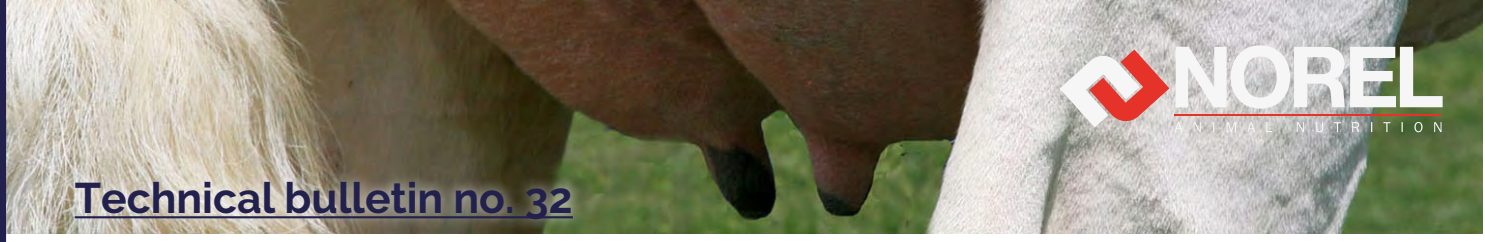


Technical bulletin no. 32

Relationships between udder resistance and dietary levels of copper and zinc

Alfredo J. Escribano, Product Manager for ruminants at Norel S.A. (Spain)

INTRODUCTION

Providing the correct amounts of trace minerals in diets must begin with a precise assessment of animals' requirements. Physiological status like gestation and lactation are really important phases during which requirements of trace mineral increase above maintenance

Another important factor is the bioavailability of the source employed. Bioavailability is determined by both minerals source and diet composition. In terms of chemical sources, two main groups can be found:

- sources of inorganic minerals such as oxides or sulphates
- organic trace minerals (OTM), in which minerals are bounded with an organic molecule (i.e. methionine, glycine, peptides, etc.)

The presence of certain compounds in the diet, such as phytates, may reduce the absorption of minerals found in the diet. This is due to phytic acid reaction with minerals, which forms insoluble salts, leading to drastical reduction in minerals absorption. The use of OTM, where minerals are bound to organic molecules, prevents the reaction with phytates and ensures maximum bioavailability

Other components present in diets, such as organic acids, could also interact with minerals, forming specific complexes that could increase minerals absorption

OTM is a good choice to adjust mineral inclusion to animal requirements, thus reducing both minerals excretion in faeces and environmental pollution

MASTITIS IN HEALTH

Mastitis and Somatic Cell Counts (SCC) constitute the main health issues in dairy cows farms, since they are widespread and lead to high economic losses. Although most of the efforts toward mastitis prevention have focused on management practices, nutritional relationships to host defense mechanisms have led to the idea of increasing the resistance of dairy cattle to mastitis through nutrition (Scaletti *et al.*, 2012). Copper, and specially zinc, have been shown to increase cows resistance to mammary infections

Hillerton JE, Berry EA, Treating Mastitis in the cow. *J. of Appl. Microbiol.* 2005; 98: 1250-5

In particular, zinc is directly related to the healing of injuries (such as those which occur during the lactation period). Furthermore, zinc deficiency leads to impaired immunity, causing disorders; i.e. mastitis (McDonald *et al.*, 2010)

Moreover, cows supplemented with zinc showed to have better immunity and lower SCC (Mutoni *et al.*, 2013; Jung *et al.*, 2013). Furthermore, Salama *et al.* (2003) observed that both mastitis incidence and positive samples to uddder infections tended to be reduced after supplementing dairy goats with zinc

With regard to copper, there is less information available in the scientific literature. However, there are some insights that could be giving clues about important effects of copper on udder resistance, that could have been undervalued so far. Thus, some authors documented the beneficial effects of copper on the immune system of both dairy cows (Stabel *et al.*, 1993; Harmon *et al.*, 1994; Harmon, 1998) and heifers (Harmon *et al.*,1994; Torre *et al.*,1996). Specifically, Scaletti *et al.* (2012) observed that dietary copper reduced the clinical response to *Escherichia coli* mastitis in first-lactation Holstein heifers, as well as lower milk bacterial count, SCC and peak rectal temperature

These findings are of great importance, since could be showing that supplementing cows with copper is an efficient strategy to prevent mammary gland disorders. If so, this may also help to reduce the use of antibiotics that are not efficient to treat colifom mastitis, but are still commonly used

