Proceedings of the 28th World Buiatrics Congress
WBC

Jul. 27 - Aug. 1, 2014
Cairns, Australia

Next Congress:

Jul. 3-8, 2015 - Dublin, Ireland

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Nutrition

Effect of an injectable trace mineral supplement containing selenium, copper, zinc, and manganese on immunity, health, and growth of dairy calves

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Objectives: The objective of this study was to evaluate the effect of two subcutaneous injections of a multimineral preparation each containing 60 mg of zinc, 10 mg of manganese, 5 mg of selenium, and 15 mg of copper at 3 and 30 days after birth on immunity, health, and growth of dairy calves during the pre-weaning period.

Methods: The study was conducted in upstate New York – USA in two commercial dairy farms. A total of 790 Holstein heifer calves were randomly allocated at birth into one of two treatments: injectable trace minerals (ITM, Multimin USA) or control. Blood samples were collected at 3, 14, and 35 days after birth to evaluate glutathione peroxidase activity (GPx), superoxide dismutase activity (SOD), haptoglobin (Hp), and neutrophil and monocyte function. Incidence of diseases and average daily gain was evaluated in first 50 days of life. At 14 days of life, ITM treated calves had increased neutrophil activity when compared with control calves. Moreover, ITM calves had greater GPx activity on day 14 after birth than control calves.

Results: ITM treatment reduced incidence of diarrhea (ITM = 41.7% vs. Control = 49.7%) and combined incidence of pneumonia or otitis or both (ITM = 41.7% vs. Control = 49.1%). Additionally, GPx was greater for calves diagnosed with otitis at day 35 after birth. However, calves diagnosed with pneumonia had a decreased GPx activity at day 35 after birth. Serum SOD and Hp were not affected by treatment or disease. Moreover, no effects were observed on average daily gain and survivability between ITM and control calves during the pre-weaning period. Supplementation with trace minerals at 3 and 30 days of life improved neutrophil function and glutathione peroxidase activity and reduced incidence of health disorders.

Conclusions: In conclusion, trace minerals supplementation improved neutrophil function and glutathione peroxidase activity of dairy calves in first two weeks after birth. Moreover, TMS calves had reduced incidence of diarrhea and combined pneumonia-otitis. However, the benefits on immunity related parameters and health did not translate into improved growth performance and reduced mortality in the first 50 days of life. Future research should focus on the investigation of the length and magnitude of trace mineral supplementation need to sustain an appropriate immunological status in the pre-weaning period to maximize health benefits and growth performance of dairy calves.

Effect of trace mineral supplementation on selected minerals, energy metabolites, oxidative stress, and immune parameters and its association with uterine diseases in dairy cattle

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Objectives: The objective of this study was to evaluate the relationship between selected minerals serum levels, energy metabolites, oxidative stress indicators, IL-8 and haptoglobin levels and the potential for uterine diseases. Additionally, we investigated the effect of injectable trace mineral supplementation (ITMS) on metabolism, immune function and animal health, under field conditions involving a dairy herd with high milk production.

Methods: The study was conducted in one dairy farm located near Ithaca, New York, and 270 multiparous cows were enrolled from October 3rd of 2012 until January 10th of 2013. Cows were randomly allocated into one of two treatments groups: ITMS or control. Cows randomly assigned to ITMS group received two injections of trace minerals at 230 and 260 days of gestation; each injection contained 300 mg of Zn, 50 mg of Mn, 25 mg Se, and 75 mg Cu. Retained placenta (RP) and metritis were diagnosed and treated by trained farm personnel. Clinical endometritis evaluation was performed by the investigators. Blood mineral levels, plasma non-esterified fatty acids (NEFA) and serum β-hydroxybutyrate (BHBA) concentrations, plasma IL-8 concentrations, serum haptoglobin concentration and serum superoxide dismutase and plasma glutathione peroxidase activities were measured at various time points before and after calving. Four groups of mixed general linear models were fitted to the data using MIXED procedure of SAS.

Results: Injectable trace mineral supplemented cows had increased serum concentration of Cu, Se, and Zn. On the other hand, ITMS did not affect energy metabolites, immune and oxidative stress parameters. Serum concentration of Ca, Cu, K, Mg, Mo, Ps, Pt, Se, and Zn varied according to days relative to parturition. Cows having RP had reduced serum concentrations of Ca, Mg, Mo and Zn when compared to cows without RP. Cows affected with metritis had significantly lower serum concentrations of Ca, Mo, Ps, Pt, Se and Zn than non-affected cows. Serum concentration of Ca, Cu, Mo, and Zn were reduced in cows diagnosed with endometritis in comparison to non-affected ones.

Conclusions: Cows suffering from RP had reduced serum concentrations of Ca, Mg, Mo, and Zn when compared with cows without RP. Cows affected with metritis had significantly lower serum concentrations of Ca, Mo, Ps, Pt, Se and Zn than non-affected counterparts. The haptoglobin levels of metritic cows increased significantly on days 3 and 7 after parturition; this was not the case for cows not having metritis. Concentration of IL-8 and activities of glutathione peroxidase and superoxide dismutase did not differ between metritic and non-metritic cows.

The cost of nutritional management in UK dairy calves: are we starving our future milkers?
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Objectives: The level of milk feed intake previously recommended for dairy heifers was 10% of liveweight, but recent studies have advocated a higher plane of nutrition to improve health and support liveweight gains of 0.7-0.8 kg/day. Calves <3 weeks old have a thermoneutral range between 15 and 25°C at temperatures below this energy is partitioned away from growth towards thermoregulation. At this age calves are most susceptible to pathogens causing enteritis. This study investigated UK dairy farms to determine whether feeding levels are sufficient to meet early growth targets.
**Methods:** Dairy farms (n=102) in England, Scotland and Wales were visited March through August 2013. During a one day visit, a face-to-face interview with questionnaire was completed where details of type, amount and frequency of feeding of milk, starter and forage was recorded along with nutritional information from feed packaging and herd butterfat and protein%. Every farm’s feeding schedule for heifer calves aged 0 to 21 days was modelled to calculate the amount of metabolizable energy (ME) consumed, the expected daily liveweight gain (DLWG) and liveweight (LW) at 3 weeks of age under thermoneutral conditions and at 5°C and 10°C below lower critical temperature (LCT). Housing facilities were also documented.

