intake were recorded daily, and milk samples obtained from each cow every second day (at both milkings) starting on d 1. There were no overall differences in DMI (20.5 kg/d), milk yield (34.1 kg/d), protein% (3.75), lactose% (4.62) or yield of these milk components. CLA supplementation decreased overall milk fat% in a dose responsive manner (4.58, 3.98, 3.43 and 3.11, respectively) and milk fat yield showed the same linear pattern. The milk fat% dose response was evident during wk 1 (P=0.15) and became highly significant during wks 2 and 3 (4.51, 3.79, 3.03, 2.81 and 3.89, 3.17, 2.77, 2.31% for wk and dose, respectively). The milk fat yield response pattern was similar with the highest CLA dose decreasing fat yield by 46% in wk 3. On d 21 the highest dose decreased milk fat% and yield by 49 and 56%, respectively. These data clearly indicate RP CLA can markedly (40-50%) induce MFD immediately postpartum without negatively affecting other production parameters and demonstrates the possibility of improving energy balance during the transition period.

Key Words: CLA, Milk Fat

Animal Health

T39 Differences in production traits between scrapie resistant and scrapie susceptible ewes. B. M. Alexander*[1], R. H. Stobart[1], W. C. Russell[1], K. I. O'Rourke[2], and G. E. Moss[1], [1]*University of Wyoming,* [2]*USDA-ARS.*

Scrapie is one of several transmissible spongiform encephalopathies (TSE) including bovine spongiform encephalopathy (BSE). The apparent transmission of BSE to humans in the United Kingdom resulted in a call for eradication of all TSEs in food producing animals. In the United States, scrapie has been detected only in sheep possessing alleles of the prion protein with glutamine (Q) or histidine (H) at codon 171, both reported as Q. Incidence of scrapie infection is rare when animals possess at least one allele for arginine (R) at 171. The objective of the present study was to determine if production traits differed between scrapie resistant (QR and RR) and scrapie susceptible (QQ) animals. Historic records of the Univ. of Wyoming purebred ewe flock were analyzed for evidence of production advantage to scrapie susceptible ewes. Lambing records from purebred Columbia (n=240), Hampshire (n=325), Rambouillet (n=227), and Suffolk (n=277) ewes with known genotype at codon 171 were analyzed for differences in birth-type, birth weight, adjusted weaning weight and total kg of lambs weaned per ewe lambing. In addition, influence of lamb genotype on birth weights and adjusted weaning weights was determined from the 2002 lamb crop (n=356). Suffolk ewes with QQ genotype gave birth to more ($P<0.001$) lambs than QR ewes (1.8 ± .06 vs 1.2 ± .13, respectively). However, QQ Suffolk ewes weaned less ($P=0.07$) total kg of lamb than QR ewes (63.2 ± 1.1 vs 70.2 ± 2.7, respectively). Although, birth weights from Rambouillet ewes tended ($P=0.09$) to be influenced by ewe genotype, differences were not noted at weaning or in total kg of lambs weaned. Production traits of Columbia and Hampshire ewes did not differ by ewe genotype. There was no influence of lamb genotype ($P\geq0.34$) on birth weight or adjusted weaning weight for any of the breeds analyzed. In conclusion, the scrapie resistance status of the ewe may influence birth-type and weight, but these differences do not appear to influence ultimate lamb production.

Key Words: Genotype, Scrapie, Sheep

T40 Effect of calving season on colostrum quality and growth of dairy calves in a hot arid region. J S. Saucedo*[1], L. Avendaño[1], F. D. Alvarez[1], T. B. Rentería[1], J. F. Moreno[1], M. F. Montaño[1], and M. P. Gallegos[2], [1]*Universidad Autónoma de Baja California, Mexicali, Baja California, México,* [2]*Universidad Juárez del Estado de Durango, Durango, México.*

