Ruminant Nutrition General

62 Meta-analysis to quantify the effect of chromium supplementation on production in dairy cows and how it is affected by Cr source and stage of lactation. Y. Roman-Garcia*, 1, D. Kleinschmit, 1, and L. Moraes, 1, 1The Ohio State University, Columbus, OH, 2Zinpro Corporation, Eden Prairie, MN.

The objective was to quantify the effect of Cr supplementation on production and how the effect changes based on Cr source and stage of lactation. A meta-analysis was performed with data from 28 studies and 93 treatment means from experiments testing the supplementation of Cr starting in the dry period (n = 38) and during lactation. Studies utilized Cr as Cr-Picolinate, Cr-Yeast, Cr-Methionine, or Cr-Propionate. Using the metaphor package in the R software, we modeled the mean difference between the experimental (cows receiving Cr) and control groups. Response variables were milk yield (MY; kg/d), energy-corrected milk (ECM; kg/d), and dry matter intake (DMI; kg/d). Difference in MY had a quadratic response to Cr supplementation expressed in mg/d and a quadratic response to days in milk (DIM). The model ΔMY = −4.65 (±1.85) + 0.640 (±0.264) × Cr − 0.0477 (±0.0173) × Cr² + 0.0949 (±0.0318) × DIM − 0.0005 (±0.0002) × DIM² suggest a dose of 9.5 mg of Cr up to 101 DIM is suggested suppletmentation of 6.8 mg of Cr to cows up to 105 DIM is suggested for a maximum increase of 2.6 kg of ECM. Increase in ECM was not affected by Cr source. model ΔECM = −3.19 (±0.76) + 0.214 (±0.099) × Cr − 0.0113 (±0.0066) × Cr² − 0.0607 (±0.0145) × DIM − 0.0003 (±0.0003) × DIM² suggest a dose of 9.5 mg of Cr up to 101 DIM to maximize DMI by 0.9 kg/d. DMI is increased another 2.9, 2.5, and 1 kg/d by Cr-Yeast, Cr-Methionine and Cr-Propionate respectively. Overall, the effect of Cr supplementation is affected by stage of lactation and Cr source. With these models and the cost of the different Cr products we can predict what stage of lactation, Cr amount, and sources would be most effective and give a recommendation that would maximize profits.

Key Words: chromium

63 Effect of supplementary source of selenium on animal performance during intramammary endotoxin challenge in lactating Holstein cows. K. M. Cruickshank*, 1, B. Hates, 1, E. S. Ribeiro, 1, and M. A. Steele, 1, 1University of Guelph, Guelph, ON, Canada, 2University of Alberta, Edmonton, AB, Canada.

The objective of this experiment was to determine how source of supplementary selenium (Se) affects animal performance during an intramammary endotoxin challenge. Twenty mid-lactation multiparous Holstein cows (591 ± 46 kg BW) were blocked by days in milk (157 ± 17 DIM) and randomly assigned to 1 of 2 treatments: 1) 0.30 ppm (100% NRC requirements on a dry matter basis) of supplementary organic (selenized yeast) Se premix, or; 2) 0.30 ppm of supplementary inorganic (sodium selenite) Se premix, top dressed and mixed into a basal ration that was allocated randomly to ITM or OTM supplementation. Automatic feeding gates were used to assign treatments to individual cows through 150 DIM. After calving, diagnoses of clinical diseases were performed by the research team and farm personnel. Following on d 21 ± 3, ovarian structures were examined weekly by ultrasonography to determine the first appearance of a corpus luteum. Cows received injections of PGF₂α, on d 42 ± 3 and 56 ± 3, and estrus behavior was evaluated using activity monitors. Continuous data were analyzed by ANOVA and binary data were analyzed by logistic regression using the GLIMMIX procedure of SAS. Statistical models included the effects of treatment, parity, season, and their interactions. P values < 0.05 were considered statistical difference and P values ≤ 0.1 were considered tendency. Analyses of data from 209 cows indicated that fewer cows in OTM group tended to have postpartum diseases than cows in ITM (ITM = 26.5 vs. OTM = 14.6%; P = 0.07). Cows in OTM group resumed postpartum estrous cyclicity earlier than cows in the ITM group (ITM = 5.3 ± 0.2 vs. OTM = 4.7 ± 0.2 wk; P = 0.04). OTM had a greater proportion of estrous cyclic cows than ITM in wk 4 (ITM = 39.2 vs. OTM 55.7%, P = 0.03) and 5 (ITM = 56.4 vs. OTM = 75.0%, P = 0.01), but not wk 6 (INO = 78.1 vs. OTM = 88.2%, P = 0.09) and later. No differences between treatments were observed in proportion of cows detected in estrus after the second PGF₂α (ITM = 65.2 vs. OTM = 64.6%, P = 0.94) or the interval from calving to first AI (ITM = 63.2 ± 0.9 vs. OTM = 64.4 ± 0.9 d; P = 0.32). Our results indicate that replacement of ITM by OTM in pre- and postpartum diets improved postpartum health and hastened resumption of estrous cyclicity.