**Results:** Based on the feeding regimes recorded, mean DLWG at thermoneutral temperatures (>15°C) was 0.62 ± 0.28 kg/d (range 0.07 to 2.16 kg/d, median 0.56 kg/d, n=102). The majority of farms (71.6%) were not predicted to achieve a DLWG of >0.7 kg/d (73/102). At 5°C below LCT, mean DLWG decreased to 0.56 ± 0.28 kg/d (range -0.02 to 2.11 kg/d, median 0.51 kg/d, n=102) with 77.5% (79/102) of farms not achieving the recommended DLWG. At 10°C below LCT, average DLWG was 0.48 ± 0.28 kg/d (range -0.11 to 2.06 kg/d, median 0.45 kg/d, n=102) with 85.3% of farms (87/102) not achieving >0.7 kg/d of DLWG. With all variables other than temperature remaining the same, mean expected LW at 3 weeks reduced by 2.4 ± 0.4% (range 0.8 to 3.6%, median -2.4%, n=102) at 5°C below LCT and by 12.7 ± 13.9% (range 2.3 to 128.6%, median 10.3, n=102) at 10°C below LCT. The mean DLWG reduced by 5.1 ± 2% and 28.6 ± 29.9% respectively at these lower temperatures. Even under thermoneutral conditions, one farm’s feeding schedule left its calves in negative energy balance (NEB) for 10 days during their first 3 weeks of life. At 5°C below LCT, feeding programmes that left calves in NEB for part of this early period (range 6 to 14 days) were found on 4 farms, doubling to 8 farms at 10°C below LCT (range 6 to 17 days).

**Conclusions:** Many farms fail to consider the energy cost of thermoregulation or mounting an immune response when deciding on the feeding plan for their calves. Less than 30% of farms were achieving a DLWG of >0.7 kg/d with many calves predicted to be in periods of NEB even at temperatures not far below LCT. Despite changing industry recommendations, feeding levels of dairy heifers in Great Britain remains insufficient to achieve growth targets and many calves are being fed below the amount needed to support vital body functions.

**Efficacy of different phosphate salts for oral treatment of hypophosphatemia in dairy cattle**

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**Objectives:** Hypophosphatemia is commonly encountered in periparturient dairy cattle and oral phosphate supplementation is often practiced. Although sodium phosphate is most commonly used for oral treatment other phosphate salts also providing calcium or potassium might be equally effective, therefore presenting interesting treatment alternatives.

**Methods:** Six lactating dairy cows were fed a phosphorus deficient diet in order to induce hypophosphatemia and were then treated with three experimental treatments in randomized order. Treatments consisted of either of 302 g NaH2PO4 dihydrate, 263 g KH2PO4 or 244 g Ca(H2PO4)2 monohydrate that were administered by orogastric tube, each treatment providing 60 g of phosphorus. Blood samples were obtained repeatedly over a period of 24h after each treatment.

**Results:** Intraruminal administration of NaH2PO4 and KH2PO4 resulted in similar increases in plasma phosphate concentrations ([Pi]) (by 1.2 ± 0.4 mmol/L and 1.1 ± 0.3 mmol/L respectively) while treatment with Ca(H2PO4) resulted in a numerically lower increment in plasma [Pi](by 0.9 ± 0.3 mmol/L). Peak concentrations were reached at 270 min (interquartile range 240-420 min), 360 min (240-420 min) and 360 min (300-420 min) for treatment with NaH2PO4, KH2PO4 and Ca(H2PO4) respectively. Differences between groups were not significant. Serum [Pi] remained above baseline values for the entire study period. Treatment with KH2PO4 significantly increased the serum potassium concentration from 120 to 420 min post treatment with an average peak increment of 1.0 ± 0.3 mmol/L. None of the treatments resulted in a significant effect on the serum calcium or magnesium concentration.

**Conclusions:** These results suggest that intraruminal administration of KH2PO4 is equally effective as NaH2PO4 while Ca(H2PO4) might be less effective in supplementing phosphate.

**Influence of feeding a low phosphorus diet on leucocyte function in dairy cows**

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**Objectives:** Phosphorus (P) depletion has been associated with impaired immune function in rats and humans. In dairy cows the influence of P depletion and hypophosphatemia on immune function has not been studied. The aim of this study was to investigate whether P depletion influences granulocyte and lymphocyte function.

**Methods:** Eight midlactaion dairy cows were fed a P deficient ration (0.2% P/kg DM) for a period of 4 weeks. The depletion phase was preceded and followed by a two-week acclimatization and repletion phase during which a P supplemented ration was fed. Blood samples were collected after acclimatization, after 2 weeks and 4 weeks of P depletion and after repletion. Plasma phosphate concentrations ([Pi]) and white blood cell counts were determined. Immune function was studied by performing a phagocytosis assay with Staphylococcus aureus and a lymphocyte stimulation test with concanavalin A and pokeweed mitogen.

**Results:** The plasma [Pi] decreased significantly with lowest values (mean 0.7 ± 0.2 mmol/L) after two weeks of depletion. Granulocyte count changes showed a similar development as phosphate values (mean 0.7 ± 0.2 mmol/L) after two weeks of depletion. Granulocyte survival after phagocytosis was impaired immune function in rats and humans. In dairy cows the influence of P depletion and hypophosphatemia on immune function has not been studied. The aim of this study was to investigate whether P depletion influences granulocyte and lymphocyte function.

**Conclusions:** Results showed a similar trend but differences were not statistically significant.
Conclusions: Data indicate that hypophosphatemia leads to a decrease in granulocyte counts. In addition, chronic P depletion impairs granulocyte survival during phagocytosis but not phagocytosis activity itself.

Effect of supplementation with an injectable mineral product containing copper, selenium, zinc and manganese on fertility in pasture based NZ dairy cattle.

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Objectives: AIMS: To determine the effect on fertility of treating seasonally calving, pasture based dairy cattle with injections of a multi mineral product containing 40mg/ml zinc (disodium zinc EDTA), 10mg/ml manganese (disodium manganese EDTA), 15mg/ml copper (copper disodium EDTA) and 5mg/ml selenium (sodium selenite), administered 4 weeks prior to the planned start of calving and again 4 weeks prior to the planned start of mating.

Methods: METHODS: Friesian and Jersey cross bred dairy cattle from 6 herds across the South Auckland, Waikato, Canterbury and Southland regions of NZ were randomly allocated into either a control group (n=1004), or a treatment group (n=990) injected with 5mls of Multinin+Copper ©, Virbac NZ LTD, by subcutaneous injection 4 weeks prior to the planned start of calving and again 4 weeks prior to the planned start of mating. Health events were recorded, and aged pregnancy testing by ultrasound was carried out at 10 weeks, 14 weeks and at 18-24 weeks post-Mating Start Date (MSD). 4 and 6 wk in-calf rates (ICR) and final pregnancy and abortion rates were determined.

Planned start of calving for the two herds treated in the South Auckland region was in the months of March and April and for the 4 other was in the months of July and August. Planned start of mating was approximately 82 days after planned start of calving for all herds.

All data was collated into Microsoft Excel and analysed using chi-square analysis and logistic regression in XLSTAT Version 2013.5.03 ©Addinsoft 1995-2013.

