

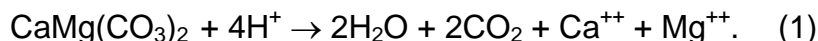


## MIN-AD<sup>®</sup> As a Mineral Source

### Chemical Composition of MIN-AD

This Bulletin discusses *in vivo* research data, rumen fermentation data, and field trial data that demonstrate that MIN-AD is an effective replacement of common sources of supplemental Mg and Ca. MIN-AD's dairy and beef performance benefits are described in other Technical Bulletins.

MIN-AD is a calcium magnesium carbonate,  $\text{CaMg}(\text{CO}_3)_2$ . It is a chemical compound and *not a physical mixture* of calcium (Ca) and magnesium (Mg) carbonates. It assays about 12% Mg and 21% Ca. These minerals are released into solution as MIN-AD neutralizes acid according to the following equation:



The existing data is summarized in the following four points.

1. *In vitro* neutralization studies and dairy ration fermentation studies demonstrate that MIN-AD solubilizes and thereby releases Ca and Mg ions into solution.
2. A metabolism study showed no difference in total tract mineral digestibility between MIN-AD and MgO and  $\text{CaCO}_3$ .
3. A 140 day feedlot performance trial in which MIN-AD fully replaced MgO as the source of supplemental Mg and 2/3 of  $\text{CaCO}_3$  showed that MIN-AD can successfully replace MgO and calcium carbonate as a source of Mg and Ca in diets for yearling steers.
4. A number of professionally supervised dairy and beef field trials showed that MIN-AD maintained or improved performance when it replaced MgO as a source of Mg.

### Metabolism Study

This was a 5x5 Latin square design experiment with five ruminally and duodenally cannulated Angus x Hereford steers. It is described in detail in Bulletin B-3. The dietary treatments are shown in Table 1; Table 2 shows the nutrient analysis for the 7.5% roughage level treatment. In the other treatments (3.8% and 11.3% roughage), flaked corn replaced or was replaced by corn silage.

All diets were balanced in Mg and Ca. Special attention was given to a complete analysis of all Mg and Ca sources, i.e. feed commodities, water and

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supplements. The contribution to the total dietary Mg for each treatment was as follows:

(a) 0% MIN-AD: ~ 2/3 from MgO and ~1/3 from feedstuffs and water

(b) 1.5% MIN-AD: ~2/3 from MIN-AD, ~1/3 from feedstuffs and water.

MIN-AD also replaced 62% of the limestone in the 1.5% MIN-AD treatment. Average Ca and Mg intake from water as a percentage of total Ca and Mg intake was in the range 3.5% – 4.3%.

Table 1. Metabolism Study Dietary Treatments

Treatment No.	Roughage Level	MIN-AD Level
1	3.8%	0%
2	7.5%	0%
3	11.3%	0%
4	3.8%	1.5%
5	7.5%	1.5%

Cattle were fed *ad libitum* twice daily at 0800 and 1300. Fresh water was always available. Each experimental period lasted 21 days: 2 diet transition days, 14 adaptation days, and 5 sampling days. Fecal, duodenal, ruminal, and rumen bacteria isolation samples were taken.

Table 2. Dry matter ingredient and theoretical nutrient composition of the 7.5% roughage level diets.

Item (%DM)	Treatment	
	Control	1.50% MIN-AD
Flaked corn	76.448	77.600
Corn silage	11.194	11.194
CCDS	3.000	3.000
Yellow grease	3.000	3.000
Soybean meal	2.600	2.702
Supplement	3.758	4.035
Nutrients		
Dry matter, % as-fed	67.661	67.689
Crude protein	13.500	13.500
Non-protein nitrogen	3.250	3.250
Acid detergent fiber	5.553	5.463
Calcium	0.700	0.700
Phosphorus	0.300	0.300
Potassium	0.700	0.700
Magnesium	0.300	0.301

Mineral digestibilities are shown in Table 3; mineral digestibility ( $P > 0.10$ ) was not altered by dietary treatment. The duodenal flow of Ca was higher than the intake, while the fecal output was lower than the duodenal flow. This is as expected and is consistent with Ca absorption post-rumen and recycling into the rumen. Total tract Ca digestion was about 25%; approximately 50% of the total Ca intake was from MIN-AD.

