

The role of OXIDATIVE STRESS in dairy cows

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The enormous metabolic load of high-yielding dairy cows makes them susceptible to oxidative stress. Field trials were conducted to verify whether feeding synthetic antioxidants has an impact on udder health.



In early lactation udder health can be severely compromised by metabolic changes (negative energy balance) as cows are particularly susceptible to oxidative stress during this phase.

Oxidative stress is triggered by harmful reactive oxygen species (ROS), so-called free radicals, which occur during processing and storage of the feed, but also in the animals' metabolism running at full speed. The excess of ROS over the capacity of the endogenous radical defence system (eRDS) is defined as oxidative stress. The result can be cell damage.

THREE TRIALS ON FIVE FARMS

Field trials were conducted to verify whether the eRDS of the cow can be strengthened by the supplementation of suitable antioxidants

to the feed. Antioxidants can render ROS harmless. The idea behind this approach was that by supplementing these antioxidants the quantity of ROS in the feed can be reduced, which in turn leads to a reduction in the load on the eRDS.

Three dairy farms from the region North Hesse and two farms from Saxony took part in the trial. The trial procedure in Saxony was performed in close cooperation with the LKV (regional control authority) resp. LKS (agricultural communication and services) Saxony. The statistical evaluation was carried out by the Anhalt University of Applied Science, Bernburg.

In the three farms in North Hesse a classification of the cows into control and trial groups was not possible, and for this reason the trial was conducted according to an "Off-On-Off" design. The vitamin E content of all feed stuffs available on the farms was analyzed, if this information was not already known from the declaration of the purchased feed. The native contents of grass silage were > 150 mg vit E/kg DM and thereby exceeded by far the usual values of 60 mg/kg DM. For this reason the ration was not calculated using table values as is usually the case, but took the native vitamin E values as per the analysis into consideration. This led to more than double the recommended vitamin E content of the DMR, (> 2.000 mg/kg per cow per day). By reducing the amount of vitamin E added to the mineral feed the vitamin E supplementation of the cows was adapted to the recommended values. At the same time 150 mg/kg DM of a blend of synthetic antioxidants (Loxidan) was added to the DMR, equivalent to 3 – 3.5 g antioxidant blend per cow per day.

Results:

No significant changes and/or. adjustments of somatic cell count (SCC) arose from this substitution of vitamin E by antioxidants. It can thus be assumed that by adding a blend of synthetic antioxidants with an adequate content of vitamin E to the ration the same protection against oxidative stress can be achieved as with diets containing vitamin E levels more than twice the recommendation. (Fig. 1)

Both farms from Saxony provided different prerequisites for the performance of the trial. On farm "MVA-1" it was only possible to conduct the trial in "Off-On-Off" design (February until end of

May with Loxidan, "On"). On farm "MVA-2" it was possible to divide the herd into two groups, control and trial group, and to feed them simultaneously (Loxidan from March until the end of June). The vitamin E content of the DMR was also analyzed with the results that the cows on these farms only received a marginal supply of vitamin E. Despite supplementation with vitamin E the cows received only 500 mg to 700 mg vitamin E per cow per day which was below the recommended level. Thus the diet was supplemented with the antioxidant blend (Loxidan) at 150 mg/kg DM DMR.