Results: RESULTS: Treatment with a multi-mineral supplement had a tendency to improve 6wkICR compared to controls (72.9% vs 69.3% respectively p=0.076). Treatment had a positive effect on final pregnancy rates compared to controls (86.9% vs 83.1% respectively p=0.018). Treatment also reduced the abortion rate in treated cows compared to control cows during the study period (1.8% vs 3.4% respectively p=0.042). Days calved prior to MSD reduced the number of days to conception (p<0.001) and tended to protect against abortion (Wald Chi-sq= p=0.061). Treatment tended to reduce the days to conception (p=0.14) and protected against abortion (p=0.041). There were significant differences in pregnancy and abortion rates between farms.

Conclusions: CONCLUSIONS: Treatment with an injectable mineral prior 4 weeks prior to calving and 4 weeks prior to mating had a protective effect on abortions occurring during the mating period. Further study is required to determine the mechanism by which this may occur.

The use of tuber coxae bone biopsy to examine bone turnover and trabecular bone structure in response to different levels of phosphorus in the diet in growing bos indicus steers

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Objectives: Phosphorus (P) deficiency is a major problem in northern Australia causing poor fertility, reduced liveweight gain, lameness, pica and bone fractures. There is, however, very little detailed information about the effect phosphorus deficiency has on bone microstructure in cattle. Plasma, faecal and bone P levels can provide indirect measures of phosphorus status but cannot provide information on the dynamic changes occurring in bone under conditions of P deficiency. Rib biopsy cortical bone thickness changes have been shown to be significantly associated with phosphorus deficiency in young cattle but this cortical thickness reflects changes that have occurred over a considerable period of time. This measure of cortical thickness does not indicate if bone is predominantly being formed or resorbed at the time the biopsy was obtained. The aim of this study was to use bone biopsies of the trabecular bone of the tuber coxae to examine the cellular and structural changes occurring in bone tissue in response to different levels of P in the diet.

Methods: Bone biopsy is the gold standard for determining the pathogenesis of bone loss in humans. Trabecular bone has a much larger surface area on which bone cells can form new bone or resorb bone. Using trabecular bone biopsies should provide much more detailed information about the effect of a phosphorus deficient diet on bone formation, mineralisation and bone resorption at the cellular level. This research can then help us to determine the most efficient way to feed phosphorus to improve bone health and animal productivity. Bos Indicus steers were kept in individual pens and fed on 5 different diets with P level ranging from 0.9 to 2.4 g P/kg DM for 6 months. Two injections of oxytetracycline (fluorescent double labelling of bone) were employed to examine mineralisation and bone formation (dynamic histomorphometry). Bone biopsies (16 mm) were obtained from the tuber coxae at the start and the end of the feeding trial. Biopsies were processed for both decalcified and undecalcified histology.

Results: Phosphorus level in the diet affected feed intake, liveweight gain and skeletal growth with a dose response seen in each of these parameters. The trabecular bone volume of steers with the highest level of P in the diet was twice that of steers in the lowest P group. Measurements of the oxytetracycline double label demonstrated a decrease in bone formation, mineral apposition rate and mineralising perimeter of the tuber coxae bone of steers in response to decreasing P intake (or P content of the diet). Tetracycline label was poorly taken up in mineralising surfaces of bone in the low P steers indicating defective mineralisation of forming bone. In addition there was increased osteoclast cell numbers with increased resorption activity along bone surfaces in the low P steers.

Conclusions: These results suggest the pathophysiology of P deficiency in cattle includes poor mineralisation, typical of osteopaenia in combination with some degree of osteoporosis (an imbalance of bone resorption over bone formation) leading to a marked loss of trabecular bone volume. Biopsy of the tuber coxae proved to be a sensitive tool in detecting bone turnover changes in response to different dietary P levels.
Expression of glucose transporter 2 protein in liver and proteins in insulin signalling in liver and adipose tissues in lactating dairy cows under dietary niacin supplementation during the peripartal period

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Objectives: Insulin sensitivity of dairy cows plays an important role in metabolic adaptation in the peripartal period. The purpose of this study was to investigate whether the protein expression of molecules involved in hepatic and adipose insulin signalling and that of hepatic glucose transporter 2 are influenced by lactation period, dietary niacin supplementation and concentrate proportion of lactating dairy cows.

Methods: 20 pluriparous German Holstein cows were fed with the same corn and grassland silage based diet with 15% concentrate proportion from 21 d prepartum (d-21) to calving. After calving cows were randomly assigned in 4 groups (n = 5/group) and fed with diets differing in the concentrate proportion ("High" with 60:40% or "Low" with 30:70% concentrate-to-roughage ratio) and Niacin content (24 g/day niacin: Nia or control without niacin: Cont) until 21 d postpartum (d+21). Diets for NiaLow and ContLow comprised 42% corn silage and 28% grass silage, whereas the diets for NiaHigh and ContHigh comprised 24% corn silage and 16% grass silage. Biopsy samples were taken from liver, subcutaneous (SCAT) and retroperitoneal (RPAT) adipose tissues at d-21 and d+21. Protein expression of key components of insulin signalling (IR: insulin receptor, Precursor of IR, PI3K: Phosphotyrosylinositol-3-kinase, PKCζ: protein kinase C ζ) and of hepatic glucose transporter 2 (SCLC2A2) was measured semiquantitatively by western blot. Ratios of protein expression at d+21 to d-21 (r = expression at d+21 / expression at d-21) and differences of ratios from 1 (Δ = r-1) were calculated. The calculated Δ reflect the degree of dynamic changes of protein expression from d-21 to d+21. A Δ greater than 0 indicates an increase in specific protein expression from d-21 to d+21; a Δ smaller than 0 indicates a decrease. The Δ were evaluated statistically for feeding effects (niacin, concentrate and their interaction) using a mixed model procedure and for time effects (lactation period) using one sample t-test.

Results: In liver expression of investigated proteins appeared to be affected by post partum feeding more than by time. Compared to controls mean Δ of hepatic expression of PI3K (p = 0.08) and SLC2A2 (p = 0.03) was significantly lower in niacin fed groups. Mean Δ of hepatic protein expression of the IR/IRprecursor ratio (p = 0.05) was lower and of SLC2A2 (p = 0.09) was higher in the high concentrate compared to the low concentrate groups. In adipose tissues protein expression of IR, PI3K and PKCζ was neither affected by dietary niacin or concentrate in SCAT and RPAT. Time had no effect on hepatic expression of IR, IRprecursor, IR/IRprecursor ratio, PI3K and SLC2A2 as well as expression of IR, PI3K and PKCζ in SCAT. Mean Δ of expression of PI3K (p = 0.004) and of PKCζ (p < 0.001) was found significantly below 0 in RPAT.

Conclusions: Results in liver indicate potential effects of niacin supplementation and concentrate proportion in the diet to modify the insulin signalling pathway and glucose transport at protein level. The decreased expression of PI3K and PKCζ independent of feeding detected only in RPAT might possibly be associated with physiologically lower insulin sensitivity in cows in early lactation.

