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SoyChlor®

Technical Bulletin

The use of SoyChlor to balance rations for Dietary Cation-Anion Difference (DCAD)

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Just what is DCAD anyway?

DCAD is the difference between strong fixed cations and strong fixed anions in the diets of close-up dairy cows. Cations are minerals with a positive charge. Anions are minerals with a negative charge. The general form of the DCAD equation is:

Cations – Anions = DCAD in Milliequivalents per kilogram of dry matter (Meq/Kg DM)

The most common DCAD equation is:

(Sodium + Potassium) – (Chloride + Sulfur) = DCAD in Meq/kg DM

Other equations using all the macromineral cations and anions have been proposed using varying multiplication factors to reflect the fact that some of the cations and anions are not absorbed very well. One such equation proposed by Jesse Goff of the National Animal Disease Center is:

(Sodium + Potassium + 0.2*Calcium + 0.16*Magnesium) –
(Chloride + 0.6*Sulfur + 0.64*Phosphorus) = DCAD in meq/kg DM

Why should close-up rations be balanced for DCAD?

Balancing for DCAD prevents milk fever or parturient paresis.

What if milk fever is not a problem?

Even if classical cases of milk fever are not a problem subclinical milk fever may be. Subclinical means that the cow's blood calcium is low but just not low enough to cause the cow to go down and not be able to get up. Cows with this type of milk fever have sluggish early lactations and are prone to displaced abomasums (DA) and other fresh cow problems.

What happened to the low calcium theory?

The low calcium theory is still valid but not practical. The diet needs to be so low in calcium that the cow's calcium regulating hormones are kicked into high gear. If a cow eats more than 20 grams of calcium a day she meets her needs through the amounts of calcium that are absorbed passively. At less than 20 grams per day the hormones (parathyroid hormone and metabolites of vitamin D) kick into gear special "pumps" that bring more calcium into the blood stream from the gut and bone. When the cow calves these pumps are primed and ready to go and prevent the blood calcium from getting low. The problem with this method of preventing milk fever is that diets that low in calcium just do not occur. If a cow receives greater than 20 grams of calcium she meets her needs without these special pumps and so, with moderately low levels of calcium, the theory does not prevent milk fever.

Tell me more about the Calcium level?

The optimum level of calcium has been a controversial topic for years. The old method of trying to feed low levels of calcium and the new method of balancing for DCAD do not mix. The way low DCAD diets prevent milk fever is by increasing the flux of calcium through the cow's body. If a very low level of calcium is fed she may be even more prone to milk fever. There have been anecdotes of trouble with corn silage based diets balanced for a negative DCAD. An early suggestion was that greater than 150 grams per day is needed. A study presented by Dave Beede at the 2001 ADSA meeting in Indianapolis suggests that there is no difference in milk fever rates between large ranges of calcium level (0.47% – 1.95% of ration DM), although at the higher levels of calcium dry matter intake was lower. From this study it appears that 0.5% t0 1.0% Calcium is adequate to prevent milk fever.

How does balancing for DCAD prevent milk fever?

A diet balanced for DCAD prevents milk fever by causing the cow's blood to become very slightly acidic. This makes the main hormone that controls the blood level of calcium (parathyroid hormone or PTH) work better.

How long have diets been balanced for DCAD?

Researchers in Norway (Ender and Dishington) had the whole theory pretty well worked out in the 1960's. They fed silages that had been preserved with hydrochloric acid and sulfuric acid to close-up cows and showed a great decrease in milk fever rates. Although this research was very well done the idea did not catch on at the time. Low calcium diets had been shown by research to prevent milk fever and became the most common method to address the problem. Research efforts were aimed at hormone shots like vitamin D derivatives and PTH. And besides who wanted to feed their cows acid? It seemed dangerous, harsh and just plain weird.

The idea died until the late 1980's. Researchers like Elliot Block in Montreal, Gary Oetzel and Jerry Olson in Colorado, Jesse Goff in Iowa, and Dave Beede in Florida showed that the salts of chloride and sulfate also worked. These salts became known as anionic salts. The idea took off in the early 1990's. These researchers and others fine tuned the concept and wrote articles on step-by-step methods to incorporate the balancing of DCAD into close-up cow diets.

How should rations be balanced for DCAD?

Step #1: Test all feeds for sodium, potassium, calcium, magnesium, chloride, sulfur, and phosphorus, along with the more typical nutrients like protein, fiber, and energy.

Step #2: Choose feeds relatively low in sodium, potassium and phosphorus; and relatively high in chloride and sulfur that balance for protein, energy, and fiber according to the nutritionist's specifications.

Step #3: If a calcium source is needed add calcium sulfate until Sulfur reaches desired level.

