



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(7): 861-864
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www.thepharmajournal.com
Received: 07-05-2022
Accepted: 11-06-2022

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Alteration in clinical, haematological and serum biochemical constituents in goats affected with ruminal acidosis

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Abstract

Ruminal acidosis is a most common affection in ruminants which occurs due to excess ingestion of highly fermentable carbohydrate rich feed, poor managemental practices etc. in this study, 10 healthy goats from farm and 20 goats presented at VCC of CVAS Navania, Vallabh Nagar, with clinical signs of ruminal acidosis and having rumen fluid pH below 6 were examined for changes in clinical, haematological and serum biochemical parameters. Among various clinical parameters evaluated, the mean values of rectal temperature ($99.94 \pm 0.17^\circ\text{F}$), ruminal motility (0.65 ± 0.18 /min) decreased significantly, while heart rate (115.6 ± 1.4 /min), respiration rate (38.05 ± 0.76 /min) significantly increased. Among the various haematological parameters, the mean values of haemoglobin (12.97 ± 0.21 g/dl), total erythrocyte count ($15.07 \pm 0.50 \times 10^6$ / μl), total leukocyte count ($12.99 \pm 0.25 \times 10^3$ / μl) significantly increased. Differential leucocyte count including lymphocytes, neutrophils, eosinophils and basophils were (67.83 ± 0.44 %), (24.02 ± 0.41 %), (3.38 ± 0.10 %) and (0.39 ± 0.02 %) percent, highly significant increase in eosinophils, lymphocytes while neutrophils decreased significantly in acidotic goats. Among various serum biochemical parameters, the mean values of serum glucose (98.12 ± 5.80 mg/dl), BUN (26.15 ± 0.38 mg/dl), serum creatinine, (1.30 ± 0.08 mg/dl) and albumin (3.91 ± 0.10 g/dl), ALT (47.694 ± 1.83 IU/L) and AST (98.71 ± 1.22 IU/L) increased significantly.

Keywords: Goats, ruminal acidosis, clinical parameters, serum biochemical

Introduction

Goats are known as the poor man's cow in India. It is a valuable asset for villagers and poor man who depend on goat farming for their source of income. It has been recorded those different diseases in goats cause economic losses to the farmers (Boscos *et al.*, 1996) [3]. Ruminal acidosis is one of important clinical emergencies in small ruminants that results in high mortality (Constalle *et al.*, 2017). Ruminal acidosis is caused by the accidental or excessive ingestion of large quantities of easily fermentable carbohydrate rich diet such as rice, paddy grains, maize, jack fruit etc in ruminant (Aleyas and Vijayan, 1981) [2]. That may be manifested in acute and sub-acute forms. Clinical signs recorded in goats affected with lactic acidosis are increased in respiration, heart rate and decrease in body temperature, rumen motility (Rodostits *et al.*, 2007) [23]. Lactic acidosis causes the variation in haematological parameters like increased haemoglobin percentage, increase erythrocytes count, leukocytes and packed cell values due to dehydrations (Shihabudeen *et al.*, 2003). Lactic acidosis associated with biochemical changes such as hyperglycaemia, increase AST, ALT, ALP (Jorg and Enemark, 2008) [15], increase urea nitrogen, creatinine level (Patra *et al.*, 1996) in affected goats. Hence, this study was conducted to evaluate changes in clinico-haemato-biochemical parameters in goats affected with ruminal acidosis in comparison to healthy ones.

Materials and Methods

The present investigation was conducted at the Department of Veterinary Medicine in collaboration with Veterinary Clinical Complex (VCC), Navania, Vallabh Nagar, Udaipur (Rajasthan). Ten apparently healthy animals were selected as control. Clinical cases of rumen indigestion in goats were examined for detection of rumen acidosis. The cases having the history of accidental ingestion of carbohydrate rich diet were selected. The clinical examination was carried out and those cases having rumen pH below 6 were include in this study. Approximately 7 ml of blood was withdrawn from jugular vein, out of which 2 ml was collected in a sterile plastic K₃ EDTA vacutainer for haematological analysis. About 5 ml of blood in a sterile plain plastic vacutainer was centrifuged at 3000-3500 rpm for 5 minutes to

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separate serum and was stored at -20°C for further investigation using assay kit.

Results and Discussion

Alteration in clinical parameters

The clinical findings on clinical parameters of healthy goats and acidotic goats are presented Table 1.

Table 1: Mean of different clinical parameters in healthy and acidotic goats

Sr. No	Parameters	Healthy goat (n=10)	Acidotic goat (n=20)
1.	Rectal temperature ($^{\circ}\text{F}$)	102.89 \pm 0.08	99.94 \pm 0.17**
2.	Heart rate (beat/min)	77.8 \pm 1.41	115.6 \pm 1.41**
3.	Respiration rate (breath/min)	27.4 \pm 1.10	38.5 \pm 0.76**
4.	Ruminal motility (2-3/min)	2.8 \pm 0.25	0.65 \pm 0.18**

Note: ** = Highly significant ($P\leq 0.01$), * = Significant ($P\leq 0.05$), NS = Non-significant

The mean values of rectal temperature ($^{\circ}\text{F}$), heart rate (beats/min), respiration rate (breaths/min) and ruminal motility in healthy goats were 102.89 \pm 0.08, 77.8 \pm 0.141, 27.4 \pm 1.10 and 2.8 \pm 0.25, respectively. The mean values of rectal temperature, heart rate, respiration rate and ruminal motility in acidotic goats were 99.94 \pm 0.17, 115.6 \pm 1.4, 38.05 \pm 0.76 and 0.65 \pm 1.8, respectively. The similar findings were documented by Alam *et al.* (2014) [1], Elnady *et al.* (2019) [9], Muhammad *et al.* (2019) Udainiya *et al.* (2020) in acidotic goats.

