

DIETARY MINERALS FOR DAIRY COWS ON PASTURE

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Minerals are required by all dairy cows, and the amounts found in most feeds normally are inadequate for high milk production or growth. If these requirements are not met, deficiency symptoms can occur. Pastures in the USA are no exception and are often deficient in several minerals compared to the NRC requirements. Even with grain supplementation of pasture-based diets, most rations need to be supplemented with concentrated sources of certain minerals.

Usually minerals are categorized as “macrominerals” and “microminerals” (Table 1). The macrominerals are generally expressed as percent of the dry matter of a feed. Minerals needed in lesser amounts, often called trace minerals, are usually expressed as parts per million (PPM) or milligrams per kilogram.

Table 1. Minerals required in the diet of dairy cattle.

Macro Minerals	Chemical Symbol	Micro Minerals	Chemical Symbol
Calcium	Ca	Iodine	I
Phosphorus	P	Iron	Fe
Magnesium	Mg	Copper	Cu
Sodium	Na	Cobalt	Co
Potassium	K	Manganese	Mn
Chlorine	Cl	Molybdenum	Mo
Sulfur	S	Zinc	Zn
		Selenium	Se

Pasture Composition

Table 2 contains average levels of minerals in four pasture forage types under intensive rotational grazing. For reference, the NRC recommended mineral content for the total ration (forages and grains) is presented for high producing lactating cows, growing heifers, and dry cows. These values are averages based on samples collected primarily in the Northeastern USA. The amounts in forages in Japan may differ significantly from these values, and need to be analyzed.

Table 2. Average mineral composition of pastures under intensive rotational grazing.

Nutrient	Forage Type				NRC ^a recommended requirements for Total Ration		
	Grass	Mixed Mainly Grass	Mixed Mainly Legume	Legume	Lactating Cows	Heifers	Dry ^b Cows
	----- % of DM -----						
Calcium, % of DM	.43	.75	1.0	1.3	.67 (.90) ^c	.40	.45
Phosphorus, % of DM	.25	.27	.29	.31	.40 (.45)	.30	.23
Magnesium, % of DM	.20	.22	.24	.26	.25 (.30)	.16	.16
Potassium, % of DM	3.0	3.0	3.0	3.0	1.0	.60	.60
Sulfur, % of DM	.22	.22	.20	.20	.20 (.25)	.16	.20
Sodium, % of DM	.03	.03	.02	.01	.22	.20	.50
Chlorine, % of DM	.08	.07	.06	.05	.29	.20	.20
	----- ppm -----						
Zinc, ppm	28	29	29	30	55	40	40
Copper, ppm	10	10	10	10	11	10	13
Manganese, ppm	70	65	60	55	40	30	30

^aAdapted from 1989 and 2001 NRC Nutrient Requirements of Dairy Cattle.

^bMineral requirements need adjusted if a special ration is fed to prefresh dry cows.

^cAmount often recommended in the field.

Calcium

The Ca content of pastures ranges from 0.43% for grass, and increases as expected with more legumes in the pasture to about 1.3%. The NRC recommendation is that Ca be at least 0.65% of the total ration DM for high producing cows. Clearly, the grass pasture would need to be supplemented with additional Ca to meet the cow's needs. In Table 3 are shown average mineral contents of feedstuffs that typically would be used to supplement pasture-based feeding programs. With the exception of alfalfa hay, all feedstuffs are low in Ca compared to the lactating cow's needs. Therefore, additional supplementation of Ca is needed to ensure adequate daily intake with grass or mixed mostly grass-based pastures.

Phosphorus

Phosphorus supplementation is required with nearly all types of feeding programs. Pasture samples averaged about 0.25 - 0.30% P (Table 3) and all are low compared to the NRC recommendations of 0.40% of the total ration DM for milking cows. Many feedstuffs typically fed with pasture-based programs, particularly grains, are low in P (Table 3), thus, additional P supplementation is usually needed. Protein supplements such as soybean meal, corn distillers, and brewers grains are high in P (Table 3), however small amounts of these products are normally fed.

Table 3. Average mineral concentrations in selected feedstuffs.

