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# LACTIC ACIDOSIS IN GOATS: PREVALENCE, INTRA-RUMINAL AND HAEMATOLOGICAL INVESTIGATIONS

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## ABSTRACT

The aim of the study was to investigate the prevalence of lactic/ruminal acidosis in goats through the utilization of intra ruminal and haematological analyses as diagnostic tools. From a total study population of 2029 goats, 265 adult goats from 8 villages of Lahore, Pakistan were diagnosed for lactic acidosis on the basis of anamnesis and clinical signs. Confirmation was made through ruminal fluid analysis for its pH and defaunation. The morbidity, mortality and case fatality rates were recorded as 1.2, 0.6 and 50%, respectively. On the basis of average ruminal fluid pH, goats were assigned to four groups *viz.* pH 4, 5, 6 and 7. A ruminal pH of 4 was found to be lethal. Significant ($P<0.05$) variation was noted between all four groups. However, no seasonal influence was observed for the disease. Haematological indices were within the normal reference ranges of goats, however, marked increase in Packed Cellular Volume (PCV) and Mean Corpuscular Volume (MCV) was observed. Total leukocyte count (TLC) was also elevated than the normal range for goats. The high fatality rate of the disease envisages further monitoring of the disease through devising various biomarkers for its earlier diagnosis with emphasis on Subacute Ruminal Acidosis (SARA).

**Key words:** Prevalence, ruminal acidosis, hematology, small ruminants.

## INTRODUCTION

Sheep and goats have maintained an unquestionable economical and ecological niche in Asian agriculture (Irshad *et al.*, 2010). Though they represent an important source of animal protein in third world countries like Pakistan, however, they seem to have benefitted less from veterinary care and production improvement, as yet (Ijaz *et al.*, 2008). The total goat population in Pakistan is estimated as 63.3 million heads (Anonymous, 2013) which makes it the third largest goat rearing country in the world after India and China. Animals of these species are often the main source of daily meat and are used in ceremonial festivities throughout the country. They also produce a considerable amount of manure which is of special importance in those areas where cattle are of lesser importance.

The growing concern in animal welfare has ignited intensive debate about the living conditions of production animals. As a consequence, production diseases have come into the glare of publicity as these sufferings arise due to production conditions (Enemark *et al.*, 2002). Particular interest is being levied upon nutritional diseases including lactic acidosis or ruminal acidosis. Ruminal acidosis is a metabolic disorder caused by feeding errors in ruminants that may be manifested in acute or subacute form. It represents a significant economic problem due to direct effects caused by alterations in the ruminal metabolism that could lead to death and indirect effects which could lead to rumenitis, liver abscesses and laminitis (Oetzel, 2003; Penner *et al.*, 2007). Rapid fermentation of carbohydrates alters the ruminal function through proliferation of acid resistant bacteria (*Lactobacillus and Streptococcus bovis*) and an increase in the production of volatile fatty acids and lactate, which cause a sharp drop in ruminal pH to less that 5.00 in most cases (Gozho *et al.*, 2005; Gonzalez *et al.*, 2010). Anorexia, apathy, teeth grinding and muscle twitching, ruminal stasis, and the excretion of soupy or watery faeces are some of predominant signs in affected animals.

Owing to the complete lack of literature in Pakistan regarding lactic acidosis, the present study was designed to determine its prevalence in goats throughout the year and to assess the intra-ruminal and haematological alterations as diagnostic markers for it.

## MATERIALS AND METHODS

**Geo-location of Study:** The study was carried out in the villages which lay on the outskirts of Lahore, Punjab (Pakistan). Lahore falls between 31°15′-31°45′ north and 74°01′-74°39′ east and bounded on the north and west by district Sheikupura, on the east by Wahga border (India) and on the south by District Kasur. The river Ravi flows on the northern side of Lahore. The weather of Lahore is extreme during the months of May, June and July, when the temperatures reach up to 40-48°C (104-118 °F). From

June till August, the monsoon seasons starts, with heavy rainfall throughout the province.