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The duodenal flow of Mg was lower than the intake which would indicate a net uptake of Mg through the rumen. The numerical average of ruminal Mg digestion was approximately 22%. A further 10% (numerical average) of the total dietary Mg intake was digested post-rationally. Over 60% of the total Mg intake was provided by supplemental Mg, either exclusively from MgO (control treatments) or exclusively from MIN-AD (MIN-AD treatments).

Table 3. Mineral Digestibilities.

Item	No MIN-AD			MIN-AD		SEM
	3.8	7.6	11.4	3.8	7.6	
Mineral intake, g/d						
Ca	36.2	44.0	46.5	47.6	41.9	3.82
P	20.7	24.2	25.9	25.4	23.5	2.19
Mg	21.6	24.4	23.7	23.7	21.4	2.11
Duodenal flow, g/d						
Ca	49.5	45.8	46.0	51.6	47.0	7.22
P	29.2	28.6	34.5	32.4	29.2	3.88
Mg	17.9	16.3	18.6	16.5	18.8	2.27
Ruminal digestion, %						
Ca	-38.6	-5.8	-1.2	-3.7	-16.2	17.4
P	-41.8	-21.1	-36.0	-29.6	-23.2	13.8
Mg	17.3	32.2	20.6	28.9	13.2	7.5
Fecal output, g/d						
Ca	31.9	34.8	32.1	30.6	32.9	8.29
P	7.00	7.50	9.03	6.55	7.25	2.40
Mg	13.6	15.4	18.7	14.0	17.4	4.25
Postruminal digestion, %						
Ca	48.0	23.9	33.6	43.9	35.9	17.5
P	108.6	90.7	102.3	102.3	97.5	14.2
Mg	18.5	2.9	5.8	6.0	16.4	16.9
Postruminal digestion, % leaving abomasums						
Ca	33.3	25.0	31.9	43.9	31.7	14.0
P	76.0	75.2	75.1	80.2	78.4	5.25
Mg	22.2	3.1	5.2	11.0	17.5	21.5
Total-tract digestion, %						
Ca	9.4	18.1	32.4	40.2	19.7	20.3
P	66.8	70.5	66.6	74.6	73.3	6.5
Mg	35.7	35.5	24.9	39.0	25.0	16.2

### **MIN-AD in Feedyard Diets - I**

MIN-AD, Inc. also conducted a companion performance study with 192 yearling steers with the same rations that were employed in the 7.5% roughage level metabolism study diets. In addition to a control treatment with supplemental Mg from MgO and a 1.5% MIN-AD treatment, there was also a 0.75% MIN-AD treatment. All animals were fed for 140 days.

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Each treatment was formulated to contain total dietary Mg at 0.30% of dry matter. The contribution to the total dietary Mg for each treatment was as follows:

- (a) Control: ~ 2/3 from MgO and ~1/3 from feedstuffs and water
- (b) 0.75% MIN-AD: ~1/3 from MIN-AD, ~1/3 from MgO, and ~1/3 from feedstuffs and water
- (c) 1.5% MIN-AD: ~2/3 from MIN-AD, ~1/3 from feedstuffs and water.

MIN-AD replaced 36% of the limestone in the 0.75% MIN-AD treatment and 62% of the limestone in the 1.5% MIN-AD treatment. Average Ca and Mg intake from water as a percentage of total Ca and Mg intake was about 4%.