Factors that favour and constrain the use of maize silage by small-scale dairy farmers, in central Mexico

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Objectives: In the highlands of central Mexico, small-scale dairy farms play an important role in employment generation and provision of daily income for rural households. However, farmers have had low uptake of innovations that have shown economic benefits, such as maize silage. The aim of this study was to identify factors that favour and constrain the use of maize silage by small-scale dairy farmers in the highlands of central Mexico.

Methods: Data were gathered between April to June (2013) from 106 small-scale dairy farmers. The sample size represents 10.7% of the total farmers in the study area. Snowball sampling method was used to identify participants. A structured questionnaire was designed, piloted and then used to gather farmer’s information, details of farm characteristics and factors that favour and constrain the use of maize silage. The sample size was divided in users of maize silage (n=48) and non-users of maize silage (n=58). The normal distribution test of Kolmorgorov-Smirnov was applied a set of 12 variables, that describe farmer’s characteristics (age, education, experience) and farm characteristics (family members, family labour, herd size, milking cows, milk yield per cow per day, milking months, milk sold per day, milk price per litre and total number of hectares). In order to identify differences between the two groups, a Student T test was conducted. The differences were considered at p<0.05. The data analyses were conducted through the software SPSS 15.

Results: Surprisingly, the three variables that describe farmer’s characteristics did not show statistical differences between groups. Whereas, out of the nine variables that describe farm’s characteristics, six showed significant differences (p<0.05) between groups, which were: herd size, milking cows, milk yield per cow per day, milk sold per day, milk price per litre and total number of hectares. These findings imply that farm’s characteristics play an important role on users’ decision for using maize silage in their farms. They also reported that the variable total number of hectares was the most important one; however, non-users considered it as a constraint, since they just have less than one hectare (0.7) on average, which is normally used for growing grassland. On one hand, users reported that factors that favour the use of silage were: availability of forage to be silage, land and machinery. On the other hand, non-users reported that lack of land, high investment, lack of machinery and lack of extension services were the most important constrains for using silage in the farm.
Conclusions: It is concluded that the analysis of the information per group was useful to identify factors that favour and constrain the use of maize silage by small-scale dairy farmers; therefore, this information could provide a useful starting point to identify appropriate alternatives for communication of the innovation among small-scale dairy farmers, in the highlands of central Mexico.

A case study of mass mortalities associated with feeding desiccated coconut to dairy cattle

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Objectives: The cost pressures associated with dairy farming often result in farmers using cheaper bi-products and waste products to reduce feed costs. This case study highlights the risks of this practice when unusual feeds are offered to cattle without an understanding of its nutritional value.

Methods: This is a unique case study of the lactation suppression in a herd of 600 milking cows and mortality of over 140 non-lactating cattle associated with feeding desiccated coconut (DC). The deaths occurred after the inclusion of DC at around 30-40% DM into a partial mixed ration. The DC was mixed with almond hulls and millrun and offered ad lib to the cattle along with cereal hay and pasture silage. The cattle initially presented with hypocalcaemia, which responded to calcium therapy. However these cattle would soon relapse and despite symptomatic therapy most affected cattle died. With the removal of desiccated coconut from the ration, no new cases were observed. A wide range of sampling was taken including haematology, biochemistry, histopathology, feed testing, fatty acid profiling and aflatoxin testing. Other major differentials including botulism, aflatoxicosis and ruminal acidosis were excluded. Symptomatic treatment was attempted in many individuals and included oxytetracycline, ketoprofen, thiamine, intravenous isotonic fluids & rumen transfaunation. A poor treatment response was observed.

Results: The crude fat of the DC fed was 61.1%w/w and the fatty acid profile is high in the medium-chain fatty acids (MCFA) Lauric acid (C12:0, 30% w/w) and Myristic acid (C14:0, 12%w/w). This FA profile is similar to that of coconut oil. These MCFAs have been shown to decrease dry matter intake (DMI) in cows fed any more than 4-5% coconut oil. In a study by Hollmann et al 2012, coconut oil in the USA (Hollmann, et al. 2012), supports a theory that the fatty acid profile of coconut oil is unsuitable for use as a feed source in ruminants. Feeding desiccated coconut, or any product high in coconut oil has very limited potential in cattle, and probably all ruminants, with our current knowledge. Future research may identify a role for coconut oils, however on farm advisors should be discouraging its use as a feed source.

Conclusions: This case, supported by research into feeding coconut oil in the USA (Hollmann, et al. 2012), supports a theory that the fatty acid profile of coconut oil is unsuitable for use as a feed source in ruminants. Feeding desiccated coconut, or any product high in coconut oil has very limited potential in cattle, and probably all ruminants, with our current knowledge. Future research may identify a role for coconut oils, however on farm advisors should be discouraging its use as a feed source.

Niacin effects on changes in subcutaneous and abdominal fat depots during the transit period in German HF cows

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Objectives: Typically in dairy cows subcutaneous and abdominal fat depots increase during the dry period before parturition and are mobilized after parturition to compensate deficits in energy balance. Excessive fat mobilization is seen as one of the major risk factors for production diseases such as ketosis, fatty liver, abomasal displacement or infectious diseases such as metritis and mastitis. In vitro Niacin demonstrated clear antilipolytic activity on adipose tissues in dairy cows. However, in vivo the antilipolytic efficacy of supplementation of Niacin is discussed controversially. Previous studies indicated that subcutaneous (sc) and abdominal (abdom) adipose tissues of dairy cows may react differently on lipolytic stimuli. Thus, the aim of the study was to test effects of Niacin on changes in adipose depots during the transit period in dairy cows.

Methods: The study included 47 dairy cows which were studied from day (d)-42 until d100 relative to parturition. Cows were kept in free stalls with cubicles and were fed total mixed ration (TMR) ad libitum based on corn and grass silage as forage components. One group received a lipomobilization stimulating diet (HC; dietary concentrate proportion on DM basis prepartum: 60%, reduction to 30% on d1 with subsequent increase to 50% until d16 pp) and one group a more typical diet (LC; dietary concentrate proportion prepartum 30% with subsequent increase to 50% from d1 until d16 pp). Half of the HC and LC cows received Niacin supplements (24g/d) from d-42 ap until d24 pp. Blood samples were taken in weekly intervals for measurement of glucose, non-esterified fatty acids (NEFA) and ß-hydroxybutyrate (BHB) and subcutaneous and abdominal fat masses (in kg) were assessed sonographically. The use of maize silage by small-scale dairy farmers; therefore, this information could provide a useful starting point to identify appropriate alternatives for communication of the innovation among small-scale dairy farmers, in the highlands of central Mexico.

Oral Communications: Nutrition

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abdominal fat (diffd1_d21 and diffd21_d100) was significantly reduced (p < 0.05) compared to cows of the LC group. Results of blood testing were not affected by the dietary concentrate proportion. Compared to the sc fat the absolute size of the abdomen fat depot increased significantly more before parturition (p < 0.01) and decreased also more after parturition (P < 0.01). Expressing changes in % of d1 depot sizes no differences in relative size changes between sc and abdomen fat depots were found before parturition. After parturition relative changes were higher in abdomen than sc fat depots in fresh cows (diffd1_d21; p < 0.05) but lower during early lactation (diffd21_d100; p < 0.01).

