How Do I Supplement My Livestock With Minerals? Part IV

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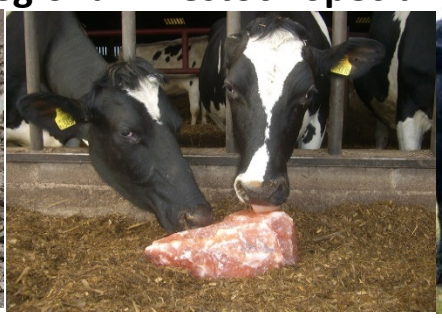


All of our livestock animals possess a specific appetite or craving for sodium. As demonstrated in part III of this article, most forage-based diets are quite deficient in sodium. In addition, most forage-based diets are quite high in potassium relative to the animal's requirement. Thus large amounts of potassium must be excreted mainly in the urine each day, which also results in substantial losses of sodium. For this reason herbivores such as cattle, sheep, goats and horses can become sodium (salt) deficient rather rapidly if supplementation is not provide. Wild herbivores will travel long distances to obtain salt from natural deposits or licks. With some mineral deficiencies animals will exhibit a **non-specific craving** sometimes called **pica**. Animals with **pica** will lick, chew and swallow all kinds of things; rocks, bones, etc. However, with a sodium deficiency, animal exhibit a **specific craving** for feeds high in sodium such as **salt**. Consequently salt can be used to **"drive" the intake** of other minerals. A good example is **Trace-Mineralized Salt (TM Salt).** Although the formulations of trace-mineralized salts vary, the following is typical:

Salt	Zinc	Mn	Iron	Copper	Cobalt	Iodine	Selenium
94.0%	4000 ppm	2000 ppm	2000 ppm	300 ppm	50 ppm	100 ppm	50 ppm

Mn = Manganese

Normally cattle will consume about 2.0 ounces (.125 lbs.) salt/day free-choice. Since the TM Salt above is 94% salt, intake would be expected to be (2.0 ÷ .94) 2.13 ounces/day (.133 lbs./day). Mineral intake from the TM Salt above would thus be:

Salt	Zinc	Mn	Iron	Copper	Cobalt	Iodine	Selenium
.125 lbs./day	242 mg/day	121 mg/day	121 mg/day	18.1 mg/day	3.0 mg/day	6.0 mg/day	3.0 mg/day

In **Part III** of this article it was shown that a full-feed (28.5 lbs. DM/day) of the example pasture grass that was in an immature or vegetative growth phase would supply a lactating beef cow with all needed minerals except **sodium, iodine, selenium and zinc**. This would be typical of a spring or early summer pasture or pasture maintained in high quality through a management intensive grazing system. The following table shows the mineral status of the lactating beef cows when offered the **TM Salt** shown above free-choice along with a **full-feed of this pasture forage**. Numbers in parentheses indicate percent of requirement provided. **Keep in Mind, These Are Examples. The Process Is Important.**

Example 1, Immature Pasture Forage

Mineral	From Pasture Forage	From TM Salt	Total Intake	Requirement
Dry matter intake, lbs./day	28.5	.133	28.63	----------
Calcium, lbs./day	.1539	0	.1539 (208%)	.0740
Phosphorus, lbs./day	.0770	0	.0770 (156%)	.0493
Calcium:Phos. Ratio	2.00	----------	2.00	1.50
Potassium, lbs./day	.7638	0	.7638 (413%)	.1848
Magnesium, lbs./day	.0542 (102%)	0	.0542 (102%)	.0530
Sulfur, lbs./day	.0484	0	.0484 (122%)	.0396
Sodium, lbs./day	.0228 (86%)	.0500	.0728 (276%)	.0264
Cobalt, mg/day	2.3313	3.00	5.33 (445%)	1.199
Copper, mg/day	150.270	18.10	168.37 (140%)	120.000
Iron, mg/day	3109.100	121.00	3230.1 (538%)	600.00
Iodine, mg/day	1.4250 (24%)	6.00	7.425 (124%)	6.00
Manganese, mg/day	1057.09	121.00	1185.5 (247%)	480.00
Selenium, mg/day	1.035 (86%)	3.00	4.035 (337%)	1.199
Zinc, mg/day	326.45 (91%)	242.00	568.45 (158%)	360.00

