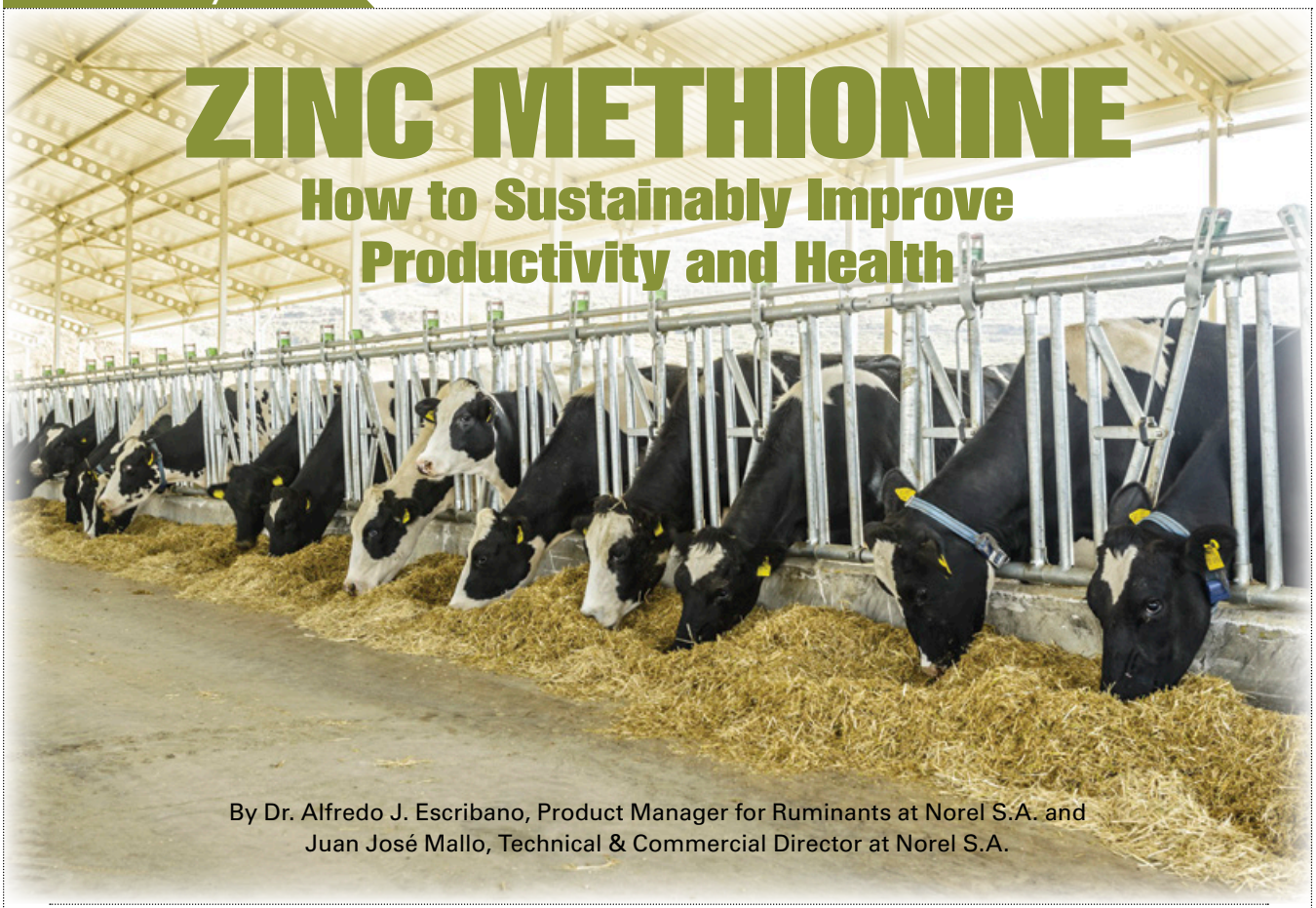

ZINC METHIONINE

How to Sustainably Improve Productivity and Health

By Dr. Alfredo J. Escribano, Product Manager for Ruminants at Norel S.A. and Juan José Mallo, Technical & Commercial Director at Norel S.A.

Chelated Minerals: Increasing Trace Minerals' Bioavailabitly And Farms' Sustainability

It is very important to assess the nutritional requirements precisely, since degradations and interactions in rumen play an important role in the quantity of nutrients that will be really available for being absorbed at the intestinal level. Specifically, the interactions between minerals and other elements of the diet are noteworthy. Due to these critical interactions, the use of 'organic' (or 'chelated') minerals is a recommendable strategy, since most researchers have come to the conclusion that organic forms of minerals increase their absorption, retention and, as a consequence, also their bioavailability.