It is necesary to mention that divergent results can be found with regard to effect of copper on udder resistance. Thus, Scaletti *et al.* (2012) found that cows supplemented with copper tended ($p<0.06$) to have less quarters negative to infection than those belonging to the control group (50% vs. 67%). On the contrary, Harmon *et al.* found contradictory results between their own studies (1994 and 1998) with regard to the abovementioned parameter. Due to such divergence in the results, Scaletti *et al.* (2012) concluded that infection status at calving may vary between trials depending on copper source or amount of copper supplemented. Hence, the potential effect of copper on the mammary gland's health remains still unclear but promising

Within this context, the present study was aimed at shedding light on the relationship between level of dietary copper on udder health parameters. However, the levels of zinc were also included in order to both deepen in such relationship and to compare the effect of copper and zinc on these parameters

OBJECTIVE

To evaluate the relationship between the level of dietary zinc and copper, and udder health parameters

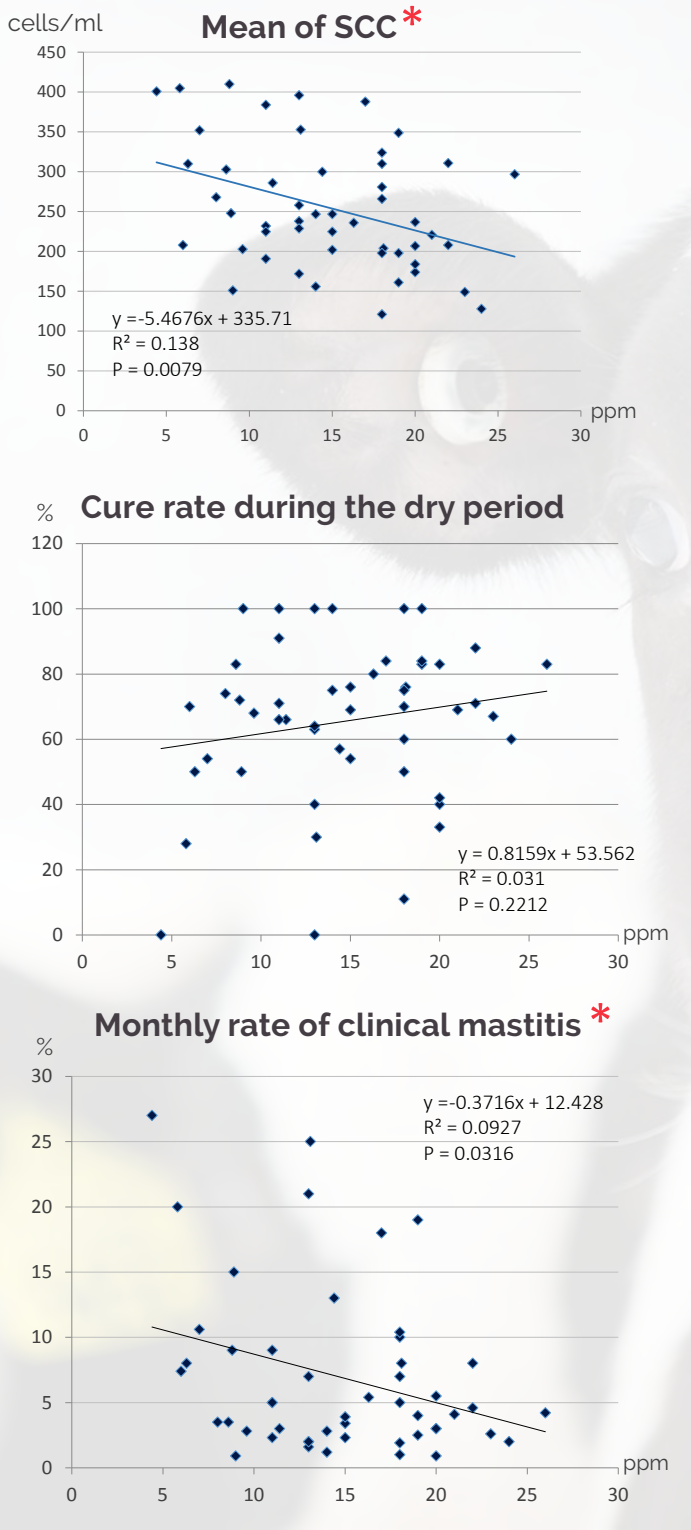
MATERIAL AND METHODS

- 55 farms representative of the Spanish dairy cattle sector were selected
- The statistical procedure followed was based on bivariate correlation analysis
- The average number of cows per farm was 160 and average milk yield per cow was 33 liters/cow/day
- Cows were housed in cubicles and dry lots, and they were milked two or three times a day
- Samples regarding udder health parameters were taken monthly during the course of year 2014 (from February to the end of November)
- Diets were nor changed, so that they were sampled once

