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Biochemical changes during therapeutic trial on ruminal acidosis in goats

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Abstract
The present study was conducted to estimate various biochemical parameters in acidotic goats in Jaipur, Rajasthan during June, 2020 to December, 2020. A total of 50 clinical cases of ruminal acidosis of different age group, sex and irrespective of breed having the history of ingestion of large quantity of highly fermentable carbohydrate rich diet and showing acidic pH (5.5 or less) of rumen liquor were selected for present investigation. They were randomly divided into five groups of ten animals in each group. Ten healthy goats were also included as healthy control group in the study. Goats were treated with intravenous 7.5% sodium bicarbonate @0.9ml/kg b.wt., oral rumen buffer with live yeast culture (Bufkind®) @1gm/kg b.wt., oral dry ginger powder @500mg/kg b.wt as electuary alone and combination of intravenous sodium bicarbonate with Bufkind and combination of intravenous sodium bicarbonate with dry ginger powder. Blood samples were collected at 0 hour before and at 24, 48 and 72 hours after initiation of treatment for biochemical studies. Biochemical profile revealed significant increase in blood glucose, BUN, serum Creatinine, AST, GGT and LDH while blood pH significantly decreased.

Keywords: Ruminal acidosis, biochemical, sodium bicarbonate, oral rumen buffer with live yeast culture (Bufkind®), ginger

Introduction
Ruminal acidosis is the most remarkable forms of ruminal microbial fermentative disorders (Radostits *et al*., 2007) [14]. It is the greatest nutritional problem for farmers which cause substantial economic losses arising directly from the treatment of acidotic animals, mortality and morbidity and indirectly from the reduction of milk, meat and reproduction. Ruminal acidosis is one of the most important clinical emergencies in small ruminants (sheep and goats) and results in high mortality. In clinically affected animals morbidity rate varies from 10-50 per cent and case mortality in ruminal acidosis may reach up to 90 per cent in untreated cases whereas it may be 30-40 per cent in treated cases (Radostits *et al*., 2007) [14]. Acidosis results in acidic pH of rumen liquor (normal being 6.2-6.8) which is caused by feeding of readily fermentable carbohydrates, feeding of low fiber diet, poor management practices or a combination of these. Degree of acidosis varies from seriousness, a slight drop in feed intake (mild) to death (severe). Clinically it is manifested by indigestion, rumen stasis, toxemia, in-coordination, collapse and frequent death (Tufani *et al*., 2013) [20]. The systemic effects of acidosis include changes in biochemical and rumen ecosystem (at pH of 5.5 or less), hyperkeratosis, liver abscesses, rumenitis and laminitis. It is very important to know the changes in biochemical parameters (Bhagavantappa, 2017) [3]. Rapid fermentation of carbohydrates alters the ruminal function through proliferation of acid resistant bacteria and an increase in the production of volatile fatty acids and D and L lactate, which cause a marked drop in ruminal pH to < 5.00 in most cases (González *et al*., 2015) [7]. Treatment is aimed to correcting the dehydration, acidic pH, toxemia and removing or neutralizing the offending feed stuffs. Intravenous fluid containing sodium bicarbonate or oral rumen buffers or oral natural herbs like ginger should be administered. Intra ruminal antibiotics have been recommended to kill gram positive bacteria (lactic acid producing bacteria) (Gupta *et al*., 2012) [8].

Materials and Methods
The work was conducted at the Veterinary Clinical Complex (VCC), Department of Veterinary Medicine Post Graduate Institute Veterinary Education and Research (PGIVER) Jaipur Rajasthan during June, 2020 to December, 2020. In the present investigation, goats of

different age, sex, irrespective of breed having the history of ingestion of excess of highly fermentable carbohydrate rich diet were screened. Total 50 goats having rumen liquor pH below 5.5 were selected for the study and were randomly divided in to five groups of 10 each. The treatment protocol for group-1 goats, was intravenous 7.5% sodium bicarbonate @0.9ml/kg b.wt., for group-2 goats oral rumen buffer with live yeast culture (Buffkind®) @1g/kg b. wt., for group-3, intravenous 7.5% sodium bicarbonate @0.9ml/kg b.wt. in combination with Buffkind® @1g/kg b. wt., for group-4 oral dry ginger powder @500mg/kg b. wt., and for group-5 intravenous 7.5% sodium bicarbonate @0.9ml/kg b.wt. in combination with oral dry ginger powder @500mg/kg b. wt.. Treatment was given at 0 hour, 24 hour, 48 hour and 72 hour along with common supportive therapy comprising of fluid therapy, antibiotics, antihistaminics and multivitamins. 10 healthy goats were also selected as healthy control group.