Conclusions: Niacin did not affect lipolysis in dairy cows during the transition period in dairy cows according to results of blood testing and sonographic assessment of sc and abdomen fat depots. In fresh cows the abdomen fat depot appears to be more lipolytic active than the sc fat depot.

The effect of conjugated linoleic acid (CLA) supplementation on the oxidative and antioxidative status of periparturient dairy cows
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Objectives: Enhanced metabolism, as present in the periparturient period in dairy cows might results in an increase of reactive oxygen species (ROS), which are thought to play an important role in various production diseases. Since antioxidative properties of conjugated linoleic acids (CLA) are discussed controversially in humans and experimental animals the aim of the presented study was to investigate effects of supplementation of CLA to dairy cows and heifers on their antioxidative and oxidative status.

Methods: German Holstein pluriparous (n = 32) and primiparous cows (n = 13) were randomly assigned to three groups and were kept in a free stall with cubicles. They received either a control fat (n = 14), 50 g (n = 15) or 100 g (n = 16) of a mixture of rumen protected CLA isomers, containing 10 % t-10,c-12 CLA and 10 % c-9,t-11 CLA starting at parturition. Stearic acid was used as control fat. The typical fed total mixed ration was based on corn and grass silage as well as concentrate. Blood samples were taken at day -21, 1, 21, 70, and 105 relative to calving and analyzed for the antioxidative (ferric reducing ability of plasma (FRAP), α-tocopherol, α-tocopherol/cholesterol ratio, retinol) and oxidative (hydroxide radicals, thiobarbituric acid test (TBARS), N-formylkynurenine, bitryosine, sulfhydryl groups (SH-groups)) status. For statistical analysis the PROC mixed procedure for repeated measurements (SAS package).

Results: Blood concentrations of vitamin A and E, N-formylkynurenine, bitryosine and SH groups as well as the vitamin E:cholesterol ratio and FRAP were all significantly decreased (p < 0.001) while concentrations of hydroxides (p < 0.001) and TBARS (p < 0.001) were significantly increased at parturition. Heifers had higher vitamin E serum concentrations (p = 0.012), and a higher α-tocopherol/cholesterol mass ratio (p < 0.001) than pluriparous cows. Plasma SH-group concentrations were significantly lower in cows than in heifers (p = 0.024). The CLA 100 group tended to have higher SH-group concentrations than the other feeding groups (p = 0.085). Else antioxidative or oxidative parameters were not different between feeding groups.

Conclusions: Supplementation of a mixture of CLA containing 10% of t-10,c-12 CLA and 10 % of c-9,t-11 CLA appears to have in the choosen dosage no effect on the antioxidative and oxidative status of dairy cows in early lactation.
**Parasitology**

**Anthelmintic resistant Ostertagia spp. on Macalister Irrigation District dairy farms**
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2-Maffra Veterinary Centre, Maffra, Victoria, Australia

**Objectives:** To establish the prevalence of anthelmintic resistant Ostertagia spp. on 12 commercial dairy cattle properties in the Macalister Irrigation District of Victoria, Australia.

**Methods:** Faecal egg count reduction tests (FECRTs) were conducted on calves on 12 commercial dairy farms in the Macalister Irrigation District of Victoria, Australia, between May 2013 and June 2014. All three currently available anthelmintic classes for cattle nematodes in Australia were tested. These included the macrocyclic lactones (ML, doramectin, Dectomax® injection, Zoetis), benzimidazoles (BZ, fenbendazole, Panacur 100®, MSD Animal Health) and imidazothiazoles (LEV, levamisole hydrochloride, Nilverm®, MSD Animal Health). Faecal samples were submitted to Dawbuts Pty Ltd (Camden, NSW, Australia) for parasitological examination. Calculations were carried out using the ‘RESO’ FECRT analysis program whereby the arithmetic mean faecal egg count (FEC) for each treatment group was compared with an untreated control 10-14 days post treatment as per WAAP guidelines. Resistance was defined as <95% reduction in FEC with a lower 95% CI <90%. Results were considered inconclusive if the untreated control FEC for Ostertagia spp. was less than 25 eggs/gram (epg) or if fewer than 50 larvae were counted during larval culture and morphological speciation.

**Results:** On three properties the derived FEC for Ostertagia spp. were too low to draw accurate conclusions about anthelmintic efficacy. Of the farms for which results were available, resistance to the MLs was detected on 3/9 (33%) farms, to BZs on 9/9 (100%) farms and to LEV on 4/9 (44%) farms. On the three farms where ML-resistance was detected there was also <95% reduction in efficacy. Of the farms for which results were available, resistance to the other two classes of anthelmintics (BZ and LEV). Conclusions: Anthelmintic resistant Ostertagia spp. are common on these dairy farms and the prevalence was higher than previous reports for beef cattle farms in SW Victoria and New Zealand. The presence of multiple resistant Ostertagia spp. on three farms is of great concern given there are no alternative anthelmintic classes or combination products currently registered for use in dairy cattle in Australia. Widespread resistance to BZs suggests that use without prior testing carries a considerable risk for ineffective treatment. The results highlight the need for dairy farmers to be more aware of anthelmintic resistance particularly given the high pathogenicity of Ostertagia spp.

**Effective treatment of llamas suffering from Dicrocoelium dendriticum infection: safety and efficacy of an innovative oral praziquantel paste**
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2-Institute of Parasitology, Department of Pathobiology, University of Veterinary Medicine Vienna, Vienna, Austria
3-Clinic for Ruminants, Department for Farm Animals and Veterinary Public Health, University of Veterinary Medicine Vienna, Vienna, Austria

**Objectives:** South American Camelids (SAC) are highly susceptible to infections with Dicrocoelium dendriticum and show severe pathological changes of the liver and bile system such as cirrhosis, abscesses and granulomas. Therapeutic options for treatment are limited. The drug of choice is praziquantel but the dose recommended for effective treatment requires large volumes of the currently available commercial formulations which have to be applied by gavage. To address this problem, the efficacy of two different dose rates of praziquantel in a special patented formulation (EP11189706.2) was investigated in llamas suffering from natural D. dendriticum infections.

**Methods:** 53 llamas of mixed sex were examined under field conditions on two occasions: before and two weeks after treatment. Animals were weighed and randomly allocated to one of the treatment groups (n = 21 each) or the control group (n = 11). Llamas of treatment groups were dosed orally using a praziquantel-containing paste specifically produced for high-dose treatment (250 mg/ml) at a dose of either 25 mg (Group 1) or 50 mg (Group 2) per kg of body weight. Criteria for efficacy were faecal egg count reduction (FECR) and extensity effect (EE).

