Magnesium Hydroxide as Curative Strategy against Lactic Acidosis in Goat

M.Q. Koondhar1, A.A. Khaskheli2, A.A. Jariko1

ABSTRACT
Lactic acidosis is a metabolic disorder caused by feeding errors. It represents a significant economic loss due to direct as well as indirect effects. In present study a total of twenty four goats were focused in order to observe the efficacy of Magnesium hydroxide against induced lactic acidosis. Goats were divided into two groups viz., A and B. Goats in group A were induced lactic acidosis by offering over feeding of grains, while group B was kept as control and normal diet was provided to the goats. After appearance of clinical signs, goat in group A were treated with Magnesium hydroxide at the dose rate of 1g/Kg body weight on the interval of 24, 48 and 72 hours. Results indicated body temperature, ruminal pH, blood pH, respiration rate and heart rate attained normal level after the treatment with Magnesium hydroxide. Serum biochemical examinations of liver function after induction of lactic acidosis revealed that glucose level (190.14±36.49mg/dl), total bilirubin (0.75±0.04mg/dl), direct bilirubin (0.27±0.03mg/dl), indirect bilirubin (0.40±0.03mg/dl), alanine aminotransferase (36.42±3.04 U/L) and alkaline phosphatase (420±3.65 U/L) were significantly (P<0.05) increased. Magnesium Hydroxide helped in improving the normal physiological parameters but did not improved the rumen and intestinal motility. The hematological examination after the induction of lactic acidosis revealed hemo-concentration and increased Hb% (15.02±1.30) which significantly (P<0.05) became normal within 72hrs after Magnesium hydroxide therapy. Present study concludes that the Magnesium hydroxide is very helpful in minimizing the complications of lactic acidosis in goat, thus may be used as therapy of choice.

Key words: Goat, Grains, Lactic acidosis, Magnesium hydroxide, Therapeutic effects.

INTRODUCTION
Lactic acidosis or ruminal acidosis is actually a metabolic disorder commonly occurs in the cows, goats, sheep due to feeding errors (Penner et al., 2007). Generally, for promoting growth and achieving fast weight gain in goats, grains or their byproducts are used. They are rich in highly fermentable carbohydrates. Minute over-feeding of such grains leads to the development of metabolic disorders, particularly the lactic acidosis (Kamra, 2005).

Treatment of lactic acidosis is difficult and recovery depends on the severity of condition (Karapinar et al., 2008). Clinical acidosis recovery chances depend on the neutralization of the acids, reducing the acid absorption from intestine, increasing motility of the rumen and intestine. Magnesium Hydroxide is an alkali and possess a good buffering property. We hypothesize that the Magnesium Hydroxide could also has curative activity against the lactic acidosis. Present study was therefore planned in order to confirm therapeutic properties of Magnesium Hydroxide against the lactic acidosis.

MATERIALS AND METHODS
Location of study
In vivo experimental trials were carried at the Livestock Experimental Farm, department of Livestock Management, however in-vitro samples analysis was performed at the Laboratory of Veterinary Medicine Department, Sindh Agriculture University, Tandojam, Pakistan.

Experimental procedures
Experimental trials for study period of 60 days were conduction during the Year 2019. A total of twenty four goats having same age and sex were selected for current study. All animals were kept in clean disinfected pens at the Livestock Experimental Station, Sindh Agriculture University, Tandojam for the adaptation phase of ten days. Goats were dewormed with Albendazole 10% and vaccinated against Enterotoxaemia. After completion of adaptation phase, goats were divided into two groups such as group A and B. Goats in group A were induced lactic acidosis by over feeding of grains. All animals were kept 12hours in fasting condition; wheat grains at the rate of 50g/kg body weight were fed orally to develop the lactic acidosis. Group B was kept as control and contained all lactic acidosis free goats. Goat were provided normal diet throughout the experimental period.

