Animate®
Anionic Mineral Supplement

Practical Applications of Acid-Base Balance

It is well understood, that diet influences acid-base balance. It has more recently been acknowledged that acid-base balance influences productivity and health and the way in which various nutrients are utilized. Adjusting the dietary acid-base balance has largely been a function of using selected minerals in practical feeding programs.

Basic Principles

Terms such as alkali-alkalinity, anion-cation balance or difference, dietary electrolyte balance, fixed ion balance, strong ion difference, with the most popular term being dietary anion-cation difference or DCAD have been used to describe the numeric relationship between anions and cations. DCAD has been shown to be a major determinant of acid-base balance. Diets can be manipulated with relative ease to change DCAD by adding either anionic or cationic salts. This practice has become more commonplace with a better understanding of the science of DCAD, research and feeding experiences.

To understand how DCAD works, first remember that dietary electrolytes can be classified as either anions or cations. Anions have a negative charge; cations have a positive charge. The charge carried by those electrolytes affects acid-base balance. Common electrolytes found in animal diets are as follows:

CATIONS **(ALKALINE; Positive charge)**	**ANIONS** **(ACIDIC, Negative charge)**
Sodium (Na)	Chloride (Cl)
Potassium (K)	Sulfur (S)
Calcium (Ca)	Phosphorus (P)
Magnesium (Mg)	

Sodium, potassium, sulfur and chloride are thought to exert the strongest ionic effects on acid-base balance and, are therefore, often referred to as the “Strong Ions”. Excessive anions (relative to cations) are associated with acidic diets; excessive cations are associated with alkaline diets.

Calculation of Electrolyte Balance

DCAD is that difference between total dietary cations and anions. The calculation is carried out in milliequivalents (mEq) because what the equation really defines is the balance of charges present in the diet, supplied by fixed cations and anions. Anion-cation balance can be used to quantitate the relationship between strong cations and anions and thus predict whether a diet will evoke an acidic or alkaline response when fed. Several methods of calculating DCAD of a diet have been utilized. The most common procedure used experimentally was a ratio of difference between two or more of the ions. Common equations for DCAD are as follows:

DCAD = mEq (Na + K – Cl)

DCAD = mEq (Na + K) – (Cl + S)

DCAD = mEq (Na + K + Ca + Mg) – (Cl + S + P)

Based on research and practical application of DCAD one of the most accurate and popular equation's in use today is (Na + K) – (Cl + S). Calculation of DCAD of a diet, regardless of the equation employed, requires using the equivalent weights of the electrolytes. This is necessary because acid-base balance is affected by electrical charge rather than mass. The equivalent weight is equal to the molecular weight divided by the valence (electrical charge strength). The term milliequivalent is used to express equivalent weights; one milliequivalent equals $1/1000^{th}$ of an equivalent.

Lactating Dairy Cows and Milk Fever

Manipulation of anion-cation balance in dry cow rations has shown remarkable promise in reducing or preventing the incidence of milk fever and hypocalcemia and related metabolic disorders in dairy cows. The anionic (acidogenic) diets through physiological changes stimulate mobilization of calcium from the bone and uptake from the small intestines. This activity maintains circulating levels of calcium above hypocalcemic levels and thus prevents the related clinical and sub-clinical disorders that often occur at the onset of lactation.

<u>Blood Calcium Level</u>

- Greater than 8.0 mg/dl – Normal calcium level
- From 5.0 to 8.0 mg/dl – Sub-clinical hypocalcemia – possible milk fever and metabolic disorders
- Less than 5.0 mg/dl – Clinical hypocalcemia – milk fever and metabolic disorders

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Most dry cow rations will have a cation-anion balance (Na + K) - (Cl + S) ranging from +5 to +30 mEq/100 gm dry matter. Higher DCAD levels are influenced by the level of potassium in the feedstuffs that are fed and/or in mineral supplementation, such as salt or potassium-based minerals . The addition of anionic salts (minerals high in Cl and S relative to Na and K) to the ration would lower the anion-cation balance promoting an acidogenic effect. Although no acid-base treatment can completely eliminate milk fever and other metabolic and non-metabolic disorders, many trials indicate that anionic supplementation can reduce their incidence dramatically at a DCAD level of -10 to -15 mEq/100 gm of dry matter.

Although it is suggested that supplementation of anionic salts into a high cation diet can reduce hypocalcemia related problems in the cow there are some dietary considerations. For example, if the forage in the prepartum diet has an excessive level of potassium, it may be difficult to effectively adjust the diet with anionics when the body is saturated with cations. Even in these situations there should be some degree of improvement related to the degree of anionic supplementation and acidification of the diet. The most significant impact however to hypocalcemia and related health disorders will be observed when we shift urine pH down to 6.2 to 6.8, a primary indicator of increased blood calcium levels in dairy cows. A switch to or blending in lower potassium feedstuffs may be necessary. An anionic salt is generally fed a minimum of 21 days just prior to parturition for best response.

Due to the lack of anionic salt palatability and its negative effect on intake, as well as DCAD inconsistency and handling and mixing issues, ANIMATE, a new generation concentrated anionic mineral supplement has been developed. Providing for an anionic product with a high level of intake that rapidly acidifies the cow and lowers urine pH; countering hypocalcemia and related health disorders while improving performance.

References

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