Patented production process activates zinc to improve calf immunity

A newborn calf has no fully evolved immune system and relies on maternal antibodies for the first two weeks of its life. It will take months until their immune system is fully developed.

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Hulbert and Moisa (2016) observed that it takes 6-8 weeks until the immune system is supportive to providing a health defence. Therefore, young calves are quite susceptible to diseases. Moreover, keeping calves healthy is aggravated by various stress factors, such as:

- Separation from the mother.
- Transport to a calf rearing location.
- Co-mingling with calves from different locations, including running through sale barns.
- Castration and/or dehorning.
- Thermal stress: Cold or heat stress, humidity, rain.
- Disease exposure, especially after re-grouping.
- Nutrition: Change from colostrum, through milk replacer to solid feed.

Proper management can reduce the impact of the above factors on calf health and performance. However, they will most likely cause additional stress on the organism during a period in which the calf is not only developing its own immune system but also its gastrointestinal tract while transitioning from monogastric to ruminant.

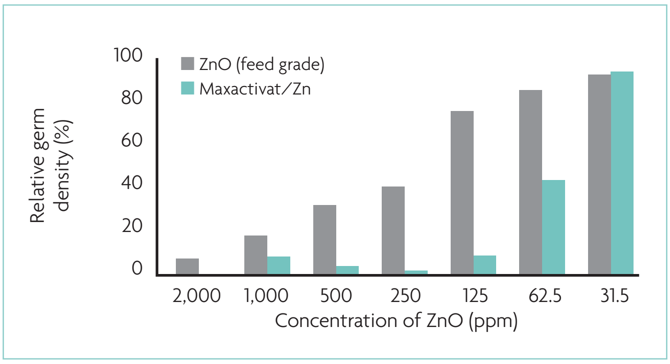

Fig. 1. Density of E. coli germs after 24 hours incubation, depending on ZnO source and dosage.

Importance of digestive health

A healthy gastrointestinal tract and strong immune system are essential to optimise growth performance and overall calf health. Also known as 'scours', diarrhoea is the biggest cause of financial loss incurred in raising calves. A USDA survey reported that 24% of pre-weaned dairy calves experienced diarrhoea while 18% received antimicrobial medication treatment.

The cause of diarrhoea can be both non-infectious or infectious. Non-infectious factors are often thought of as contributing to diseases. Those factors include inadequate nutrition, sub-optimal environment and calving conditions that result in an insufficient colostrum intake.

Infectious causes include exposure to pathogens such as Escherichia coli, salmonella and clostridia; viruses including bovine virus diarrhoea (BVD), coronavirus and rotavirus, infectious bovine rhinotracheitis (IBR) virus and other organisms like coccidia or even yeasts and moulds.

Besides using best management practices, the preventive use of antibiotics is still common in many places in order to obviate problems related to calf diarrhoea. However, this practice is controversial nowadays, as public awareness for subjects like antimicrobial resistance and the one-health approach is rising. Many countries around the world are tightening their legislations regarding antibiotic use in livestock.

Zinc supplementation for neonatal health

Alternative approaches from a nutritional perspective are also needed when addressing diarrhoea prevention. In human infants, and across multiple species, supplemental zinc has shown positive effects to diarrhoea and young animal performance.

Effectiveness against the incidence and severity of diarrhoea as well as improvements in calf performance have been measured.

Several theories exist about the mechanism of action of dietary zinc oxide including having an anti-microbial activity and mucosal-protective role as well as being a modifier of electrolyte secretion and absorption.

Zinc is an essential co-factor in more than 300 metabolic enzymes, it stabilises the molecular structure of cellular components and membranes, and has immune system functions in macrophages, neutrophils and natural killer cells.

Effects of activated zinc oxide

Provita Supplements has developed an activated feed grade zinc oxide: Maxactivat/Zn. By using a patented process, utilising eccentric vibrating

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Fig. 2. Number of animals with therapeutic treatments, depending on ZnO source and dosage.

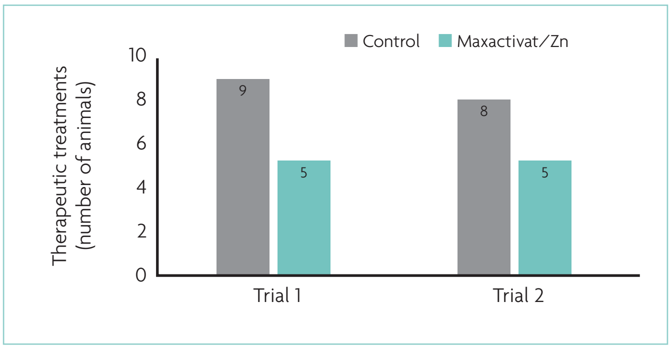
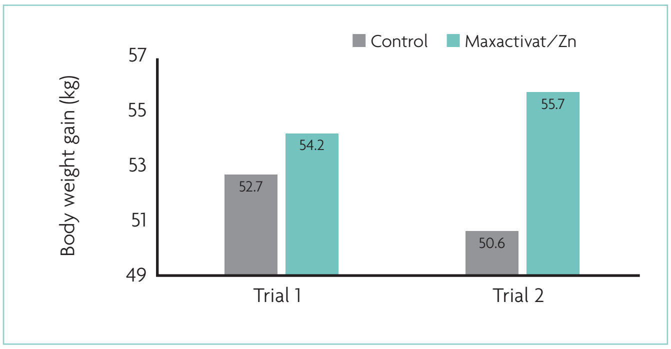


Fig. 3. Performance parameters of different treatment groups in Trial 1 and 2.