The objective of the present study was to determine the effect of calving season on colostral immunoglobulin levels (CIL), colostral immunoglobulin transfer (CIT), calf birth weight (CBW), weight at 60 d (W60) and daily weight gain from birth to 60 d of age (DWG) of Holstein calves in a dairy herd located in a desert region of Baja California, Mexico. Calving season was grouped in summer (n=12), autumn (n=24), and winter (n=36). The CIL levels were measured using a colostrometer during the first four milkings postpartum. Blood samples were taken from the jugular vein of calves at birth, 24 and 48 h after partum in order to measure CIT using the ELISA procedure. Calves consumed 2 L of colostrum at 6 and 12 h of age and then 4 L of whole milk until 60 d of age. Calf starter was offered to all calves from the first week of age. Statistical analyses were performed using linear models through analysis of variance in SAS. In the first milking, cows calved during winter had higher (P<.05) CIL than those calved during summer and autumn (99.2 ± 6.98 vs 85.2 ± 5.33 and 89.28 ± 4.93 mg/ml, respectively). During the following three milkings, CIL was higher for cows calved in winter and autumn than the cows calved during summer (47.5 ± 4.4; 20.0 ± 2.9; 5.83 ± 2.9 mg/ml, in three milkings, respectively). The CBW were higher (P<.05) in cows calved during winter (35.6 ± 1.9 kg) than those calved during summer (29.6 ± 1.6), but similar (P>.05) to those cows calved in autumn (32.8 ± 1.3 kg). Weights of calves at 60 d were similar (P>.05) during summer (65.3 ± 2.91 kg), autumn (64.3 ± 2.32 kg) and winter (67.6 ± 3.36 kg). The DWG were also similar during summer, autumn and winter (0.593 ± 0.03, 0.524 ± 0.02 and 0.534 ± 0.04 kg, respectively). These results indicate that there is a significant effect of hot environmental temperatures on colostral quality and calf birth weight. However, no significant effect of calving season was observed in daily weight gain and weights at 60 d of age.

Key Words: Calves, Colostral immunoglobulin, Growth

T41 Effect of batch and high-temperature-short-time pasteurization on IgG concentrations in colostrum. L. Green*, S. Godden, and J. Feirtag, *University of Minnesota, St. Paul, MN.*

The objectives of this study were to determine the loss of IgG 1) during pasteurization of the colostrum in both a batch/vat (B/V) and a high-temperature short-time (HTST) pasteurizer; 2) with different volumes of colostrum pasteurized in a batch pasteurizer unit; 3) when different cooling treatments were applied post-pasteurization; and 4) when colostrum was frozen after pasteurization and thawed. The B/V and HTST pasteurizers used in this study were made for on-farm commercial use. A small laboratory-scale B/V pasteurizer (1 gallon aliquots) and a large scale on-farm commercial B/V pasteurization unit (8 gallon aliquots) were used to determine the effect of volume. Three cooling treatments (ice bath, cooler and room temperature) were applied to pasteurized colostrum in the laboratory-scale batch pasteurizer. Pasteurized colostrum samples were frozen immediately after pasteurization. The samples were thawed and re-tested for the impact of freezing on the available IgG concentration in the colostrum. IgG concentrations were quantified in both the pre- and post-pasteurized samples using a radial immunodiffusion assay. Pasteurization caused an average decrease in the IgG for the laboratory-scale batch pasteurizer, commercial on-farm batch pasteurizer and the HTST pasteurizer of 25%, 31%, and 29%, respectively. Pasteurization of different volumes did not appear to have an effect on the final concentration of IgG. A 24.4%, 12.6% and 20.9% decrease in colostral IgG from pre- to post-pasteurized samples was observed when the ice bath, cooler and room temperature cooling treatments were applied, respectively. No significant differences in IgG concentrations were detected in the pasteurized colostrum after being frozen and thawed. Results from this study have demonstrated that on-farm commercial batch pasteurization units can consistently produce a product of normal consistency which can easily be fed to calves.

