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Alterations in Ruminal Fluid and Serum Biochemical Constituents in Goats Affected with Ruminal Acidosis

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Abstract

Ruminal acidosis is an important clinical emergency in small ruminants. In this study, eight healthy farm goats and 24 goats presented at TVCC of the college of Veterinary Sciences and A.H., Anand with clinical signs of ruminal acidosis and having rumen liquor pH below 6 were examined for alterations in the ruminal fluid and serum biochemical parameters. Among various rumen fluid parameters evaluated, the mean values of rumen fluid pH decreased significantly (4.71±0.11 vs. 6.90±0.10), while sediment activity time (46.67±1.20 vs. 24.50±0.78 min) and methylene blue reduction time (29.50±0.73 vs. 10.03±0.27 min) increased significantly in acidotic goats. The normal greenish, aromatic viscous color, odour and consistency of rumen fluid of healthy goats also changed to milky grey/creamy, sour/pungent watery in acidotic goats. The rumen protozoal activity decreased to nil in acidotic goats as compared to the healthy goats. Among various serum biochemical constituents, the mean values of glucose (92.43±1.37 vs. 74.13±1.83 mg/dl), BUN (26.49±0.47 vs. 22.63±1.19 mg/dl), serum creatinine (01.01±0.02 vs. 00.83±0.02 mg/dl) and albumin (03.22±0.03 vs. 03.05±0.05 g/dl), ALT (56.75±1.55 vs. 27.88±1.14 IU/L) and AST (93.25±1.82 vs. 54.00±1.75 IU/L), increased significantly, while there was significant decrease in serum calcium (09.09±0.14 vs. 10.29±0.08 mg/dl) in acidotic goats. The mean values of alkaline phosphatase (IU/L) in acidotic goats increased non-significantly from the base values of healthy goats.

Key words: Goats, Ruminal acidosis, Alterations in ruminal fluid, Serum biochemistry, Enzymatic profile.

Introduction

Goat is a versatile animal known as the “Poor man’s cow” in India. It has been documented that different diseases in goats cause considerable economic losses to the farmer (Boscos *et al*., 1996). Ruminal acidosis is one of the most important clinical emergencies in small ruminants (sheep and goats) that results in high mortality (Radostits *et al*. 2007). Ruminal acidosis is caused mainly by the accidental or excessive ingestion of large quantities of feeds rich in highly fermentable carbohydrates, such as rice, paddy grains, payasam, jack fruit etc. in cattle and goats (Aleyas and Vijayan, 1981). Severe dehydration and cardiovascular impairments are common (Shihabudeen *et*

al. 2003) as reflected by haemato-biochemical alterations (Sarma and Nath, 2005; Darwin and Thangathurai, 2017) and changes in properties of ruminal fluid (Kasaralikar *et al.,* 2007) in affected animals and these changes are more obvious at 24 hours after induction of acidosis (Zein-Eldin *et al*., 2014). Hence, this study was aimed to evaluate alterations in the properties of ruminal fluid and serum biochemical constituents in goats affected with ruminal acidosis in comparison to healthy ones.

Materials and Methods

The study was undertaken with the approval of the Institutional Animal Ethics Committee at the Department of Veterinary Medicine College of Veterinary Sciences & A.H., Anand. Eight healthy goats from the University farm were taken as control. Clinical cases of rumen indigestion in goats brought to the TVCC of College of Veterinary Sciences & A.H., Anand were screened for detection of rumen acidosis. The cases having the history of ingestion of large quantity of highly fermentable carbohydrate rich diet were selected, although the diet varied between goats, and mostly included rice, wheat, pearl millet and chapaties or other cooked human food. The clinical examination was carried out and rumen liquor samples were collected by aspiration from such cases for immediate estimation of pH and other physical & functional properties (Benjamin, 1985). Those cases having rumen pH below 6.0 were included in this study. Approximately 6 ml of blood was withdrawn from jugular vein in a sterile plastic vaccutainer from the healthy and diseased goats. The samples after clotting were centrifuged at 3000-3500 rpm for 5 minutes. The serum separated out was stored at -20°C for further investigation on chemistry analyzer using assay kits. The data were compared by employing student's 't' test for variations between healthy and acidotic goats.

Results and Discussion

Alterations in Rumen Fluid

The findings on rumen fluid properties observed in healthy and acidotic goats are presented in Table 1.

Table 1: Rumen fluid evaluation (Mean±SE) in healthy and acidotic goats

Sr. No.	Parameter	Healthy goats (n=8)	Acidotic goats (n=24)
1	pH	6.90±0.10	4.71±0.11**
2	Color	Olive green, Green, Yellowish brown	Milky, grey, Creamy
3	Odour	Aromatic	Sour, Pungent
4	Consistency	Viscous	Watery
5	Protozoal activity	+++	+/-
6	SAT (/min)	24.50±0.78	46.67±1.20**
7	MBRT (/min)	10.03±0.27	29.50±0.73**

**P<0.01.

Rumen pH: The mean value of the rumen liquor pH in healthy goats was 6.90±0.10, while it was 4.71±0.11 in acidotic goats. There was highly significant reduction ($p<0.01$) in rumen fluid pH in acidotic goats. This observation corroborate with several other investigators (Lal *et al*., 1990; Eldine *et al*., 2005; Kasaralikar *et al*., 2007; Ram *et al*., 2007; Sharma *et al*., 2010; Alam *et al*., 2014).

