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EFFECTS OF SODIUM BICARBONATE ON INDUCED LACTIC ACIDOSIS IN BLACK BENGAL GOATS

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The aim of this study is to determine the effects of sodium bicarbonate on induced lactic acidosis in Black Bengal goats. For these study 40 mature Black Bengal goats were selected. Four different feeding regimes with crushed wheat and crushed rice at the dose rate of 35 g/kg and 70 g/kg were used for induction of rumen acidosis. Two percent sodium bicarbonate ($NaHCO_3$) was incorporated with each dose regime to record its effect on rumen acidosis. After administration of computed doses of concentrates the effect on various parameters was studied over a period of 60 hours. The recorded pathological changes were more pronounced with higher dose of crushed rice without $NaHCO_3$. The rectal temperature was significantly reduced while heart rate and respiration rates were significantly increased. The rumen pH was significantly diminished. Haemoglobin and packed cell volume were increased. Rumen motility was abolished and abdomen was distended. There was lameness and teeth grinding. All these changes were expressed prominently in goats fed crushed rice at 70 g/kg. The mortality recorded in this group was 100% within 48 hours which, however, reduced to only 20% when the same dose of feed was supplemented with 2% $NaHCO_3$. Supplementation of lethal dose of crushed rice with $NaHCO_3$ appears to reduce the deleterious effects of rumen acidosis and thereby salvaged the experimental animals. Postmortem changes associated with rumen acidosis were congestion and patchy epithelial desquamation of the rumen wall. This is thought to be associated with reduced rumen pH.

Key words: Lactic acidosis, Sodium bicarbonate, Black Bengal goat

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In recent years, it has become a routine practice in feedlots to rapidly increase the concentrate portion of the diet being fed to ruminants in order to have them on a high concentrate diet as soon as possible. Following ingestion of large quantity of carbohydrate rich diet there is rapid accumulation of excess lactic acid in the reticulorumen which subsequently gives rise to symptoms of lactic acidosis (Bladwin, 1967). Unlike other ruminants this condition is often fatal in goats (Sen, 1984). As there is accumulation of lactic acid in the rumen and blood of animals, the condition has been designated as lactic acidosis (Dunlop and Hammond, 1965). Lactic acidosis is initiated by the gram-positive ruminal microbe, Streptococcus lactis, which converts starches and sugars to lactic acid (Chaplin and Jones, 1973). Clinically, this syndrome is characterized by severe toxaemia, anorexia, diarrhoea, weakness, dehydration, complete ruminal stasis and a high mortality rate (Blood and Henderson, 1960). Most of the available literature abounds with data of the condition in sheep (Doughterty et al., 1975, Kezar and Chruch, 1979), and cattle (Dirksen, 1970, Dunlop, 1972, Doughterty et al., 1975, Sethuraman and Rathors, 1979). However, there are fewer reports concerning the condition in goats (Tanwar and Mathur, 1983, Cao et al., 1987). In Bangladesh the

goat population is about 33.5 million (Anon, 1998). These animals are usually owned by poor families for milk and meat production. The disease is commonly encountered due to unintended ingestion of large quantity of rice and flour kept for human consumption. Experimental sheep in poor condition died when given 50 to 60 g of crushed wheat /kg body weight, whereas it took 75 to 80 g /kg to produce fatal acidosis in same species in good condition (Turner and Hodgetts, 1950). The toxic dose of whole-wheat grain for goats has been reported to range from 100 to 120 gm/ kg body weight (Tanwar and Mathur, 1983). The mortality rate may be reduced by removing the noxious ruminal contents (Radostits et al., 2000).

Prophylactic measures could be of major importance to the feedlot industry. This includes restriction of feed intake or slow adaptation to high carbohydrate diets (Underwood, 1992).

The use of buffering materials in ruminant nutrition is a common practice (Zinn, 1991). Buffer helps maintain a constant pH. When high-grain rations, rations high in rapidly fermentable carbohydrates, or rations with small particle size are fed to ruminants, the rumen environment become more acidic, dropping from a normal pH of 6.5 to a pH as low as 4.0. Saliva contains a natural buffer, sodium bicarbonate. When chewing is not stimulated, saliva production is reduced which allows pH in the rumen to decline further. Rations containing sodium bicarbonate minimize this condition (Hart and Doyle, 1985).

Therefore, the present investigation was designed to study the following objectives: clinico-pathological changes of different doses of crushed wheat and crusted rice feeding in goats and therapeutic influence of sodium bicarbonate on acidosis in goats.

