Trace minerals: consider the source of these essential nutrients

Trace minerals such as copper (Cu), zinc (Zn), manganese (Mn) and selenium (Se) are of great importance for optimal health and performance. An optimal trace element supply, provided by a high quality source of trace minerals, is necessary to avoid deficiencies and associated health issues.

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New generation trace minerals (hydroxy Cu, Zn and Mn and L-selenomethionine) are highly available to the animal. They contribute to a secure trace mineral supply to the animal, which results in improved animal health and performance.

Characteristics of high quality trace minerals

An important characteristic of high quality trace mineral sources is the availability of the trace element at the right place, at the right time, where it can be absorbed by the animal.

For ruminants, low levels of reactive trace elements, specifically Cu and Zn, in the rumen is required for a good fibre fermentation and volatile fatty acid (VFA) production by the rumen microbiota. In a recent in vitro trial, this low reactivity of hydroxy Cu and Zn was demonstrated.

In a simulation of rumen fermentation, the influence of multiple sources of Cu and Zn were tested, at a dosage providing from each source the same additional level of Cu and Zn. Of all sources tested, the hydroxy trace elements were the only ones that did not influence the total VFA production during fermentation (Fig. 1).

For the sulphate and for the three tested organic sources (glycinate, amino acid-complex and proteinate), a significant decrease in total VFA production was observed compared to the unsupplemented control, indicating inhibition of fermentation by trace element reactivity.

Under practical circumstances, impaired efficacy of the rumen microbiota by toxic antimicrobial effects of soluble, reactive Cu and Zn, will result in lower ruminal fibre fermentation, reduced animal performance and health.

An important characteristic of L-selenomethionine, on the other hand, is its ability to circumvent the reducing power of the Se reducing

microbes that reside in the rumen. These organisms are able to reduce, specifically, inorganic Se into elemental Se which is non-soluble and therefore excreted to a high extend. This reaction explains why inorganic Se is not able to fulfil the nutritional requirements of ruminants.

In a recent ex vivo trial it was proven that when L-seleno-methionine is used instead of inorganic Se sources, this resulted in far less elemental Se formation. Moreover, L-selenomethionine was incorporated to a greater extent into rumen micro-organisms (Fig. 2).

L-selenomethionine is a unique molecule as it has the ability, as an amino acid, to be incorporated into animal and bacterial proteins. Lysis of rumen micro-organisms in the abomasum liberates high quality microbial protein, including L-selenomethionine, which will be readily available for absorption in the small intestine, ensuring a Se reserve in ruminant tissues.

Higher availability as a condition for economic yield

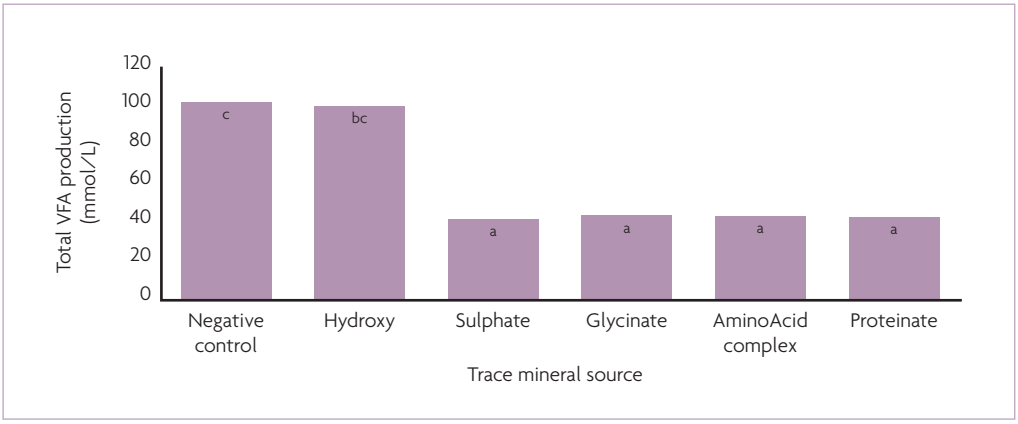
Low reactivity and subsequent high availability are important high quality characteristics of hydroxy Cu, Zn and Mn. As a result, in various animal trials, both under practical and controlled conditions, hydroxy trace minerals show higher rumen fermentation, dry matter digestibility, milk production and (claw) health.