**Results:** Animals from Group 1 showed a FECR of 85%, those from Group 2 a FECR of 91%. Almost twice the number of animals of Group 1 (33%) still shed eggs two weeks after treatment compared with Group 2. No side effects were recorded. Dosing was convenient and safe.

**Conclusions:** Results of this study indicate that 50 mg/kg BW oral praziquantel is required for efficacious dosing against Dicrocoelium dendriticum in llamas. This dose rate applied in the novel paste formulation is safe in this species and thus is recommended for the treatment of llamas naturally infected with D. dendriticum. The new innovative formulation using a high concentration of praziquantel in a small volume of paste is suitable for applying the required amount of drug without the necessity of gavage.

**In practice: bovine nematode control in the face of resistance.**
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2-Private Practitioner, Lincoln, Argentina

**Objectives:** Integrated Nematode control of bovines in Argentina has been considered "state of the art" for many years because it comprises diagnosis, reasonable use of drugs and epidemiology, and it involves a veterinarian with a holistic vision of the farm's health and production objectives. In the year 2000 resistance to...
Anthelmintic resistance in cattle: Have we the tools for fieldwork? A snapshot of a 3 year grazing study on the early detection of anthelmintic resistance in cattle in England

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2-Duilio, Churcham, Gloucester, UK
3-University of Strathclyde, Glasgow, UK
4-VPARST Ltd, Market Weighton, East Yorkshire, UK

Objectives: Anthelmintic resistance (AR) in sheep nematode populations has been widely reported in the United Kingdom. Whilst there have been reports of AR in cattle nematodes in other countries, in the UK such reports remain largely un-verified, with questions on accuracy of dosing, robustness of sampling, sensitivity of egg-counting techniques and statistical analysis preventing definitive conclusions being drawn. The Veterinary Medicines Directorate (VMD) and the Department for Environment, Food and Rural Affairs (Defra) are funding a three year grazing study programme to develop effective protocols for the early detection of AR in cattle and to propose strategies to mitigate against the development of resistance to currently available anthelmintics. Results and conclusions from the first two years grazing seasons are presented and discussed.

Methods: Each year, groups of co-grazing first-season animals in geographically distinct English regions had faecal egg counts (FEC) monitored throughout the grazing season, and were subjected to either a Faecal Egg Count Reduction Test (FECRT) or a “Wormer Test” (WT) once pre-defined FEC counts were reached, as per the World Association for the Advancement of Veterinary Parasitology (WAAVP) guidelines. Avermectin (poor-on and injectable), benzimidazole (oral) products, and negative control groups were used where appropriate. Fifty-six groups in two regions were monitored in 2012 (27 of which completed FECRT/WT; ~850 treated animals in total), and forty-one groups in three regions were monitored in 2013 (20 of which completed FECRT/WT; ~1,100 treated animals in total), with monitoring consisting of a fortnightly FEC evaluation of composite faecal samples from the group. Treatment was typically initiated when composite counts exceeded 150epg, and was conducted by veterinarians or veterinary technicians based on actual bodyweights, or weights estimated by weighband. Eggs were counted using a combination of modifications of the McMaster technique (30, 15 and 10 epg sensitivities), sensitive centrifugal salt flotation and Flotac (1 epg sensitivity). Additionally, larval culture and identification was performed on pre and post-treatment bulked samples (by treatment) to identify the predominant parasite species present. Percentage reductions in egg counts were calculated, by farm, using a variety of published techniques, including those recommended by WAAVP, and 95% confidence intervals constructed. Group sizes were increased between 2012 and 2013 due to the poor precision found when using the minimum group sizes recommended by WAAVP.

Results: Point estimates of efficacy varied between farms and treatments, and also within farm, and within treatment, depending on the sensitivity of the egg counting technique used. Confidence intervals (95%) for calculated efficacy were widest in small groups of animals, and on some farms ranged from 0 – 100%, highlighting the risks of interpreting point estimates of efficacy alone. Group size, FEC technique sensitivity and statistical methodologies employed all influenced the precision of efficacy assessments, and WAAVP guidelines were found to give imprecise efficacy determinations. The precision of efficacy estimates was improved...
by increasing group size, and increasing FEC test sensitivity. Many first season groups either failed to reach the defined treatment threshold, or reached the threshold late in the grazing season.

Conclusions: The FECRT and WT were found to be relatively imprecise tests when conducted according to current WAAVP guidelines, with group size, FEC technique sensitivity and statistical methodology all influencing efficacy estimates. The construction of 95% confidence intervals around calculated efficacy estimates is necessary to accurately determine egg count reduction, and we risk falsely identifying “anthelmintic resistance” by not doing so. Routine monitoring of group egg counts appears to be a useful tool in optimising anthelmintic use on-farm.

WORMTRAX - analysis of the Zoetis cattle worm egg count database from 2002-2012
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2-Zoetis VMRD, Parkville, Victoria, Australia

Objectives: Zoetis has coordinated worm egg count testing of cattle from across Australia for 11 years. Results from samples submitted over this period have been analysed to provide contemporary data on worm egg count (WEC) and worm species distribution in Australian cattle.

Methods: Ten faecal samples were collected from groups of cattle and WEC and larval cultures were conducted using standard procedures. A submission form was completed with data requested including date of sampling, property address, age, average weight, production type of cattle, last drench used and date of drenching. Regional analysis was done by postcode region and postcode regions were grouped into bioclimatic regions.

Results: A total of 5069 submissions were received to the end of 2012 representing over 50,000 individual dung samples. Seventy-seven percent of cattle sampled were no more than 2 years of age with the remainder representing a range of age groups. Samples were collected from all the cattle rearing regions of Australia. There was a tendency for higher geometric mean WEC in cattle in northern regions of Australia and in high rainfall areas along the east coast of Australia. Geometric mean WEC for bioclimatic regions varied seasonally with a peak in autumn in regions with winter predominant rainfall, but little seasonal variation in regions with summer predominant rainfall patterns. Worm genera varied throughout Australia with Cooperia spp being most prevalent across the country, followed by Haemonchus spp and Oesophagostomum spp in summer rainfall dominant regions and Ostertagia spp and Trichostrongylus spp in winter rainfall regions. In the coastal, tablelands, and temperate rangelands regions of NSW, Haemonchus spp were as prevalent as Cooperia spp during autumn months and levels of Haemonchus spp found in south-western Western Australia were higher than previously documented.

Conclusions: These data provide an up-to-date summary of internal parasites in Australian cattle. Regional differences in WEC between northern and southern Australia are evident and should be further explored. These data suggest that there has been a move to Cooperia spp being the predominant worm genus in Australian cattle, with increasing levels of Haemonchus spp being evident in southern temperate regions of Australia.

