Magnesium Oxide Contraindicated as a Cathartic for Cattle in the Absence of Rumen Acidosis

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Cathartics are chemicals that promote defecation. Saline cathartics are salts of poorly absorbed ions for example the cation magesium or the anions sulphate, phosphate, tartrate or citrate. Although these chemicals are not absorbed from the intestine they are osmotically active and attract and retain fluid within the intestinal tract and in this way promote defecation. Saline cathartics that are commonly used in cattle practice include magnesium sulphate (Epsom salts), sodium sulphate (Glauber's salts), magnesium oxide and magnesium hydroxide. These latter two compounds are primarily used as antacids in the treatment of rumen acidosis but they also have a cathartic effect. In fact, magnesium oxide and magnesium hydroxide are ideal chemicals for the treatment of grain overload in cattle. The combination of antacid activity which neutralizes excess acid in the rumen and cathartic activity which stimulates passage of toxic material out of the digestive tract is very beneficial. Tables 1 and 2 list some commercially available antacids for use in ruminants for the treatment of grain overload or acid indigestion. Generally, the powders contain magnesium oxide as the active ingredient or a mixture of magnesium oxide and magnesium hydroxide. Boluses, on the other hand, as illustrated in Table 2, usually contain magnesium hydroxide. Although these compounds are very efficacious as antacids in the treatment of grain overload, a problem associated with their use has recently been noted at O.V.C. A number of adult cattle have, at presentation, exhibited a profound metabolic alkalosis with no detectable abomasal abnormality. The metabolic alkalosis has been characterized by a blood pH ranging from 7.45 to 7.48 compared to a normal range of 7.32 to 7.38 in venous blood, blood bicarbonate ranging from 30 to 34 mEq/l compared to a normal range of 22 to 28 mEq/l and base excess of +4 to +10 compared to a normal of +2. A frequent history in these cases has been the prior administration via stomach tube or by drench bottle of magnesium oxide or magnesium hydroxide as a cathartic or rumen stimulant for the treatment of acute or chronic anorexia. Invariably these compounds have been administered as one of the aforementioned commercially available antacid products. Accordingly, several questions arose as a result of these baffling cases. Does a dose of magnesium oxide sufficient to cause catharsis cause a

Table 1. Some commercially available antacid preparations (powders) for the treatment of grain overload in ruminants.

COMMERCIALLY AVAILABLE ANTACIDS FOR RUMINANTS

TRADE NAME	COMPANY	FORM	ACTIVE INGREDIENT
OXAMIN	M.T.C.	POWDER	MgO 240 gm/lb
CARMILAX	NORDEN	"	MgO 361 "
EMBLAX	HAVER- LOCKHART	"	MgOH 300 " MgO 60 "
LAXALIN	DIAMOND LABORATORIES	"	MgOH 227 "
POLYOX	INTERNATIONAL MULTIFOODS	"	MgOH 142 "

Table 2. Some commercially available antacid preparations (boluses) for the treatment of grain overload in ruminants.

COMMERCIALLY AVAILABLE ANTACIDS FOR RUMINANTS

TRADE NAME	COMPANY	FORM	ACTIVE INGREDIENT
CARMILAX	NORDEN	BOLUS	MgOH 108 gm/4 Boluses
LAXALIN	DIAMOND LABORATORIES	"	MgOH 107 "
MAGNALOX	INTERNATIONAL MULTIFOODS	"	MgOH 108 "
POLYOX II	INTERNATIONAL MULTIFOODS	"	MgOH 24 "

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metabolic alkalosis when administered to normal cattle? If so, how long does this alkalosis persist and does it cause any other clinical pathological or clinical abnormalities and finally does a dose of magnesium sulphate sufficient to cause catharsis cause any clinical pathological or clinical abnormalities when administered to normal cattle? Magnesium sulphate is the standard saline cathartic used in cattle and should be the ideal reference chemical. If magnesium oxide causes significant clinical pathological and/or clinical abnormalities in normal cattle, how much more severe would its effects be in anorectic cattle in the absence of significant rumen acidosis?

It was necessary to obtain rumen juice from cattle in order to conduct this experiment and a standard technique of passing a stomach tube via a Frick speculum into the rumen and then aspirating rumen juice was employed. Using narrow range pH paper it was then possible to quickly and accurately determine the pH of this material in comparison to a standard color chart provided with the narrow range pH paper. The accuracy of this method was confirmed by checking it against a standard pH meter.

