Choline or betaine – key aspects in the formulation of premixes and compound feed

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Interchangeability of choline chloride and betaine

Choline and betaine are both known as methyl group donors. In most diets, sufficient native choline is available to fulfil specific choline needs. Added choline chloride has the function of increasing the availability of methyl groups. Since choline has to be oxidized to betaine first, the latter is a much more efficient supplier of methyl groups. Efficiency studies using the betaine concentration in the liver as an indicator for the availability of methyl groups, showed that choline has a bioefficiency in supplying methyl groups of 55 % compared to betaine. Together with a higher molar weight of choline chloride, betaine is 2.17 times more efficient in donating methyl groups compared to choline chloride.

Effects on feed formulation

Poultry diets should contain balanced dietary electrolytes to achieve optimal performance. Since potassium, sodium and chloride are the decisive substances for calculating the electrolyte balance, the addition of choline chloride affects them. The dietary electrolyte balance (DEB) is expressed as mEq/kg dry matter and calculated by mmol/kg K^+ + mmol/kg Na^+ - mmol/kg Cl^-. High performing broiler diets typically have a DEB of + 250 mEq/kg dry matter and 150 mg chloride coming from 1 kg choline chloride 60 % will reduce the DEB by - 4.2 mEq/kg. Betaine in an anhydrous form has no chloride. Rebalancing the DEB after replacing 1 kg choline chloride 60 % results in the following changes in the diet composition which is shown in table 1:

Raw materials	Diet 1 - Choline chloride	Diet 2 - Betaine
Choline chloride 60%	0.1 %	-
Hepatron® 95%	-	0.029 %
Sodium chloride	0.2 %	0.225 %
Sodium bicarbonate	0.175 %	0.139 %
Required volume	0.475 %	0.393 %

Table 1: Diet complements to provide equal amounts of methyl groups from choline chloride or betaine and rebalanced for sodium and chloride

Due to more efficient methyl group supply higher betaine concentration of Hepatron® 95% and the possibility to use higher concentrated sodium chloride, the volume required to supplement this nutrient is reduced by 0.08 %. This gives more flexibility to reach the high nutrient densities needed by fast growing broilers. In addition, sodium chloride is also less expensive than sodium bicarbonate, which means that the replacement of choline chloride offers a certain cost-saving potential in the supply of sodium.

Practical application of betaine and choline chloride in feed

Choline is always supplemented as choline chloride which is a very aggressive substance to the feed mill equipment. Also, other ingredients in the diet like vitamins can be negatively affected, especially when it is used in combined premixes. Betaine is much less aggressive to both, the fed mill equipment and sensitive vitamins in feed. Betaine anhydrous like Hepatron® 95% shows no aggressiveness to vitamins (figure 2). Vitamin B1 stability was even better than in the premix without addition of choline

or betaine, suggesting that Hepatron® 95% might protect the vitamins from harmful effects of the trace minerals contained.

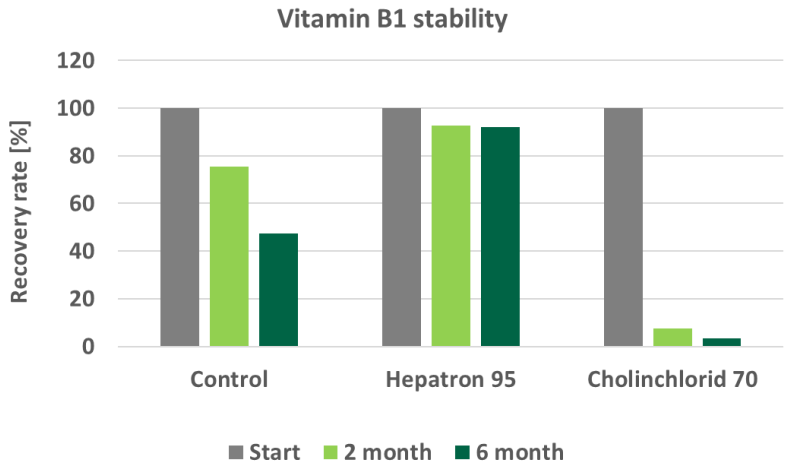

Figure 1: Vitamin B1 stability in commercial premix including betaine or choline chloride (Biochem research 2020)

Hepatron® 95% is an efficient solution for increasing the availability of methyl group with a high flexibility in the application via premixes or directly into the feed mixer. Disadvantages of choline chloride like the aggressiveness to vitamins and the feed mill equipment can be avoided. A further advantage of using betaine anhydrous is the osmolyte effect, which requires an increased dosage of 1 kg per ton in feed and will be partly paid by the choline replacement. By supporting the intestinal osmoregulation, bird's resistance to heat stress and subclinical coccidiosis will be improved. These effects will be discussed more in detail in a later article.