Key Words: Colostrum, IgG, Pasteurization

T42 The absorption of immunoglobulins from a plasma-based IgG supplement. A. L. Riddle*[1], H. D. Tyler[1], M. L. O'Brien[2], K. J. Touchette[2], and J. A. Coalson[2], [1]*Iowa State University, Ames, IA,* [2]*Merrick's Inc., Union Center, WI.*

Calves that fail to absorb adequate amounts of antibodies within the first 24 h after birth have increased susceptibility to infectious diseases and increased mortality rates. Colostrum supplements, such as plasma-based IgG supplements, are useful when colostrum is unavailable, of poor quality, or a potential disease vector. A plasma-based IgG supplement may provide adequate levels of passive immunity to the neonatal calf. The objective of this experiment was to compare the efficiency of uptake of immunoglobulins from three different sources; a plasma-based IgG supplement, the same plasma-based IgG supplement with

an added emulsifying agent, and from colostrum. Twenty colostrum-deprived newborn calves were used for this trial. Immediately following parturition, each calf was fed one of three treatments (colostrum (n=7), plasma-based IgG supplement (n=7), or plasma-based IgG supplement with added emulsifiers (n=6)). Blood samples were collected at 1 h, 6 h, 12 h, 18 h, 24 h, 36 h, 48 h, 60 h, and 72 h after birth to determine efficiency of antibody absorption. Calves were monitored for visual signs of illness including refusal of milk, body temperature, and scour scores. All 24 h blood samples were tested for IgG concentration. Peak concentrations of IgG were not different ($P > 0.05$) between treatments, although apparent efficiency of absorption was higher for the plasma-based products than for colostrum ($P < 0.05$). Although the emulsifying agent did not further enhance the uptake of immunoglobulins from this product, these data reinforce the value of plasma-based IgG products as a source of supplemental IgG for neonatal calves.

Key Words: Calf, Colostrum, Passive immunity

T43 Practical considerations related to installation and use of commercial pasteurization units for on-farm pasteurizing of milk and colostrum. L. Green, S. Godden, and J. Feirtag*, *University of Minnesota*.

The objectives of this study were to utilize in-lab experience and self-reported survey data to determine the issues and concerns of implementation and use of two commercial pasteurization units (batch/vat and high-temperature short-time) for on-farm pasteurization of waste milk and colostrum. In-lab experiments, conducted at the University of Minnesota pilot plant, involved pasteurizing milk and colostrum in both a fully automated commercial batch pasteurizer and a manual commercial high-temperature short-time pasteurizer. Several issues arose when initially using both of the commercial pasteurization units. These issues included special set-up requirements with respect to water and electrical requirements, their ease in use of pasteurization of milk and colostrum and cleanability of the units. Both of the units were successful at pasteurizing milk, while the batch unit had a higher success rate when pasteurizing colostrum. Our study is one of a few studies reporting on whether agglutination is a concern if pasteurizing colostrum in these new commercially available pasteurizers. A 33-question survey was mailed to dairy producers who have implemented either a commercial or home-made pasteurization unit in their operation for the purpose of collecting information on their experiences and degree of satisfaction in installation and day-to-day use of this technology. The questions focused on issues such as pasteurizer design, cost, set-up requirements, service, pasteurizing and feeding milk, and effects on calf health and performance. Twenty-two out of 51 (43%) of the surveys sent to dairy producers implementing pasteurizer units were completed and mailed back. Six farms had a batch/vat unit while 14 farms had a high-temperature short-time (HTST) unit. Overall, 91% (20/22) of the farms felt that they made a good decision in purchasing this technology and feeding pasteurized milk to their dairy calves.

Key Words: On-farm pasteurization, Batch pasteurizer, HTST pasteurizer

T44 Destruction of *Mycobacterium paratuberculosis*, *Salmonella* sp., and *Mycoplasma* sp. in raw milk by a commercial on-farm high-temperature, short- time pasteurizer. J. R. Stabel*[1], S. Hurd[1], L. Calvente[2], and R. F. Rosenbusch[2], [1]*USDA-ARS-National Animal Disease Center, Ames, IA,* [2]*Iowa State University, Ames, IA*.