Alteration in haematological parameters

The mean values of haematological parameters of healthy and acidotic goats are presented in table 2.

Table 2: Mean value of different haematological parameters of healthy and acidotic goats

Sr. No	Parameters	Healthy goat (n=10)	Acidotic goat (n=20)
1.	Hb (g/dl)	9.96 \pm 0.36	12.97 \pm 0.21**
2.	TEC ($\times 10^6/\mu\text{l}$)	12.65 \pm 0.18	15.07 \pm 0.50**
3.	TLC ($\times 10^3/\mu\text{l}$)	7.78 \pm 0.86	12.99 \pm 0.25**
4.	PCV (%)	30.82 \pm 1.2	39.96 \pm 1.26**
5.	MCV (fl)	24.36 \pm 0.95	26.52 \pm 0.63**
6.	MCH (pg)	7.87 \pm 0.4	8.61 \pm 0.13**
7.	MCHC (g/dl)	32.31 \pm 1.19	32.45 \pm 0.45
Differential leucocyte counts			
8.	Neutrophils (%)	37.05 \pm 0.60	24.02 \pm 0.41**
9.	Lymphocytes (%)	58.76 \pm 0.67	67.83 \pm 0.44**
10.	Eosinophils (%)	2.62 \pm 0.27	3.38 \pm 0.10**
11.	Basophils (%)	0.35 \pm 0.1	0.39 \pm 0.02

Note: ** = Highly significant ($P\leq 0.01$), * = Significant ($P\leq 0.05$), NS = Non-significant

Haemoglobin (Hb): The mean value of haemoglobin was 9.96 \pm 0.36 g/dl in healthy goats and 12.97 \pm 0.21 g/dl in acidotic goats. The level of Hb was found to be increased highly significantly ($P<0.01$) in acidotic goats as compared to healthy goats.

An increase in Hb value observed in the acidotic goats under study was in agreement with the reports of Sharma and Nath (2005) [26], Sharma *et al.* (2009) [25], Gupta *et al.* (2012) [11], Shah *et al.* (2013) [24], Tufani *et al.* (2013), Zein-Eldin *et al.*

(2014) [30] and Ibrahim (2016) [13]. The rise in haemoglobin levels could be due to haemoconcentration caused by dehydration and drawing of systemic fluid in the rumen, which was evident from clinical signs and elevated PCV percent as observed by Shihabudeen *et al.* (2003) and Sharma and Nath (2005) [26].

Total erythrocyte count (TEC): The mean value of erythrocyte count of 12.65 \pm 0.18 $\times 10^6/\mu\text{l}$ reported in the healthy goats and 15.07 \pm 0.50 $\times 10^6/\mu\text{l}$ in acidotic goats were in the agreement with the value reported by Rodostits *et al.* (2007) [23]. The higher significant increase in erythrocyte count observed in acidotic goats was in accordance with the observations made by Tanwar *et al.* (1983) [29], Basak *et al.* (1993) [4], Sharma and Nath (2005) [26], Makhdoomi *et al.* (2011) [21], Shah *et al.* (2013) [24], Tufani *et al.* (2013) and Zein-Eldin *et al.* (2014) [30]. This rise in erythrocyte count may be attributed to dehydration or because of release of blood cell from spleen due to stress as opined by Huber (1971) [12] and Das and Mishra (1972) [8].

Total leukocyte count (TLC): The mean value of total leukocyte count recorded in healthy goats was 7.78 \pm 0.86 $\times 10^3/\mu\text{l}$ and 12.99 \pm 0.25 $\times 10^3/\mu\text{l}$ in acidotic goats. TLC was found to be significantly higher in acidotic goats as compared to the healthy goats. Similar findings were reported by Sharma *et al.* (2009) [25], Ismail *et al.* (2010) [14], Mahmood *et al.* (2013) [20], Zein-Eldin *et al.* (2014) [30] and Ibrahim (2016) [13]. This change could be due to the endotoxins of ruminal origin according to Dunlop (1972).

Differential leukocyte counts (DLC): The mean values of Differential leucocyte count (DLC) including lymphocytes (%), neutrophils (%), eosinophils (%) and basophils (%) in healthy goats were 58.76 \pm 0.67, 37.05 \pm 0.60, 2.62 \pm 0.27 and 0.35 \pm 0.1 percent, respectively. The corresponding mean values of DLC in acidotic goats were 67.83 \pm 0.44, 24.02 \pm 0.41, 3.38 \pm 0.10 and 0.39 \pm 0.02 percent, respectively. Haematological examination revealed highly significant increase in eosinophils and lymphocytes. Similar findings were reported by Garry (2002) [10], Noura (2012) and Soha (2017) [28], while highly significant decreased in neutrophils. The observed changes might be due to dehydration, malnutrition and associated immunosuppression.