In recent years, it has become a routine practice in feedlots to rapidly increase the concentrate portion of the diet being fed to ruminants in order to have them on a high concentrate diet as soon as possible. Following ingestion of large quantity of carbohydrate rich diet there is rapid accumulation of excess lactic acid in the reticulorumen which subsequently gives rise to symptoms of lactic acidosis (Bladwin, 1967). Unlike other ruminants this condition is often fatal in goats (Sen, 1984). As there is accumulation of lactic acid in the rumen and blood of animals, the condition has been designated as lactic acidosis (Dunlop and Hammond, 1965). Lactic acidosis is initiated by the gram-positive ruminal microbe, Streptococcus lactis, which converts starches and sugars to lactic acid (Chaplin and Jones, 1973). Clinically, this syndrome is characterized by severe toxaemia, anorexia, diarrhoea, weakness, dehydration, complete ruminal stasis and a high mortality rate (Blood and Henderson, 1960). Most of the available literature abounds with data of the condition in sheep (Doughterty et al., 1975, Kezar and Chruch, 1979), and cattle (Dirksen, 1970, Dunlop, 1972, Doughterty et al., 1975, Sethuraman and Rathors, 1979). However, there are fewer reports concerning the condition in goats (Tanwar and Mathur, 1983, Cao et al., 1987). In Bangladesh the goat population is about 33.5 million (Anon, 1998). These animals are usually owned by poor families for milk and meat production. The disease is commonly encountered due to unintended ingestion of large quantity of rice and flour kept for human consumption. Experimental sheep in poor condition died when given 50 to 60 g of crushed wheat /kg body weight, whereas it took 75 to 80 g /kg to produce fatal acidosis in same species in good condition (Turner and Hodgetts, 1950). The toxic dose of whole-wheat grain for goats has been reported to range from 100 to 120 gm/ kg body weight (Tanwar and Mathur, 1983). The mortality rate may be reduced by removing the noxious ruminal contents (Radostits et al., 2000).

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MATERIALS AND METHODS

Experimental Animals

Ten goats were used to study the effect of sodium bicarbonate buffer on rumen lactic acidosis. The effect of two feeding regime was studied at a time with five animals for each regime. The animals were purchased from the local market and were kept in the departmental animal shed. The average age and body weights were 1.5 years and 13 kg respectively. The animals were dewormed using morental citrate (Deminth®, Reneta Bangladesh Ltd.) @ 8.8 mg/ kg body weight and were acclimatized for 15 days prior to experiment. The experimental animals were allowed to graze for 8 hours a day and had access to water *ad libitum*. The goats were also supplied with wheat bran once a day. An interval of 3 weeks was allowed between two experimental trials on the same goat so as to ensure recovery from the effect of carbohydrate engorgement.

Monitoring of clinical parameters

Respiration rate, pulse rate and rectal temperature were recorded prior to feeding and at 4, 8, 16, 24, 36, 48 and 60 hours post feeding.

Monitoring of clinical signs

Clinical signs with regard to various feeding regime for both crushed wheat and crushed rice were recorded.

Collection of rumen fluid

Rumen fluid was collected using stomach tube, which was connected with a suction device.

Experimental design

Goats used in the present experiment were divided into different groups as follows:

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Groups	Number of goats	Feeding protocol
A	5	Crushed wheat @ 35 gm/kg body weight
B	5	Crushed wheat @ 35 gm/kg body weight with 2% $NaHCO_3$
C	5	Crushed wheat @ 70 gm/kg body weight
D	5	Crushed wheat @ 70 gm/kg body weight with 2% $NaHCO_3$
E	5	Crushed rice @ 35 gm/kg body weight
F	5	Crushed rice @ 35 gm/kg body weight with 2% $NaHCO_3$
G	5	Crushed rice @ 70 gm/kg body weight
H	5	Crushed rice @ 70 gm/kg body weight with 2% $NaHCO_3$

Measurement of pH

Hydrogen ion concentration of freshly collected rumen fluid was determined using a electronic pH meter (CG 840 Schott-Gerate GmbH, Germany). The device was callibrated using two standard pH solutions pH 4.0 and 7.0 (CibaCorning analytical, Switzerland) before each measurement. After callibration the probe was used to determine the pH of the rumen aspirate. The probe was placed vertically for at least 2 minutes without moving its sensitive tip. On recording of the pH the electrode was rinsed with distilled water and calibrated again for the next measurement. The real pH was recorded by comparing the calibration pH of the buffers.

Collection of blood sample

Blood sample was collected from jugular vein using 21- gauze hypodermic needle with 5-ml disposable plastic syringe. Ethylene Diamine Tetraacetic Acid (EDTA) was used as anticoagulant.