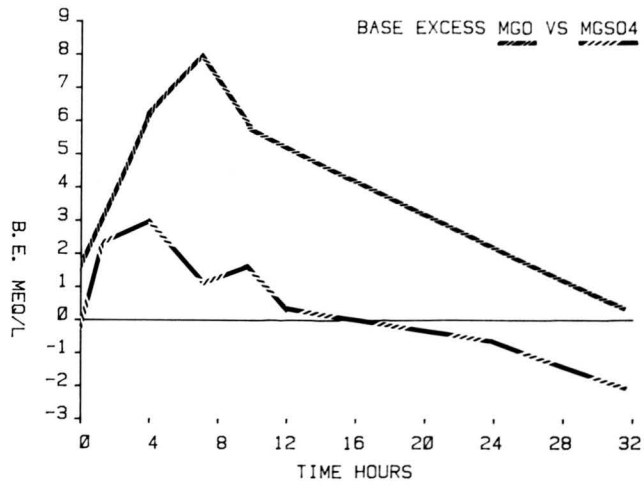
Prior to starting this study, the dose of magnesium oxide and magnesium sulphate required to cause catharsis in normal cattle was established, based both on fecal consistency and dry matter content of the feces subsequent to administration of the cathartic chemical. The experimental design involved the use of 12 mature cattle (Holsteins weighing 900 to 1100 pounds) that had *not* been fasted, 6 of which were to receive magnesium oxide and 6 magnesium sulphate via stomach tube. Prior to treatment with either chemical, it was ascertained that the animals were eating and had normal rumen activity. Rumen juice was collected by the aforementioned method in order to measure pH and blood was collected from the jugular vein to determine acid base parameters (pH, bicarbonate, base excess), plasma electrolytes (sodium, potassium and chloride), and total plasma protein and plasma osmolality. The previously determined dose of either magnesium oxide or magnesium sulphate was then administered into the rumen via stomach tube and subsequent to the administration of either magnesium oxide or magnesium sulphate the cows were observed for rumen motility and appetite. Rumen pH was remeasured at one hour post treatment, and blood acid base parameters and plasma electrolytes as well as total protein and osmolality were reassessed at the following times: 1/2 to 2 hours, 3-5 hours, 6-8 hours, 10, 12, 24, and 30-33 hours post treatment.

Results

One pound (0.4 Kg) of the commercial magnesium oxide containing compound or 3 pounds (1.4 Kg) of magnesium sulphate were required to produce catharsis in normal, non-fasted, mature Holstein cattle.

Although all cows scoured after treatment with either the magnesium oxide or magnesium sulphate, there were no adverse effects on either rumen activity or appetite that could be detected clinically after administration of either chemical, and mean rumen pH at one hour after administration of either magnesium oxide or magnesium sulphate was 7.5 to 8.0. However, administration of *magnesium oxide* to normal, mature, non-fasted Holstein cows produced a significant alkalosis and electrolyte disturbance for up to 24 hours post treatment whereas administration of magnesium sulphate produced only a transient alkalosis. The changes in base excess following the administration of either magnesium oxide or magnesium sulphate is illustrated graphically in figure 1. Not only did

Figure 1. Graph of changes in blood Base Excess values in normal, nonfasted, mature Holstein cattle at 1/2 to 2, 3 to 5, 6 to 8, 10, 12, 24 and 30 to 33 hours after treatment with either 1 pound of magnesium oxide (6 cows) or 3 pounds of magnesium sulphate (6 cows)



the base excess rise significantly above control values as values observed in cows treated with magnesium sulphate, but the elevation in base persisted for up to 24 hours before returning to normal values. Figure 2 illustrates the changes in blood pH following the treatment of normal cows with magnesium oxide or magnesium sulphate and it is obvious that the changes are not nearly as dramatic compared to the changes in base excess. However it must be remembered that blood pH is very carefully controlled by homeostatic machanisms particularly the PCO_2 (carbon dioxide tension) of the blood and thus would not be expected to show the

Figure 2. Graph of changes in blood pH values in normal, nonfasted, mature Holstein cattle at 1/2 to 2, 3 to 5, 6 to 8, 10, 12, 24 and 30 to 33 hours after treatment with either 1 pound of magnesium oxide (6 cows) or 3 pounds of magnesium sulphate (6 cows)