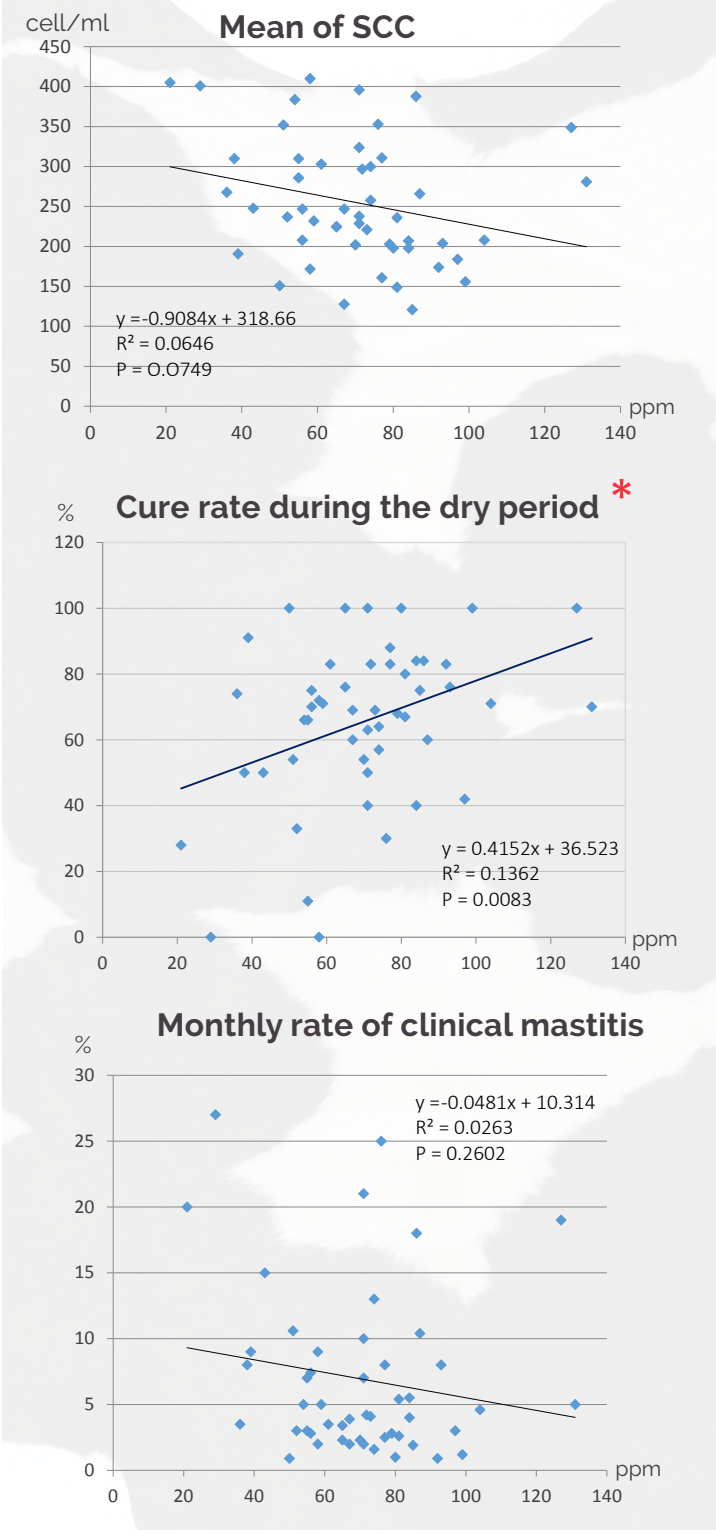
RESULTS AND DISCUSSION

Interestingly, from all analysed parameters, it has been observed that the effect of Zinc had a lower impact on udder health parameters than copper. Some researchers have already observed an important role of dietary copper in enhancing resistance to mastitis (Scaletti *et al.*, 2003)

Correlations with copper



Correlations with cinc



These results could be showing interactions between minerals levels and other dietary compounds. Also, as levels of Zinc were above the recommendations, a low response to increasing Zinc levels was found. On the contrary, as not all diets were satisfying animals' needs for copper, higher responses to the level of this mineral were found

CONCLUSIONS

Further research is needed to have a deeper knowledge about both minerals interactions with udder health. In order to feed animals efficiently, the use of organic (chelated) minerals is recommended, and a combination of chelated copper and zinc would be of interest

Norel, S.A. CIF: A-28617801 · C/Jesús Aprendiz, 19 1º A y B, 28007 Madrid · SPAIN +34 915 014 041 · www.norel.net · info@norel.net

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