Subsequent to appearance of clinical signs goats in group A were treated with Magnesium hydroxide at the dose rate of 1g/Kg body weight at the interval of 24, 48 and 72 hours.
Magnesium Hydroxide as Curative Strategy against Lactic Acidosis in Goat

Clinical observations
All the goats were closely inspected and data was recorded regarding different parameters like body temperature, heart rate, respiration rate, appetite, regurgitation, behavior, urination, feces, gait, rumen motility, rumen pH, rumen ingesta color, odor and consistency at different intervals.

Blood samples analysis
Blood samples were collected and analysis was carried out at the interval of 12, 48 and 72 hours after the treatment with Magnesium hydroxide. Blood glucose level was determined by digital blood glucometer monitoring system (Accusign, Germany), pH level was determined by digital pH meter (RoHS, China) and hemoglobin (Hb%) was analyzed by Sahli method using haemometer (Marienfeld laboratory glassware Germany). For Liver function test the blood serum samples were processed at Latif diagnostic and research laboratory, Tandojam.

Rumen fluid analysis
The rumen fluids were collected from all experimental goat using sterile plastic stomach tube to observe the ruminal pH. The samples were also sucked by connecting plastic syringe 50cc. All rumen fluid material was passed through the sieve of sterile gauze and examined rumen pH by electronic pH meter.

Statistical analysis
The data was collected and statistically analyzed by using statistical software SPSS (Version 22.0; 2013. IBM, USA). Two-way analysis of variance (ANOVA) was applied in order to observe any significant variation among the means. Values (means ± SD.) were considered significantly different at P≤0.05.

RESULTS AND DISCUSSION

Lactic acidosis is a common management disease of goats. This study was carried out in 24 goats to determine the efficacy of Magnesium hydroxide against lactic acidosis. After the induction of lactic acidosis in treatment group (A), the goats were treated orally with Magnesium hydroxide. Goats in both groups (A and B) were examined for physical, clinical examination and biochemical parameters at the different intervals during the experiment. Clinical signs were improved gradually with the starting of the treatment and returned to the normal after treatment, such as rectal temperature 98.4±0.60 to 101.4±0.76 and 102.9±0.41, heart rate 138.28±4.71 to 99.28±5.46 and 83.14±5.17, respiration rate 61.14±7.15 to 45.14±8.30 and 27.42±5.56 and rumen motility 1.28±0.48 to 2±0.40 and 3.07±0.53 at the interval of 24hrs, 48hrs and 72hrs, respectively. Statistical analysis showed considerable (P<0.05) change among the clinical findings at different time periods in treated group B as shown in Table 1. However, in control group health parameters remained constant. No significant change was noticed in any physiological parameter (Table 1).

Blood samples analysis
Blood is the major component which is affected by the lactic acidosis approximately in all the cases. Blood biochemistry is disturbed due acids formation in the stomach and absorption of the acids. Blood samples of all experimental goats were collected and analyzed for pH, hemoglobin percent (Hb%) and blood glucose level. There was increase in the blood pH from 7.05±0.07 to 7.30±0.07 level with in 72hrs, while Hb% level was too much increased (14.64±0.89g/dl) returned to its normal level (10.4±0.64g/dl) within 72hrs of the treatment. Two way ANOVA data analysis showed significant (P<0.05) variation among the means during the 24hrs, 48hrs and 72hrs. On other hand goats in the control group B did not show any change in blood pH and Hb% level (Table 2).

Liver function test and glucose analysis
The serum biochemical examination of all experimental goats of group A and B was performed and results are depicted in the Table 3. Table indicates that the increased blood glucose level (157.14±36.49mg/dl) returned to normal (91.8±67mg/dl) within 72hrs after treatment with Magnesium hydroxide. Liver enzyme analysis showed increased total bilirubin, direct bilirubin, indirect bilirubin, ALT (SGPT) and alkaline phosphatase level in goats affected with lactic acidosis. Total bilirubin (0.77±0.04mg/dl) and alkaline

Table 1. Mean values of the clinical signs of lactic acidosis goats treated with Magnesium hydroxide versus normal goats.