Nutrient	Feedstuff								
	Corn Silage	Alfalfa Hay	Corn Grain	Barley Grain	Brewers Grain	Soybean Meal	Whole Soybean	Corn Distillers	Wheat Mids
	----- % of DM -----								
Ca	.25	1.30	.02	.10	.33	.29	.28	.11	.13
P	.23	.30	.31	.35	.57	.70	.65	.43	.99
Mg	.18	.25	.12	.14	.18	.32	.26	.08	.40
K	1.2	2.8	.40	.57	.10	2.30	1.89	.18	1.13
S	.13	.29	.12	.17	.36	.48	.38	.46	.20
Na	.01	.15	.03	.03	.23	.03	.02	.10	.10
Cl	.02	.34	.05	.18	.17	.08	.03	.08	.14
	----- ppm -----								
Fe	200	340	51	85	266	148	158	169	93
Zn	27	28	23	37	30	61	50	45	116
Cu	5	9	2	6	22	22	14	32	20
Mn	35	50	7	22	40	33	33	17	126

Magnesium

The NRC recommendation is that Mg be fed at 0.25% of the total ration DM. On spring pastures, which bring a risk of grass (Mg) tetany, a Mg level of 0.30 - 0.35% of the total ration DM or higher is often needed. Pasture Mg content averaged 0.20 - 0.28% being lowest on grass and increasing as the legume content increased (Table 1). Magnesium levels were lowest in the spring, emphasizing that supplemental Mg is most critical in the spring. Magnesium oxide is the most common source of supplemental Mg and should be added to the grain ration to bring the total ration Mg to at least 0.30%. Cows often will not consume all the allotted grain with lush pastures in the spring, thus other supplemental methods may be needed. Bolusing individual cows with MgO is one option. A free-choice mineral block with elevated Mg content can also be considered.

Potassium content of pastures is high (Table 1) compared to needs and may cause problems related to the mineral imbalances. Excess K in spring is thought to be a factor in causing grass tetany and hypomagnesemia, and can also lead to imbalances in cation:anion in dry cows. This can contribute to increased milk fever and other metabolic diseases post-partum.

Sodium and chlorine content of pastures are low compared to needs (Table 1). Most feeds listed in Table 3 have low levels of Na relative to the cows' requirements. Supplemental salt should be provided to cows on pasture.

The *trace mineral* content of pastures varies among elements compared to the cows' needs. A deficiency of any trace mineral can lead to serious health and production problems. Zinc and copper appear to be the lowest in pasture compared to needs (Table 1). Other trace minerals that need to be supplemented are Mo, Co, I, and Se. The Northeast USA is considered to be an area deficient in I and Se, and cows are supplemented with these trace minerals. With the availability of trace mineral mixtures and trace mineral salt, cows should not be deficient in trace minerals.

Forage Analysis

Analysis of pastures for macro minerals is needed periodically. Mineral composition varies by type of pasture and season of the year, as shown in Table 2. In addition, mineral content will differ between years due to changes in the plant composition of the pasture and to the fertilization program. In one study, Ca content differed by 0.17% in two consecutive grazing seasons in the same pastures. In an Ohio study, K and P were both higher than typically expected. This suggests that a complete mineral analysis be considered at the beginning of each grazing season. At least one additional analysis may be needed to monitor any seasonal changes.

Methods of Feeding Minerals

Minerals are best fed mixed with other feeds (force fed), such as in the concentrate mixture or in a total mixed ration. Supplemental grain is usually fed to cows on pasture and provides a means to get known amounts of minerals into cows. With lush spring pastures, some cows may not consume all their allotted grain and minerals. The minerals in the grain may need to be concentrated to a higher nutrient density to avoid deficiencies.

Free-choice feeding of minerals containing macro and micro minerals can be considered in this situation, but these blends should have a salt base to ensure consumption (cows do have an appetite for salt). A mixture containing about 20% salt is common. Offering free-choice minerals may be considered when cows or heifers are on pasture and receive no supplemental feeds. They are not needed if adequate minerals are fed and consumed elsewhere.

The general practice of free choice feeding by offering several sources of minerals separately as the only source of minerals is not recommended. Research has shown that the dairy cow does not have the nutritional wisdom to enable her to choose the individual minerals that she needs. Research has clearly shown that cattle have the ability to taste and select salt, but not other minerals. Intake of minerals, except salt, seems to be more related to palatability and taste than need. A cow, contrary to popular belief, will seldom choose the minerals she needs, and will likely end up deficient or imbalanced in dietary minerals. Offering free choice minerals above that provided from grain or TMRs is usually wasteful and may lead to luxury consumption and mineral imbalances.

In the short run, an imbalance or deficiency of some minerals may not be evident in the animal. For example, if the cow has adequate reserves of Ca and P, a dietary deficiency may not be observed for a couple months. The long term effects on milk yield, animal health, and reproduction are of major concern and are the reason that we should try to ensure an adequate daily intake of all minerals through supplementation.