PCV, MCHC, MCH and MCV: The mean values of PCV (%), MCV (fl), MCHC (g/dl) and MCH (pg) in healthy goats were 30.82 \pm 1.2, 24.36 \pm 0.95, 32.31 \pm 1.19 and 7.87 \pm 0.4, respectively. The corresponding mean values of PCV (%), MCV (fl), MCHC (g/dl) and MCH (pg) in acidotic goats were 39.96 \pm 1.26, 26.52 \pm 0.63, 32.45 \pm 0.45 and 8.61 \pm 0.13, respectively. The changes in PCV, MCV and MCH due to haemoconcentration as a result of dehydration following drawing of systemic fluid in the rumen and profuse diarrhoea by Huber, (1971) [12] and Rodostits *et al.* (2007) [23] and stress of lactic acidosis which stimulated the adrenals to release red blood cells from the spleen by Kilburn, (1966) [17].

Biochemical alteration

The mean values of serum biochemical parameters of healthy and acidotic goats are presented in table 3.

Table 3: Mean value of serum bio-chemical parameters in healthy and acidotic goats

Sr. No	Parameters	Healthy goat (n=10)	Acidotic goat (n=20)
1.	ALT (IU/L)	29.33±0.78	47.694±1.83**
2.	AST (IU/L)	52.85±0.741	98.71±1.22**
3.	Blood glucose (mg/dl)	49.87±1.56	98.12±5.80**
4.	BUN (mg/dl)	22.23±0.78	26.15±0.38**
5.	Serum creatinine (mg/dl)	1.16±0.11	1.30±0.08*
6.	Alkaline Phosphatase (IU/L)	236.64±7.18	316.68±21.42**
7.	Total serum protein (g/dl)	6.58±1.39	7.99±0.25**
8.	Albumin (g/dl)	3.55±0.05	3.91±0.10*

Note: ** = Highly significant ($P \leq 0.01$), * = Significant ($P \leq 0.05$), NS = Non-significant

Glucose: The mean values of serum glucose in healthy goats and acidotic goats were 49.87±1.56 mg/dl and 98.12±5.80 mg/dl, respectively. In the present study, the blood glucose level was highly significant in acidotic goats when compared with healthy goats. Similar observations were reported by Ismail *et al.* (2010)^[14], Kasaralikal *et al.* (2012)^[16], Ibrahim (2016)^[13], Darwin and Thangathuria (2017) in goats and Camara *et al.* (2013)^[5] in sheep.

The increase in serum glucose levels could be due to the absorbed lactic acid is used for the process of gluconeogenesis Garry, (2002)^[10]. This can be also attributed to increased glycogenolysis, gluconeogenesis or decreased peripheral utilization of glucose associated with decreased insulin production as a result of degeneration of beta cells of pancreas as reported by Randhawa *et al.* (1980)^[22].

Alanine amino transferase (ALT), Aspartate amino transferase (AST), Alkaline phosphate (ALP), Blood urea nitrogen (BUN), Creatinine, Total serum protein and Albumin: The mean values of ALT, AST, ALP, BUN, Creatinine, Total serum protein and albumin in healthy goats were 29.33±0.78 IU/L, 52.85±0.74 IU/L, 236.64±7.18 IU/L, 22.23±0.78 mg/dl, 1.16±0.11 mg/dl, 6.58±1.39 mg/dl and 3.55±0.05 mg/dl, respectively. The corresponding mean values in acidotic goats were 47.69±1.83 IU/L, 98.71±1.22 IU/L, 316.68±20.42 IU/L, 26.15±0.38 mg/dl, 1.30±0.08 mg/dl, 7.99±0.25 and 3.91±0.10 g/dl, respectively.

Among various serum biochemical parameters studied, the levels of ALT, AST and ALP significantly high ($P < 0.01$) in acidotic goats in comparison to healthy goats. These findings were in agreement with Karasalikal *et al.* (2012), Sharma *et al.* (2010) and Gupta *et al.* (2012)^[11]. The serum total protein recorded significantly higher ($p < 0.01$) in acidotic goat because of dehydration due to transmission of fluid from lumen of blood stream into the rumen Marchesini *et al.* (2013)^[19]. The blood glucose and blood urea nitrogen were also found highly significant ($p < 0.01$). The mean value of blood creatinine having no significant difference between healthy and acidotic goats.

The mean values of ALT, AST, and ALP increased might be due to hepatocellular damage as a result of toxic products like alcohol, histamine, thiaminase and other endotoxin produced in rumen epithelium and entering the portal circulation by Rodostits *et al.* (2007)^[23].

The elevated levels of BUN and creatinine could be due to reduced glomerular filtration rate associated with impaired renal perfusion and arterial blood pressure by Lal *et al.* (1992)^[18].

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