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Full Length Research Paper

Study on the alteration of bubaline blood biochemical composition owing to slaughter

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Bubaline blood biochemistry as affected by slaughter was the agenda for this work. Blood samples were collected from 30 buffaloes from abattoirs before and at slaughter. After biochemical and statistical analysis (mean was compared with t-test), it was observed that the albumin, lactate dehydrogenase and creatine kinase increased ($p < 0.05$), while globulin, urea nitrogen and creatinine decreased ($p < 0.05$) significantly. Significant ($p < 0.01$) increase in glucose and cholesterol, and marginal variation in concentration of total protein and biliurubin were observed. The macro-minerals of the blood were observed to have decreased significantly ($p < 0.01$) at slaughter. Sodium and chloride decreased, potassium was observed to have increased highly significantly ($p < 0.01$) due to slaughter. Slaughter induced changes in blood biochemical profile in buffaloes as reported here are of significance in commercial biomedical use of this connective tissue.

Key words: Biochemistry, blood, buffalo, slaughter.

INTRODUCTION

Blood circulating in the body, carrying substances to and fro, is the first by-product obtained after slaughtering an animal. Blood serves as food for both animal (blood meal) and human. For several ethnic groups of Africa and India, blood is the primary source of animal protein, where it holds ritualistic importance. The animal is offered to deities, and then blood is consumed as food, often in combination with meat (Davidson, 2006) while the 'Maasai' tribe of Tanzania consume the blood of cattle let directly from the neck of live animal, and the wound allowed to heal (Ndou et al., 2011). In European and Asian countries, since long time, blood is used as traditional foods, such as blood sausages, puddings, blood soups, bread sand crackers. Though in some cultures (Islamic and Jews), blood consumption is seen as a taboo. Although, its high nutritional value, coupled with serious disposal issues, has fueled recent research and industrial efforts to incorporate blood proteins into a wide range of food products. Besides, commercial blood products (derived from plasma or cellular fraction) serves particular functions in different products. For example, they are used in meat products, primarily to increase protein levels and enhance water binding and emulsifying capacity. Also, blood derived products are beginning to be found as ingredients in non-meat processed food and dietary supplements (Ofori and Hseih, 2011).

India has 53% of the total world buffalo population, hence, the world's largest buffalo population (Food and Agriculture Organization (FAO), 2006). Proper disposal of blood as waste, during slaughter, is a bone of contention for slaughter house viability with public health concerns. Evidently, this raises avenues for use of blood for its nutritive and constituent significance. By-product blood comes easy, and is fancied for its diverse application in medicine and food industry, making its processing an active area of research in recent times. Its appropriate utilization is a concern for the veterinarians too. Most blood constituents of animals are essential nutrients for human and blood biochemistry and correlated with its

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nutritive value (Duarte et al., 1999). There are quite a large number of previous reports, existing on the effect of slaughtering on blood biochemical profile for other meat animal, but very few study of such type was done for buffalo.

In various parts of Asia, Indian sub-continent and south-east Asian countries in particular, buffalo (both riverine and swamp); constitute the major portion of slaughtered animal. India is a hot exporter of buffalo meat, making up 35.7% of the total meat produced to the Gulf countries. Subsequently, buffalo blood is also readily available (Rao et al., 2009). Hence, the present study aimed to study the changes caused by slaughter on bubaline blood biochemistry.

MATERIALS AND METHODS

Blood samples from 30 buffaloes, equal number from either sex, from local abattoirs, were collected in heparinized and non-heparinized vials for harvesting plasma and serum, respectively. Sampling was done once, 2 h pre-slaughter (in the lairage), by jugular vein puncture and then again at slaughter (Salajpal et al., 2005). Total protein (TP) was estimated by biuret method, albumin by bromocresol green method, globulin by calculating the difference between total protein and albumin, glucose by Folin-Wu method, blood urea nitrogen (BUN) by diacetyl-monoxime method, creatinine by modified Folin-Wu method, cholesterol by Zaltki's method, total biliurubin by Malloy and Evelyn method, calcium (Ca) by Clark and Collip method, phosphorous (P) by Fiske and Subbarow method, magnesium (Mg) by Titan yellow method, chloride (Cl^-) by the method of Schales and Schales, and sodium (Na) and potassium (K) were estimated by flame photometry (Hawks et al., 1954). Lactate dehydrogenase (LDH) and creatine kinase (CK) were estimated by commercial kit, manufactured by Bayers Company Limited, with Spectralab II autoanalyzer. The standardized protocol provided with the kit was followed for estimation.

