corn silage than the values currently used by the NRC. True absorption of phosphorus from these forages was also found to be higher than the values used currently.

The exact ratio of calcium to phosphorus needed in the total ration is about 1.6 to 1.0. While deficiencies and excesses of any mineral should be avoided, several studies have shown equal performance with ratios varying from 1:1 to 4:1. In Florida we recommend a ratio of approximately 1.5:1 to 2:1. High-fat diets increase fecal calcium losses through the formation of soaps and thus increase the requirements for calcium. A number of nutritionists increase the level of calcium in the total ration dry matter to about 1% when feeding high-fat diets.

Milk fever has not been a problem in Florida dairy herds receiving rations containing adequate amounts of phosphorus and calcium. Several studies have shown that rations narrower than 1:1 and wider than 2.5:1 tend to increase the incidence of milk fever when fed during the dry period. It seems only logical that if such rations fed during the dry period can reduce the incidence of milk fever, similar rations would be optimum during lactation.

Vitamin D is associated with calcium absorption and utilization. Since in the presence of vitamin D, calcium is absorbed more efficiently, phosphorus is also used more effectively.

While the bone stores of phosphorus are large, an inadequate supply of phosphorus in the ration will soon lead to borderline deficiencies. Such deficiencies have been identified as reduced appetite, lowered disease resistance, a decline in reproductive efficiency, poor feed utilization and increased incidence of milk fever. Since the two elements are combined in bone, the mobilization of calcium as a result of parathyroid gland actions is accompanied by the incidental mobilization of phosphorus. Therefore, if calcium is not being actively mobilized from body stores, the ruminant depends on a daily intake of phosphorus. Studies have shown that low phosphorus diets for beef heifers have resulted in decreased bone density and mineral content.

Calcium and phosphorus are important in several body functions. Calcium functions in cell equilibrium, heart beat and muscle contraction, and blood coagulation. Phosphorus is present in all living cells of the body as part of many enzyme systems and is essential in the utilization, transfer and storage of energy and in protein metabolism. Phosphorus is also necessary for normal growth and function of rumen microorganisms, especially cellulose digesters. It is also a major blood buffer.

Several sources of minerals are available in formulating mineral mixtures and balancing rations. Some of the common sources are in Table 1.

Magnesium

Magnesium functions in many important enzyme systems in the body, as a constituent of bone, and in muscle contractions. Magnesium in the bone probably has a structural function as well as a storage function.

Grass tetany is the common condition associated with a magnesium deficiency in ruminants. Several states (Virginia, Pennsylvania, Maryland, West Virginia, Georgia, Florida, and Alabama) have reported grass tetany in beef cows on wintering rations. The condition occurs more frequently in cattle grazing small-grain pastures in early spring and is usually related to low levels of blood magnesium. Supplemental feeding of magnesium to cows grazing such pastures has been very effective in preventing the tetany syndrome. Dairy cattle receiving grain in addition to such pastures have not been reported as having a problem.

High levels of nitrogen and potassium fertilization have been associated with a greater incidence of the tetany syndrome, and appear to make that magnesium which is present less available to animals. Apparently, increased production of ammonia in the rumen reduces magnesium absorption.

Some studies have reported that magnesium has a relaxing effect on animals. This is probably true to the extent that symptoms of a magnesium deficiency include hyper-irritability, increased nervousness, restlessness, muscle twitching, grinding of teeth and excessive salivation.

Work at Florida shows a greater need for magnesium than suggested in the 1989 NRC Update (Table 2). Supplementation of magnesium above current NRC recommendations (0.2 to 0.25% of DM) resulted in increased FCM yield. Maximum response to magnesium depended on stage of lactation. However, early lactation, high-producing cows produced maximum FCM when 0.45% magnesium was added to the diet. In general, we recommend the