The 2002 NAHM's Dairy Survey indicated that 87.2% of dairy farms feed waste milk to their neonatal calves. Although cost-effective, this practice can lead to increased calf morbidity and mortality due to ingestion of pathogenic agents. In an effort to reduce the risk of infection, dairy producers are implementing on-farm pasteurization of the waste milk as a control procedure before feeding the milk to calves. We previously demonstrated the efficacy of an on-farm batch pasteurizer unit for the destruction of *M. paratuberculosis* in waste milk. However, the batch pasteurizer requires a hold time of 30 minutes for adequate killing. Commercial HTST pasteurizer units are now available for on-farm use and these units operate at a higher temperature for a much shorter hold time (15 sec). In the present study we evaluated the efficacy of a commercial HTST on-farm pasteurizer unit to destroy *M. paratuberculosis*, *Salmonella*, and *Mycoplasma* in raw milk. Replicate experiments were run for 3 isolates of *M. paratuberculosis*, 3 strains of *Salmonella* (derby, dublin, typhimurium); and 4 strains of *Mycoplasma* (bovis, californicum, canadense, serogroup 7) at two different levels of experimental inoculation. After culture of the pasteurized milk samples, no viable organisms were recovered. These results suggest that HTST pasteurization of waste milk contaminated with these pathogens is effective at generating a clean product to feed to young calves.

Key Words: Pasteurization, Neonatal calves, Pathogens

T45 Factors associated with transition cow ketosis incidence in selected New England herds. W. S. Burhans*[1], A. W. Bell[1], R. Nadeau[2], and J. R. Knapp[2], [1]*Cornell University, Ithaca, NY,* [2]*University of Vermont, Burlington, VT*.

We conducted an observational field study of diet, facility, and management factors associated with transition disorders in 28 dairy herds in New England. From January to April 2002 dry cows (n=657) from a convenience sample of both Holstein (n=22) and Jersey (n=6) herds were enrolled either at entry into the close up dry group (CUD) or at 3 weeks before expected calving. Health events (incidences of clinical disorders and all preventive, therapeutic, and routine interventions or treatments) were diagnosed and recorded by farm personnel. Data on health, management, diets, and facilities during the CUD and FRESH (calving to 30 days postcalving) periods were collected at biweekly herd visits. Random effect (RE=farm) logistic regression and likelihood ratio tests were used to assess factor odds ratios (OR) for ketosis. Associations with ketosis were assessed separately for Diet and Facility by CUD and FRESH period to minimize collinearity. Reference groups were facilities with fixed opening to outside, without headlocks, and with trough waterers. Overall transition period health disorder incidence (any type) was 42.4%, and not different by breed. Ketosis incidence (unadjusted) was greater (P=0.036) in Holsteins (14.2%) than Jerseys (7.9%). Increasing NFC %DM and eNDF %DM was protective in both CUD and FRESH diets. CUD diet increases in metabolizable Lysine were protective (OR=0.48, P=0.002); increasing CUD degradable protein raised OR, (1.65, P=0.016). Selected factors tabled below may increase odds by affecting intake. Additional factors associated with ketosis occurrence will be presented.

	CUD PERIOD			FRESH PERIOD		
	Odds Ratio	*P*	90%CI	Odds Ratio	*P*	90%CI
Factors						
Barn Type Enclosed Barn	10.35	0.001	3.09-34.72	21.66	0.012	2.89-162.37
Curtained Barn	6.03	0.017	1.75-20.80	11.70	<0.001	4.07-33.7
Headlocks present	2.53	0.064	1.11-5.81			
Waterer Type Ball Waterers	49.42	<0.001	11.37-214.84			
Waterbowls	5.08	0.036	1.41-18.25	0.18	0.112	0.03-1.06
Breed (Adjusted) Jersey	2.82	0.073	1.09-7.31			

Key Words: Ketosis, Health

T46 Prevalence of subclinical hypocalcemia in U.S. dairy operations. R. L. Horst*[1], J. P. Goff[1], and B. J. McCluskey[2], [1]*USDA-ARS-National Animal Disease Center, Ames, IA,,* [2]*Centers for Epidemiology and Animal Health, Fort Collins, CO*.

