**Effects of a customized trace mineral supplementation on health status and mineral metabolism in seven dairy cattle farms**

**Application:** Zinc (Zn), copper (Cu) and manganese (Mn) are added to the feed of dairy cows as a supplement to the basic ration (forage, cereals, etc.) to cover their physiological needs, improve their health and optimize their productivity. Excessive use, however, wastes non-renewable mineral resources, is potentially toxic in animals and in the soil, which receives dejecta with high concentrations of metals.

**Introduction:** Imprecise supplementation of Zn, Cu and Mn can result in nutritional imbalances, economic losses, and environmental impacts. Because mineral content in forages is extremely variable compared to total digestible nutrients or protein, proposing customized mineral supplementation is a great of interest. The objective of this work was to assess the effect of a customized mineral supplementation for Cu, Zn and Mn on health status and mineral metabolism in 7 commercial dairy herds.

**Material and methods:** Seven commercial dairy herds in Auvergne-Rhône-Alpes Region, France with in average 89 dairy cows per herd were selected for this study. In each farm, forages and all ingredients of the basal diets were collected each month and analyzed by ICP-MS for mineral content (Zn, Cu, Mn, S, Mo and Fe). Labels of the mineral feeds were also collected with a focus on Cu, Zn and Mn. New mineral feeds were formulated by farm to provide a total intake of Zn and Mn of respectively 80 and 70 ppm/kg DM (+11% and -20% of Zn and Mn supplemented on average). The total intake of Cu recommended was between 9.5 and 11 ppm/kg DM (-50% on average of Cu supplemented) depending on the level of Cu antagonists int the basal diet (S, Mo and Fe). The dairy cows were fed the new mineral feeds for a total duration of 6 months. In each farm, blood samples were collected three times on 10% of the animals (n=47; T0=beginning, T1= 3 months and T2= 6 months after the beginning of the trial). Blood samples were analysed for Cu, Zn (Colorimetry technique) and Mn (ICP-MS) concentrations in plasma, the activity of SODe and the oxidase activity of ceruloplasmin (Colorimetry technique). The effects of the customized mineral supplementation on the later parameters were explored through ANOVA integrating in the statistical model the treatment (T0 vs T1 vs T2) and the farm as fixed effects and the cow nested within the farm as a random effect.

**Results:** Before supplementing with the new mineral feeds, there was a global tendency to over supplement the diets in Cu (on average +182% of the requirements). Cu in plasma did not differ among the treatments (*P*=0.079) and was maintained within the biological thresholds (13,65µmol/L; Hussein and Staufenbiel, 2012). Zinc in plasma significantly increased (P=0.000; T2 > T1 > T0; +21%). No statistical differences were observed regarding Mn in plasma for T0 and T2, however, T1 was significantly lower (2,92, 2,82 and 1,96 µg/L respectively). Ceruloplasmin activity significantly increased in T2 compared to T0 (*P*=0.001; 7628 vs 5708 mU/mL). No statistical differences were observed regarding the activity of SODe (*P*=0.135).

**Conclusion:** These results showed that Cu, Zn and Mn requirements of dairy cattle can be covered with a customized mineralization without inducing any deficiencies or metabolic problem. Last but not least, environmental and economic aspects should be taken into account in such studies.

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