

Effect of injectable trace minerals (zinc, manganese, selenium, and copper) on the humoral and cell-mediated immune responses to vaccine antigens following administration of a modified-live viral vaccine in dairy calves

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Introduction

The benefits of administering injectable trace minerals (ITM; Zn, Mn, Cu, and Se) on animal health and performance have been previously assessed in dairy and beef cattle. Previous studies demonstrated that ITM improved humoral immune response to bovine herpesvirus 1 (BHV-1) following administration of a modified live virus (MLV) vaccine in cattle. The objective of this study was to evaluate the effect of an ITM supplement containing zinc, manganese, selenium, and copper on the humoral and cell mediated immune (CMI) responses to individual vaccine antigens in dairy calves receiving a MLV vaccine containing bovine viral diarrhea virus (BVDV), BHV1, parainfluenza virus 3 (PI3V), and bovine respiratory syncytial virus (BRSV).

Materials and Methods

This study was designed as a randomized controlled trial. A total of 30 dairy calves (3 months of age) were administered 2 mL of a 5-way MLV vaccine containing BHV1, BVDV1 and 2, BRSV, PI3V (Express 5®, Boehringer Ingelheim-Vetmedica), and 2 mL of an attenuated-live *M. haemolytica* and *P. multocida bacterin* (Vista Once PMH®, Merck Animal Health) subcutaneously (SC). Calves were randomly assigned to 1 of 2 groups: (1) subcutaneous administration of ITM (1 mL/100 lb BW, ITM; MultiMin 90, Fort Collins, CO; n=15) or (2) subcutaneous injection of sterile saline (2 mL, control; n=15). Administration of ITM provided 15, 60, 10, and 5 mg/mL of Cu, Zn, Mn, and Se. Three weeks after initial vaccination, calves received a booster of 2 mL of the 5-way MLV vaccine, and 2 mL of the attenuated-live bacterin SC. Concurrently with the booster, a second administration of ITM or sterile saline SC was given to calves in the ITM and control groups, respectively. Blood samples were collected into tubes with and without EDTA to obtain serum and whole blood respectively on days 0, 7, 14, 21, 28, 42, 56, and 90 relative to prime vaccination for antibody titer determination, antigen-induced in vitro IFN- γ production by peripheral blood mononuclear cell (PBMC), and antigen-induced PBMC proliferation. Statistical analysis was performed using the

Statistical Analysis System (SAS®). The Kruskal Wallis test was used to compare antibody titer, IFN- γ concentration, and PBMC proliferation between groups for each day. Additionally, a repeated measure analysis was done to compare each variable during the experimental period with the baseline on day 0. For all analysis values of $P < 0.05$ were considered significant.

Results

Administration of ITM concurrently with MLV vaccination resulted in higher serum neutralizing antibody titer to BVDV-1 on day 28 post prime vaccination compared to the control group ($P=0.03$). There was a tendency of a higher PBMC proliferation response to BVDV ($P=0.08$) on day 14 post prime vaccination in calves treated with ITM compared to the control group. Additionally, calves treated with ITM showed an earlier and more consistently increased PBMC proliferation to BVDV following MLV vaccination (on days 14, 21, and 42 relative to day 0), compared to the control group (only increasing on day 28). There was a significantly higher PBMC proliferation upon BRSV stimulation on day 7 post prime vaccination in the ITM group compared to the control group ($P=0.01$). Calves treated with ITM showed a significantly augmented PBMC proliferation upon stimulation with BRSV on days 7, 14, and 42 after prime vaccination relative to day 0 ($P < 0.05$). Proliferation of PBMC was increased upon BHV1 recall in both ITM and control groups on days 14, 21, 28, and 42 post-vaccination compared with day 0 ($P < 0.05$). Significant differences were not found in the production of IFN- γ by PBMC after stimulation with BVDV, BHV1, and BRSV between calves treated or not treated with ITM.

Significance

In conclusion, administration of ITM concurrently with MLV vaccination in dairy calves resulted in increased antibody titer to BVDV1 (on day 28 after prime vaccination) and PBMC proliferation upon BVDV and BRSV stimulation when compared to the control group. Administration of ITM might represent a promising tool to enhance humoral and CMI responses to MLV vaccines in cattle.