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mill (EVM) technology, the zinc oxide molecule is mechanically activated.

The physiochemical properties of the raw material, such as particle size, surface area and the amount of internally stored energy inside the oxide-molecules are modified throughout the process.

When ingested by the animal, Maxactivat/Zn is more reactive than conventional zinc oxides. Furthermore, the antibacterial properties of the material are improved. In-vitro tests have shown that the inhibitory effect of Maxactivat/Zn (aZnO) against E. coli is higher when compared to conventional zinc oxide (ZnO) at the same concentration.

To examine this, the different zinc oxide compounds were brought into suspension at concentrations of 2,000/1,000/500/250/125/62.5/31.5mg/l and were incubated with the test strain of E. coli.

After an incubation period of 24 hours, the germ count was measured in relation to the negative control. At a dosage of 125ppm, aZnO showed better inhibitory effects on the growth of E. coli than the feed grade ZnO at a dosage of 1,000ppm. At a dosage of 125ppm of aZnO, the growth of E. coli bacteria was limited to 8.8% (Fig. 1), relative to the negative control.

	Age (days post arrival) of treatment	Average number of scour days	Calves receiving antibiotic for scours (%)
Control	5.90	5.00	46.3
Maxactivat/Zn	5.60	5.10	38.8

Table 1. Appearance of diarrhoea and antibiotic treatments within the control and treatment group.

Improved immune status in calf rearing

When added to the milk-replacer, Maxactivat/Zn has shown positive effects on both zootechnical parameters and the immune status of suckling Holstein calves.

Two separate trials with 40 animals each were conducted at a trial farm in Northern Germany. In the first trial, the calves were allotted to two groups and fed a milk replacer supplemented with 100ppm feed-grade ZnO (control) and 100ppm aZnO Maxactivat/Zn in the treatment group. During the second trial, the dosage was increased to 135ppm ZnO per group.

As shown in Fig. 2, the calves that received aZnO proved to be more robust, requiring fewer therapeutic treatments with the number of treatments being reduced by 37% and 46% respectively.

In addition, there was a positive effect on zootechnical parameters, such as daily weight gain (Fig. 3) and feed conversion (data not shown).

The body weight gain increased by even more than 10% in Trial 2, while the feed conversion was improved by 2.8%.

North American trial

An additional trial was conducted in North America with 160 Holstein bull calves, 5-14 days of age, sourced from auction barns or directly from approximately 30 various dairy farms.

The health status (serum total protein) was assessed on the calves' arrival.

Treatments were a standard milk replacer (24% protein, 17% fat, no feed additives) or the same milk replacer with Maxactivat/Zn added at 242mg/kg dry milk replacer powder (180mg Zn/kg dry powder).

When allotting calves to the treatment and control groups, the initial immune status on arrival was taken into account.

Calves of both groups were individually housed for the first 56 days, and co-mingled within the same treatment group post-weaning for the remaining 21 days of the trial.

In total, calves treated with Maxactivat/Zn required less antibiotic treatment because of diarrhoea (Table 1). 38.8% of the treatment group individuals needed treatment, while 46.3% of the calves of the control group required the same. Furthermore, calves with a high initial immune status seemed to benefit highly from Maxactivat/Zn supplementation (Table 2).

While the number of animals with high immune status requiring an initial antibiotic treatment with Meloxicam was on a similar level, only 22 animals treated with Maxactivat/Zn needed a second antibiotic treatment with Meloxicam and Trimethoprim + Sulphadoxin, while 31 calves of the control group required the same.

The above observations suggest that Maxactivat/Zn contributes to reducing the use of antibiotics and at the same time improves zootechnical parameters in calf rearing. It can be considered as a viable option for diarrhoea prevention. ■

References are available from the author on request

Table 2. Immune status of animals within the control and treatment groups.

Immune status	Treatment	Total animals (n)	Initial treatment (n) (faecal score 4) Meloxicam	Second treatment (n) (consecutive faecal score 4) Meloxicam + Trimethoprim + Sulphadoxin	Third treatment (n) (consecutive faecal score 4) Meloxicam + Enrofloxacin
High ($\geq$5.2g TSP/dl)	Control	61	45	31	7
	Maxactivat/Zn	61	42	22	7