Ontario

MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS

Dietary Cation-Anion Difference (DCAD)

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Introduction

Milk fever (periparturient paresis) occurs in dairy cattle after calving because of low blood calcium levels as a result of calcium moving into milk. There are about 23 grams of calcium in 10 litres of colostrum, and when this is added to the normal amount of calcium needed for maintenance, the needs of the cow can be more than 10 times the supply of calcium in her bloodstream. When the demand for calcium is greater than the supply in the blood this can cause the problems of milk fever, unless the cow can rapidly mobilize stored calcium in her body (e.g. in bones) to offset the situation. A nutritional approach to managing milk fever involves monitoring specific elements in the diet.

Cations have a positive charge like sodium (Na), potassium (K), calcium (Ca), and magnesium (Mg). Cations in the diet promote a more alkaline (higher blood pH) metabolic state which has been associated with an increased incidence of milk fever. Anions have a negative charge such as chloride (Cl), sulfur (S) and phosphorus (P). Anions promote a more acidic metabolic state (lower blood pH) that is associated with a reduced incidence of milk fever. A cow adjusts to a lower blood pH by buffering the acidic condition.

Buffering the blood is done by the cow through mobilization of calcium phosphate from bones. When a lower pH is achieved by feeding more anions, the result causes the cow to mobilize stored calcium which can better prepare her for the time when calcium will be lost in milk. This is the reason that there are various anionic products on the market: to reduce the incidence of milk fever.

The use of anionic salts and newer products based on hydrochloric acid-treated ingredients (See also: "Salt-free Diet" OMAFRA information sheet http://www.omafra.gov.on.ca) to lower blood pH is a common approach in close-up dry cow nutrition to avoid milk fever.

Typically in Ontario, dry cow diets are high in cations because of feeding high potassium forages that are associated with milk fever.

You can evaluate the cation-anion status of ingredients or complete diets to determine the cation-anion difference, and it allows you to decide whether or not a change in forages (to lower potassium ones) or use of anionic products might be an effective strategy to manage milk fever. Calculating a diet's DCAD status to check for potential problems is easily done using a straightforward equation. Balancing a diet with the use of anionic products should be done in consultation with a nutritionist.

The calculation for DCAD requires converting the various anions and cations in a diet into milliequivalents (mEq). This is done because of the different chemistry of each element and a system that accounts for the impact of each one in the balance calculation is necessary. DCAD is reported in mEq/kg of diet. The DCAB equation involves subtracting the mEq of anions from the mEq of cations and the result can be positive or negative.

An important aspect of evaluating a diet for DCAD is that the mineral content of the diet has been accurately determined. A mineral analysis by wet chemistry, not by near-infrared (NIR) analysis is important. Another consideration is to adjust for the cations and anions present in drinking water. Not all minerals in water are necessarily nutritionally available to the cow but water high in cations or anions could affect the DCAB.

Milliequivalents (mEq):

Milliequivalents are calculated by multiplying the content of each element in the diet by a conversion factor. The factors are as follows for mEq/kg (dry matter):

Mineral	Conversion Factor
Sodium	435
Potassium	256
Chloride	282
Sulfur	624

For example, a diet containing 0.15% sodium, 1.1% potassium, 0.2% chloride and 0.2% sulfur, the milliequivalents would be:

Element	% of Diet ("A")	Conversion Factor ("B")	mEq/kg ("A" x "B"=)
Sodium	0.15	435	65.25
Potassium	1.10	256	281.6
Chloride	0.20	282	56.4
Sulfur	0.20	624	124.8

DCAD Equation:

The equation for calculating the DCAD for a diet (or ingredient) is:

(sodium+potassium) - (chloride + sulfur) = DCAD in mEq/kg

From the above example, the result is:

(65.25 + 281.6) - (56.4 + 124.8) = mEq/kg

(346.85) - (181.2) = +165.65 mEq/kg

The DCAD equation and conversion to milliequivalents can be combined as follows into one step:

[(sodium x 435)+(potassium x 256)] - [(chloride x 282)+(sulfur x 624)] = mEq/kg

Guidelines:

1. If a diet is calculated to be +200 mEq/kg dry matter or more, a switch to lower potassium forages in the dry cow diet should be considered first. In some cases, the introduction of anionic products, particularly the older anionic salts, can reduce feed intake because they may be unpalatable. Reduced feed intake before calving can create bigger problems than milk fever such as displaced abomasum and ketosis.

2. The DCAD in the transition diet should be between negative 100mEq/kg and negative 200 mEq/kg dry matter to effectively control milk fever and low blood calcium.

3. Check your ration for added cations such as sodium coming from sodium bicarbonate. A general rule of thumb is to avoid lactating cow minerals to close-up cows in lead-feeding situations.

4. Monitor cow urine when using anionic products. Urine pH is a reasonable indicator of metabolic pH status and reflects the effectiveness of anionic products. Urine pH should be 6.0 to 6.5 for Holsteins and 5.5 to 6.0 for Jerseys.

5. A gradual introduction to anionic products and incorporating them into a total mixed ration (TMR) can

reduce palatability problems.

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