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Dietary Cation-Anion Difference (DCAD)

Dietary Cation-Anion Difference (DCAD), is a way to help balance the electrical charges of the cations and anions in the diet. These electrical charges affect blood buffering capacity and acidity in a cow's blood. The following DCAD equations are used by Litchfield Analytical Services:

$$\text{DCAD-7 (meq / lb)} = (1.00 * \%Na * 197.72) + (1.00 * \%K * 116.25) + (0.15 * \%Ca * 226.82) + (0.15 * \%Mg * 373.93) - (1.00 * \%Cl * 128.21) - (0.20 * \%S * 283.52) - (0.30 * \%P * 264.15)$$

$$\text{DCAD-4 (meq / lb)} = (\%Na * 197.72) + (\%K * 116.25) - (\%Cl * 128.21) - (\%S * 283.52)$$

Conversions: (meq / kg) = (meq / lb) * 2.2 (meq / 100g) = (meq / lb) * 0.22

High-producing dairy cows tend to have a high level of acid buildup in their blood, in large part due to a corresponding increase in feed intake and absorption of acids produced in the rumen as well as the metabolic production of acids as feed is transformed into milk.. Under modern feeding practices, cows do not generate as much salivary bicarbonate (the major blood buffer) since they do not "chew the cud" as much as they did when they were fed only pasture or hay. This, along with the high metabolic rate, results in depleted blood buffer levels so cows cannot neutralize all of the acids they produce.

The optimum DCAD level should be based on the cow's milking status. For just-fresh cows and lactating cows, producers should achieve a highly positive DCAD level, between +159 and +204 meq / lb of total ration dry matter or TRDM (equivalent to +35 to +45 meq / 100g of TRDM or +350 to +450 meq / kg of TRDM). This level helps improve feed intake and milk production without affecting milk fat and protein percentages. Higher DCAD levels are especially effective during heat-stress conditions, when cows naturally reduce feed intake and have further problems with low blood bicarbonate and rumen acidosis.

For dry cows three weeks from calving, a negative DCAD is desirable. This increases blood calcium levels prior to freshening. Lowering the DCAD level to –36 to –55 meq / lb of TRDM (equivalent to –8 to –12 meq / 100g of TRDM or –80 to –120 meq / kg of TRDM) helps increase blood calcium, preventing milk fever, reducing udder edema, and leading to fewer retained placentas and displaced abomasums.

To lower DCAD, add the appropriate anionic salts. Magnesium is recommended as the first addition because it appears to be the most palatable, and because it can be used to meet the cow's requirement for magnesium. Formulate to 0.4% dietary magnesium in the TRDM. Add calcium sulfate or ammonium sulfate next to achieve 0.4% dietary sulfur in the TRDM. Then, add chloride sources (ammonium, calcium, or magnesium chloride) to bring the DCAD down to to –36 to –55 meq / lb of TRDM (equivalent to –8 to –12 meq / 100g of TRDM or –80 to –120 meq / kg of TRDM). Check the dietary non-protein nitrogen and degradable protein. Reduce the use of ammonium salts if NPN is greater than 0.5% of TRDM (more than 3.1% of crude protein from NPN in the TRDM) or degradable protein is greater than 70% of the total crude protein. If it is possible to lower DCAD to –45 to –68 meq / lb (equivalent to –10 to –15 meq / 100g or –100 to –150 meq / kg), add calcium to achieve calcium 1.5% to 1.8% dietary Ca in the TRDM. In field reports where problems were encountered with the feeding of negative DCAD diets, many were due to inadequate dietary calcium.

To raise DCAD through good nutrition, add supplemental sodium, potassium or both to the ration, without additional sulfates or chlorides. During hot summer months, it is clear cows respond positively to a combination of sodium and potassium. Heat-stressed cows lose potassium through sweat and milk, often making them deficient. Three studies at Texas A&M University showed that each 0.1 percentage increase in potassium led to almost one pound per day more milk. Nutritionists continue to find the best ways to raise DCAD levels. Dr. Elliot Block, Manager of Animal Research for the ARM & HAMMER Animal Nutrition Group, conducted research at McGill University that showed balancing DCAD with combination of potassium and sodium achieved the optimal dry matter intake and milk production.

Potassium is present in milk in greater quantities than even calcium. Therefore, to maintain high milk production, dairy cows need dietary potassium to avoid deficiencies. Potassium also appears to play an important role in insulin production, protein metabolism and in controlling the cows' "cell pumping ." Yet high-producing cows lose potassium through the normal everyday functions of milking and sweating. Replenish potassium levels without adding chlorides or sulfates that can negatively impact a ration's DCAD balance.

If the buffer being fed is sodium bicarbonate, or sodium sesquicarbonate, it does help increase the DCAD level. You can determine the amount of impact the buffer will have on DCAD by checking the minimum sodium guarantee, as not all buffers carry the same guarantee. In addition, it is vital that overall nutrient requirements provide the proper balance of both potassium and sodium. It is also important to supplement magnesium in rations when feeding extra potassium, and subsequently, to monitor potassium fertility levels on farms.

A pre-fresh ration should be an intermediate step between a high fiber, low energy dry cow diet to a low fiber, high energy lactating diet. The diet should transition the rumen to prepare rumen microbes for the changing diet, while providing key nutrients to avoid metabolic disorders common at calving. This step is important to maintaining cow health and enhancing productivity in early lactation. Provide the cow with essential nutrients rumen microbes need to produce microbial protein efficiently. This creates an optimal rumen environment that enhances dry matter intake and feed efficiency, preparing pre-fresh cows for early lactation diets. A palatable source of chlorides creates a negative DCAD that helps prevent costly metabolic disorders. Metabolic disorders, especially milk fever, can dramatically reduce productivity and profitability in early lactation cows. This has a multiplier effect throughout lactation, with lower peak production and decreased total milk throughout the lactation. Research at Cornell University indicates the one case of milk fever alone can cost over $180 per cow. Add the costs of the added effects of milk fever, including displaced abomasum, retained placenta, ketosis and other metabolic disorders, and the impact on your profitability can be enormous.
Recent multi-herd evaluations from Idaho and Minnesota have shown that the ultimate effect of these transition disorders is that many more cows are leaving the dairy early in lactation. When these cows are culled so early they give little or no profit back to the dairy and they are becoming increasingly more expensive to replace.

References:

"Prevention of Milk Fever by Application of the Dietary Cation-Anion Balance Concept", W.K. Sanchez & R. Blauwiekel, University of Idaho, Moscow ID, Washington State University, Pullman WA, Bulletin EB1783, April 2001.

"Use of Acidifying Diets for Prevention of Milk Fever in Dairy Cattle", G. Oetzel DVM, University of Wisconsin-Madison, Madison, WI, 1997.