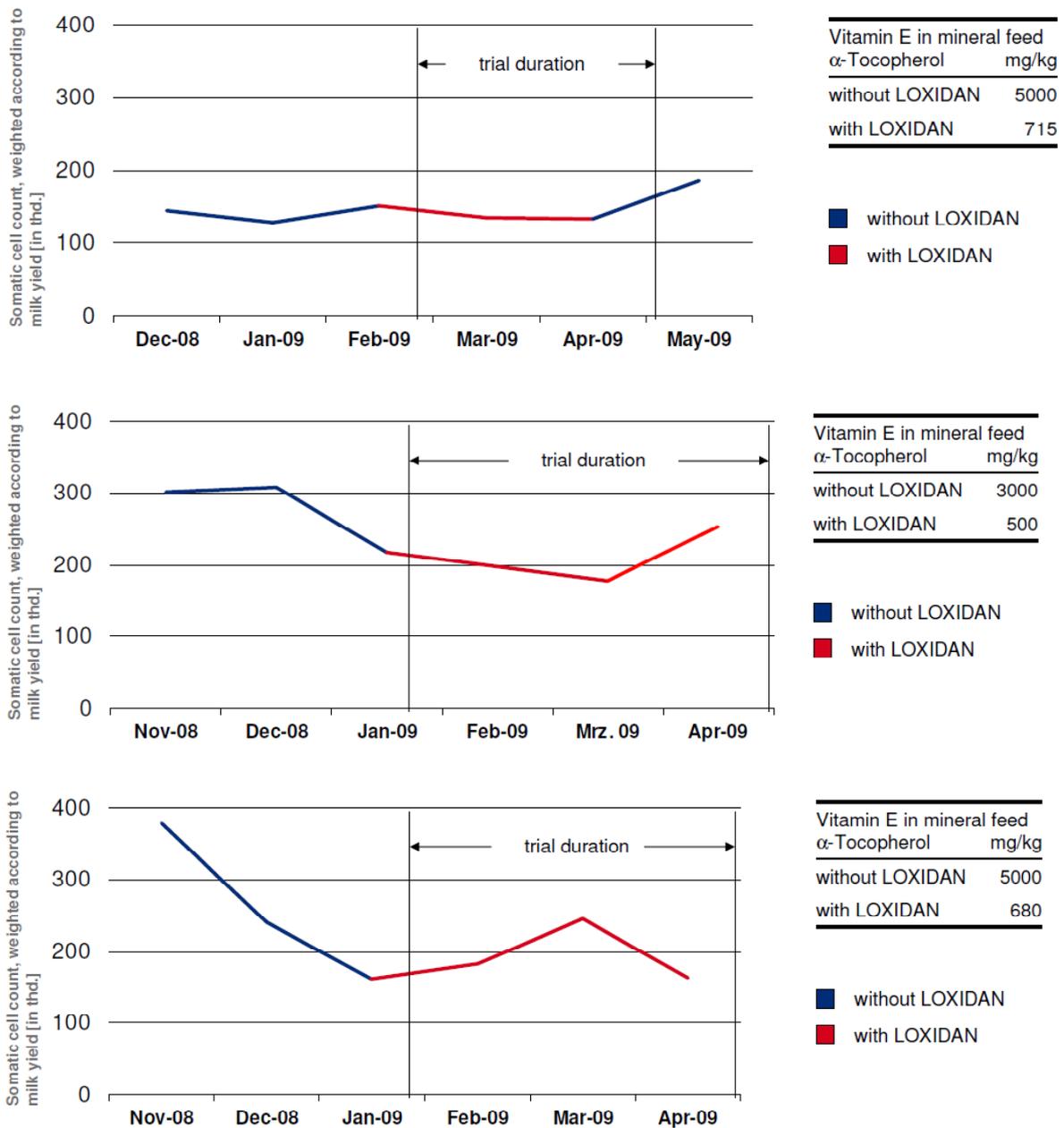
The SCC in MVA-1 decreased significantly during Loxidan supplementation, whereby the average SCC was 37,000 / ml. After eliminating Loxidan from the diet the SCC increased again

up to 59,000 cells / ml reaching its peak of 98,000 cells at the end of September.

The SCC of the cows of the trial group (with Loxidan) in MVA-2 was 224,590 cells / ml milk and thus by 114,830 cells per ml less than the cows in the control group (without Loxidan). This difference further increased during Loxidan supplementation in favour of the trial group up to 243,780 cells (Fig. 2).

After eliminating Loxidan this ratio reversed and the SCC of cows of the former trial group (now without Loxidan) increased up to 458,280 cells and was thus by 137,810 cells higher by trend than the control group. By the end of the trial the SCC of both groups had come back into line.

Fig. 1: Impact of antioxidants (field trial in three farms in North Hesse). 150 mg/kg DM TMR was supplemented (i.g. 3 – 3,5 g/cow/day). Vitamin E supply via mineral feed was reduced according to official recommendations (500 mg/cow per day).



TRIAL AT THE UNIVERSITY OF APPLIED SCIENCE, BINGEN

In addition, the University of Applied Science in Bingen in cooperation with the University in Bonn studied the impact of antioxidants on the oxidative status of dairy cows. No significant impact on vitamin E content

in blood, milk, back fat and liver were verifiable through supplementation with antioxidants. The values were within the physiological range. This might be due to the good supply of vitamin E of the cows (1,165 mg vit E). The significant decrease of d-ROM values, however, indicated an improvement in the oxidative status of the cows.

Fig. 2: Impact of antioxidants (field trial in Saxony). 150 mg/kg DM TMR was supplemented (i.g. 3 – 3,5 g/cow/day). Vitamin E supply via mineral feed was reduced according to official recommendations (500 mg/cow per day). Vitamin E supply was unvaried at a low level (< 1,000 mg/kg).