Determination of packed cell volume (PCV)

Special loading pipette was filled with sample blood. The tip of the pipette was then inserted down to the bottom of the Wintrobe hematocrite tube. The blood from the loading pipette was gradually put into the hematocrite tube until it was filled up to '10' or '0' mark. The blood filled hematocrite tube was then centrifuged at 3000 rpm for 30

minutes. The tube was removed from the centrifuge machine and the recording was taken from the graduated scale of the hematocrite tube. The PCV was read by percentage (%).

Determination of haemoglobin (Hb)

Sahli haemoglobinometer technique was used for this purpose (Coffin, 1955). Hydrochloric acid N/10 was placed in the special graduated tube to equal 2 gm or 10 percent mark. The collected blood was drawning up to the 20 mark in the Sahli pipette. The pipette was then introduced into the tube containing acid and stirred and discharged the blood. The blood acid mixture was allowed to stand for half an hour until the haemoglobin was converted to acid hematin. This acid hematin mixture was diluted with N/10 hydrochloric acid until its colour matched the standard. The haemoglobin was read in grams per 100 ml.

Postmortem finding

A detailed postmortem examination was conducted in animals due to lactic acidosis. Specimens collected for necropsy included rumen wall, kidney, liver, lung, brain. Immediately after collection these specimens were fixed in 10% formalin.

Histopathology

The fixed specimens were processed, embedded in paraffin wax, cut at 5 um and stained with haematoxylin and eosin (H &E) for histopathological examination.

Data analysis

The data generated from this experiment were entered in Microsoft Excel® worksheet, organized and processed for further analysis. Descriptive statistics were performed to calculate mean and slandered deviations. Paired *t-test* was used to find the difference between pre and post feeding values of this experiment. All statistical analyses were performed using MINITAB® statistical software.

RESULTS

Effects of feeding regime on clinical parameters

Rectal temperature

Crushed wheat

The mean pre-feeding rectal temperature for group A, B, C, D were 102.88 ºF, 103.2 ºF , 102.68 ºF, 102.84 ºF respectively. In case of group A it increased to 103.44 ºF at 24 hours and then progressively decreased. In group B decreased to 102.94 ºF at 16 hours after feeding. Then the value gradually increased up to 36 hours. For group C temperature also decreased to 101.72 ºF at 36 hours after feeding and then the value started increasing until the end of the experiment. However, in group D the values recorded at various postfeeding hours did not show any noticeable changes. On statistical analysis only group C shows these changes were significant ($P<0.05$) as compared to the prefeeding control value.

Crushed rice

The mean prefeeding rectal temperature for group E, F, G, H were 103.22 ºF, 102.82 ºF, 103.00 ºF and 102.90 ºF. In group E it decreased to 102.62 ºF at 36 hours and then progressively increased. In group F after feeding this value decreased rapidly to 95.75 ºF at 36 hours. Value recorded in this group at various postfeeding hours did not show any consistent pattern (Table 1) and the changes were statistically insignificant ($P>0.05$).In case of group G on statistical analysis these changes were found significant ($P<0.05$) as compared to the prefeeding control value. All the 5 experimental goats, however, died after 36 hours.

In group H rectal temperature was decreased to 101.62 º F at 48 hours after feeding and then the value started increasing until the end of the experiment (Table 1). On statistical analysis these changes were significant ($P<0.05$) as compared to the prefeeding control value.

Effects of different dose regimes of crushed wheat and crushed rice with or without sodium bicarbonate on rectal temperature in goats are shown in Figures 4.1 and 4.2 respectively.

Heart rate

Crushed wheat

In group A the mean prefeeding control value of heart rate in experimental goats was 85.6. This value increased to 97.6 at 24 hours and thereafter decreased progressively to 85.8 at 60 hours (Table 2). These changes were insignificant ($P>0.05$). In group B the mean prefeeding control value of heart rate was 86.2, which increased to 89.8 at 36

