AMINODairy®

mepron®

Information for the Dairy Industry

AMINODairy®

Mepron® alleviates oxidative stress in the mammary gland to support milk production of transition cows

Introduction

Methionine (MET) is a precursor of glutathione, a powerful antioxidant that actively participates in oxidative stress regulation. Besides, Mepron® supplementation showed a positive impact on the global oxidative stress level of transition cows (AD9). Whether this effect is reproducible in mammary tissue is unknown. Previous work suggested that the Nuclear Factor Erythroid 2-Like 2 (NFE2L2) gene plays a key role in controlling cellular antioxidant response in the mammary gland of dairy cows. With its ability to donate methyl groups, greater MET supply may impact activity of genes involved in protecting mammary cells against oxidative damage, such as NFE2L2.

Therefore, we hypothesized that MET alleviates oxidative stress in the mammary gland via altered genes activity, including those involved in glutathione production. Thus, the objective of this work was to assess the impact of Mepron® supplementation to transition cows on oxidative stress at the mammary gland level.

Materials and Methods

This study was conducted by the research group of Dr. Juan Loor at the University of Illinois (USA; Batistel et al., 2017; Han et al., 2018). Starting 4 weeks before expected parturition until 60 DIM, 2 balanced groups of 30 Holstein cows were fed the same corn silage based-diet without (LYS:MET = 3.8:1) or with Mepron® (LYS:MET = 2.8:1) fed at a rate of 0.09% and 0.10% of DMI during the prepartum and postpartum periods, respectively (Figure 1).

Daily DM intake and milk production were recorded, and milk composition was analyzed weekly. Three weeks after calving, mammary gland tissue was harvested from 5 cows per group to assess activity of genes and abundance of proteins involved in oxidative stress regulation (NFE2L2 and downstream antioxidant genes involved in glutathione, quinone and heme metabolism).

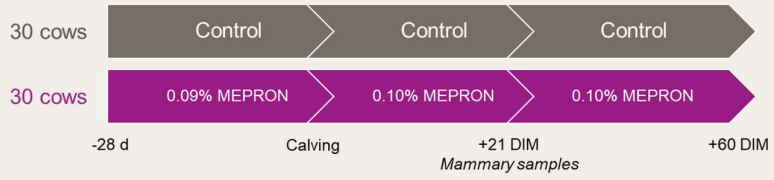

Figure 1: Experimental design

Mepron® supplementation activated NFE2L2, upregulating the antioxidant response in the mammary tissue

Methionine supply to transition cows modified NFE2L2 gene activity in the mammary gland, most probably because of gene methylation. As a consequence, transcription of the downstream antioxidant genes was upregulated. For instance, glutathione synthesis was favored, as suggested by the enhanced activity of genes involved in the transsulfuration pathway (Figure 2).

Also, as part of the heme metabolism, stress can produce excessive ferrous ion (Fe^{2+}) which acts as an oxidant in the organism. To prevent cells damage, Fe^{2+} needs to be converted and/or stored, which activities are controlled by ferrochelatase (FECH) and Ferritin heavy chain 1 (FTH1) genes, respectively. Both genes activity was upregulated by methionine supplementation (via NFE2L2), indicating a protective effect of Mepron® from iron-catalyzed oxidative damage in mammary tissue.

Therefore, the present study revealed for the first time that antioxidant mechanisms in mammary tissue also are responsive to methionine supply. Our hypothesis was validated: feeding rumen-protected methionine upregulates activity of antioxidant genes through activation of NFE2L2 and supports glutathione synthesis.

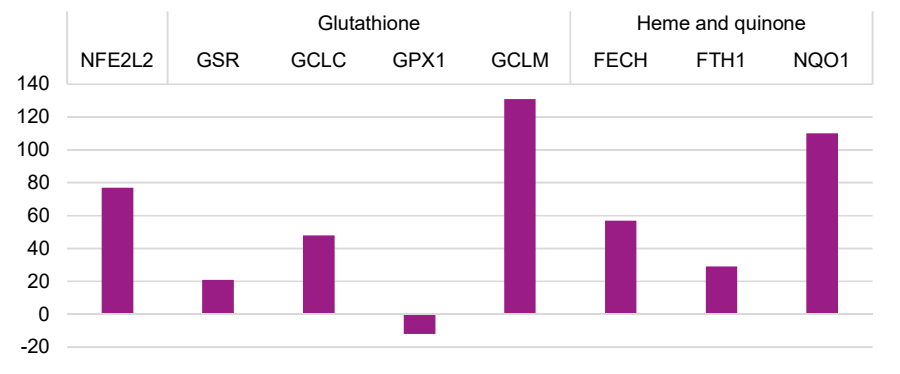

Figure 2: Impact of Mepron® on activity of genes involved in oxidative stress regulation in mammary tissue (expressed as % difference to the control diet)

Reduced oxidative stress in the mammary gland with Mepron® supported milk performances of transition cows

The benefit of Mepron® on the mammary antioxidant response is likely part of the overall benefits observed on lactation performance and alleviation of inflammation and oxidative stress status in the same group of cows. Compared with control cows, Mepron® increased energy-corrected milk by 4.1 kg/d during the fresh period (1-30 DIM) and by 4.8 kg afterwards (Figure 2).

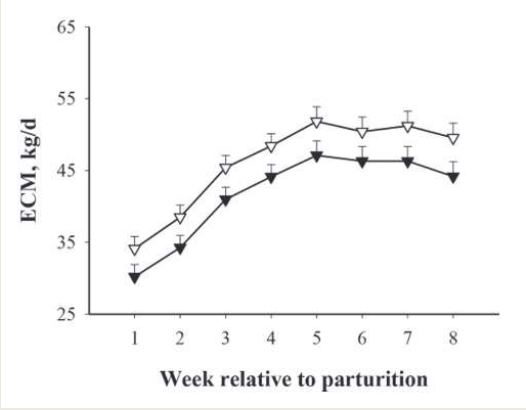

Figure 3: Energy-corrected milk production of cows fed a control diet without (black triangle) or with Mepron® (white triangle) during transition

Reference

- AMINODairy No. 9 (2019): Mepron® provides the functional amino acid methionine - Advantages for the immune system and liver function.
- Batistel F et al (2017): Ethyl-cellulose rumen-protected methionine enhances performance during the periparturient period and early lactation in Holstein dairy cows. J Dairy Sci 100(9): 7455-7467
- Han L et al (2018): Methionine supply alters mammary gland antioxidant gene networks via phosphorylation of nuclear factor erythroid 2-like 2 (NFE2L2) protein in dairy cows during the periparturient period. J Dairy Sci 101(9): 8505-8512

Evonik Operations GmbH
Nutrition & Care
Animal Nutrition Business Line

animal-nutrition@evonik.com
www.mepron.com

EVONIK Leading Beyond Chemistry