| Variables            | Group A          | Group B          |
|----------------------|------------------|------------------|
|                      | Magnesium hydroxide | Control          |
|                      | 24h** Mean ±SD   | 48h** Mean ±SD   | 72h** Mean ±SD   | 24h* Mean ±SD   | 48h* Mean ±SD   | 72h* Mean ±SD   |
| Rectal temperature   | 98.4±0.60a       | 101.4±0.76a      | 102.97±0.41a     | 103.11±0.21a     | 103.15±0.21a     | 103.11±0.21a     |
| Heart rate           | 138.28±4.71a     | 99.28±5.46a      | 83.14±5.17a      | 80.12±2.99a      | 80.87±3.39a      | 80.12±2.99a      |
| Respiration rate     | 61.14±7.15a      | 45.14±3.80a      | 27.42±5.56a      | 23.62±3.96a      | 24.5±4.14a       | 23.87±3.60a      |
| Rumen motility       | 1.28±0.48a       | 2±0.40a          | 3.07±0.53a       | 3.25±0.65a       | 3.25±0.65a       | 3.25±0.65a       |

** Post treatment, different letters shows a significant difference.
phosphatase were highly increased (439±3.65 U/L) at 24hrs, while minimum difference was observed in indirect bilirubin level (0.42±0.03). All these enzymes returned to normal level with in 72hrs of treatment with Magnesium hydroxide. Statistically highly significant at difference (P<0.05) was noted among the means during the 24hrs, 48hrs and 72hrs (Table 3). Comparatively, the serum biochemical examination of goats in control group B did not show any change in glucose and liver function test results of total bilirubin, indirect bilirubin, direct bilirubin, ALT (SGPT) and alkaline phosphatase level (Table 2).

Rumen fluid analysis

The rumen fluid of all goats in group A and B were analyzed and findings are shown in the Table 4. Table depicts that following induction of lactic acidosis, the color, odor and consistency of ruminal juices changed from normal to yellowish, watery and soured, respectively. However, after treatment with Magnesium hydroxide, color, odor and consistency of rumen changed to yellow green, mild soured and mild watery within 48 hours and olive green, aromatic and viscous within 72 hours. pH level which was observed decreased (5.02±0.07) returned to normal level (6.41±0.28) within the 72hrs of treatment. Two way ANOVA data analysis showed significant difference (P<0.05) among the means during 24hrs to 72hrs (Table 4). However, goats in group B (control) did not show any change in rumen fluid and all parameters remained within normal ranges.

Current research was conducted in order to assess the efficacy of Magnesium hydroxide against lactic acidosis in goats. In this study, goats were offered to take grains to induce lactic acidosis. All the goats in the treatment group were examined clinically and confirmed the lactic acidosis through the analysis of the ruminal fluid and treated with Magnesium hydroxide. Reported clinical findings of current study are in agreement with (Ullah et al., 2013). The decrease in body temperature, ruminal motility, pH and increase in heart rate, respiration rate and Hb% were observed as reported previously that goats’ ruminal flora suddenly causes fermentation of grain feed and produces the lactic acidosis (Hernandez et al., 2014). Lactic acidosis in this study also led to dehydration, ruminal motility, ruminal pH and blood pH, were similar to the report of (Rodostitis et al., 2000). Similar to our study has also been investigated that ruminal activities in goats influence by severity of acidosis (Ram et al., 2007). Further, long et al. (2016) evaluated of the protective effect of the acid-tolerant engineered bacterial strain M. elsdenii H6F32 as a probiotic fed to sheep during the lactic acidosis challenge. Their findings are somewhat opposite to our study. It may be because species variation.