Replacing sulphates, oxides and chelates with hydroxy trace minerals has also shown improved fertility.

This has been expressed as a higher percentage of successfully inseminated cows at first service, reduced interval calving⁄successful insemination and lower percentage of cows needing more than three

Continued on page 22

Fig. 1. Total Volatile Fatty Acid (Total VFA) production during an in vitro fermentation trial where a negative control fermentation substrate was supplemented with five different sources of trace elements. (P<0.05 for different superscripts)



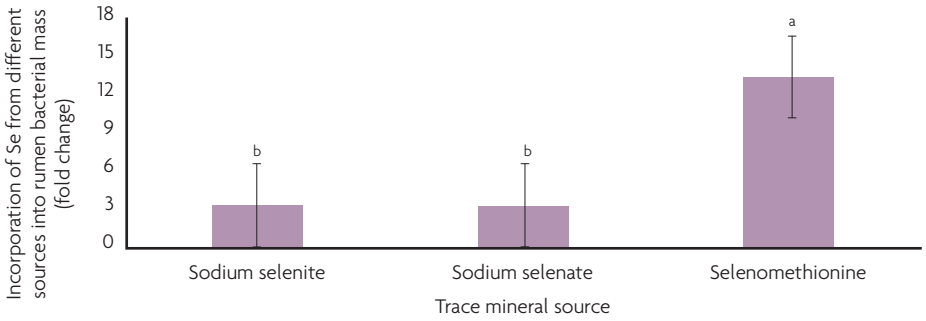


Fig. 2. Incorporation of Se into rumen bacterial mass compared with control (no added Se). Fold change is expressed as ng Se/mL/g bacterial mass. Data are shown as mean ± SEM, with letters indicating significant differences (adapted from Galbraith et al. 2016).

Continued from page 21
inseminations. These fertility improvements result in an important cost saving for the farmer.

Stressful periods (for example, periparturient period, heat, weaning) are plentiful during life and always correlated with an increase in oxidative stress.

To combat this stress the animal is in need of high bioavailable Se. The periparturient period in particular, presents a big challenge to ruminants as they transition from late gestation to early lactation.

The calving process and the increased metabolic activity and energy demand that marks this period, is linked to a high increase in oxidative stress. In literature, it is seen that supplementation of organic Se to Se-adequate cows during late gestation improves antioxidant function in early lactation.

This leads to effective attenuation of oxidative stress. Plasma malondialdehyde, which is a biomarker for lipid peroxidation, and reactive oxygen species (ROS) levels are lowered significantly postpartum with organic Se supplementation.

The plasma total antioxidant capacity (T-AOC) is also significantly improved. These results show that storable Se has a big positive impact during stressful periods. Positive effects for organic Se are also seen for the immune system (neutrophils).

This effect is beneficial in improving the mammary gland health, where the primary defence mechanism is the phagocytic activity of neutrophils, and lowering the somatic cell count (SCC).

Birth to weaning also presents a huge challenge for calves and stress reduction is key.

To enhance the Se status of calves during the first weeks, Se transfer from cows to their offspring via colostrum/milk is essential. When the effect of supplementation of different sources of Se on the Se concentrations in milk from dairy cattle was investigated, L-selenomethionine increased the milk Se level to the highest extent throughout the whole trial period.

Conclusion

To supplement feed with trace elements, it is important to choose a high quality trace mineral source to guarantee the best supply of these essential nutrients to the animal.

Hydroxy trace minerals and L-selenomethionine (Excential Smart and Excential Selenium 4000, Orffa Additives BV, The Netherlands), with no implications for rumen functioning, provide your animals with these nutrients in a safe and optimal way. ■

References are available from the author on request