**Seasons of Study:** The study was conducted over a 12-month period from January to December, 2010. Keeping in view the prevailing climatic conditions of the study area, 4 seasons were defined as winter (November, December and January), spring (February, March and April), summer (May, June and July) and autumn (August, September and October). The data regarding climatic conditions (temperature and relative humidity) during the study period was retrieved from Regional Meteorological Centre, Lahore, Pakistan (Fig 1).

**Experimental Animals:** A multistage probability sampling method was practiced with random final selection of a total of eight villages (V1, V2..V8). Out of the total goat population of 2029 heads (Table 1), 265 goats were selected on the basis of anamnesis and clinical signs (anorexia, apathy, ruminal stasis and watery diarrhea) which was later on confirmed through intra-ruminal analyses (ruminal fluid pH and defaunation). Each homestead was visited from door to door in all villages and the relevant information regarding the affected animals (morbidity, mortality and case fatality rates) was recorded on a questionnaire.

**Intra-Ruminal Analyses:** For the collection of ruminal fluid, a percutaneous aspiration technique was employed in which a 16 gauge needle fitted to a 5 mL disposable syringe was introduced percutaneously in a vertical direction in the left lower flank of the animal (ventral sac of rumen) and 0.5 ml of the fluid was aspirated in the syringe. Landmarks for puncture site were the left side, on a horizontal line level with the top of the patella about 15 to 20 cm posterior to the last rib (Nordlund, 2003). pH strips were used for the instant/on spot analysis of the pH of the rumen fluid collected. On the basis of average ruminal fluid pH, goats were assigned to four groups *viz.* pH 4, 5, 6 and 7.

At the same time, a drop of the rumen fluid was placed on a glass slide, covered with a cover slip and was examined under the low power of microscope for the detection of protozoa. The rumen fluid with pH ≤6 and detection of no protozoa or very few with sluggish movement were considered positive for lactic acidosis (Radostits *et al.*, 2007).

**Blood collection and haematological analysis:** Owing to the resentment encountered by various owners, blood samples could be collected only from sixty animals and not from all. From each animal, about 5 mL blood was collected aseptically with the help of a disposable syringe from the jugular vein and transferred into the screw capped tubes containing 0.5 ml of 1% ethylene diamine tetra acetate (EDTA) solution as an anticoagulant. The samples were transferred to the University Diagnostic Laboratory, University of Veterinary and Animal Sciences, Lahore in ice bags for analysis. Haematological analysis was made through an automated hematology analyzer (Diatron Abacus, Diamond Diagnostics, USA).

**Statistical analysis:** A questionnaire based survey was conducted to generate epidemiological data and the variates were presented in percentages. Data thus collected were subjected to chi square analyses. Mean values (±SE) of various haematological parameters for the animals were also computed.

## RESULTS AND DISCUSSION

Though the researchers have levied avid attention to lactic acidosis globally (Ding and Xu, 2003; Gozho *et al.*, 2005; Gonzalez *et al.*, 2010), however, it still lurks as one of the biggest threat to ruminant industry. This is the first report being presented for lactic acidosis in goats regarding its prevalence with especial emphasis on intra-ruminal and haematological analyses.

**Epidemiology:** In the present survey, a total of 265 adult goats of various breeds and age were tentatively diagnosed for lactic acidosis on the basis of anamnesis and clinical signs. The confirmation was later on made through ruminal fluid analysis. Various epidemiological variates of the present study are presented in Table 2. From the total study population, 24 animals (1.2%) were found to be positive for lactic acidosis with a case fatality rate of 50%. These results are lower than those reported elsewhere regarding the epidemiological data both for large and small ruminants. Kleen *et al*. (2003) reported a 40% incidence of the problem in bovine herds while Gonzalez *et al*. (2010) reported 18% for goat herds. Contrarily, Suarez and Busetti (2009), in a cross sectional survey of 19 dairy sheep farms in Argentina reported a higher incidence of lactic acidosis (42.1%) and attributed it to farmer's inexperience, especially at the start of concentrate feeding. A higher mortality rate of 9% was reported by Nour *et al*. (1998) for Nubian goats in Sudan, compared to a lower rate (0.6%) recorded in the present study. Lower incidence in the present study may be due to field grazing, extensive veterinary services being provided, farmer's literacy of the disease and appropriate management and housing conditions. Furthermore, it is also indicative of the fact that the rural areas are better familiarized with this metabolic disorder than the urbanites.