Oral Communications

Distribution of enteric parasites in Dairy and Beef Cattle in different production stages. A study from 2008 to 2013 in the main cattle states of México
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1-Tecnológico de Monterrey-campus Querétaro, Querétaro, Mexico
2-Bayer Animal Health, Mexico City, Mexico

Objectives: An ongoing cross-sectional study has taken place since 2008 up to date in the leading cattle states in México. A brief description of risk factors and clinical signs from some protozoa follows: Giardiasis, produced by Giardia duodenalis affects the gastrointestinal tract of animals. Distributed through direct contact, waterborne, contaminated feed and through wild life; clinical signs show in three days. Cryptosporidiosis is an infection produced by Cryptosporidium spp. a waterborne parasite, also transmitted by direct contact. Usually present in immunosuppressed calves with or without clinical signs. The biological cycle is between 10 to 14 days; hence signs can appear at two weeks of age if infected at birth. Coccidiosis is caused by Eimeria spp., affecting mainly young animals. Clinical manifestations can be linked to immunosuppression due to changes in the environment and mycotoxins in feedstuff (especially T-2 mycotoxin); its biological cycle lasts around 21 days. Eimeria spp. needs an environmental stage to complete its biological cycle; henceforth, is transmitted through contaminated feedstuff, grass, licking and cross-suckling, likewise soil can carry viable oocysts. The aim of the study was to detect parasites found in the fecal samples that could be involved in gastrointestinal problems in cattle in different stages of production.

Methods: Samples were sent to the Diagnostic Molecular Laboratory of the Tecnológico de Monterrey-campus Querétaro to be analyzed, along with a format containing age, production stage, facilities, breed and place of production. 1,069 fecal samples were analyzed from 19 states of México. Diagnosis consisted in morphological characterization by: direct smears; oocysts quantitation with modified Sheather's flotation method at 1,120, 1,200, and 1,280 Sp. gr. and counted in a Neubauer chamber; sedimentation; viability of Eimeria spp, staining with acid fast. Information was stratified in Dairy (D), Beef (B) and Unknown breed cattle (UB), production stages in Adult; Finishing (feedlot cattle just cattle); Nursing (0-60 days old); Growth (61-120 days old); Development (121 up to calving), and not classified (NC). Dairy breeds were considered Holstein-Friesian and Jersey, while beef breeds were: Zebu and F1 and F2 with European cattle (Holstein, Jersey, Swiss, Simmental), and Angus. Parametric and not parametric statistical analyses were performed with JMP 10.0.2 (M94VJPJJJ2).

Results: Results showed an overall prevalence in dairy of 56.1% (± 23.8) and beef cattle of 70% (± 19.3) with a media of 59.7 % (± 23.8) including UB and NC. The most common parasitic presence was: Cryptosporidium spp. (25.3%), Giardia spp. (31.6%), Eimeria spp. (40.9%), and nematodes (strongyles and Trichuris) (1.1%). Some animals presented up to four different parasites, and diversity in coccidias such as: E. zuernii, E. bovis, E. alabamensis, E. subspherica and E. ellipsoidalis. The groups that presented a higher prevalence of parasitic presence were: beef nursing calves with 92.7% prevalence and 69.2% in dairy cattle, being adult dairy cattle the less prevalent (28.4%). Logistic regression analyses showed that Cryptosporidium spp. was highly significantly different to the rest of the parasites in the nursing stage in dairy breeds,
while Giardia spp., was significantly higher than the rest in nursing beef cattle. *Eimeria* spp. was significantly higher in the growth stage, with 91.9% cases out of the total in beef cattle. Oocysts were non-viable when toltrazuril was involved in the treatment program, furthermore they are not infective.

**Conclusions:** The study shows a distribution of parasites that is consistent with production stage and risk factors involved. Nematode and trematode diagnosis might be biased, its low presence may be attributed to the facilities, or because it is considered a pneumonic problem, and no samples were sent. Some parasites are underdiagnosed in the country, hence associations are not always acknowledged. *Eimeria* spp. oocysts can appear in smears and flotation; it does not mean that they are infective. An integrative diagnosis is needed to understand the variability of parasites present in cattle in order to determine specific prevention and treatment protocols.

**Weight gains in sucking beef calves treated with macrocyclic lactone anthelmintics in either an extended-release injectable formulation or a pour-on formulation.**

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1-Virginia-Maryland Regional College of Vet Med VA Tech, Blacksburg, Virginia, USA  
2-Department of Vet Clin Sci Wash SU, Pullman, WA, USA

**Objectives:** The objective of this trial was to test the hypothesis that treating suckling beef calves grazing summer pastures with an extended-release injectable parasiticide containing eprinomectin (ERE) would result in additional weight gain when compared to ivermectin in a pour-on (POI) formulation. ERE contains the anthelmintic with PLGA polymer allowing slow release of eprinomectin following injection with a label claim for protection against reinfection with Cooperia oncophora and punctata for 100 d and Ostertagia ostertagi for 120 d. POI claims 21 d control for Cooperia punctata with 14 for Ostertagia ostertagi and Cooperia oncophora.

**Methods:** Nine hundred and twenty-nine (929) spring-born calves grazing on twenty-two pastures Virginia, USA were measured. Pastures are permanent and continuously grazed ( stocking rate of 0.5 to 1.5 ha per pair). Cattle grazing these pastures have been dewormed with macrocyclic lactone products for many years. One third of the calves in each pasture were assigned to ERE, the other two thirds were assigned to POI. Calves assigned to treatments were blocked by sex, sire AI vs. natural service, Angus vs. Simmental sired, and age. Calves assigned, weighed, and treated in late June/ early July when gastrointestinal parasite infections in calves increase as grazing replaces nursing and seasonal conditions promote infective L3 larval development and distribution.

Calves were weighed mid-trial (avg. 49 d after start) and again at weaning (avg. 103 d after start). Fecal samples were taken from a subset of calves for fecal egg counts from each treatment group within each pasture at the start of the study and again 14 d later for a fecal egg count reduction technique evaluation and at weaning. Care givers and study personnel were blinded to calf treatment assignments.

Weight gains were analyzed using PROCC GLM of SAS version 9.3. The analyses were performed separately for the three outcome variables. Other variables in the models were location, gender, crossbreed, AI vs. natural sire, age of dam, treatment (ERE or POI) and 2-way interactions. Backward elimination procedure created a final model (P ≤ 0.1 for inclusion) with treatment forced into the model.

**Results:** Calves gained, on average, 94.8 kg from start to weaning with a standard deviation of 29.0 kg. Weight gain differences for ERE vs. POI for start to mid-trial and mid-trial to weaning were not significant at the P< 0.05 level. There was a 2.45 kg advantage in weight gain for the ERE over the POI calves (P=0.04) for the entire trial from start to weaning over the 99 to 109 day entire trial period. Other factors that had significant influences on calf gain were location(farm) (P<0.01), crossbreed status of one half or one quarter Simmental (P<0.01), gender (P<0.01), and there was a location by treatment interaction (P<0.01). Of the 22 pasture groups, ten had LS mean gains where POI was superior to ERE ranging from a 0.04 kg advantage to 19.8 kg advantage. 12 pastures had LS mean gains where ERE was superior to POI ranging from an advantage of 0.2 kg to 29.0 kg. The parasitology of this trial is reported in a separate abstract. However, fecal egg count analyses and coprocultures confirmed that pastures were naturally infected with both Cooperia spp. and Ostertagia spp. of gastrointestinal parasites.

