean chloride content in milk from healthy buffaloes to be 0.15±0.02 and 0.12±0.004 per cent, respectively. The mechanism of chloride secretion is not as clear as that of Na⁺ and K⁺. However, it appeared that chloride is transported both actively and passively across the basal and apical membranes and its concentration is much higher in blood and extra-cellular fluid than in milk (Peaker, 1977).

Milk from infected quarters showed significant (P<0.01) increase in Na⁺ (85%) and Cl⁻ (36.50%) and a significant (P<0.01) decrease in K⁺ (36.27%). This corroborates with the findings of Mann (1999) who also reported 95.56 and 80.83 per cent increase in Na⁺ and Cl⁻ contents, respectively and a 25.70 per cent decrease in K⁺ contents of milk from mastitic buffaloes. Mahran et al. (1992) also reported 33.3 per cent increase in chloride content of milk from clinically infected quarters. These changes occurring in Na⁺, K⁺ and Cl⁻ levels of milk with mastitis can be explained on the basis that normally these ions are directed in milk from intracellular fluid. However, bacterial infection of udder causes damage to ductal and secretory epithelium opening up of tight junctions between secretory cells and increased permeability of blood capillaries. Thus, Na⁺ and Cl⁻ which are higher in extra-cellular fluid pour into the lumen of alveolus and in order to maintain osmolarity, K⁺ levels decrease proportionately.

Lactose: The lactose content (mean ± S.E.) of milk from healthy udders of buffaloes was found to be 5.92±0.01 gm/dl (Table 1). Singh (1990) estimated the milk lactose content in buffaloes to be 4.45±0.09 gm/dl, whereas Hirpurkar et al. (1987) reported mean lactose level to be 5.27 gm/dl. The variability in lactose content of milk in different investigations may be attributed to difference in breed, yield, season, age of animal, diet,
<table>
<thead>
<tr>
<th>Biochemical component</th>
<th>Mean ± S.E. content in Healthy quarters</th>
<th>Mean ± S.E. content in Clinically mastitic quarters</th>
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</thead>
<tbody>
<tr>
<td>Sodium (mg/dl)</td>
<td>40.00±1.19</td>
<td>74.00±1.66*</td>
</tr>
<tr>
<td>Potassium (mg/dl)</td>
<td>102.00±0.06</td>
<td>65.00±2.40*</td>
</tr>
<tr>
<td>Chloride (%)</td>
<td>0.126±0.06</td>
<td>0.172±0.012</td>
</tr>
<tr>
<td>Protein (gm/dl)</td>
<td>3.33±0.03</td>
<td>3.68±0.02*</td>
</tr>
<tr>
<td>Lactose (gm/dl)</td>
<td>5.92±0.01</td>
<td>3.80±0.02*</td>
</tr>
<tr>
<td>Solids not fat (gm/dl)</td>
<td>8.77±0.05</td>
<td>8.36±0.02*</td>
</tr>
</tbody>
</table>

* P<0.01.

stage of lactation and fraction of sampling. Fernando et al. (1985) reported that foremilk samples of cows have higher lactose than strippings.

As compared to healthy quarters, the infected quarters had a significantly (P<0.01) lower lactose content, the actual value for mastitis quarters being 3.80±0.02 gm/dl. It is in agreement to the findings of Hirpurkar et al. (1987) who reported a fall in lactose content of milk from infected quarters of buffaloes (mean level in acute cases 4.24 gm/dl). Mehran et al. (1992) reported a 16.3 per cent fall in lactose of clinically infected quarters in buffaloes. The different levels of fall in different studies may be attributed to different type of organisms, severity and stage of infection. The decrease in lactose content by infection of quarters can be explained by the fact that lactose is synthesised in the golgi apparatus of the secretory cells of the mammary gland by a complex mechanism involving enzyme galactosyl transferase and α-lactalbumin (Ebner and Schanbacher, 1974). The infection of mammary gland results in tissue damage and thus decreased synthetic ability of the enzyme synthesis in the secretory cells (Giesesse, 1974). Reduced levels of lactose may also be caused by less glucose being available to the mammary gland as a result of reduced blood flow due to general stress conditions during the diseased state.

**Protein:** The average protein content of milk from healthy buffaloes was found to be 3.33±0.03 g/dl. Buffaloes with clinical infection showed 10.51 per cent increase (P<0.01) in protein content. However, Mann (1999) reported 2.52 per cent decrease in protein content of milk from mastitic quarters. Such conflicting reports have been observed in cattle also. Ashworth et al. (1967), and Casado and Garcia (1988) respectively reported 5.38 per cent and 0.29 per cent increase in protein content of milk from mastitic cows. Whereas, SreeKumar et al. (1975) and Sharaby (1989) reported reduced levels of protein in infected quarters of cows. The confusion arises from the fact that some protein fractions decrease while others increase following udder infection. For instance, the proteins synthesized in mammary gland viz., α-casein, β-casein, α-lactalbumin and β-lactoglobulin decrease and those coming in from blood i.e. immunoglobulins (lgG’s) and serum albumin increase (Baenlein et al., 1973 and Randolph et al., 1974). Thus, a net result may be an increase or a decrease or no change in total protein content.

**Solids not fat (SNF):** The SNF content of milk from healthy quarters of buffaloes was found to be 8.77±0.05 gm/dl, and it decreased to 8.36±0.02 gm/dl (P<0.01) in infected
quarters. Results are in agreement with the findings of Badran et al. (1986) and Mann (1999) who have reported SNF content of 9.84±0.57 and 8.66±0.28 gm/dl for the milk from healthy quarters in buffaloes, respectively.

Since lactose and protein are the major components of SNF, it appeared that drop in SNF was mainly due to decrease in lactose content in mastitic milk.

REFERENCES