Table-1 Effects of different dose regime of concentrates with or without sodium bicarbonate on rectal temperature in goats

se rate		Rectal temperature (°F)							
		PFV	st feeding value at different hours						
			4	8	16	24	36	48	60
Crushed wheat	35gm/kg (n=5)	102.88 ±0.25[a]	103.04 ±0.23[a]	103.14 ±0.30[a]	103.34 ±0.27[a]	103.44 ±0.32[a]	103.14 ±0.38[a]	102.98 ±0.25[a]	102.88 ±0.26[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	103.02 ±0.24[a]	102.96 ±0.16[a]	102.96 ±0.20[a]	102.94 ±0.16[a]	103.10 ±0.17[a]	103.08 ±0.08[a]	102.94 ±0.13[a]	103.12 ±0.27[a]
	70gm/kg (n=5)	102.68 ±0.58[a]	102.62 ±0.52[a]	102.62 ±0.56	102.38 ±0.71[a]	102.02 ±0.70[b]	101.72 ±0.60[b]	102.04 ±0.42[b]	102.34 ±0.40[a]
	70gm/kg with 2% $NaHCO_3$ (n=5)	102.84 ±0.23[a]	102.64 ±0.35[a]	102.66 ±0.24[a]	102.52 ±0.08[a]	102.32 ±0.22[a]	102.14 ±0.26[a]	102.46 ±0.28[a]	102.62 ±0.81[a]
Crushed rice	35 gm/kg (n =5)	103.22 ±0.47[a]	103.2 ±0.55	103.1 ±0.46[a]	102.86 ±0.13[a]	102.78 ±0.17[a]	102.62±0.42[a]	102.82 ±0.41[a]	103.12 ±0.30[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	102.82 ±0.28[a]	102.52 ±0.64[a]	102.78 ±0.14[a]	102.84 ±0.20[a]	102.88 ±0.21[a]	102.92 ±0.22[a]	102.96 ±0.16[a]	103.22 ±0.17[a]
	70 gm/kg (n =5)	103.00 ±0.20[a]	102.84 ±0.25	102.80 ±0.25[a]	102.06 ±0.61[a]	99.42 ±2.30[b]	95.75 ±1.76[b]	-	-
	70gm/kg with 2% $NaHCO_3$ (n=5))	102.90 ±0.15[a]	102.74 ±0.20[a]	102.64 ±0.16[a]	102.40 ±0.15[a]	102.20 ±0.46[a]	101.82 ±1.13[b]	101.62 ±2.15[b]	102.75 ±0.20[a]

PFV= Prefeeding value (control)
± =Standard deviation
- = Death of the animal
Values with different superscripts in horizontal line differ significantly (P<0.05).

Table-2 Effects of different dose regime of concentrates with or without sodium bicarbonate on heart rate in goats.

se rate		Heart rate							
			t feeding value at different hours						
		PFV	4	8	16	24	36	48	60
Crushed wheat	35gm/kg (n=5)	85.60 ±3.04[a]	89.80 ±6.22[a]	92.60 ±6.22[a]	95.60 ±7.02[a]	97.60 ±7.89[a]	95.40 ±7.92[a]	91.40 ±6.69[a]	85.80 ±5.11[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	86.20 ±0.83[a]	86.20 ±0.44[a]	87.40 ±1.14[a]	88.20 ±2.28[a]	88.80 ±1.48[a]	89.80 ±1.92[a]	85.40 ±1.67[a]	84.60 ±3.64[a]
	70gm/kg (n=5)	75.40 ±11.54[a]	82.00 ±5.14[a]	89.60 ±2.88[a]	104.6 ±10.4[b]	115.8 ±13.9[b]	128.0 ±7.58[b]	116.8 ±3.49[b]	108.2 ±4.43[b]
	70gm/kg with 2% $NaHCO_3$ (n=5)	75.40 ±5.77[a]	77.00 ±4.69[a]	79.80 ±5.16[a]	83.20 ±3.03[a]	85.80 ±3.03[a]	91.40 ±2.07[a]	88.40 ±4.97[a]	88.40 ±9.12[a]
Crushed rice	35 gm/kg (n =5)	82.20 ±1.48[a]	82.60 ±1.14[a]	83.20 ±1.30[a]	83.40 ±1.51[a]	87.00 ±2.64[a]	92.80±3.11[a]	88.60±2.90[a]	86.00 ±3.74[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	81.80 ±1.48[a]	83.80 ±3.70[a]	85.00±9.06[a]	84.80 ±4.65[a]	85.40 ±3.64[a]	86.20 ±2.48[a]	86.60 ±1.94[a]	86.20 ±2.68[a]
	70 gm/kg (n =5)	81.40 ±1.67[a]	86.20 ±3.27[a]	92.20 ±6.93[a]	107.6 ±15.8[b]	112.6 ±17.7[b]	131.0 ±1.41[b]	-	-
	70gm/kg with 2% $NaHCO_3$ (n=5))	84.40 ±1.67[a]	85.00 ±2.44[a]	86.60 ±2.07[a]	91.00 ±2.00[a]	92.80 ±2.48[a]	97.20 ±7.75[b]	100.2 ±12.6[b]	89.00 ±1.63[a]

PFV= Prefeeding value (control), ± =Standard deviation, - = Death of the animal,
Values with different superscripts in horizontal line differ significantly (P<0.05).