Thus, Spears (1989) found that that apparent retention of Zinc was higher in lambs supplemented with Zinc Methionine (ZnMet onwards). According to Spears (2003), Zinc absorption from some organic Zinc sources appears to be higher than those from inorganic Zinc sources, when supplemented at high concentrations. Salama *et al.* (2003) found greater apparent Zinc digestibility, apparent absorption and retention in the ZnMet group. In line with these results, Spears *et al.* (2004) found that ruminal soluble concentrations of Zinc were higher in steers supplemented with ZnMet or Zn Glycine (which means more available Zinc for absorption). As a consequence, a higher Zinc presence has been also observed in the blood and organs (Kinclaid *et al.*, 1997; Cao *et al.*, 2000; Wright and Spears, 2001) of animals fed high concentrations of Zinc proteinate in comparison to the Zinc concentrations observed in animals supplemented with Zinc sulfate. These results indicate a higher mineral availability for metabolic functions.

Moreover, as Zinc retention in animals fed ZnMet is higher, urinary excretion of Zinc tends to be lower (Spears, 2003), thus reducing the environmental impact caused by minerals. This also means that organic minerals have a role to play in terms of environmental sustainability, which is of great relevance since limitations on the use of minerals are increasing with the aim of reducing the environmental pollution of the livestock sector. In this sense, it has been observed that when organic minerals are given to livestock, the amount of minerals secreted is lower (table 1 on page 12).

Moreover, it must be noted that the use of ZnMet has proven not only to improve Zinc utilization, but also that of nitrogen (N), thus reducing its excretion (table 1). For instance, Spears (1989) observed that heifers fed ZnMet had lower plasma urea N than those receiving Zinc Oxide, suggesting greater utilization of amino acids for protein

Table 1. Effect of different forms of Zinc on indicators related to absorption, retention and bioavailability of Zinc and nitrogen.

Parameter	Control (447mg/kg Zn)	ZnMet (684mg/kg Zn)	Sig. (p-value)	
Apparent absorption (%)	12.1	19.1	ns	**GOAT[1]**
Retained Zinc (g/day)	21.4	52.5	ns	
Nitrogen fecal excretion (mg/day)	13.6a	10.9b	<	
Apparent N absorption (%)	71.3a	76.0b	<	

a, b, c Within a row, means without a common superscript letter differ (p<0.05). < means p<0.05. ns: not significant differences were found (p≥0.05). 1 Salama *et al.* (2003)

synthesis in animals fed ZnMet. According to these findings, Salama *et al.* (2003) found lower faecal N in animals fed ZnMet, which means that N retention tended to be higher in this group. Thus, protein utilization was improved by the ZnMet supplement.

Nitrogen excretion is worthy to mention because the livestock sector is a major contributor to the Climate Change due to their emissions of greenhouse gasses annually (18% of the anthropogenic GHG emissions), which in a high degree are related to nitrogen emissions of livestock farms, since nitrogen has GWP (Global Warming Potential) as high as 298 CO2 equivalents (Steinfeld *et al.*, 2006). These authors estimated that of all anthropogenic nitrous oxide emissions, the agricultural share is 65 % of all emissions, from which most of them come from the livestock sector, and particularly, from manure management. Specifically, manure management and use accounted for the 73% of the CO2 equivalents emitted by the agricultural sector in 2010 (FAO, 2012).

EFFECTS OF DIFFERENT FORMS OF CHELATED ZINC ON MILK PRODUCTION

Apart from the bioavailability issue, organic minerals have shown positive effects on milk production in the majority of the studies. In this sense, Kellogg *et al.* (2004) indicated that ZnMet increased lactation performance (produced more milk, energy-corrected milk and fat-corrected milk). El Ashry *et al.* (2012) showed that cows fed a combination of Zn, Co and Mn methionates had milk fat and protein percentages (both approx.7%) and milk yield (11%), than those fed inorganic trace minerals with the same level of supplementation to cows: Zn (15 mg/kg), Mn (20 mg/kg) and Cu (10 mg/kg). Nocek *et al.* (2006) also compared the effect of a combination of different minerals in the inorganic form against its organic counterpart, and found similar effects. Later, Cope *et al.* (2009) found that dairy cows fed recommended levels of organic Zinc increased their milk yield (from 35.2 to 37.6 kg/day) with respect to recommended daily levels of inorganic Zinc (300 mg of Zinc/kg) according to NRC (2001). Finally, (Somkuwar *et al.*, 2011) found that minerals chelated with Zinc improved the milk yield, net gain in milk and the milk fat percentage of animals across the various stages of lactation as compared to in control and inorganic mineral treated group of animals. Moreover, Jung *et al.* (2013) observed an increase in 4% fat corrected milk (kg/day) when ZnMet was used.