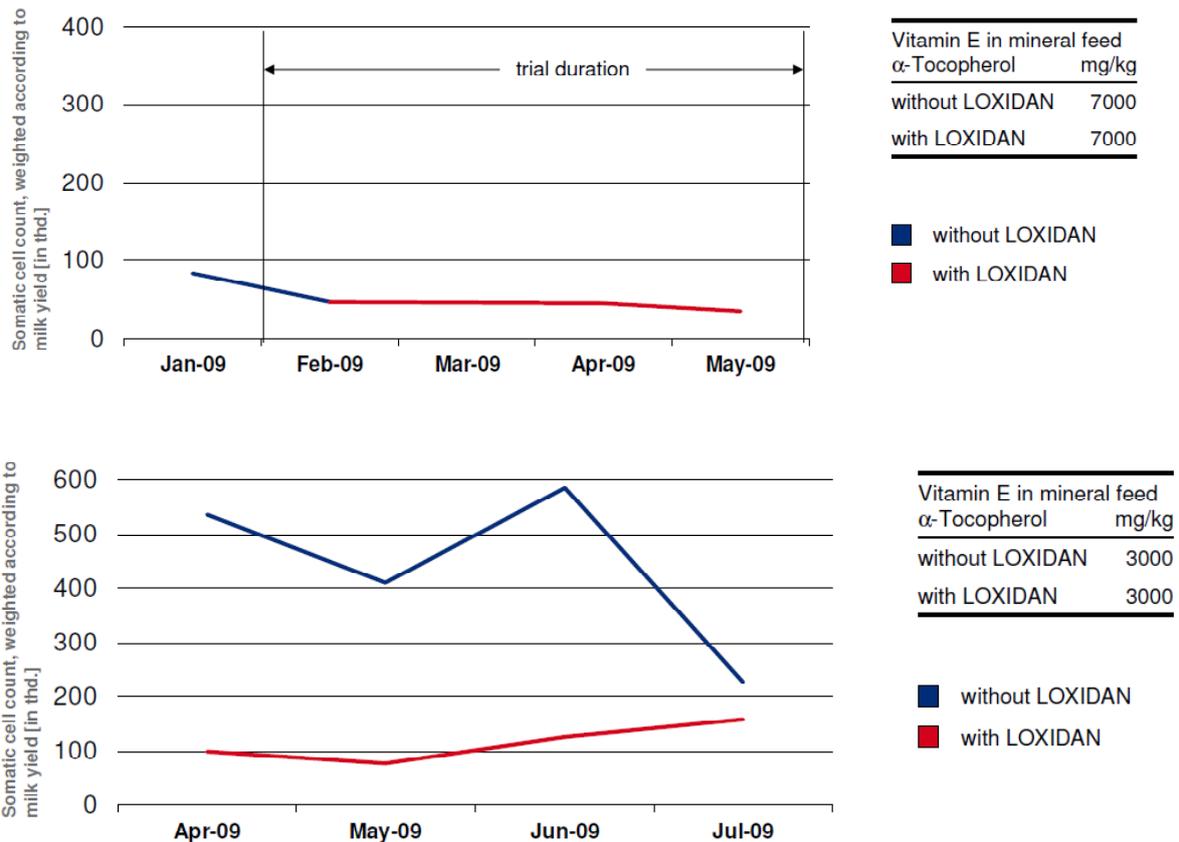
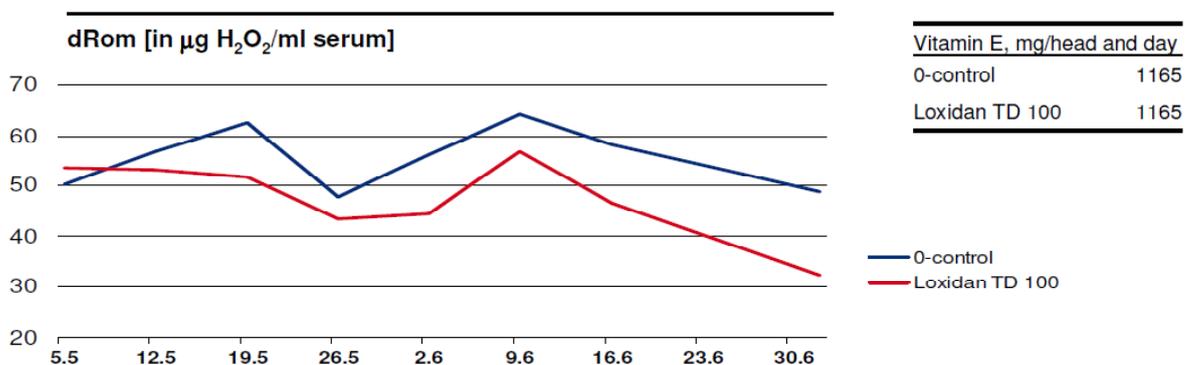


Fig. 3: Effect of Loxidan on oxidative status of dairy cows, Loxidan supply 150 mg/kg DM. For both treatments the d-ROM level was within the physiological range of healthy cows. Loxidan reduced radical formation even under healthy conditions.



Dusel G et al.: Einsatz von Antioxidantien in der Milchkühhütterung. Forum angewandte Forschung, Fulda (DE) 2010; Poster #23