Comparison of means of estimated concentration of different parameters in pre-slaughtered and post slaughtered blood was done by t-test. All statistical analysis was done with Statistical Package for Social Sciences (SPSS) statistical software, version 11.0 (Gade et al., 2010).

RESULTS AND DISCUSSION

High quality slaughtered animal blood, particularly buffalo in India, has recently become available as an industrial food commodity. It is valuable due to its functional and nutritional properties, which directly dependents upon blood components. The present study was done to look at the alteration in blood biochemical profile caused by slaughter.

Though the total protein concentration did not show any significant alternation due to slaughter, but it was observed that albumin increased, while globulin decreased significantly ($p < 0.05$) in slaughtered blood. Our observation is supported by the report of Rojas et al. (2009) for pig. This observation conflicts Smiecińska et al. (2011) who reported significant increase of total protein and albumin in blood samples collected at slaughter, when compared with blood samples collected before transport. They also observed that these parameters increased significantly during transport. Although, when these parameters were in blood samples during slaughter with blood samples collected just after transport, it was observed that these parameters decreased significantly in pigs. Haslinger et al. (2007) reported marginal alternation of total protein and albumin in poultry. Demir et al. (2004) also observed a minimal increase of total protein and albumin, and concluded major reduction of albumin is to be expected only after longer periods without feed. Nevertheless, all these values remained within normal ranges for poultry.

In the present study, the significant alternation in albumin and globulin is attributed to pre-slaughter and stunning stress. Albumin concentration might have increased, due to increase in packed cell volume, owing to dehydration or spleenic contraction, induced by sympathetic nerve activity or circulating catecholamines (Tadich et al., 2005). The explanation behind the decrease of globulin might be the fact that stunning stress might have caused reduction of immunoglobins by immuno-supression (Lee et al., 2000). Hence, the increase of albumin compensating globulin decrease prevented the alternation of total protein.

The marked increase ($p < 0.01$) of glucose and cholesterol was observed (Table 1). Shorthose and Shaw (1977) reported that slaughter caused hyperglycemia in sheep. Averos et al. (2007) also reported significant increase of blood glucose in post slaughter blood in pigs. Jain et al. (2000) reported that slaughtering of rat caused elevation in the serum cholesterol. This might be due to the fact that during stress, primitive instincts prepare the body for flight or fight. As a protection mechanism, the body triggers the generation of two hormones, cortisol and adrenaline, from the hypothalamus. These two hormones produced by the hypothalamus trigger the production of energy, by stimulating the production of cholesterol. Cortisol produces more glucose by acting on the liver, increasing the synthesis of some enzymes which promote gluconeogenesis, in order to provide the body with instant energy (Werner and Gallo, 2008). The high sugar levels, however, often are not used up by the body and eventually are converted to fatty acids and cholesterol (Coleman et al., 1998). Lynch et al. (1964) attributed the increase of blood glucose level to rapid glycogenolysis in the liver after death.

Marai et al. (2006) also reported significant ($p < 0.05$) decrease of BUN and creatinine. Same was observed in the present study. They attributed it to stress, which might be due to heat, psychotic or stunning. Doornenbal et al. (1987) reported that concentration of BUN and creatinine were significantly higher and lower, respectively in post slaughter blood of bull, and concluded that pre-slaughter management had a significant effect on several blood components. The biliurubin in the slaughtered blood increased insignificantly. The marginal increase might be due to

Table 1. The outcome of slaughter on bubaline blood biochemistry.