Colour, Consistency and Odour: The normal olive green, green or yellowish color of rumen fluid observed in healthy goats was found to be altered to milky grey and creamy in acidotic goats. Similarly, the viscous and thick consistency of normal rumen fluid with aromatic smell was found to be altered to semi-liquid or watery with sour or pungent odour in acidotic goats. These findings

were in line with the observations of Braun *et al*. (1992), Eldine *et al*. (2005), Ram *et al*. (2007), Ismail *et al.* (2010), and Gupta *et al.* (2012).

Activity of rumen protozoa: The concentration of protozoa in rumen liquor of healthy goats was high (+++) with vigorous (+++) motility, while it was found to be decreased (+/-) in acidotic goats, as noted in many of the above reports on goats. The acidic pH of rumen fluid is known to adversely affect the concentration and motility of rumen protozoa (Radostits *et al.,* 2007).

Sedimentation activity time (SAT) and Methylene blue reduction time (MBRT): The mean values of SAT and MBRT noted in the ruminal fluid of healthy goats were 24.50±00.78 and 10.03±00.27 minutes, which increased highly significantly (P<0.01) to 46.67±01.20 and 29.50±00.73 minutes, respectively, in acidotic goats. This highly significant increase in SAT and MBRT in acidotic goats might be due to change in microbial population on account of changed eating and drinking habit of goats, and also due to the destruction of normal microflora (cellulolytic bacteria) and a shift in their pattern from predominantly Gram negative to amylolytic Gram positive nature (Randhawa *et al.,* 1989). The present observations are in line with the earlier reports of Kasaralikar *et al.* (2007) Ram *et al.* (2007), Shah *et al*. (2013), and Zein-Eldin *et al.* (2014) in sheep and/or goats.

Biochemical Alterations

The mean values of serum biochemical parameters of healthy and acidotic goats are presented in Table 2.

Table 2: Serum biochemical parameters (Mean±SE) in healthy and acidotic goats

Sr. No.	Parameter	Healthy goats (n=8)	Acidotic goats (n=24)
1	Glucose (mg/dl)	74.13±1.83	92.43±1.37**
2	BUN (mg/dl)	22.63±1.19	26.49±0.47*
3	Creatinine (mg/dl)	00.83±0.02	01.01±0.02**
4	Albumin (g/dl)	03.05±0.05	03.22±0.03**
5	Calcium (mg/dl)	10.29±0.08	09.09±0.14**
6	ALT (IU/L)	27.88±1.14	56.75±1.55**
7	AST (IU/L)	54.00±1.75	93.25±1.82**
8	Alkaline Phosphatase (IU/L)	203.00±6.88	208.92±2.54

**(P<0.01); * (P<0.05)

Glucose: The mean values of blood glucose in healthy goats and acidotic goats were 74.13±1.83 and 92.43±1.37 mg/dl, respectively. It was significantly higher in acidotic goats when compared with healthy goats, and concurred with the earlier reports of Lal *et al*. (1990), Kasaralikar *et al.* (2007), Ismail *et al.* (2010) and Darwin and Thangathuria (2017). The increase in blood glucose value could be due to increased reabsorption from the surplus that was not metabolized by the rumen microbes, and utilization of absorbed lactic acid for gluconeogenesis (Braun *et al.* (1992), increased glycogenolysis or decreased peripheral utilization of glucose with decreased insulin production as a result of degeneration of beta cells of pancreas (Randhawa *et al.* (1989) and/or increased synthesis by the liver, arising from higher production and absorptions of volatile fatty acids in the rumen (Nagaraja *et al.,* 1985).

Blood urea nitrogen (BUN), Creatinine and Albumin: The levels of serum BUN (26.49±0.47 vs. 22.63±1.19 mg/dl), creatinine (01.01±0.02 vs. 00.83±0.02 mg/dl) and albumin (03.22±0.03 vs. 03.05±0.05 g/dl) were significantly (P<0.01) increased in acidotic goats as compared to healthy

goats (Table 2). Similar observations were reported by Ismail *et al.* (2010). The significant increase in BUN and serum creatinine indicated decreased glomerular filtration rate in acidotic animals. This could be due to the renal damage or reduction in renal functions (Lal *et al.,* 1990).

Calcium: The mean values of serum calcium in healthy goats and acidotic goats were 10.29±0.08 and 09.09±0.14 mg/dl, respectively, which differed significantly. The significant reduction in calcium level obtained was in agreement with the findings of Shah *et al*. (2013) and Zein-Eldin *et al.* (2014). The hypocalcemia may be due to a temporary malabsorption of calcium due to damaged mucosa of intestine (Radostits *et al.,* 2007).

Enzymes ALT, AST and ALP: The mean values of alanine amino transferase (ALT), aspartate amino transferase (AST) and alkaline phosphate (ALP) in healthy goats were 27.88±1.14 IU/L, 54.00±1.75 IU/L and 203.00±6.88 IU/L, respectively. The corresponding mean values in acidotic goats were 56.75±1.55 IU/L, 93.25±1.82 IU/L and 208.92±2.54 IU/L, respectively. Significantly increased levels of ALT and AST found in acidotic goats in comparison to healthy goats were in agreement with Karasalikar *et al.* (2007), Sharma *et al*. (2010) and Gupta *et al*. (2012). The levels of ALP increased non-significantly in acidotic goats than healthy goats. This finding was however in disagreement with Sharma *et al.* (2010) and Gupta *et al*. (2012).

It was concluded that significant alterations in the properties of ruminal fluid and serum biochemical profile concurrent with clinical manifestations observed in goats are the good indications to assess the severity of ruminal acidosis and predict the treatment response in goats.

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Conflict of Interest: All authors declare no conflict of interest.

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