Although all mineral requirements are being met, the **Grass Tetany Ratio** is quite high, (potassium ÷ (calcium + magnesium) (.7638÷(.0542+.1539) **3.67**. Noted that the cows are receiving over 4 times their potassium requirement. A grass tetany ratio of **2.2** or greater increases the chance of grass tetany, especially in older and high milk producing cows when they are adapting from hay-based diets to lush spring pastures. Even if the cows on this high-quality pasture do not show signs of grass tetany, they will likely suffer from a **borderline magnesium deficiency** due to marginal magnesium intake and high potassium and crude protein intake. In this case a simple mixture of **TM Salt (87%), Magnesium Oxide (8%), and Dry Molasses (5%)** would be one method of insuring that these heavy-milking cows have adequate mineral nutrition. It is important to remember that **Magnesium Oxide is quite unpalatable**. That is why the dry molasses was added to this mixture. Magnesium Oxide will harden rather quickly if it becomes wet so weather proof feeders are important. Some TM salt formulations contain magnesium, which would be helpful in this example.

The following table shows the mineral intake of lactating beef cows consuming a full-feed of the **early-bloom pastures shown in part III** of this article along with free-choice TM Salt. These pastures would be green and growing but most of the plants would show seed heads, typical of cool-season summer pastures.

Example 2, More Mature Pasture, Early Bloom

Mineral	From Grass Pasture, early bloom	From .133 lbs. of TM-Salt	Total Mineral Provided	Requirement
Dry matter intake, lbs./day	26.4	.133		
Calcium, lbs./day	.1135	0	.1135 (153%)	.0740
Phosphorus, lbs./day	.0533	0	.0533(108%)	.0493
Calcium:Phos. Ratio	2.13	----------	2.13	1.50
Potassium, lbs./day	.4875	0	.4875 (264%)	.1848
Magnesium, lbs./day	.0422 (80%)	0	.0422 (80%)	.0530
Sulfur, lbs./day	.0400 (101%)	0	.0400 (101%)	.0396
Sodium, lbs./day	.0107 (41%)	.0500	.0607 (230%)	.0264
Cobalt, mg/day	1.6943	3.00	4.6943 (392%)	1.199
Copper, mg/day	110.190 (92%)	18.10	128.29(107%)	120.000
Iron, mg/day	1816.360	121.00	1937.36 (323%)	600.00
Iodine, mg/day	.7273 (12%)	6.00	6.7273 (112%)	6.00
Manganese, mg/day	801.98	121.00	922.98 (192%)	480.00
Selenium, mg/day	.551 (46%)	3.00	3.551 (296%)	1.199
Zinc, mg/day	254.76 (71%)	242.00	496.76 (138%)	360.00

Supplementing this more mature pasture with only TM Salt resulted in a **frank deficiency of Magnesium and borderline deficiencies of Phosphorus, Sulfur, and Copper**. Common observation would probably

not readily detect these problems but animal productivity and/or health would be somewhat compromised.

For these types of pastures a **Commercial Mineral Supplement** may be the best choice. Although various mixtures of TM salt, dicalcium phosphate, magnesium oxide, etc., can successfully be used, many farms lack proper weighing and mixing equipment. Often commercial supplements are less expensive when all costs are accounted. The following are a few facts about commercial mineral supplements for beef cattle:

1. There are many formulations that vary greatly in price, ingredients used, actual mineral content and mineral bioavailability.
2. Control of mineral intake (not too much or too little) is the key to successful use.
3. There are some very expensive commercial mineral supplements that contain chelated minerals of high bioavailability, ingredients to stabilize nutrients, and beneficial additives such as probiotics or fermentation extracts. These supplements are very useful during periods of **nutritional stress**, e.g., cattle are recovering from long periods of **nutritional deficiencies**, **during the last 2 months of pregnancy**, **during peak lactation in heavy milking cows**, **during the breeding season**, or **when cattle are consuming very low-quality forages**. However, it is not likely that it is necessary to use these very expensive supplements on a year around basis.
4. It is important to use mineral supplements formulated to rectify deficiencies known to be prevalent to your specific geographic area.
5. Many mineral supplements are fortified with fat-soluble vitamins (A, D, E) that are not necessary when cattle are grazing good quality pastures but would be needed when cattle graze stockpiled pastures or are being fed hay.

The following table shows examples of a few **commercial mineral supplements**. Of course, the prices listed would be relative to the time this article was written.