Key Words: trace minerals, health, reproduction

64 Impact of supplementary trace mineral source on health and reproduction in lactating dairy cows. B. Mion*, 2, J. F. W. Spricigo, 2, K. King, 2, L. Ogilvie, 2, O. Chiu, 2, L. Lobe, 2, B. Van Winters, 2, E. Merry, 2, S. LeBlanc, 2, M. A. Steele, 1, B. W. McBride, 1, and E. S. Ribeiro, 1, 1Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada, 2Department of Population Medicine, University of Guelph, Guelph, ON, Canada.

Our objectives were to evaluate the impact of supplementary trace minerals source, inorganic (ITM; Co, Cu, Mn, Zn sulfates and sodium selenite) or organic (OTM; Co, Cu, Mn, Zn proteinates and Se yeast; Bioplex Sel-Plex, Alltech Inc.), fed at 100% of recommended levels, on the incidence of clinical disease and the intervals from calving to resumption of estrous cyclicity and to first AI. Heifers and cows (n = 240) were enrolled at 45 ± 3 d before expected calving date, blocked by parity and BCS, and allocated randomly to ITM or OTM supplementation. Automatic feeding gates were used to assign treatments to individual cows through 150 DIM. After calving, diagnoses of clinical diseases were performed by the research team and farm personnel. Following on d 21 ± 3, ovarian structures were examined weekly by ultrasonography to determine the first appearance of a corpus luteum. Cows received injections of PGF₂α, on d 42 ± 3 and 56 ± 3, and estrous behavior was evaluated using activity monitors. Continuous data were analyzed by ANOVA and binary data were analyzed by logistic regression using the GLIMMIX procedure of SAS. Statistical models included the effects of treatment, parity, season, and their interactions. P values < 0.05 were considered statistical difference and P values ≤ 0.1 were considered tendency. Analyses of data from 209 cows indicated that fewer cows in OTM group tended to have postpartum than cows in ITM (ITM = 26.5 vs. OTM = 14.6%; P = 0.07). Cows in OTM group resumed postpartum estrous cyclicity earlier than cows in the ITM group (ITM = 5.3 ± 0.2 vs. OTM = 4.7 ± 0.2 wk; P = 0.04). OTM had a greater proportion of estrous cyclic cows than ITM in wk 4 (ITM = 39.2 vs. OTM 55.7%, P = 0.03) and 5 (ITM = 56.4 vs. OTM = 75.0%, P = 0.01), but not wk 6 (INO = 78.1 vs. OTM = 88.2%, P = 0.09) and later. No differences between treatments were observed in proportion of cows detected in estrus after the second PGF₂α (ITM = 65.2 vs. OTM = 64.6%, P = 0.94) or the interval from calving to first AI (ITM = 63.2 ± 0.9 vs. OTM = 64.4 ± 0.9 d; P = 0.32). Our results indicate that replacement of ITM by OTM in pre- and postpartum diets improved postpartum health and hastened resumption of estrous cyclicity.

