Trace Elements and Vitamins for Dry Cows

William S. Swecker, Jr., *DVM, PhD*
Production Management Medicine
VA-Maryland Regional College of Veterinary Medicine
Virginia Tech
Blacksburg, VA 24061-0442

Trace element and vitamin nutrition for dry cows tends to be ignored unless a problem exits. Mastitis, retained placentas, metritis, milk fever, ketosis, lipidosis, and impaired immune function have been associated with trace element / vitamin deficiencies or supplementation of trace elements / vitamins in the dry period has decreased the occurrence of some of these abnormalities. Dry cow programs, however, can vary from a forage alone process to separate TMR programs for the early and late (transition) dry periods and cows may be grouped by body condition at dry off or by parity. The requirements from NRC (Table 1) show that requirements for all trace elements and vitamins for the dry cow are similar to requirements for the lactating cow. A three step process can be utilized to assess the trace element / vitamin nutrition program for dry cows: 1) Assess the animal, 2) Assess the feeds, and 3) Assess the feeding management.

Table 1. Requirements for Trace Elements and Fat Soluble Vitamins, 1989 Dairy NRC.

Nutrient	Requirement	Maximum Tolerable Levels
Copper (ppm)	10	100
Zinc (ppm)	40	500
Selenium (ppm)	0.3	2
Manganese	40	1000
Cobalt	0.1	10
Iron	50	1000
Iodine	0.25	50
Vitamin A	1,800	30,000
Vitamin D	540	4,500
Vitamin E	7	900

The Cow

In theory, the dry cow should have a decreased requirement for trace elements and vitamins relative to lactation because of the decrease in energy and protein requirements. The dry cow, however, must respond to an increasing demand from the rapidly growing fetus. In addition, the cow partitions the vitamins A and E into the colostrum as the calf is born with minimal supplies. Cows can store some of the vitamins (vitamin A - 6 months) and depletion of trace elements appears to take weeks or months, thus adequate supplementation of lactating cows could possibly result in a decreased need for these elements in the dry period.

Many diseases occur primarily in the post -parturient period. Supplementation with specific trace elements and vitamins in the dry period have decreased the occurrence of diseases such as retained placenta and mastitis in spite of the ability to store trace elements and vitamins and a decreased requirement. (Table 2) Changes in metabolism of the cow in the periparturient period may reduce the repartitioning of these elements in the body even though stores may appear adequate.

Table 2. Parturient disorders and associated nutrient(s).

Disorder	Nutrient(s)
Mastitis	Vitamin A, beta carotene, Vitamin E, Se
Retained placenta / metritis	Vitamin A, beta carotene, Se, protein
Ketosis, Lipidosis	Niacin
Milk Fever	Vitamin D

The Feeds

We rely on the microbes to manufacture B vitamins, forages to provide fat soluble vitamins and mineral salts to provide trace elements when the soils and accompanying feeds are deficient. Vitamins are rarely evaluated on feeds due to cost, and a minimal number of labs that do analysis relative to the number of forage testing labs. Even with appropriate analysis, the content of the vitamins may vary. Book values may be of limited value as many book values come from a wide

range of plants and assay techniques. The practitioner may utilize several generalizations to determine vitamin content. Fresh green plants tend to contain the highest concentration of the fat soluble vitamins. Heat and oxidation decrease vitamin A and E content of forages, thus silages and hays stored for 4-6 months in adverse conditions can have minimal concentrations of these vitamins. Likewise, supplements are also prone to heat and oxidative damage. Vitamin D content of sun - cured hays is actually higher than the fresh forage.

Trace element content of forages and grains tend to reflect the concentration of the soils that supported their growth. Many regions of the country are known to be deficient in various trace elements such as selenium (Se), copper (Cu) and zinc (Zn) The increased use of non-native feeds and by-product feeds may bring new mineral deficiencies and imbalances into the ration. For example, heat treated soybeans and soybean meal tend to have molybdenum (Mo) concentrations in the 4-7 ppm ranges while most feeds tend to be less than 2 ppm. Copper supplementation should be increased when these high molybdenum feeds are used. Likewise, the author has noted several forages with high Fe concentrations (> 500 ppm) that may interfere with Cu absorption. Many forage labs provide analyses for Fe, Cu, Zn, and Mo. Selenium analysis is offered less often and tends to be more expensive.

