The importance of organic zinc for udder health and disease resistance

by Dr Alfredo J. Escribano and Juan José Mallo. NOREL, Jesús Aprendiz 19, 1, A y B, 28007 Madrid, Spain.

Although required in very small amounts, trace minerals are essential for the diets of highly productive animals such as dairy cows. In particular, zinc is the only metal that is essential for at least one enzyme in all six enzyme classes in the body. This element plays a key role in dairy cow health and immunity during transition, as well as in the development and function of their reproductive organs.

Zinc also intervenes in the synthesis and metabolism of milk components (proteins, carbohydrates, and fats), and is related to the healing of injuries (such as those which occur during the lactation period).

A lack of this mineral is commonly reflected in the loss of appetite and a delay in growth, among other symptoms. Given these implications, zinc is a mineral that must be seriously taken into account when formulating dairy cow diets.

There are different factors that affect ration zinc concentration: zinc content may vary greatly between different feedstuffs and water. Besides, livestock needs for zinc vary according to cows' idiosyncracy, their physiological state, and the environmental conditions to which they are exposed.

Moreover, this mineral is poorly absorbed, and its absorption may be hindered by calcium, phytates, copper, and oxalates; cadmium also acts as a zinc antimetabolite.

	Treatments			
Jung et al, 2013	**Control (100mg/kg)**	**ZnS (100mg/kg)**	**ZnMet (100mg/kg)**	**Sig. (P-value)**
Milk somatic cell count ($x10^3$)	122.00[a]	119.00[b]	118.00[b]	<
Plasma IgG (mg/mL)	23.42[c]	27.10[ab]	27.60[a]	<
Mutoni et al, 2012	**Control**	**Zinc (80mg/kg)**	**-**	**Sig. (P-value)**
Neutrophils (%)	24.61	20.26		<
Lymphocytes (%)	59.02	60.03		<
Macrophages (%)	16.43	19.77		*
Total immunoglobulins (mg/ml)	Lower *	Higher *		<
Milk somatic cell count ($x10^5$)	Lower *	Higher *		<
Salama et al, 2003	**Control (447mg/kg)**	**-**	**ZnMet (684mg/kg)**	**Sig. (P-value)**
Mastitis incidence (%)	15		5	>
Positive samples	6		1	>

[a, b, c] Means in a row not sharing a common superscript differ (P<0.05)
* Data not available in the original article

Table 1. Effect of different forms of zinc on immune response and mammary health indicators.

Protect against undernutrition

Due to the aforementioned issues, rations must take into account such variations, in order to protect livestock against under-nutrition with regard to this mineral; which can be achieved by adhering to the following suggestions.

Firstly, it is important to reduce the mineral's interactions at the gastrointestinal level, which may be achieved by using organic minerals. Thereby, we will be able to assess not only the total amount of mineral given, but also its bioavailability. In this sense, organic sources are used more often (especially proteinates, methionates and glycinates) than non-organic sources, since mineral absorption of the latter is believed to be lower. Secondly, farmers and nutritionists must determine the optimum level and source of trace minerals for each specific situation and feed their animals with tested and evaluated rations to ensure that the levels of supplementation are suitable.

Thus, despite the recommendation of the different feeding systems (NRC, UFL, VEM, among others), some adjustments must be carried out at the farm level for every single case.

Zinc nutrition is especially important during the transition from pregnancy to lactation, since this period is a metabolic challenge with almost instantaneous, several-fold increases in the amount of minerals required by the cows.

As this period is critical to the welfare and profitability of individual cows, deficiencies in either nutritional or non-nutritional management increase the risk of infectious diseases, and, hence, of economic losses. Immunological and metabolic dysfunctions appear to be the primary reason for the high prevalence of postpartum diseases.

Fortunately, there is evidence that these diseases have their onset before calving and

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that suitable nutritional management in the transition period may help to alleviate this issue. Due to this, the provision of adequate zinc nutrition during such periods may be used as a strategy to enhance the cows' immunity against disease.

Zinc's role

Mastitis is a highly morbid disease that negatively affects the production longevity of dairy animals and leads to noticeable reductions in the profitability of the dairy industry worldwide.

Further, mastitis also affects human health and environmental quality as this disease increases farms' reliance on antibiotics. Moreover, mastitis tends to become chronic and some infections are readily transmitted, creating a difficult problem to solve. Due to the disease's far-reaching implications, it is necessary to prevent mastitis.

Prevention may and must go hand in hand with suitable animal nutrition, given that some organic trace minerals, such as zinc, play a central role in the immune response to mammary and reproductive infections.

In fact, some researchers suggest that organic forms of zinc may affect mammary gland health status. Micronutrients are part of proteins with specific functions at the immune system level. Zinc is usually bound to metallothionein, whose effects are related to the proliferation, adherence and invasivity of macrophages. Zinc blood concentrations often decrease around calving and when animals go through mastitis. Moreover, animals' requirements vary, and supplementation with zinc around the peripartum period can boost immunity and prevent mastitis. Therefore, this practice is beneficial in this period of time.

Due to this finding, security margins (supplementation above feeding systems' guidelines) are recommended, since it leads to better udder health, and reduced milk SCC.

Moreover, this supplementation increases the total colostral Immunoglobulins, neutrophils and lymphocytes percentage, as well as reducing macrophages percentage and SCC (as can be seen in Table 1).

As a consequence, newborns' health and survival rates may improve. In fact, if zinc is partially or totally substituted with organic trace minerals, mortality at calving, the number of subclinical mastitis, and the average SCC are lower.

However, some studies showed conflicting results in relation to the influence of organic trace minerals on mammary gland health. Therefore, it is not possible to compare results among some of the studies, due to the fact that there was variation among the levels of zinc administered, their form, the control diet, and the animals' previous diet.

Given these findings, the importance of zinc in udder health must be taken into account, as well as the higher bioavailability of organic minerals, when determining an animal's diet. The use of organic zinc is justified as a strategy to deal with issues related to udder health. In this sense, the combination of zinc with glycine is very interesting; some studies suggest that zinc bioavailability from zinc glycinate (ZnGly) may be higher than zinc alone.

Conclusions

Zinc is a trace mineral essential for udder health and must be addressed with serious consideration to ensure that animal dietary requirements and feedstuff content is precisely assessed.

The level of dietary zinc in feed, as well as its form, is crucial for success due to the fact that both factors influence the mineral's absorption and bioavailability. In this sense, organic salts lead to better results with regard to the binomial udder health-milk quality (mastitis and somatic cell count). Within this group of salts, ZnGly appears to have a higher bioavailability, thus, it may be of recommended use. ■

References are available from the author on request