Parameter	Pre-slaughter (n = 30)	Post-slaughter (n = 30)
Total protein (g/dl)	7.41±0.89	7.95±0.53
Albumin (g/dl)	3.63^{a}±0.66	6.49^{b}±1.12
Globulin (g/dl)	3.78^{a}±0.64	1.46^{b}±0.41
Glucose (mg/dl)	62.67^{c}±7.89	91.50^{d}±6.98
Cholesterol (mg/dl)	154.37^{c}±22.67	260.20^{d}±35.52
Urea nitrogen (mg/dl)	28.77^{a}±4.11	16.53^{b}±2.91
Creatinine (mg/dl)	0.84^{a}±0.06	0.67^{b}±0.04
Total biliurubin (mg/dl)	0.25±0.02	0.32±0.03
Ca (mg%)	8.90^{c}±1.26	4.51^{d}±0.95
P (mg%)	4.75^{c}± 0.41	2.98^{d}±0.27
Mg (mg%)	3.76^{c}±0.38	2.17^{d}±0.23
Sodium (mEq/L)	144.87^{c}±17.63	82.65^{d}±12.84
Potassium (mEq/L)	5.32^{c}±0.71	2.78^{d}±0.56
Chloride(mEq/L)	98.34^{c}±8.74	67.85^{d}±5.59
Lactate dehydrogenase (U/L)	1045.50^{a}±248.89	1955.54^{b}±301.64
Creatine kinase (U/L)	87.59^{a}±14.82	130.65^{b}±10.38

Mean with superscripts (a, b) in a row differ significantly ($p < 0.05$). Mean with superscripts (c, d) in a row differ significantly ($p < 0.01$).

hemolysis, resulting from contraction of blood vessel during stunning (Lynch et al., 1964). It was observed that blood calcium (Ca), phosphorous (P) and magnesium (Mg) concentrations decreased significantly ($p < 0.01$) after slaughter. Significant hypocalcemia was also reported by Shorthose and Shaw (1977) in slaughtered sheep. This might be due utilization of Ca ions by calpain proteolytic system (Duckett et al., 2001). Calcium is also utilized to maintain heart-beat and blood clotting mechanism (Kaneko et al., 2008). Both P and Mg are required to carry out vital body functions. The significant decrease of P and Mg are attributed to their utilization during body exposure to stress bearing factors during slaughter (Wojcik et al., 2009).

Slaughter also affected the electrolyte profile significantly ($p < 0.01$), which plays an important role in homeostasis, acid-base balance, osmotic pressure, neural transmission, etc. Earlier, Wojcik et al. (2009) reported similar observation for broiler chicken. Schaefer et al. (1997) reported alternation in electrolyte profile in post slaughter blood of pigs, which they attributed to transport stress. They proved it, by supplementing electrolytes in drinking water of pigs, during and after transport. Death will cause the potassium (K) to be released from tissue or from liver into the blood. During stress, epinephrine might play a role in the release of K from brain cell in the blood. To maintain the electrical neutrality, sodium (Na) will move from the blood into the cells to carry out vital function at death. Chloride (Cl^-) moves with the electrical gradient along with Na (Lynch et al., 1964). LDH and CK are released in the blood when there is tissue damage or rigorous exercise. In the present study, significant ($p < 0.05$) increase in LDH and CK was observed, which concurs with the report of Werner et al. (2010) and Smiecińska et al. (2011) and opposes the observation of Averos et al. (2007). Werner et al. (2010) reported significant increased LDH activity within 40 min postmortem in Duroc-Pietrain crossbreed. After 12 h, the activity of the enzyme decreased to the amount of the pre-slaughter samples. They concluded that LDH influence the muscle-to-meat transition process after slaughter of the animals without an impact on the muscle quality. Smiecińska et al. (2011) observed that serum CK activity were higher in blood samples collected during carcass bleeding than in samples collected before, pointing to a strong stress response of animals to pre-slaughter treatment. They suggested that rest before slaughter alleviated stress, induced by pre-slaughter handling operations. Averos et al. (2007) determined the influence of slaughter transports, carried out under commercial conditions. They observed that both CPK and LDH activity decreased significantly, exsanguinations, when compared to blood samples collected pre-slaughter. They attributed the alternation to stress factor and reported that females showed higher stress reactivity. They suggested that an improvement in stress resistance could be obtained, by controlling the halothane gene of pigs.

The alternation is attributed to some kind of tissue damage which might have occurred during or just before slaughter, due to mishandling of animals, animals jumping or improper stunning procedure etc. (Chai et al., 2010). It can finally be concluded that, disturbance in the homeostasis before and during slaughter are responsible

for statistically significant changes in bubaline blood biochemistry. It apparently may not affect the blood quality for consumption for short time, but consuming the same for a long time may affect human health, as the macro-minerals and electrolytes tend to decrease and cholesterol increase significantly in the post-slaughtered blood samples. Further studies, regarding the dynamics causing the changes in the blood profile may help us to identify the deleterious causes and also assist to find alternate ways to obtain blood, without inducing marked changes.

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