A higher fatality rate of 50% in the present study indicates the severity of the disease. These results are in line with those of Nour *et al*. (1998) and Aschenbach *et al*. (2000). Higher absorption of histamine and other vasoactives through ruminal epithelia due to decreased pH leads to bronchial constriction and cardiovascular shock (Xu and Ding, 2006).

**Intra-Ruminal Analyses:** The results on groups based on ruminal fluid pH revealed that majority of the cases (241/265) were found to be in the healthy range of rumen pH *i.e.* above 6, with the prevalence of 11.9% (Table 3). Out of these, maximum cases of 137 (6.7%) were in the range of pH 7 and the second highest number of cases *i.e.* 104 (5.1%) were of pH 6. Statistically, a significant difference in the number of cases at different average pH was observed ($P<0.05$) with a ruminal pH of 4 proving to be very lethal in this study for goats as all the animals with pH 4 could not survive (77.8% case fatality). These results are in line with most of the earlier published literature (Nour *et al*., 1998; Xu and Ding 2011) which has reported pH of <5 being lethal for goats. An increased absorption of histamine, lipopolysaccharide endotoxins and other vasoactives has been attributed to this lethality (Khafipour *et al.* 2009).

The results of present study regarding the detection of ruminal protozoa in ruminal fluid revealed no protozoa in samples with pH 4. However, a drastic decrease was noticed both in terms of number and motility of protozoa in samples with pH 5 as compared to those with normal ruminal fluid pH. This is in line with previously reported work (Cannizzo, 2009; Enemark *et al.* 2004). This defaunation has been attributed to proliferation of acid resistant bacteria and a decrease in ruminal pH because of feeding high concentrates (Oetzel, 2003).

**Haematological analyses:** In many cases ruminal pH monitoring would be useful to prevent outbreaks of acidosis that will cause serious economic losses. Monitoring herds for acidosis demands the use of adequately sensitive blood or ruminal indicators because signs are usually unnoticed especially in subacute form (Enemark *et al.*, 2004). Haematological analysis-a routine diagnostic and management tool in veterinary practice-provides an opportunity to clinically investigate the presence of various metabolites and other constituents in blood of the animal and helps ascertain the physiological, nutritional and pathological status of the animal (Farooq *et al.*, 2011). In the present study, owing to the resentment encountered by various owners, blood samples could be collected from sixty animals with lactic acidosis and the results are presented in Table 4.

The erythrocytic indices recorded in the present study showed no substantial alterations in Hb and TEC. However, marked increase in the values of PCV and MCV was observed. Similarly, MCHC was decreased than the normal ranges for goats given by Jain, 1998. These results are in line with those reported by Gianesella (2008) while working on Italian dairy herds. The increase in PCV during lactic acidosis is attributed to the water drawn from the normal circulation resulting in hemoconcentration and hence elevated PCV (Cannizzo, 2009).

The leukocytic indices revealed a markedly increased TLC ($16.0\pm0.81\times10^3/\mu l$) in goats with lactic acidosis than published normal ranges/values for goats. Abdelatif *et al*. (2009) reported an overall mean of $10.16\pm2.00\times10^3/\mu l$ WBCs for Nubian goats. Similarly, Piccione *et al*. (2010) reported a TLC of $10.60\pm0.25\times10^3/\mu l$ for Girgentana goats. The results, however, are in line with those of Gianesella (2008) who reported a higher than normal TLC for cows with ruminal acidosis. Similarly, Cannizzo, 2009 also reported a stress like leukogram with marked leukocytosis and alterations in the ratio of neutrophils/lymphocytes. As suggested in previous studies (Sajjad *et al.*, 2011), an increase in the cortisol level during stress causes an increase in the TLC.