Step #4: Add a chloride source like SoyChlor until DCAD is –100 meq/kg

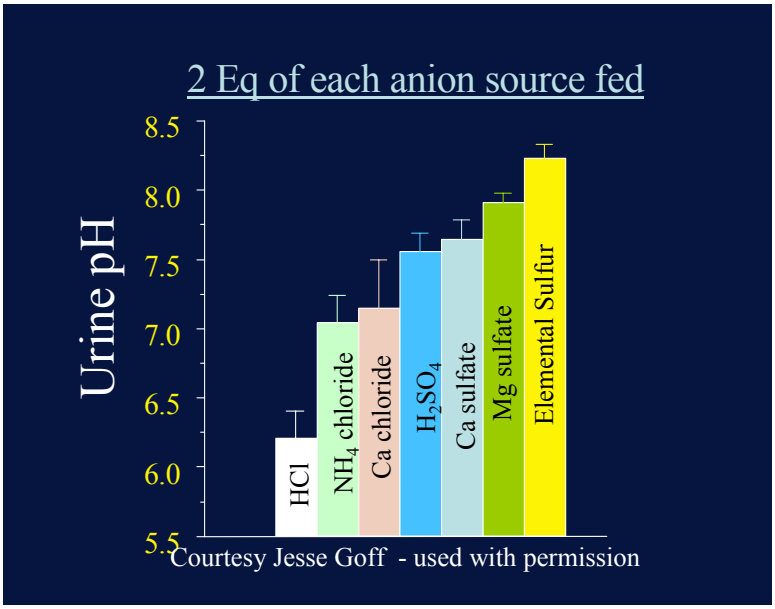
Step #5: Make sure Phosphorus is low (30 –50 g/day), Calcium is medium (1 –1.2% of DM), and Magnesium is around 0.4 % of DM. The K/Mg ratio should be less than 4:1.

Step #6: Add fat-soluble vitamins and trace minerals

Step #7: Monitor effectiveness with urine pH and milk fever rates.

What are the best sources of Chloride and Sulfur?

The following graph summarizes research by Jesse Goff. Note that chlorides are better acidifiers than sulfates and elemental sulfur does not acidify the urine at all. The best acidifier is hydrochloric acid.



So what are the advantages and disadvantages of the different SoyChlor products?

SoyChlor 37 was the original recipe. It was discontinued in 2002. The disadvantage of this product was that it was difficult to titrate the proper amount using urine pH because the diet CP changed drastically with small changes in inclusion rate. Another disadvantage is that it was not as high in chloride and was higher in sodium and potassium than the newer products.

SoyChlor 16 was the next SoyChlor introduced. Great effort has been made to start with ingredients very low in sodium and potassium. We even pay for a special run of distiller's grains without the solubles. We also insist on beet pulp without molasses added. Distiller's solubles and molasses are high in potassium and sodium. SoyChlor 16 contains only about 0.67% potassium on a 100% DM basis. This is of great benefit when trying to dilute out the potassium in high potassium rations. Titration of amount fed to the optimum urine pH is easy. Whether a nutritionist wants to balance for 12% or 18% CP small changes in amount fed will not greatly influence the energy or CP level of the diet.

SoyChlor 16-7 was the last SoyChlor introduced. It is very similar to SoyChlor 16. When introduced in 2000, the only difference was that it contained two sources of chloride, hydrochloric acid and calcium chloride. The product was thus higher in both chloride and calcium. It is used by nutritionists looking for a smaller inclusion rate and an increased calcium level.

We have since succeeded in improving SoyChlor 16-7. Working with engineers and our experienced production staff we are now able to utilize hydrochloric acid as the sole chloride source while maintaining calcium levels to the original specifications. With the most chloride from HCl, SoyChlor 16-7 is the most effective anionic supplement available. It is the SoyChlor with the most economical source of chloride.

Why do you consider lower crude protein an advantage?

SoyChlor provides the dairy nutritionist with a versatile source of palatable chloride. Some of our competitors are stuck with only one high protein, high NPN product. We believe in giving the nutritionists choices.

Many other products available today are limiting to nutritionists, in that they have high protein and NPN values. West Central Soy is committed to aiding nutritionists with a selection to better meet individual dairy needs.

The level of crude protein needed by the close-up cow is currently a controversial topic. Most evidence points toward a fairly low crude protein diet (12%) as being best for close-up cows. The protein needs are really quite low and energy must be used to detoxify the extra ammonia. The negative effects are probably worse for sources of non-protein nitrogen. Heifers on the other hand require more crude protein because they are still growing. For more details see Pages 186-188 of the 2001 Dairy NRC.

Companies that make high protein supplements for close-up dairy cattle have downplayed the real science that went into the NRC recommendations. West Central Soy could have taken that tact because our main goal is to market soybeans, but have chosen instead to give nutritionists a more versatile tool. By introducing SoyChlor 16 and SoyChlor 16-7 to the market West Central is telling the dairy industry that it is willing to keep up with the most recent ideas of dairy nutrition.

How do you use urine pH to monitor DCAD?

Normal Cow urine has a pH of about 8.0 – 8.5. As chloride and sulfur are added to the diet the urine pH drops. Somewhere in the range of 6.0 – 7.0 is optimum. Values under 6.0 indicate that too much SoyChlor is being fed. Values around 5.0 indicate that way too much is being fed and the cows may actually be at risk for increased negative health problems. It is definitely not a case where more is necessarily better. Values above 7.0 tend to indicate that not enough SoyChlor is being fed although the high values could also be due to other problems (feeding errors, high potassium feeds, accidentally feeding sodium bicarbonate, etc…). Be careful not to over interpret the results.