Effects of injectable trace minerals on the inflammatory cytokines' response to vaccination in dairy calves

A. Megahed,[1] DVM, PhD; W. Filho Carvalho,[1] DVM, PhD; A. Stoskute,[2] DVM; R. Palomares,[1] DVM, MS, PhD; J. Bittar,[1] DVM, MS, PhD

[1]Department of Large Animal Clinical Sciences, College of Veterinary Medicine, University of Florida, Gainesville, FL 32610
[2]Department of Population Health, College of Veterinary Medicine, University of Georgia, Athens, GA 30602

Introduction

Trace mineral supplementation concurrent with the bovine respiratory diseases complex (BRDC) vaccine boosts antibody production and leukocyte proliferation. However, the mechanism underlying this effect is not well understood. On the other hand, cytokines response post-vaccination is an important driver of both humoral and cellular immunity. Therefore, we hypothesized that trace mineral supplementation may improve BRD vaccine immunogenicity and effectiveness by modulating inflammatory cytokines in dairy calves. Our objective was to characterize the effects of injectable trace minerals (ITM) on the cytokines response to the BRD modified-live virus (MLV) vaccine in post-weaning dairy calves.

Materials and methods

Several inflammatory cytokine gene expression profiles (CGE) were determined in 30 calves randomly assigned into 2 groups: 15 calves received 2 doses of ITM subcutaneously (ITM), and 15 calves received saline (CONT) concurrently with the MLV vaccines containing bovine viral diarrhea virus 1 and 2 (BVDV1 & 2), bovine herpesvirus 1 (BHV1), bovine respiratory syncytial virus (BRSV), and parainfluenza 3 virus (PI3V), and attenuated-live *Mannheimia-Pasteurella* (MP) bacterin. Blood samples were collected on days 0 (treatment + vaccination), 7, 14, 21 (booster: treatment + vaccination), 28 and 42 for the determination of CGE, and serum antibodies titer (SNA). Trace minerals were assessed in the liver biopsy samples collected on days -7, 21 and 42.

Results

Marked associations were reported between CD80 and hepatic zinc concentration (rs = 0.50; $P < 0.001$) and BHV1-SNA (rs = 0.60; $P < 0.001$), and between hepatic cobalt concentration and IL-1β (rs =0.60; $P < 0.001$), IL-12 (rs = 0.50; $P < 0.001$), and IFN-γ (rs = 0.4; $P < 0.01$). Hepatic manganese concentration was associated with TLR-7 (rs = 0.7; $P < 0.001$) and TNF-α (rs = 0.5; $P < 0.01$). Compared to CONT calves, ITM-treated calves showed higher TNF-α ($P = 0.02$), TLR-3 ($P = 0.032$), IFN-α ($P = 0.027$), and IFN-γ ($P = 0.018$). Compared to baseline level (d0), all cytokines were downregulated on d42, except TLR-3.

Significance

Injectable trace mineral supplementations likely potentiate the immunogenicity of the BRDC vaccines through the regulation of inflammatory cytokines at the gene expression level post-vaccination in dairy calves; however, it is unclear whether these effects contribute to improved protection against BRDC in dairy calves.