Mineral	Mineral-Vitamn 1	Mineral-Vitamn 2	Mineral-Vitamn 3	Mineral-Vitamn 4
Calcium, %	**14.0**	**17.8**	**14.0**	**19.0**
Phosphorus, %	**4.5**	**2.0**	**8.0**	**5.0**
Potassium, %		**.10**	**1.0**	
Magnesium, %	**5.0**	**5.0**	**2.0**	**5.0**
Sulfur, %				
Sodium, %	**8.0**	**8.7**	**5.8**	**8.0**
Salt, %	**21.6**	**21.8**	**15.0**	**20.0**
Cobalt, ppm	**30**	**30**	**20**	**20**
Copper, ppm	**711**	**1200**	**2500**	**1000**
Iron, ppm				
Iodine, ppm	**70**	**60**	**200**	**60**
Manganese, ppm	**2339**	**4800**	**4000**	**3000**
Selenium, ppm	**14**	**27**	**26**	**20**
Zinc, ppm	**3568**	**4800**	**6000**	**3000**
Vitamin A, IU/lb.	**173600**	**150000**	**555000**	**110000**
Vitamin D, IU/lb.	**10000**	**15000**	**100000**	**11000**
Vitamin E, IU/lb.	**325**	**150**	**300**	**400**
$/lb.	**.52**	**.38**	**.50**	**.40**

Many commercial mineral supplements are designed such that free-choice intake will be about **4 ounces (.25 lbs.)/cow /day**. The cows being used in this example lack (.0530-.0422) **.0108 lbs.(4.9 grams)** of magnesium/day in their diet. **Which of the commercial supplements above should be selected?** At 4 ounces (.25 lbs.) of intake/day, the supplement would have to contain at least (.0108÷.25) **4.32% magnesium**. **Mineral-Vitamin 1,2 and 4** in the table above meet this criterion. There are price difference in these supplements. Mineral-Vitamin 1 likely contains costly ingredients like chelated minerals and other additives, and would be most applicable during times of nutritional stress (late gestation, peak lactation, breeding). However, during other periods in the yearly production cycle **Mineral-Vitamin 2 and 4** would be a satisfactory but less expensive choices. Mineral-Vitamin 4 has a higher concentration of phosphorus compared to Mineral-Vitamin 2. Since this forage is marginal in phosphorus, the best choice would likely be mineral-vitamin 4. The following table shows the mineral status of these heavy-milking cows when they are grazing more mature summer pastures and offered **commercial mineral-vitamin supplement 4**:

Mineral	From Grass Pasture, early bloom	From .25 lbs. mineral suppl. 4	Total Mineral Provided	Requirement
Dry matter intake, lbs./day	26.4	.25	26.65	---------
Calcium, lbs./day	.1135	.0475	.1610 (217%)	.0740
Phosphorus, lbs./day	.0533	.0125	.0658 (133%)	.0493
Calcium:Phos. Ratio	2.13	----------	2.440	1.50
Potassium, lbs./day	.4875	?	.4875 (264%)	.1848
Magnesium, lbs./day	.0422	.0125	.0547(103%)	.0530
Sulfur, lbs./day	.0400	?	.0400 (101%)	.0396
Sodium, lbs./day	.0107	.0200	.0307 (116%)	.0264
Cobalt, mg/day	1.6943	2.275	3.9693 (331%)	1.199
Copper, mg/day	110.19	113.6	233.79 (195%)	120.000
Iron, mg/day	1816.36	?	1816.36 (303%)	600.00
Iodine, mg/day	.7273	6.816	7.5433 (126%)	6.00
Manganese, mg/day	801.98	454.4	1256.38 (262%)	480.00
Selenium, mg/day	.551	2.272	2.823 (235%)	1.199
Zinc, mg/day	254.76	340.8	595.56 (165%)	360.00

All mineral requirements of these cows are now being met, although the margins of safety for magnesium and sulfur are somewhat narrow.

In the last example, the **full-bloom grass hay** described in part III of this article will be used as the example forage. The same 1200 lb. lactating beef cows used the previous examples will serve as the example animal. Since this is a lower quality forage than those used in previous examples, a full-feeding will not provide adequate energy and protein. Consequently, an **energy/protein supplement** will be

required. Such supplements can be an important source of minerals for the cows. For example, **corn distillers dried grains (DDG)** has been an important energy/protein supplement since the initiation of the ethanol-for-fuel era and is a source of many limiting minerals. To meet the energy and protein requirements of these cows when being fed full-bloom grass hay it was estimated that 2.67 lbs. of