Table-3 Effects of different dose regime of concentrates with or without sodium bicarbonate on respiratory rate in goats

se rate		Respiratory rate							
		PFV	**t feeding value at different hours**						
			4	8	16	24	36	48	60
Crushed wheat	35gm/kg (n=5)	32.60 ±3.50[a]	33.80 ±3.27[a]	38.00 ±1.58[a]	42.40 ±3.64[a]	47.80 ±4.32[a]	52.00 ±5.19[a]	54.60 ±1.80[a]	43.40 ±6.06[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	29.00 ±1.73[a]	30.40 ±1.94[a]	31.00 ±4.24[a]	32.20 ±5.53[a]	34.40 ±6.18[a]	38.20 ±3.27[a]	36.20 ±2.86[a]	33.60 ±3.04[a]
	70gm/kg (n=5)	21.80 ±4.49[a]	24.00 ±3.31[a]	26.80 ±2.58[a]	28.00 ±2.91[a]	35.10 ±4.41[b]	37.20 ±2.86[b]	33.00 ±4.00[a]	29.20 ±3.49[a]
	70gm/kg with 2% $NaHCO_3$ (n=5)	22.60 ±2.70[a]	24.00 ±2.23[a]	24.60 ±2.88[a]	26.60 ±1.81[a]	29.00 ±1.22[a]	32.40 ±3.97[a]	31.00 ±2.82[a]	29.80 ±2.04[a]
Crushed rice	35 gm/kg (n =5)	29.00 ±1.00[a]	30.80 ±2.28[a]	32.40 ±3.28[a]	34.80 ±3.63[a]	38.80 ±4.60[a]	40.40 ±2.96[a]	41.4 ±5.36[a]	38.00 ±5.24[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	30.60 ±1.51[a]	32.40 ±2.19[a]	33.80 ±4.06[a]	34.20 ±3.11[a]	35.60 ±2.79[a]	38.00 ±3.53[a]	38.40 ±4.62[a]	34.00 ±4.00[a]
	70 gm/kg (n =5)	29.20 ±1.48[a]	31.40 ±1.14[a]	33.20 ±2.94[a]	38.60 ±5.41[b]	44.00 ±6.96[b]	51.00 ±4.24[b]	-	-
	70gm/kg with 2% $NaHCO_3$ (n=5))	28.20 ±0.44[a]	30.20 ±0.83[a]	32.60 ±2.30[a]	36.40 ±2.19[a]	36.60 ±1.14[a]	39.60 ±1.94[b]	38.40 ±3.57[b]	32.75 ±3.09[a]

PFV= Prefeeding value (control), ± =Standard deviation, - = Death of the animal,

Values with different superscripts in horizontal line differ significantly ($P<0.05$).

hours (Table 2). These changes were again insignificant (P>0.05). For group C the mean prefeeding control value of heart rate was 75.4. After feeding, the value increased progressively and the highest heart rate was recorded to be 128.0 at 36 hours after feeding. Thereafter, the value started declining until the end of the experimental trial (Table 2). These changes were significant (P<0.05). Where as in group D the control value of heart rate was 75.4, which gradually increased and the highest increase was recorded to be 91.4 at 36 hour after feeding (Table 2). These changes, however, were insignificant (P>0.05).

Crushed rice

The mean prefeeding control value of heart rate in experimental goats was 82.20. This value increased to 92.8 at 36 hours and after that decreased progressively to 86.2 at 60 hours (Table 2). These changes were insignificant (P>0.05).

DISCUSSION

Effects of feeding regime on clinical parameters

Rectal temperature

The mean value of rectal temperature decreased significantly (P<0.05) at 36 hours of feeding with both crushed wheat and rice at 70 g/kg body weight. Following concentrate feeding rumen pH is reduced which impairs the integrity of reticuloruminal wall. There is increased production of endotoxin in the rumen which is readily absorbed through the compromised rumen wall (Anderson et al., 1993). Elevation of endotoxin level in the circulation may lead to peripheral vasodilatation (Radostits et al., 2000). This may reduce the effective circulatory volume, tissue metabolism and hypothermia (Chaplin and Jones, 1973).

Heart rate

The heart rate increased significantly (P<0.05) at 36 hours of feeding with both crushed wheat and crushed rice at 70 g/kg body weight. Acidosis activates sympathetic nervous system and this in tern might cause an increased heart rate (Radostits, et al., 2000). However, the heart rate did not undergo significant increase when the same feed with same dose was incorporated with 2% sodium bicarbonate. This might be due to buffering effect of this supplement on rumen pH (Coa, et al., 1987).

