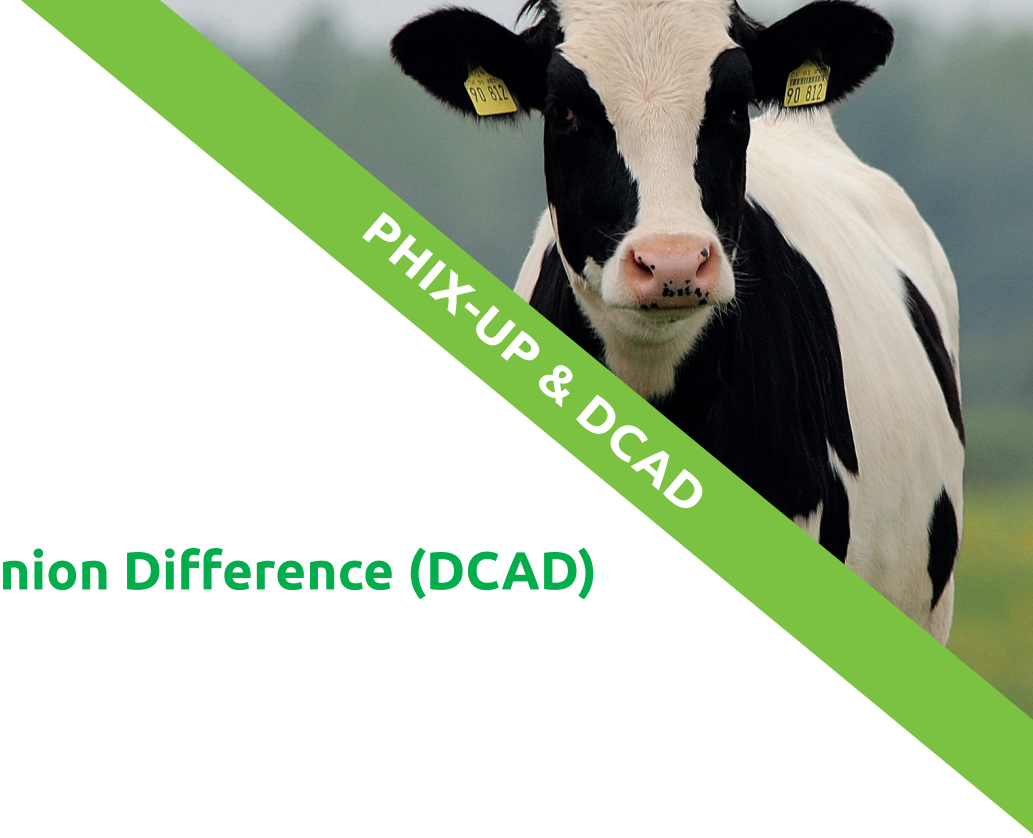

PHIX-UP
& Dietary Cation-Anion Difference (DCAD)

WHAT IS DCAD ?

Dietary cation anion difference (DCAD) depicts the relative balance between the most important cations (K, Na..) and the most important anions (Cl, S..) in dairy rations.

DCAD has an important effect on the acid-base status of cows. A positive DCAD is desirable for lactating cows. However, the use of DCAD as a proxy for the acid-base status of the animal is inaccurate.

First, DCAD equations are not consistent among nutritionists and nutrition software used to formulate rations. Most account for Na, K, and Cl, some include S, and a few include Ca, Mg, and P. Thus, very different DCAD values can be obtained from different software. However, including the multivalent minerals such as Ca, Mg, P, and S in the DCAD calculation faces the challenge of including a large variation from the bioavailability of these ions compared with that of Na, K, and Cl. **Thus, nutritionists need to be aware of the drastic difference in DCAD values that are reported in formulation programs (based on the way DCAD is calculated).**

Also, because acid-base is only affected by those cations and anions that are ultimately absorbed, it depends not only on DCAD but also on rumen pH and bioavailability of minerals in the ration. For this reason, the best option to assess acid-base in ruminants is to monitor urine pH (an ideal urine pH in lactating cows would be ≥7.70).

WHY DCAD IS IMPORTANT ?

Manipulation of dietary cation anion difference has been an important tool for dairy cattle rations. **The most important and well defined role of DCAD is associated with its effect during the close up period,** while negative DCAD is used to reduce the incidence of hypocalcemia (milk fever) after parturition (1).

In contrast, research concerning the lactation period has focused on the benefits of having a positive DCAD. However, the role of positive DCAD and targeted values are not well understood nor well established. For example, a common strategy to increase DCAD in the diet is adding sodium bicarbonate or potassium carbonate. The most relevant **conclusion was that the tendency towards increased milk yield and the increase in feed intake were most likely due to changes in ruminal pH, feed digestibility, and ruminal volatile fatty acid concentrations.**

With regards to **targeted DCAD in a lactating cows diet**, the literature has indicated that production benefits correlate with having a **DCAD ranging from 25 to 30 mEq/ 100 g** dietary dry matter. As Several studies indicate that a DCAD above 25 to 30 mEq/100g of DM have no further benefits on feed intake.

More information on the white paper

ACID-BASE STATUS IN DAIRY CATTLE: A PRACTICAL PERSPECTIVE

by Alex Bach

IMPACT OF PHIX-UP ON DCAD ?

When sodium bicarbonate is replaced by pHix-up, the DCAD will be decreased. However, it is important to properly quantify the decrease and identify the possible impact.

There are several ways of determining DCAD. The DCAD equation cited by Ender et al. (1962) and used by Block (1984) is the one most commonly applied in ruminants. This equation considers the four main anions and cations:

$$DCAD, mEq/kg = (Na^{+} + K^{+}) - (Cl^{-} + S^{2-})$$

But, later, Horst et al. (1997) and the NRC (2001) recommended to account for the effect of bivalent cations to calculate DCAD with the following equation to account for the strength and bioavailability of Ca, Mg, and S:

$$DCAD, mEq/kg = (0.15\ Ca^{2+} + 0.15\ Mg^{2+} + Na^{+} + K^{+}) - (Cl^{-} + 0.6\ S^{2-})$$

This equation was later amended by Goff (2000) accounting for the contribution of P^{3-}.

Based on the last equation, pHix-up has a DCAD of 620 mEq/ 100 g and, therefore, should be accounted for in the DCAD balance of the final ration.

Table 1: DCAD value for most common feed ingredients used to increase DCAD value

ITEM	DCAD (mEq/100g) [a]
Potassium carbonate	+ 1.440
Sodium bicarbonate	+ 1.170
pHix-up	+ 620

[a] DCAD calculated using Goff Horst (1997).

OUR RECOMMENDATION ON PHIX-UP AND DCAD :

Concerns about potentially hampering dry matter intake if dietary sodium bicarbonate is removed seem only justified if DCAD falls <280 mEq/kg of DM. Also, if pHix-up (high availability magnesium based product) is used, then rumen pH is likely to increase, and that in turn, should increase the acid-base status of the cow due to an increased supply of Mg and an improved digestibility of the ingredients consumed.

So, if DCAD is above 280 mEq/kg of DM, sodium bicarbonate can be reduced until a DCAD is 280 mEq/kg of DM, and **even if it goes below this value, dry matter intake could be brought up by increasing the supply of sodium chloride** (less expensive than sodium bicarbonate) which will increase the palatability of the ration and help maintaining or even increase intake. An optimum level of sodium chloride in dairy rations is 80-100 g/d, or around 0.3-0.5% of the ration (in a DM basis).

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