Cows developing clinical hypocalcemia are known to experience biochemical and physiologic changes that predispose them to other diseases such as mastitis, retained placenta, displaced abomasum, and ketosis. For example, severe hypocalcemia results in higher plasma cortisol which may exacerbate the immunosuppression ordinarily present at calving; a greater decline in feed intake after calving exacerbating the negative energy balance; decreased secretion of insulin, preventing tissue uptake of glucose, and increasing lipid mobilization. Although milk fever is the clinical manifestation of severe hypocalcemia, an emerging concern is subclinical hypocalcemia. Cows suffering from subclinical hypocalcemia

have few overt clinical signs. However, they may be more susceptible to secondary problems than normocalcemic cows. The objective of this study was to determine the occurrence of subclinical hypocalcemia in U.S. dairy operations. As part of the USDA's National Animal Health Monitoring System (NAHMS) Dairy 2002 study, blood samples were taken from 1,446 cows within 48 hours of parturition, representing 480 dairy operations in 21 states. Serum was harvested and frozen within 24 hours of collection. The samples were divided in three groups: 1st lactation (n=442); 2nd lactation (n=424); >=3rd lactation (n=580). Subclinical hypocalcemia was defined as serum calcium <8.0 mg/dl. Subclinical hypocalcemia increased with advancing age and represented 25.3%, 43.9%, and 57.8% of 1st, 2nd and >=3rd lactation cows, respectively. Specific management data was also evaluated for association with hypocalcemia. In this study, 38.7% of the animals were identified as being on a DCAD program. Animals on the DCAD program suffered a significantly (P<0.01) lower incidence of subclinical hypocalcemia than those not being offered a DCAD program, with the biggest difference observed in the >=3rd lactation group. Animals with calcium values of >=8 mg/dl also had lower serum NEFAs than those that were <8 mg/dl, indicating that normocalcemic animals were in better energy status than those suffering from hypocalcemia. Subclinical hypocalcemia can induce some of the same secondary disease problems as clinical milk fever and should be viewed as an impediment to the health of a cow.

Key Words: Subclinical hypocalcemia, Anionic diets, Milk fever

T47 The relationship between disease occurrence, feeding management and return over feed. C. J. McLaren*[1], K. D. Lissemore[1], K. E. Leslie[1], T. F. Duffield[1], D. F. Kelton[1], and B. Grexton[2], [1]*University of Guelph, Department of Population Medicine,* [2]*Ontario Dairy Herd Improvement Corporation.*

Dairy producers of many countries throughout the world are becoming increasingly concerned with global competition. Therefore, it has become important to examine the many management factors that effect profitability of the dairy enterprise. The objective of this research is to examine the relationship between profitability as measured by The Ontario Dairy Herd Corporation's (DHI) Return over Feed (ROF) index, and herd characteristics (herd size, TMR use, monensin use, facility type, dry cow therapy, and disease prevention). Producers (n=148) were identified through the DHI ROF and Management Club groups. The ROF was calculated from the difference between monthly milk revenue and feed cost. Percent dry matters were taken from provincial averages and herd average cow dry matter intakes were calculated. These intakes were multiplied by fixed market prices to generate feed costs per cow per day. Revenue was calculated based on the Dairy Farmers of Ontario multiple component pricing formula for milk. Herd management information was generated through a phone survey of all participants. In previous studies milk production was determined to have a significant effect on the ROF. However, this current research is focused on management factors of dairy enterprises. Total herd size, facility type and monensin use, both as a feed supplement and a controlled release capsule were determined to have no significant effect on the ROF index. There are many management factors that can affect the profitability of dairy operations. Currently, there are few studies that have examined management factors and profitability as measured by the Return Over Feed index.