Respiratory rate

The respiratory rate increased significantly (P<0.05) with both crushed wheat and rice at the dose rate of 70 g/kg. These increases were irrespective of the incorporation of 2% sodium bicarbonate. This might be associated with absorption of large quantity of lactic acid, which brings about a lower arterial pH and reduced plasma bicarbonate level. The increased carbondioxide tension of the blood in association with depleted bicarbonate might stimulate the respiratory centre (Radostits et al., 2000).

Effects of feeding regime on rumen pH

After feeding of crushed wheat and crushed rice at 70 g/kg body weight the rumen pH was significantly (P<0.05) reduced at 4 hours of feeding. The presence of highly fermentable feed in the rumen is followed by a marked change in the microbial population. The number of Streptococcus lactis is increased which is responsible for the production of excessive lactic acid in the rumen. On the other hand, the number of Lactobacilli in the rumen fluid has been reported to increase 10^7 fold within 24-48 hours of feeding highly fermentable carbohydrate like wheat and rice (Dirksen, 1985). Moreover, the volatile fatty acid concentration in the rumen is increased. All these factors contribute to a fall of rumen pH (Dunlop, 1972, Patra, et al., 1993). Of the two type of concentrate used in the present study crushed rice inflicted more precipitating effect on rumen pH as compared to the same dose of crushed wheat. This may due to difference in composition of these feeds. The presence of unsaturated fatty acid in rice grain is significantly higher (4-6%) than that in the wheat grains (1-2%). These unsaturated fatty acids (Linoleic and Oleic) have been reported to hasten fermentation process and this might consequently reduced rumen pH (Lean, 1987).

Table-4 Effects of different dose regime of concentrates with or without sodium bicarbonate on rumen pH in goats

se rate		men pH							
		PFV	st feeding value at different hours						
			4	8	16	24	36	48	60
Crushed wheat	35gm/kg (n=5)	7.00 ±0.15[a]	6.94 ±0.13[a]	6.78 ±0.14[a]	6.66 ±0.11[a]	6.42 ±0.08[a]	6.16 ±0.11[a]	6.28 ±0.08[a]	6.4 ±0.15[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	6.96 ±0.11[a]	7.20 ±0.07[b]	7.14 ±0.11[a]	7.06 ±0.11[a]	7.02 ±0.08[a]	6.88 ±0.13[a]	6.60 ±0.20[a]	6.52 ±0.23[a]
	70gm/kg (n=5)	6.78 ±0.07[a]	6.56 ±0.08[a]	6.38 ±0.10[a]	6.06 ±0.05[a]	5.60 ±0.15[b]	5.16 ±0.29[b]	5.32 ±0.13[b]	5.60 ±0.22[b]
	70gm/kg with 2% $NaHCO_3$ (n=5)	6.78 ±0.09[a]	7.02 ±0.13[b]	6.94 ±0.18[a]	6.78 ±0.17[a]	6.58 ±0.13[a]	6.24 ±0.16[a]	6.16 ±0.23[a]	6.26 ±0.23[a]
Crushed rice	35 gm/kg (n =5)	6.92 ±0.16[a]	6.82 ±0.08[a]	6.66 ±0.21[a]	6.34 ±0.35[a]	6.00 ±0.20[a]	5.82 ±0.17[a]	5.82 ±0.39[a]	5.96 ±0.41[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	6.84 ±0.11[a]	7.06 ±0.43[b]	6.88 ±0.13[a]	6.84 ±0.16[a]	6.66 ±0.16[a]	6.52 ±0.19[a]	6.36 ±0.20[a]	6.38 ±0.16[a]
	70 gm/kg (n =5)	6.76 ±0.08[a]	6.46 ±0.11[a]	6.00 ±0.17[a]	5.52 ±0.30[b]	4.72 ±0.36[b]	4.70 ±0.28[b]	-	-
	70gm/kg with 2% $NaHCO_3$ (n=5))	6.72 ±0.14[a]	7.10 ±0.10[b]	6.66 ±0.18[a]	6.26 ±0.11[a]	6.16 ±0.42[a]	5.50 ±0.14[b]	5.40 ±0.29[b]	6.00 ±0.08[a]

PFV= Prefeeding value (control), ± =Standard deviation, - = Death of the animal
Values with different superscripts in horizontal line differ significantly ($P<0.05$).