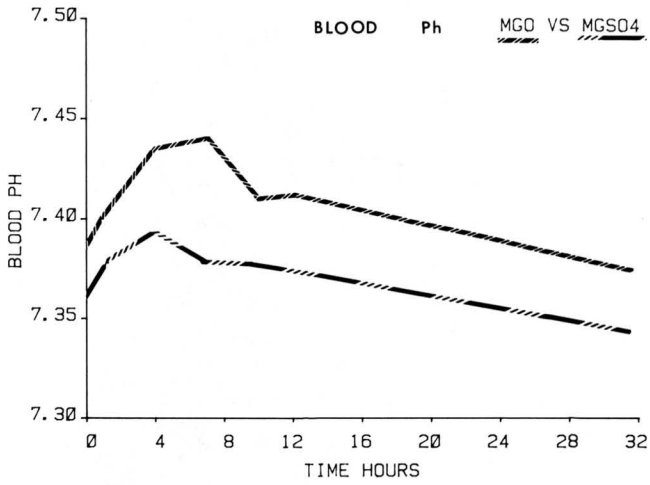


Figure 3. Graph of changes in blood bicarbonate in concentration values in normal, nonfasted, mature Holstein cattle at 1/2 to 2, 3 to 5, 6 to 8, 10, 12, 24, and 30 to 33 hours after treatment with either 1 pound of magnesium oxide (6 cows) or 3 pounds of magnesium sulphate (6 cows)

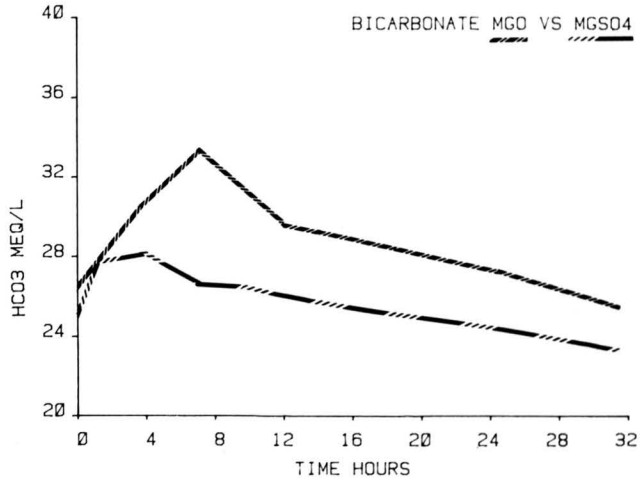
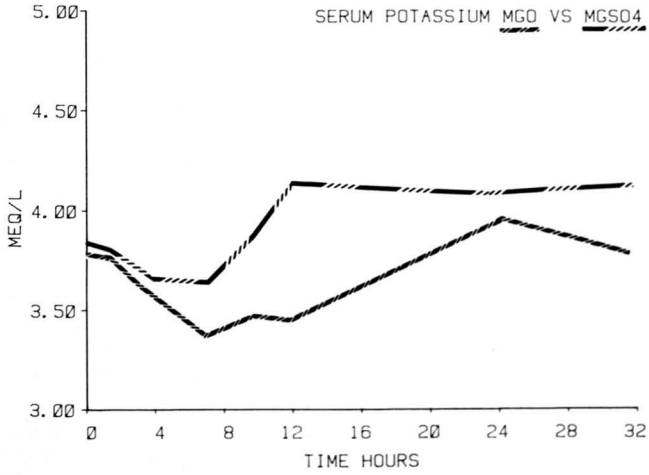


Figure 4. Graph of changes in plasma potassium in concentration values in normal, nonfasted, mature Holstein cattle at 1/2 to 2, 3 to 5, 6 to 8, 10, 12, 24 and 30 to 33 hours after treatment with either 1 pound of magnesium oxide (6 cows) or 3 pounds of magnesium sulphate (6 cows)



same degree of aberration. Figure 3 illustrates the changes in bicarbonate ion concentration comparing cows treated with magnesium oxide and magnesium sulphate and again the plasma bicarbonate concentration is seen to rise significantly in cows treated with magnesium oxide and this elevation tends to persist for up to 20 hours post treatment in comparison with relatively minor changes in the plasma bicarbonate ion concentration in cows treated with magnesium sulphate. Figure 4 illustrates the plasma potassium ion concentration in cows treated with either magnesium oxide or magnesium sulphate and, in this particular instance, it must be remembered that alkalosis tends to lower plasma potassium ion concentration. The severe alkalosis experienced by cows treated with magnesium oxide coincided with a lowering of plasma potassium ion concentration to a much lower level compared to cows treated with magnesium sulphate.

In summary then, neither chemical had any significant effect on rumen activity or appetite when administered orally to normal non-fasted mature cattle. However, the commercial compound containing magnesium oxide did cause severe acid base and electrolyte derangements for up to 24 hours post treatment. Since magnesium oxide induced these severe disturbances in healthy cattle with normal rumen function (motility and pH), it would seem reasonable to expect similar if not more severe changes in ill cattle with abnormal rumen function (poor to negligible motility and normal to alkaline pH) subsequent to treatment with such magnesium oxide containing compounds. Although these compounds are ideal chemicals for the treatment of grain overload because of their primary antacid and secondary cathartic activities, they are contraindicated as cathartics in the absence of rumen acidosis. In the absence of rumen acidosis one should use magnesium sulphate for catharsis not magnesium oxide.