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 (< 5.00) and dehydration were observed similar to previous study (Gozho et al., 2005 and Gonzalez et al., 2012). The present experiment results were similar to the decreased in rumen pH that favors the growth of streptococcic bovis and decrease in the Gram negative bacteria and rumen protozoa, similar findings has been reported by several other researchers (Yang et al., 2012 and Lascano, 2011). The decrease in blood pH of lactic

---

**Table 2:** Mean values of blood pH and Hb% of lactic acidosis goats treated by Magnesium hydroxide versus normal goats.

| Variables | Group A | Group B |
|-----------|---------|---------|
|           | Magnesium Hydroxide | Control |
| 24h**     | Mean ±SD | Mean ±SD |
| Blood pH  | 7.05±0.07c | 7.15±0.09b |
| Blood Hb% (g/dl) | 14.64±0.89b | 13.07±0.78c |

**Post Treatment, different letters shows a significant difference.**

**Table 3:** Mean values of blood glucose and liver function test analysis of lactic acidosis goats treated by Magnesium hydroxide versus normal goats.

| Variables | Group A | Group B |
|-----------|---------|---------|
|           | Magnesium Hydroxide | Control |
| 24h**     | Mean ±SD | Mean ±SD |
| Glucose (mg/dl) | 157.1±36.49a | 131±35.32c |
| Total bilirubin (mg/dl) | 0.77±0.04a | 0.71±0.05b |
| Direct bilirubin (mg/dl) | 0.29±0.03a | 0.26±0.02b |
| Indirect bilirubin (mg/dl) | 0.42±0.03a | 0.40±0.02b |
| ALT (SGPT) (U/L) | 37.42±3.04a | 33±2.88b |
| Alkaline Phosphatase (U/L) | 439±3.65a | 409.71±10.75b |

**Post Treatment, different letters shows a significant difference.**
Table 4: Mean values of rumen fluid analysis of lactic acidosis goats treated with Magnesium hydroxide versus normal goats.

| Variables                  | Group A            | Group B            |
|----------------------------|--------------------|--------------------|
|                            | Magnesium hydroxide | Control Group      |
|                            | 24h** Mean ±SD     | 48h** Mean ±SD     |
| Color                      | Yellowish          | Yellow green       |
| Odor                       | Sourde             | Mild Sourde        |
| Consistency                | Watery             | Mild watery        |
| Rumen fluid pH             | 5.02±0.07*         | 5.4±0.25*          |

** Post Treatment, different letters shows a significant difference.

acidoic goats was found in close agreement with (Oetzel, 2003).

Goats showed decreased blood circulating volume, heamoconcentration and severe dehydration in lactic acidosis. These findings were similar to the previous reports that increase in the release of histamine and absorption of the lipopolysaccharide endotoxins and other vasoactive agents attribute to rapid death in goats, these results are in agreements to the earlier reports that pH of (<5.00) is being lethal for goats (Oliveira et al, 2009). All goats after the ingestion of grains showed anorexia, dehydratation, increase in ruminal fluid and decreased ruminal pH, these physiological changes would have lead to decrease in gram negative bacteria and increase in gram positive bacteria in the rumen resulting decrease in appetite, further these changes favor the lactobacilli to utilize more carbohydrates and to produce excessive amount of lactic acids and its isomers with lactate salt. These all caused increase in osmotic pressure significantly which result in the movement of excessive quantities of fluid in to the rumen and dehydration, these results are in close agreement with previously reports (Rodostits et al, 2007). In contrast to our study, Valent et al (2017) reported similar aspects when studied influence on nutrition on acidosis in ruminants.

Treatment of lactic acidosis is always focused on the correction of ruminal and systemic acidosis and to inhibit the further production of lactic acid (Anderson and Rings, 2008). The clinical symptoms were returned to the normal after treatment with Magnesium Hydroxide. In all goats with acidosis, ruminal fluid was observed with watery consistency and souring odor, these findings were in agreement with (Alam et al, 2014). Magnesium Hydroxide was orally used for the correction of dehydration and stabilizing the pH of rumen, these results suggested that using ruminal antacids orally to neutralize the ruminal acids are very effective to neutralize systemic acidosis and stable the animal to normal condition (Arora et al, 2011). After treatment with alkalizing agent like Magnesium Hydroxide, lactic acid decreased more rapidly that stabilized ruminal pH between 6.2-7.2, as reported before that normal return of rumen pH was the main factor for the early recovery to feed intake after the course of lactic acidosis (Karapinar et al, 2008).