Table-5 Effects of different dose regime of concentrates with or without sodium bi carbonate on haemoglobin (Hb) in goats

se rate		Hb (g%)							
		PFV	**t feeding value at different hours**						
			4	8	16	24	36	48	60
Crushed wheat	35gm/kg (n=5)	11.08 ±0.17[a]	11.08 ±0.17[a]	11.12 ±0.13[a]	11.16 ±0.13[a]	11.2 ±1.58[a]	11.30 ±0.12[a]	11.44 ±0.15[a]	11.48 ±0.08[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	11.14 ±0.11[a]	11.14 ±0.11[a]	11.12 ±0.13[a]	11.08 ±0.08[a]	11.14 ±0.11[a]	11.18 ±0.11[a]	11.28 ±1.30[a]	11.34 ±0.11[a]
	70gm/kg (n=5)	10.80 ±0.33[a]	10.68 ±0.36[a]	10.86 ±0.40[a]	11.40 ±0.40[a]	11.34 ±0.47[a]	11.58 ±0.34[b]	11.78 ±0.31[b]	11.94 ±0.38[b]
	70gm/kg with 2% $NaHCO_3$ (n=5)	9.86 ±1.01[a]	9.90 ±0.91[a]	10.82 ±0.59[a]	11.00 ±0.67[a]	11.12 ±0.70[a]	11.12 ±0.71[a]	11.38 ±0.73[b]	11.58 ±0.87[b]
Crushed rice	35 gm/kg (n =5)	10.96 ±0.30[a]	10.94 ±0.27[a]	10.96 ±0.28[a]	11.00 ±0.28[a]	11.04 ±0.32[a]	11.40 ±0.04[a]	11.48 ±0.30[a]	11.52 ±0.38[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	11.04 ±0.20[a]	11.06 ±0.19[a]	11.10 ±0.20[a]	11.12 ±0.22[a]	11.2 ±0.24[a]	11.20 ±0.24[a]	11.20 ±0.24[a]	11.24 ±0.16[a]
	70 gm/kg (n =5)	10.20 ±0.10[a]	10.20 ±0.10[a]	10.44 ±0.16[a]	10.66 ±0.20[a]	11.00 ±0.41[b]	11.65 ±0.49[b]	-	-
	70gm/kg with 2% $NaHCO_3$ (n=5))	10.60 ±0.27[a]	10.60 ±0.22[a]	10.60 ±0.22[a]	10.66 ±0.26[a]	10.70 ±0.27[a]	10.86 ±0.26[a]	11.02 ±0.39[a]	10.85 ±0.33[a]

PFV= Prefeeding value (control)
± =Standard deviation
- = Death of the animal
Values with different superscripts in horizontal line differ significantly (P<0.05).

Table-6 Effects of different dose regime of concentrates with or without sodium bicarbonate on Packed Cell Volume (PCV) in goats

se rate		PCV (%)							
		PFV	st feeding value at different hours						
			4	8	16	24	36	48	60
Crushed wheat	35gm/kg (n=5)	21.80 ±1.30[a]	22.00 ±1.00[a]	22.20 ±1.30[a]	22.20 ±0.83[a]	24.40 ±1.51[a]	25.20 ±1.30[a]	26.00 ±0.70[a]	27.60 ±1.14[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	21.80 ±1.48[a]	21.80 ±1.48[a]	21.80 ±1.48[a]	21.80 ±1.48[a]	22.40 ±1.51[a]	23.00 ±0.70[a]	24.00 ±1.58[a]	24.20 ±1.48[a]
	70gm/kg (n=5)	23.60 ±2.07[a]	24.00 ±2.34[a]	25.00 ±3.67[a]	27.20 ±5.31[a]	29.40 ±4.50[b]	31.00 ±2.73[b]	32.40 ±1.94[b]	33.20 ±2.16[b]
	70gm/kg with 2% $NaHCO_3$ (n=5)	25.00 ±4.30[a]	26.20 ±5.70[a]	26.80 ±6.01[a]	27.70 ±6.43[a]	29.00 ±6.04[a]	29.80 ±5.76[a]	31.00 ±4.24[a]	31.60 ±4.39[a]
Crushed rice	35 gm/kg (n =5)	22.60 ±1.34[a]	22.80 ±1.64[a]	22.80 ±1.64[a]	23.20 ±2.16[a]	25.00 ±2.23[a]	26.80 ±2.28[a]	27.60 ±2.19[a]	28.40 ±1.67[a]
	35 gm/kg with 2% $NaHCO_3$ (n =5)	23.00 ±0.70[a]	23.00 ±0.70[a]	23.00 ±0.70[a]	23.20 ±0.83[a]	23.40 ±0.89[a]	24.20 ±0.44[a]	24.40 ±0.89[a]	24.80 ±1.78[a]
	70 gm/kg (n =5)	22.40 ±1.67[a]	22.40 ±1.67[a]	24.00 ±2.23[a]	26.20 ±2.16[a]	28.00 ±2.23[b]	32.00 ±4.24[b]	-	-
	70gm/kg with 2% $NaHCO_3$ (n=5))	23.00 ±1.41[a]	23.00 ±1.41[a]	23.00 ±1.94[a]	24.80 ±1.48[a]	25.80 ±1.30[a]	27.60 ±1.81[a]	28.60 ±2.88[b]	27.00 ±1.41[b]