Sampling Procedure

Collection of blood and serum

Blood slants were made and incubated for one hour at 30 °C. The tubes were then kept in refrigerator for some time (allowing retraction of clot) and centrifuged at 3500 rpm for 10 minutes to separate the serum. On separation, serum was immediately transferred into sterilized screw capped vial and stored in deep freeze at -20 °C for biochemical estimation. The blood samples were also collected from 10 healthy goats (Healthy control group) as described above and subjected for the estimation of haematological and biochemical values.

The data obtained were statistically analyzed for ANOVA (Snedecor and Cochran 1994) [16]. Means showing significant differences were compared by Duncan's New Multiple Range Test. Statistical significance was accepted at $p \leq 0.05$ (Duncan, 1955) [6].

Results and Discussion

Comparison between healthy control group and the Group 1,2,3,4, and 5 (table-1) at 0 hour before treatment showed blood glucose, BUN, Creatinine, AST, GGT and LDH.

Table 1: Comparison of healthy control with '0' hour (Before treatment) values

S. no.	Parameters	Healthy Group (N=10)	Group-1 (N=10)	Group-2 (N=10)	Group-3 (N=10)	Group-4 (N=10)	Group-5 (N=10)
1.	Glucose	48.26±4.85^{aA}	85.4±0.96	79.3±0.95	92.60±9.82^{c}	70.5±2.44	92.1±7.76^{c}
2.	GGT	42.74±4.66^{aA}	73.42±8.08	73.54±2.89	75.94±7.52^{c}	73.26±2.82	72.73±3.41
3.	LDH	287.54± 2.69^{aA}	370.2±7.75^{b}	352.4±16.56^{bB}	400.59±4.24^{c}	356±11.48	400.59±4.24^{c}
4.	AST	79.76±5.74^{aA}	112.38±16.93	102.38±11.31	121.66±6.05^{c}	101.76±11.21	120.62±8.62^{c}
5.	BUN	21.22±0.93^{aA}	39.48±2.78	38.56±1.23	47.4±1.50^{C}	33.4±0.92	38.86±1.27
6.	Creatinine	0.78±0.055^{aA}	3.48±0.13^{cC}	2.29±0.13	4.1±0.10	2.35±0.17	2.24±0.21^{b}

Mean bearing same superscript do not differ significantly

After treatment, acidosis affected goats in the treatment groups showed gradual improvement as indicated by the changes in the, Mean ± SE values of different parameters in order to assess the efficacy of treatment in the treated Groups, Mean ± SE values of Biochemical parameters were compared at 24 hours, 48 hours, and 72 hours after treatment in groups receiving treatment with healthy control Group.

Table 2: Comparison of healthy control with '24' hours (After treatment) values

S. no.	Parameters	Healthy Group (N=10)	Group-1 (N=10)	Group-2 (N=10)	Group-3 (N=10)	Group-4 (N=10)	Group-5 (N=10)
1.	Glucose	47.98±4.85^{aA}	84.082±1.67	76.47±2.00	70.37±19.02^{b}	67.9±2.49	78.9±1.04
2.	GGT	42.49±4.68^{aA}	71.35±7.32	72.02±3.05	53.65±2.24^{bA}	72.97±2.66	62.87±5.06
3.	LDH	287.27±2.65^{aA}	362.2±6.69	315.6±13.04	325.78±19.88^{b}	346±10.89	362.18±4.58^{b}
4.	AST	79.53±5.73^{aA}	110.3±16.94	101.67±7.95	100.21±8.50^{b}	101.76±11.21	100.21±8.50^{b}
5.	BUN	20.82±0.90^{aA}	38.74±2.75	35.42±1.51^{c}	25.47±1.63^{bB}	32.6±0.87	35.66±1.22
6.	Creatinine	0.74±0.04^{aA}	3.01±0.16^{bC}	2.29±0.21	1.04±0.06	2.21±0.15	1.03±0.06