The blood glucose level was found increased after the ingestion of grains, this indicated that grains feed was converted into highly fermentable action of the rumen microbial flora, these results are similar (Rahman, 2009). While liver function test like, total bilirubin, direct bilirubin, indirect bilirubin, ALT (SGPT) and alkaline phosphatase increased during the lactic acidosis in all goats, as reported that in cattle being placed on a grain ration gradually on daily intake basis, hepatic cell damage and liver dysfunction occur even though dietary adaptation may have occurred in 2-3 weeks. The biochemical profile liver indicated that complete metabolic adaptation requires at least 40 days for adoption and decrease to damage to liver (Chakrabarti, 2006). While increased level of ALT reflected hepatocellular damage which may be due to mild degeneration or necrosis to the hepatic cells and increase in AST may be the reason of hepatocellular damage or by the degeneration of skeletal muscles, over-distention of rumen also impedes venous return to liver and heart, this impairs hepatic perfusion and further decrease in lactic acid utilization resulting development of systemic lactic acidosis (Chaudhary, 2009).

**CONCLUSION**

Current study concludes that the Magnesium hydroxide is significantly effective against lactic acidosis in goats. It helps in minimizing the complications of lactic acidosis in goat excepting rumen and intestinal motility. Thus it may be used as therapy of choice against lactic acidosis in goats.

**REFERENCES**

Alam, M., Das, B.C., Hassan, M.M, Ahaduzzaman, M, AlFaruk, M.S., Hasanuzzaman, M. (2014). Ruminal acidosis-A case compilation study in SAQ Teaching Veterinary Hospital, Bangladesh. Veterinary World. 7: 2653-2663.

Anderson, D.E., Rings, M. (2008). Current Veterinary Therapy-E-Book: Food Animal Practice. Elsevier Health Science. 3: 1234-1220.

Arora, N., Tufani, N.A., Kumar, T. (2011). Grain overload in buffalo and its therapeutic management. Intas Polivet. 12: 315-317.

Chakrabarti, A. (2006). Text Book of Clinical Veterinary Medicine 3rd revised and enlarged edition. Kalyani Publishers, New Delhi, 291-295.

Chaudhary, P., Varshney, J., Deshmuah, V. and Desai, S.B. (2009). For the management of bovine acidosis. Intas Polivet. 1: 8-12.

Gonzalez, L., Manette, A.X., Calsamiglia, S., Schwartzkopf, G.K.S. and Ferret, A. (2012). Ruminal acidosis in feedlot cattle.
Interplay between feed ingredients, rumen function and feeding behavior a review. Animal Feed Science and Technology. 1: 66-79.

Gozho, G., Plaizier, N.J.C., Krause, D.O., Kennedy, A.D. and Wittenberg, K.M. (2005). Sub-acute ruminal acidosis induces ruminal lipopolysaccharide release and triggers an inflammatory response. Journal Dairy Science. 88: 1399-1403.

Hernandez, J., Benedito, J.L., Abuelo, A. and Castillo, C. (2014). Ruminal acidosis in feedlot from aetiology to prevention. Pakistan Veterinary Journal. 4: 2823-2831.

Joaquin, H., Jose, L.B., Angel, A. and Cristina, C. (2014). Ruminal acidosis in feedlot from aetiology to prevention. Journal of Agriculture Science. 6: 2134-2142.

Kamra, D.N. (2005). Rumen microbial ecosystem. Current Science. 1: 124-135.

Lascano, G.J. (2011). Optimizing nutrient utilization of a precision feeding system for dairy heifers using low and high forage diets. The Pennsylvania State University.

Oetzel, G. (2003). Sub-acute ruminal acidosis in dairy cattle. Advance Dairy Cattle. 15: 307-17.

Yang, W., Li, Z.Y., McAllister, T.A., McKinnon, J.J. and Beauchemin, K.A. (2012). Wheat distillers grains in feedlot cattle diets: Feeding behavior, growth performance, carcass characteristics and blood metabolites. Journal of Animal Science. 4: 1301-1310.