The cattle fed the 0.75% MIN-AD treatment outperformed the control treatment while the cattle fed diets containing 1.5% MIN-AD achieved similar performance as cattle fed the control diets. One of the trial conclusions was that ***“...this suggests that MIN-AD can successfully replace calcium carbonate and magnesium oxide as a source of magnesium and calcium in finishing diets for yearling steers.”***

**Dairy Ration Fermentation Studies**

Dairy ration rumen fermentation studies were carried out in 2000 (Bulletin D-1) in order to understand the impact of MIN-AD on rumen fermentation. One of the variables measured in these studies was pH. If the MIN-AD treatments had an effect on pH, then this would imply that MIN-AD was solubilizing in the rumen fluid and releasing Ca and Mg according to Equation (1).

The mean pH values over time for one experiment as a function of treatment are shown in the Table below. Both the Control and Bicarbonate treatments contained MgO. None of the MIN-AD treatments contained any MgO. (Percentages are the buffer inclusion as a percent of dry matter; the combination treatment contained 0.5% sodium bicarbonate and 0.5% MIN-AD.)

Treatment	Control	Bicarb 1%	MIN-AD 1.0%	MIN-AD 2.0%	MIN-AD + Bicarb	MIN-AD Fines 1%
pH	5.71 <sup>d</sup>	5.76 <sup>ab</sup>	5.72 <sup>b</sup>	5.75 <sup>ab</sup>	5.84 <sup>a</sup>	5.80 <sup>ab</sup>

<sup>ab</sup> Values not sharing the same superscripts differ (P<0.05).

One of the Rumen Fermentation Profiling Laboratory’s conclusions was that ***“in situations of severe pH depression (~5.7) MIN-AD+bicarbonate was more effective than bicarbonate alone as a rumen buffer”***.

This result demonstrates that at these pH levels, which are not uncommon at times in high production dairy cows, MIN-AD acts as an acid neutralizer and thereby releases Mg and Ca ions into the rumen fluid.

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## **MIN-AD in Dairy Field Trials**

Bulletin D-4 discusses a field trial that was conducted with 860 Holstein cows. It was supervised by a professional nutritionist and was carried out over a 5 month period. A switchback design was used in which MIN-AD was compared with a blend of sodium bicarbonate and MgO. The average daily production with MIN-AD was 30.83 litres/day/cow, while that with the sodium bicarbonate + MgO buffer was 30.69 litres/day/cow; there were no differences in fat or protein.

MIN-AD Bulletin D-2 describes a dairy field trial in which MIN-AD replaced a sodium bicarbonate and MgO buffer pack. This trial was carried out with 300 cows and was supervised by Extension Service scientists. Again, the cows on the MIN-AD treatment had the same fat corrected milk production as they did while on the control diets.

***In both field trials, there was never any sign of Mg or Ca deficiency and performance was either maintained or improved.***

## **MIN-AD in Feedyard Diets - II**

A set of experiments with MIN-AD in feedyard diets evaluated the use of MIN-AD with steam flaked corn, steam flaked wheat and combination corn:wheat rations. In this study (Bulletin B-1) with 378 steers, each grain combination was studied with and without MIN-AD. Calcium and magnesium from MIN-AD replaced portions of MgO and CaCO<sub>3</sub> in the appropriate diets. The finishing rations were formulated to provide Mg at 0.25% of dry matter and Ca at 0.65% of dry matter. MIN-AD was included at 1% of the *as fed* ration. Rations were fed for 128 days.

With all three grain combinations, the cattle receiving MIN-AD had increased average daily gain. With the all corn and corn:wheat diets, the MIN-AD treatments had improved dry matter conversion and reduced cost of gain.

***MIN-AD successfully replaced the Mg and Ca from MgO and CaCO<sub>3</sub> in all three MIN-AD treatments and resulted in performance improvements with no observed signs of Mg or Ca deficiencies.***

## **30 Years of Use**

MIN-AD has been employed in dairy and beef cattle rations for over thirty years. It has been used in both liquid and dry supplements under a variety of feeding conditions. Some nutritionists employ it as their sole source of supplemental Mg while others use it in combination with other Mg sources.

This long record of field performance, in combination with sound research, provides assurance to nutritionists and producers that when they are purchasing MIN-AD for buffering, they can also count on a quality mineral product.

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