Feeding Management / Supplementation

A simple option for supplementation is the "dry cow mineral" offered by many commercial feed companies. As always, a nutritionist should recommend analysis of the primary feeds and then selection of a complementary mineral package. Vitamin content of these minerals tends to vitamin A in the 100,000 range / lb, vitamin D in the 10,000 range/ lb and vitamin E in the 10 range/ lb. Vitamin E fortified dry mineral / vitamin products may contain 1000-2000 IU vitamin E / lb which would supply 500-1000 units per day as recommended by some nutritionists. Trace element concentrations vary in feeds but a product that contains 0.4000 % Zn, 0.1000 % Cu and 0.0030 % Se would provide 100% of the NRC requirements for the respective minerals in a cow with a dry matter intake of 12 kg and mineral intake of 4 ounces. As mineral content of the ration increased, the amount needed in the supplement would decrease. Iron supplementation is generally not needed in Virginia.

A common discussion item is the bioavailability of different mineral sources. Copper sulfate appears to be a superior inorganic source of copper as compared to copper oxide. The difference in availability between zinc sulfate and zinc oxide is less clear. Iron oxide is unavailable and sodium selenite appears to be an adequate source of Se. Zinc methionine and Cu Lysine appear to be more available in the author's experience, especially with stressed cattle. The problem with most mineral sources is that little information exists on supplementation of dry cows, thus we must extrapolate from lactating cows, beef cattle, and even other species. The role of anionic salts on trace element balance is unknown.

Summary

I agree wholeheartedly with the comment made by Dr. Jenks Britt in the June 1995 Dairy Herd Management "The key to a cow's lactation may be related to only three weeks out of the entire year. That's how important the three weeks prior to calving - known as the transition period - is to your cow." Trace element and vitamin supplementation of dry cows should be a routine and relatively simple process. Certainly a wide spectrum of programs can be effective. My general recommendation is to compare the cost of various supplementation programs to potential returns in the prevention or reduction of disease.

Table 3. Trace Elements and Vitamins: The Animal

Nutrient	Animal Sample	Comments
Vitamin A	Plasma	Subject to heat and oxidation, protect samples from light and heat
Vitamin E	Plasma	Associated with plasma cholesterol, decreases in periparturient period
Vitamin D	not routinely sampled	Toxicosis may occur? , prevention of milk fever
Copper	Serum, liver	Serum only detects severe deficiencies, serum Cu will increase with stress, Liver Cu may be technically difficult to obtain
Zinc	Serum, liver	Serum may only detect severe deficiencies, Serum Zn decreases with stress, must be collected in special trace element tube, liver may be difficult to obtain
Selenium	Whole blood, plasma	Serum / plasma may be more accurate in detecting an acute deficiency

Table 4. Trace Elements and Vitamins: Feeds and Supplements.

Nutrient	Feed Comment	Sources
Vitamin A	Beta - carotene and retinol degraded by heat and moisture (sun-cured hays and silages)	Subject to heat and oxidation, protect supplements from heat and light
Vitamin E	Tends to be highest in dried alfalfa products, book values vary	Subject to heat and oxidation, protect supplements from heat and light
Vitamin D	Increased in sun-cured hays, rumen appears to be able to adapt to high D concentrations	Commonly found in vitamin packages
Copper	Consider negative interactions with high Fe (> 250-500 ppm), Sulfates (feed and water) Maintain Cu:Mo ratio > 6:1	Copper sulfate preferred over copper oxide. Copper Lysine appears to be more available in certain situations
Zinc	Consider interactions with high Ca	Zn Sulfate may be better than Zn Oxide. Feeding of Zn methionine associated with decreased SCC
Selenium	Feeds < 0.3 ppm Se should be supplemented	Na selenite at 0.3 ppm in total ration