Mean bearing same superscript do not differ significantly

Table 3: Comparison of healthy control with '48' hours (After treatment) values

S. no.	Parameters	Healthy Group (N=10)	Group-1 (N=10)	Group-2 (N=10)	Group-3 (N=10)	Group-4 (N=10)	Group-5 (N=10)
1.	Glucose	47.86±4.84^{aA}	82.48±1.72	67.5±2.84	50.44±0.68	63±2.60	78.9±1.04
2.	GGT	42.41±4.68^{aA}	65.74±4.96	69.18±2.32	39.97±2.61	72.44±2.62	56.83±4.39^{B}
3.	LDH	287.23±2.69^{aA}	302.5±13.52	307.6±16.28	292.58±17.44	332.3±11.54	300.58±18.89
4.	AST	79.44±5.73^{aA}	88.38±3.83	93.03±9.43	80.84±4.11	101.76±11.21	88.92±4.27
5.	BUN	20.94±0.96^{aA}	36.1±1.1	32.6±0.70^{b}	23.67±0.34^{A}	32±0.74	32.5±0.76
6.	Creatinine	0.72±0.08^{aA}	1.06±0.10	1.03±0.04	0.90±0.02	2.13±0.14^{C}	0.97±0.05

Mean bearing same superscript do not differ significantly

Table 4: Comparison of healthy control with '72' hours (After treatment) values

S. no.	Parameters	Healthy Group (N=10)	Group-1 (N=10)	Group-2 (N=10)	Group-3 (N=10)	Group-4 (N=10)	Group-5 (N=10)
1.	Glucose	48.14±4.87^{aA}	48.6±1.13^{a}	49.414±7.29^{a}	48.36±0.49	52.875±1.25	50.74±0.61^{a}
2.	GGT	42.52±4.69^{aA}	44.64±2.44^{a}	55.6±2.38^{a}	38.91±2.33	72.26±2.32^{D}	41.73±2.05^{a}
3.	LDH	287.39±2.69^{aA}	289±15.45	291.8±16.35	288.14±15.72	301.625±10.52	295.58±16.48
4.	AST	79.50±5.72^{aA}	79.15±10.92	80.88±6.31	77.02±2.45	105.1375±5.31	81.02±4.09
5.	BUN	21.16±0.91^{aA}	23.99±0.42^{a}	23.2±0.95^{a}	21.91±0.36	31.63±0.86^{B}	21.4±0.26^{a}
6.	Creatinine	0.72±0.03^{aA}	0.87±0.04	0.88±0.03	0.79±0.02	1.95±0.08^{C}	0.92±0.02

Mean bearing same superscript do not differ significantly

Comparison between healthy control group and the Group - 1(Sodium bicarbonate) goats at 24 hours after treatment (table-2) showed significant difference ($P \leq 0.05$) in parameters of Creatinine out of six parameters and non significant difference in rest parameters. At 48 hours after treatment showed non significant difference all parameters. At 72 hours after treatment showed non significant difference all parameters. Comparison between healthy control group and the Group-2(Buffkind) goats at 24 hours after treatment showed significant difference ($P \leq 0.05$) in parameters of BUN out of six parameters and non significant difference in rest parameters. At 48 hours after treatment showed significant difference ($P \leq 0.05$) are parameters of BUN, and non significant difference in other parameters. At 72 hours after treatment showed non significant difference all parameters. Comparison between healthy control group with the Group-3(Sodium bicarbonate + Buffkind) goats at 24 hours after treatment showed highly significant difference ($P \leq 0.05$) in parameters (glucose, GGT, LDH, AST, BUN,) out of six parameters and non significant difference in rest parameters. At 48 hours after treatment showed non significant difference in all parameters. At 72 hours after treatment showed non significant difference are all parameters. Comparison between healthy control group and the Group-4 (Ginger) goats at 24 hours after treatment showed non significant difference are all parameters. At 48 hours after treatment showed non significant difference are all parameters. At 72 hours after treatment showed non significant difference are all parameters.