Key Words: trace minerals, health, reproduction
Our objectives were to evaluate the impact of supplementary trace minerals source, inorganic (ITM; Co, Cu, Mn, Zn sulfates and sodium selenite) or organic (OTM; Co, Cu, Mn, Zn proteinates and Se yeast; Bioplex Sel-Plex, Alltech Inc.), fed at 100% of recommended levels, on milk production, dry matter intake (DMI), gross feed efficiency, blood metabolites, rumen fluid pH and volatile fatty acid (VFA) concentration, and rumination activity. Heifers and cows (n = 240) were enrolled at 45 ± 3d before expected calving date, blocked by parity and BCS, and allocated randomly to ITM or OTM treatments. Cows in both groups were fed the same diet, except for the source of supplemental TM, using automatic feeding gates to assign treatments to individual cows, which were fed until 150 DIM. Blood was collected on d −4, 0, 3, 7, 10, 14, 23, and 65 relative to calving. Cows were fitted with a neck-based collar to measure rumination activity, and ruminal fluid was collected on d −21, 23 and 65 ± 3 relative to calving. Data were analyzed by ANOVA using PROC GLIMMIX of SAS. Statistical models included the effects of treatment, parity, season, time, and their interactions. For repeated measures, data were summarized weekly and cow nested within treatment was considered a random term. Analyses of data from 145 cows indicated differences in prepartum DMI (ITM = 12.3 ± 0.3 vs. OTM = 13.1 ± 0.3 kg/d; P = 0.04). Cows in OTM group had reduced concentration of NEFA (ITM = 0.55 ± 0.02 vs. OTM = 0.48 ± 0.02 mmol/L; P < 0.01), and greater concentration of albumin (ITM = 35.29 ± 0.21 vs. OTM = 35.89 ± 0.21 g/L; P = 0.04) in serum compared with cows in ITM group. Cows in OTM tended to have greater concentration of butyric acid (ITM = 9.4 ± 0.5 vs. OTM = 10.7 ± 0.5 µmol/mL; P = 0.06), valeric acid (ITM = 1.5 ± 0.07 vs. OTM = 1.7 ± 0.07 µmol/mL; P = 0.06) and total VFA (ITM = 96.5 ± 2.7 vs. OTM = 102.7 ± 2.7 µmol/mL; P = 0.10) in ruminal fluid on d 23 than cows in ITM. Cows in ITM spent more time ruminating during the prepartum (ITM = 480 ± 13 vs. OTM = 442 ± 13 min/d; P = 0.04) and postpartum periods (ITM = 468 ± 11 vs. OTM = 430 ± 11 min/d; P = 0.01). Postpartum DMI, yields of milk, energy-corrected milk, protein, and fat, gross feed efficiency, and ruminal fluid pH did not differ between treatment (P ≥ 0.1). Our results indicate that replacement of inorganic sources of supplementary TM by organic sources affects prepartum feed intake and rumen parameters, and slightly improve the postpartum metabolism of dairy cows.

Key Words: trace minerals, feed intake, milk production

66 Controlled trial of the effect of negative dietary cation-anion difference on postpartum health and culling of dairy cows. R. Couto Serrenho1, T. C. Bruinje1, E. I. Morrison1, T. J. DeVries2, T. F. Duffield1, and S. J. LeBlanc1, 1Department of Population Medicine, University of Guelph, Guelph, ON, Canada, 2Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada.