**Conclusions:** Treatment of nursing calves at mid-summer with ERE experienced a measureable but modest increase in weight gain vs. calves treated with POI. The location by treatment interaction indicates parasite challenge differences due to stocking rates, grazing history and different pasture conditions. Housing all of the calves in same pasture might have had an influence on the outcome but was preferable to housing ERE and POI calves in separate pastures where pasture variation might have large and immeasurable effects. Calves treated with ERE might have consumed and killed larvae, thus reducing the contamination challenge for the POI calves.

**Parasitology of sucking beef calves treated with macrocyclic lactone anthelmintics in either an extended-release injectable formulation or a pour-on formulation.**

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1-Virginia-Maryland Regional College of Vet Med VA Tech, Blacksburg, VA, USA  
2-Department of Vet Clin Sci Was SU, Pullman, WA, USA

**Objectives:** The objective of this trial was to test the hypothesis that treating suckling beef calves grazing summer pastures with an extended-release injectable parasiticide containing eprinomectin (ERE) would result in changes in GI parasite loads when compared to ivermectin in a pour-on (POI) formulation. ERE contains the anthelmintic with PLGA polymer allowing slow release of eprinomectin following injection with a label claim for protection against reinfection with Cooperia oncophora and punctata for 100 d and Ostertagia ostertagi for 120 d. POI claims 21 d control for Cooperia punctata with 14 for Ostertagia ostertagi and Cooperia oncophora.

**Methods:** Nine hundred and twenty-nine (929) spring-born calves grazing on twenty-two pastures Virginia, USA were measured. Pastures are permanent and continuously grazed ( stocking rate of 0.5 to 1.5 ha per pair). Cattle grazing these pastures have been dewormed with macrocyclic lactone products for many years. One third of the calves in each pasture were assigned to ERE, the other two thirds were assigned to POI. Calves assigned to treatments were blocked by sex, sire AI vs. natural service, Angus vs. Simmental sired, and age. Calves assigned, weighed, and treated in late June/ early July when gastrointestinal parasite infections in calves increase as grazing replaces nursing and seasonal conditions promote infective L3 larval development and distribution.

Calves were weighed mid-trial (avg. 49 d after start) and again at weaning (avg. 103 d after start). Fecal samples were taken from a subset of calves for fecal egg counts from each treatment group within each pasture at the start of the study and again 14 d later for a fecal egg count reduction technique evaluation and at weaning. Care givers and study personnel were blinded to calf treatment assignments.

Weight gains were analyzed using PROCC GLM of SAS version 9.3. The analyses were performed separately for the three outcome variables. Other variables in the models were location, gender, crossbreed, AI vs. natural sire, age of dam, treatment (ERE or POI) and 2-way interactions. Backward elimination procedure created a final model (P ≤ 0.1 for inclusion) with treatment forced into the model.

**Results:** Calves gained, on average, 94.8 kg from start to weaning with a standard deviation of 29.0 kg. Weight gain differences for ERE vs. POI for start to mid-trial and mid-trial to weaning were not significant at the P< 0.05 level. There was a 2.45 kg advantage in weight gain for the ERE over the POI calves (P=0.04) for the entire trial from start to weaning over the 99 to 109 day entire trial period. Other factors that had significant influences on calf gain were location(farm) (P<0.01), crossbreed status of one half or one quarter Simmental (P<0.01), gender (P<0.01), and there was a location by treatment interaction (P<0.01). Of the 22 pasture groups, ten had LS mean gains where POI was superior to ERE ranging from a 0.04 kg advantage to 19.8 kg advantage. 12 pastures had LS mean gains where ERE was superior to POI ranging from an advantage of 0.2 kg to 29.0 kg. The parasitology of this trial is reported in a separate abstract. However, fecal egg count analyses and coprocultures confirmed that pastures were naturally infected with both Cooperia spp. and Ostertagia spp. of gastrointestinal parasites.

**Conclusions:** Treatment of nursing calves at mid-summer with ERE experienced a measureable but modest increase in weight gain vs. calves treated with POI. The location by treatment interaction indicates parasite challenge differences due to stocking rates, grazing history and different pasture conditions. Housing all of the calves in same pasture might have had an influence on the outcome but was preferable to housing ERE and POI calves in separate pastures where pasture variation might have large and immeasurable effects. Calves treated with ERE might have consumed and killed larvae, thus reducing the contamination challenge for the POI calves.
other two thirds were assigned to POI. Calves assigned to treatments were blocked by sex, sire AI vs. natural service, Angus vs. Simmental sired, and age. Calves were assigned and treated in late June/early July when gastrointestinal parasite infections in calves increase. Also at start, at least 5 g of fecal material was collected from a subset of 20 calves (10 ERE and 10 POI) from each pasture and analyzed for strongyle type fecal egg counts (FEC) using either the Modified Wisconsin or 3-chamber McMasters technique. Twenty randomly selected fecal samples were analyzed by coproculture to distinguish the genera of strongyle helminthes contributing to the FEC. Fecal samples were taken from a subset of calves 14 d later for a fecal egg count reduction technique evaluation and again at weaning. Care givers and study personnel were blinded to calf treatment assignments. FEC were analyzed using PROC GLM of SAS version 9.3. Other variables in the models were location, gender, crossbreed, AI vs. natural sire, age of dam, treatment (ERE or POI) and 2-way interactions. Backward elimination procedure created a final model (P ≤ 0.1 for inclusion) with treatment forced into the model.

**Results:** Fecal egg count analyses and coprocultures confirmed that pastures were naturally infected with both Cooperia spp. and Ostertagia spp. of gastrointestinal parasites. EPG means for ERE and POI were similar at start (113.7 EPG and 100.8 EPG P=0.87). The average fecal egg count reduction for the POI treated animals was less than ERE treated animals (12.51% vs. 89.92% (P<.01). At weaning ERE treated calves had lower EPG than POI treated calves (64.2 EPG vs. 235.2 EPG P<0.01). Also significant in the model were location(farm) and calf age (P<0.05). The weight gain performance of this trial is reported in a separate abstract in detail but there was a 2.45 kg advantage in weight gain for the ERE over the POI calves (P=0.04) from start to weaning over the 99 to 109 day entire trial period.

**Conclusions:** Treatment of nursing calves at mid-summer with ERE resulted in decrease in fecal strongyle EPG compared with POI treated calves. Also influencing fecal strongyle EPG were locations nested in farms and age of the calves. Differences in fecal egg count reduction between the formulations might indicate that prolonged exposure to the parasites was necessary for control, that the pour-on route was not effective in delivering drug to the parasites or that there is resistance to the ivermectin but not the eprinomectin.