Another issue must be addressed from the social point of view (food safety and public health): The need of reducing the use of antibiotics. In this sense, the increase of udder health and resistance is of great relevance as this leads to lower incidence of mastitis and lower reliance on veterinary medicines. This can be achieved by the use of ZnMet, since many authors have shown that plasma IgG tends to be higher (Jung *et al.* 2013), while mastitis incidence (Salama *et al.*, 2003), and milk somatic cell counts (Jung *et al.*, 2013) tend to remain lower. All these aspects are summarized in figure 1 (opposite).

Table 2. Effects of the supplementation with different Zinc forms on milk fat %.

	Treatments				
Parameter	**Control** (100 mg/kg)	**ZnS** (100mg/kg Zn)	**ZnMet** (100mg/kg Zn)	**Sig. (p-value)**	
4% fat corrected milk (kg day-1)	27.90a	29.20b	29.80c	<	**DAIRY COWS[1]**

a, b, c Means in a row not sharing a common superscript differ (p<0.05). < means p<0.05. 1Jung et al. (2013)

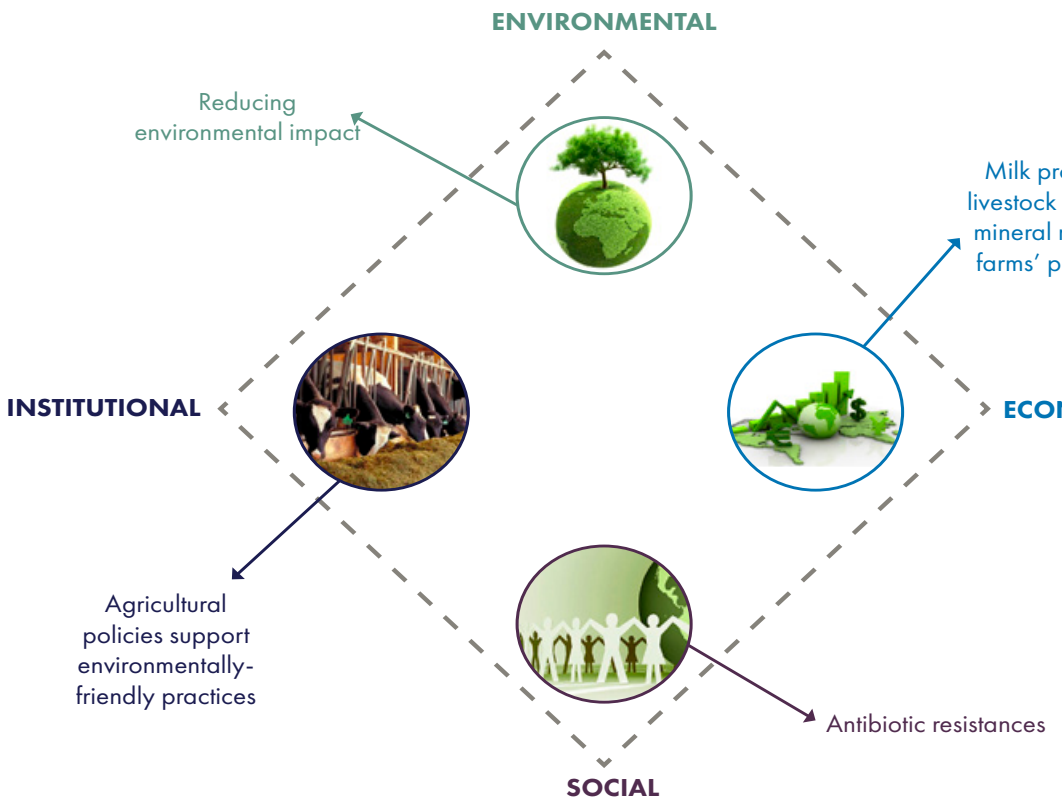

Figure 1. Organic minerals role on sustainability: goals and issues according to sustainability dimensions.