Example 3, Mature Forages, Full Bloom

Mineral	From Grass Hay, full bloom	From Corn DDG	Total Mineral Provided	Requirement
Dry matter intake, lbs./day	22.8	2.67	26.65	---------
Calcium, lbs./day	.0775	.0085	.0860 (116%)	.0740
Phosphorus, lbs./day	.0387	.0373	.0760 (154%)	.0493
Calcium:Phos. Ratio	----------	----------	1.131	1.50
Potassium, lbs./day	.4218	.0489	.4707 (255%)	.1848
Magnesium, lbs./day	.0250	.0173	.0423(80%)	.0530
Sulfur, lbs./day	.0296	.0107	.0403(102%)	.0396
Sodium, lbs./day	.0022	.0064	.0086	.0264
Cobalt, mg/day	1.97	.2184	2.1884 (183%)	1.199
Copper, mg/day	54.61	101.82	156.43 (130%)	120.000
Iron, mg/day	1606.26	697.63	2285.89 (381%)	600.00
Iodine, mg/day	.5905	.1092	.6997(12%)	6.00
Manganese, mg/day	462.53	94.18	556.71 (116%)	480.00
Selenium, mg/day	.3488	.4854	.8342(70%)	1.199
Zinc, mg/day	162.92	115.05	277.97(77%)	360.00

This diet is adequate in both calcium and phosphorus but the **Calcium to Phosphorus Ratio (Ca:P)** is too narrow (1.13). The Ca:P should be at least 1.5:1. This diet will require calcium supplementation to correct this ratio. Magnesium is provided at only 80% of the minimal requirement. Sulfur is adequate but with a narrow margin of safety. Sodium of course is deficient. Only 12% of the iodine requirement is provided. And selenium and zinc supplementation will be required.

Since this diet is **adequate in Phosphorus** but with a narrow calcium to phosphorus ratio, a mineral supplement with a low phosphorus but fairly high calcium content would be indicated. This diet is **deficient in Magnesium,** (.0530-.0423) .**0107 lbs./day**. At .25 lbs. mineral supplement intake, the supplement should contain at least (.0107 ÷ .25) **4.28% magnesium**. The most limiting trace mineral is **Iodine**. The mineral supplement should contain at least (6.00 - .6997) ÷ .25) 21.2 mg Iodine/lb. or 46.64 ppm Iodine. **Mineral-Vitamin Supplement 2** in the table above most closely fits these criterion and is also the least expensive of the choices. The following table shows minerals provided by the full bloom grass hay-corn distillers dried grain diet supplemented with **mineral-vitamin supplement 2**:

Mineral	From Grass Hay, full bloom + Corn DDG	From Mineral Supplement 2	Total Mineral Provided	Requirement
Dry matter intake, lbs./day	25.47	.25		---
Calcium, lbs./day	.0860	.0445	.1305 (176%)	.0740
Phosphorus, lbs./day	.0760	.0050	.0810 (164%)	.0493
Calcium:Phos. Ratio	1.131		1.61	1.50
Potassium, lbs./day	.4707	.00025	.4710 (255%)	.1848
Magnesium, lbs./day	.0423(80%)	.0125	.0548(103%)	.0530
Sulfur, lbs./day	.0403(102%)	?	.0404(102%)	.0396
Sodium, lbs./day	.0086	.02175	.0304 (115%)	.0264
Cobalt, mg/day	2.1884	3.40	5.59 (466%)	1.199
Copper, mg/day	156.43	136.00	292.43 (243%)	120.000
Iron, mg/day	2285.89	?	2285.89 (381%)	600.00
Iodine, mg/day	.6997(12%)	6.8181	7.5178 (125%)	6.00
Manganese, mg/day	556.71	545.45	1102.16 (230%)	480.00
Selenium, mg/day	.8342(70%)	3.0681	3.9023 (325%)	1.199
Zinc, mg/day	227.97(77%)	545.45	773.42 (215%)	360.00

The full bloom grass hay-corn DDG diet supplemented with Mineral-Vitamin 2 will meet all mineral requirements of these lactating beef cows, even though the margins of safety for Magnesium and Sulfur are somewhat narrow.

It is important to remember that the examples above are just that, **examples**. The nutrient (mineral) content of your actual forages and supplements vary and the nutrient requirements of animals vary through the yearly production cycle and with different circumstances. The following are the major points being made in this article:

1. Know the nutrient (mineral) content of your feeds: forages and supplements.
2. Know the nutrient (mineral) requirements of your animals.
3. Select the Mineral-Vitamin Supplement that most closely rectifies the mineral deficiencies associated with the animal's basal diet.