The objective of this study was to assess the effects of a negative dietary cation-anion difference (DCAD) dry cow diet on postpartum health and culling. Cows from 4 commercial dairy farms in Ontario, Canada were enrolled in a randomized controlled trial from November 2017 to April 2019. Closed-up pens (1 per farm) with cows 3 wk before expected calving were randomly assigned to a negative DCAD (TRT; −100 mEq/kg DM; target urine pH 6.0–6.5) or a control diet (CON; +95 mEq/kg DM with a placebo supplement). Each pen was fed TRT or CON for 3 mo (one period) then switched to the other treatment for the next period, with 4 periods per farm. Body condition score (BCS) was measured at enrollment and urine pH was measured weekly until calving. Data from 1086 animals (TRT: n = 681; CON: n = 405) that received the assigned diet for ≥2 wk were included. The incidence of milk fever (MF), retained placenta (RP), metritis, ketosis (blood BHB ≥1.2 mmol/L, measured weekly in wk 1 and 2), clinical mastitis <30 DIM (CM), displaced abomasum (DA), purulent vaginal discharge (PVD, assessed once at wk 5), ≥1 disease (DIS) or culling by 35 DIM were analyzed with logistic regression models with treatment, parity, BCS, and their interactions, accounting for pen-level randomization and clustering of animals within farm with random effects. There were no interactions of treatment with parity or BCS for any outcome. There were only 43 cases of MF, allowing only univariable analysis. The incidence of MF was 5 ± 3% in CON and 1 ± 1% in TRT (P = 0.18). There were no treatment effects (CON vs TRT, LSM ± SE) on RP (7 ± 3%; 6 ± 2%; P = 0.71), metritis (11 vs 12%; SE = 4; P = 0.83), ketosis (21 vs 23%; SE = 4; P = 0.59, PVD (13 vs 12%; SE = 3; P = 0.51), or DIS (44 vs 41%; SE = 7; P = 0.41). Cows fed TRT had lesser incidence of CM (4 vs 2%; SE = 1, P = 0.09) and DA (3 vs 1%; SE = 1, P = 0.05). Culling <35 DIM tended to be greater in CON (7 ± 2%) than TRT (5 ± 1%, P = 0.11). Under commercial herd conditions, a negative DCAD fed 3 wk before parturition improved some but not all health outcomes assessed.

Key Words: milk fever, transition cow, nutrition

67 Impact of supplementary trace mineral source on immune cell function of dairy cows and its association with postpartum diseases. L. Ogivile1, J. F. W. Spricigo1, B. Mion1, B. Van Winters1, M. A. Steele1, B. W. McBride1, S. J. LeBlanc1, and E. S. Ribeiro1, 1Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada, 2Department of Population Medicine, University of Guelph, Guelph, ON, Canada.

Our objectives were to evaluate the impact of supplementary trace minerals source, inorganic (ITM; Co, Cu, Mn, Zn sulfates and sodium selenite) or organic (OTM; Co, Cu, Mn, Zn proteinates and Se yeast; Bioplex Sel-Plex, Alltech Inc.), fed at 100% of recommended levels, on neutrophil function in vitro and their association with postpartum disease. Heifers and cows (n = 240) were enrolled at 45 ± 3d before expected calving date, blocked by parity and BCS, and allocated randomly to ITM or OTM supplementation. Cows in both treatments were fed the same diet, except for the source of supplementary TM. Automatic feeding gates were used to assign treatments to individual cows. Blood was collected on days −10 ± 3 and 7 ± 3 relative to calving in a subgroup of cows (n = 104) to measure neutrophil phagocytic capacity in vitro using fluorescence-labeled beads and flow cytometry. Diagnoses of clinical diseases were performed by the research team and farm personnel. To evaluate the association of in vitro assay responses with the incidence of postpartum disease, cows were categorized as low response (below median) or high response (above median). Continuous data were analyzed by ANOVA and binary data were analyzed by logistic regression using the GLIMMIX procedure of SAS. Statistical models included the fixed effects of treatment, parity, season, and their interactions. Treatment did not affect (P ≥ 0.60) the percentage of neutrophils performing phagocytosis on d −10 or 7, which averaged 24.6 and 23.9% respectively. However, the mean fluorescence intensity of phagocytosis on d 7 was greater for OTM than ITM (SQRt scale: 91 vs. 85 ± 1.8, respectively; P = 0.03). Cows classified as low prepartum phagocytosis intensity tended to have greater incidence of postpartum diseases (low = 33.3 vs. high = 15.3%; P = 0.06). In conclusion, replacement of inorganic sources of supplementary TM by organic sources modestly improved one measure of phagocytic capacity of neutrophils in vitro. In addition, phagocytosis intensity response of our in vitro assay was negatively associated with incidence of postpartum diseases.

Key Words: trace minerals, immunity, health