The present study indicates a lower prevalence of lactic acidosis in goats. However, a higher case fatality rate highlights its serious life threatening sequel for goats. Furthermore, a ruminal fluid pH ≤ 4 has been found to be lethal for goats. In order to diagnose lactic acidosis at a herd level and at an earlier stage, a combination of clinical signs, production records, diet characteristics and various diagnostic tools such as haematobiochemical analyses need to be devised. The present study also envisages for a further research on pathophysiologic and diagnostic aspects of lactic acidosis with an experimental induction of the disease.

**Table 1. Demographic detail of goat population under study in 8 villages of district Lahore, Pakistan**

| Village | Goat population 2010 | Cases studied |
|---|---|---|
| V1 | 915 | 91 |
| V2 | 494 | 87 |
| V3 | 443 | 55 |
| V4 | 38 | 14 |
| V5 | 21 | 3 |
| V6 | 69 | 6 |
| V7 | 22 | 4 |
| V8 | 27 | 5 |
| **Total** | **2029** | **265** |

*Data provided by District Livestock Office, Lahore, Pakistan as per their local census of 2006

**Table 2. Various epidemiological variables of lactic acidosis in adult goats of district Lahore, Pakistan**

| Study variables | Variates |
|---|---|
| Total population | 2029 |
| Total number of sick | 24 |
| Morbidity (%) | 1.2 |
| Mortality (%) | 0.6 |
| Case Fatality (%) | 50 |

**Table 3. pH wise prevalence of lactic acidosis in goat population of district Lahore, Pakistan**

| pH Groups | No. of Cases | Morbidity (%) | Mortality (%) | Case Fatality (%) |
|---|---|---|---|---|
| 4 | 9 | 0.4 | 0.3 | 77.8 |
| 5 | 15 | 0.7 | 0.2 | 33.3 |
| 6 | 104 | 5.1 | 0 | 0 |
| 7 | 137 | 6.7 | 0 | 0 |

**Table 4. Mean (±SE) haematological variables of goats (n=60) with lactic acidosis**

| Parameters | Values obtained | Reference range* |
|---|---|---|
| Hemoglobin (g/dl) | 8.0±0.42 (7.6-8.3) | 8-12 |
| Packed cell volume (%) | 45.08±1.23 (40.20-48.20) | 22-38 |
| Total erythrocytic count ($10^6$/µl) | 12.0±0.25 (9.2-14.5) | 8-18 |
| Mean corpuscular volume (fl) | 38.34±2.33 (30.28-43.70) | 16-25 |
| Mean corpuscular hemoglobin (pg) | 6.66±0.88 (5.82-7.20) | 5.2-8 |
| Mean corpuscular hemoglobin concentration (g/dl) | 17.80±0.48 (16.39-19.90) | 30-36 |
| Total leukocyte count ($10^3$/µl) | 16.01±1.38 (10.2-19.8) | 4-13 |

*Jain, 1998

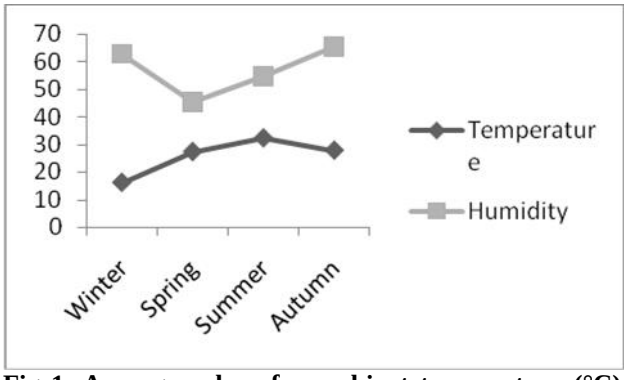


**Fig 1. Average values for ambient temperature (°C) and relative humidity (%) of the study area during four seasons.**

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