PFV= Prefeeding value (control)
± =Standard deviation
- = Death of the animal
Values with different superscripts in horizontal line differ significantly ($P<0.05$).

In the present study when feeding was supplemented with sodium bicarbonate the control pH value of rumen increased at 4 hours of feeding. These findings were consistent with both crushed wheat and rice. An initial increase of rumen pH might result from alkalizing effect of sodium bicarbonate. Similar observations have been reported elsewhere (Stround et al., 1985, Zinn, 1991). In the present study, 2% sodium bicarbonate was used as feed additive. Thomas and Hall (1984) studied different strength of sodium bicarbonate and reported that supplementation of concentrate feed with 2% $NaHCO_3$ was safe to prevent small range of pH reduction.

Effects of feeding regime on haematological parameters

The haemoglobin and packed cell volume significantly ($p< 0.05$) increased after feeding crushed wheat and rice at the dose rate of 70g/kg during the experimental period. Both D and L-forms of lactic acid are produced in the rumen after feeding high concentrate diets. This markedly increases ruminal osmolality which increases from a normal of 280 mOsm/L to almost 400 mOsm/L (Garry, 2002). In this situation water from the rumen wall is drawn in to the reticulorumen. As a result there is development of haemoconcentration that contributes to the increased value of Hb and PCV. Similar results have been reported in goats (Dunlop, 1972, Basak et al., 1993).

Effects of feeding regime on clinical signs

The major clinical signs recorded in the experimental animals comprised diminished of rumen motility, abdominal distension, diarrhoea, teeth grinding and lameness. The experimental goats affected with induced rumen acidosis appeared to be dull and depressed with no detectable rumen motility. The abolishing of rumen motility may be associated with diminished rumen pH. The rumen wall in acidotic environment releases histamine which is known to cause rumen atony (Jani et al., 2001). Recent evidence suggested that increased intraruminal concentration of butyrate might reduce rumen motility (DeBrabander et al., 2002). Teeth grinding was predominantly observed in animals fed concentrates without buffer. This clinical sign might be attributed to acute ruminitis due to acidosis (Radostits et al., 2000). The evidence of lameness in the experimental goats was more pronounced when feed was not supplemented with sodium bicarbonate. In this situation the vasoactive substances like lactic acid, endotoxin and histamine are thought to impair micro-circulation of lamillae and eventually may predispose to laminitis (Bergsten, 1994). Abdominal distension in the present study was recorded in goats fed higher doses of concentrates. In such cases the intraruminal osmolality is increased and there is pooling of fluid from the circulation into rumen. The excessive accumulation of fluid is thought to contribute abdominal distension (Aiello and Mays, 1998). In this experimental trail, all animals fed 70g/kg crushed rice died within 48 hours. The high mortality might be associated with circulatory collapse (Narendra et al., 1990). However, the same dose of crushed wheat incorporated with 2% sodium bicarbonate did not produce any marked clinical sign. It may due to alkalizing effect in rumen environment (Zinn, 1991). In the contary, the same dose of crushed rice with 2% sodium bicarbonate caused classical signs of lactic acidosis with 20% mortality. This might be due to alkalizing effect of sodium bicarbonate that prevents reduction of rumen pH (Kennelly et al., 1999).

Necropsy findings

Congestion in the rumen and intestinal wall was recorded. The rumen wall also demonstrated patchy mucosal desquamation. These changes might result from acidosis. The rumen fluid with significantly lower pH exerts corrosive action on the rumen wall and this may cause sloughing of mucous membrane (Lal et al., 1990).

CONCLUSION

The clinico-pathological changes of 70 g/kg body weight doses of crushed wheat and crusted rice feeding in goats were mostly fetal and if we use 2% sodium bicarbonate incorporated with feed reduce the clinical effect and mortality rate distinctly.

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