Comparison between healthy control group and the Group-5 (Sodium bicarbonate + Ginger) goats at 24 hours after treatment showed highly significant difference ($P \leq 0.05$) parameter of LDH, AST out of six parameters and non significant difference in rest parameters. At 48 hours after treatment showed non significant difference are all parameters. At 72 hours after treatment showed non significant difference are all parameters.

Discussion

Group-1 Showed gradual improvement in health status at 48 hours post treatment. Administration of intravenous Sodium bicarbonate neutralized the lactic acid produced locally inside the rumen to prevent chemical ruminitis and to restore normal ruminal pH, which reduced the effect of metabolic / systemic acidosis **(**Tanwar *et al*., 1983, Patra *et al*., 1997, Metkari *et al*., 2001, Peer and Ansari 2008, Selvaraj *et al*., 2009, Arora *et al*., 2011 and Karale, 2012) [18, 12, 10, 13, 15, 2, 9].

Group-2 also showed gradual improvement in health status at 48 hours post treatment. Buffkind powder is a buffering oral drug containing ideal rumen buffer, metabolic booster and yeast are used for the management of ruminal acidosis. It's having alkalizing substances which cause increase in rumen liquor pH. Similar treatment was advocated by many earlier researchers (Chaudhary *et al*., 2009, Gupta *et al*., 2012) [4, 8].

Group-3 and 5 showed gradual improvement in health status at 24 hours post treatment.

It was concluded that ruminal acidosis is a common disease of goats and its severity can be effectively reduced by combination of either Bufkind or ginger and sodium bicarbonate along with supportive therapy (Valmik *et al*., 2017) [21].

Group-4 goats receiving ginger treatment showed slow response as compared to other groups but combination with sodium bicarbonate had increased its efficacy.

Ginger has antioxidant, anti-inflammatory, antitumor, pain-relieving, liver-protecting activities and antimicrobial effect (Nattha, 2019) [11]. Ginger is one of most alkaline herbs (Taylor, 2017) [19]. Ginger stimulates the flow of saliva, bile, and gastric secretions and therefore is traditionally used to stimulate appetite, reduce flatulence, colic, and gastrointestinal spasms, and generally act as a digestive aid as opined by earlier workers (Blumenthal¸ *et al*., 2000) [4]. In recent years, several studies have focused on ginger's potential in rumen fermentation modification (Al-Azazi *et al*., 2018, Soroor and Moeini 2015) [1, 17]. But previous studies have not concentrated on ginger's impact on acid-base balance. A study was applied to investigate the effect of ginger powder (*Zingiber officinale*) @ 500mg/kg bwt orally supplement for 5 days on (acid-base balance), rumen (physical, cellular, and biochemical), and blood constituents in apparently healthy Egyptian sheep. Depending on changes in blood and rumen constituents it was recommended for using ginger supplementation as 500mg/kg b. wt orally for 3-5days as an immune stimulant and in the treatment of rumen acidosis and respiratory affections in sheep (Zaki *et al*., 2020) [22].

Conclusion

Goats belonging to group 1, 2, 3, 4 and 5 were observed during the therapy. Improvement in appetite, rumination and haemato-biochemical parameters were noticed in group 3 and 5 next day after treatment. Whereas, the group 1 goats receiving Sodium bicarbonate, group 2 receiving buffkind and group 4 receiving ginger had shown slow recovery in symptoms at 48 and 72 hours post treatment as compared to group 3 and 5 goats. Improvement in biochemical parameters, their reversal to normalcy and overall clinical recovery was also evaluated at 24, 48 and 72 hours of treatment within and between groups. Combination of Buffkind with Sodium bicarbonate and combination of Sodium bicarbonate with Ginger along with supportive therapy was found to produce

remarkable changes in biochemical parameters and resumed to normalcy during the present study in goats. Hence, it is concluded that therapeutic regimen as formulated in present investigation can be recommended for the treatment of ruminal acidosis in goats under field conditions.

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