Management Factors		Coefficient	p-value
Dry Cow Intramammary Antibiotic[1]	Selective	-0.7531	0.032
	None	-1.2767	0.033
TMR Feeding		0.5923	0.058
3X Milking		1.1977	<0.001
E.coli Vaccination		0.6712	0.003
Preventive Periparturient Therapy		0.5219	0.016

[1]dry cow therapy to all cows as referent, r^2=0.30

Key Words: Return over feed, Management, Disease

T48 Effects of intravenous infusion of triglyceride emulsions varying in lipid source on development of bovine fatty liver. D. G. Mashek*, S. J. Bertics, and R. R. Grummer, *University of Wisconsin, Madison.*

Previous research from our laboratory has shown that individual long chain fatty acids influence hepatic lipid and glucose metabolism in vitro, however, little is known about the effects of different fatty acids in vivo. Therefore, our objective was to test the effects of intravenous infusion of triglyceride (TG) emulsions derived from different lipid sources on plasma indicators of energy metabolism and hepatic TG accumulation during a period of fatty liver induction. Six multiparous, non-pregnant, non-lactating Holstein cows were used in a replicated 3x3 Latin Square design. For 4 d, cows were fasted and infused intravenously with a 20% TG emulsion derived from tallow, linseed oil, or fish oil. The emulsions were administered for 20 to 30 min every 4 h throughout the 4 d fast at a rate of 0.54 g TG/kg BW/d. Blood samples were taken every 8 h during the fast and liver biopsies were taken prior to and immediately following the 4 d fast. Cows were fed ad libitum for 24 d between the fasts. Infusion of linseed oil emulsion decreased plasma TG concentrations ($P < 0.01$) compared to tallow and fish oil treatments, which were similar ($P > 0.10$). There was no effect of treatment on plasma glycerol or glucose concentrations ($P > 0.10$). The infusion derived from linseed oil decreased plasma non-esterified fatty acid (NEFA) and β-hydroxybutyric acid concentrations ($P < 0.05$) compared to tallow and fish oil, which were not significantly different from each other ($P > 0.10$). Overall, plasma NEFA concentrations increased from approximately 100 uM at the start to 700 uM at the end of the fast ($P < 0.001$). Liver TG content increased 29.9, 16.3, and 44.1 ug/ug DNA during the fast for tallow, linseed oil, and fish oil treatments, respectively; all treatments were different from each other ($P < 0.05$). In summary, intravenous infusion of a linseed oil emulsion resulted in the lowest hepatic TG accumulation during a 4 day fast, which in part may have been due to lower plasma NEFA concentrations.

Key Words: Fatty liver, Fatty acids, Bovine

T49 Anti-diabetic potentials of *Momordica charanta* and *Andrographis paniculata* and their effects on estrus cyclicity of Alloxan-induced diabetic rats. B. Reyes[1], N. Bautista[2], R. Magtoto*[2], N. Tanquilut*[2], A. Leung[2], Z. Battad[2], G. Sanchez[2], R. V. Anunciado[4], H. Tsukamura[5], and K.-I. Maeda[5], [1]*Thomas Jefferson University, Philadelphia, Penn.,* [2]*Pampanga Agricultural College, Magalang, Pampanga, Philippines,* [3]*Iowa State University, Ames Iowa,* [4]*University of the Philippines, Los Banos, Philippines,* [5]*Nagoya University, Nagoya, Japan.*

Momordica charanta and Andrographis paniculata are commonly used herbs by the diabetic folks in Pampanga, Philippines. While the anti-diabetic potential of M. charanta is well established, it is not known whether A. paniculata possesses anti-diabetic property. Moreover, the effects of these herbs on estrous cyclicity of diabetic rats are not known. Thus, in this experiment, we determined the anti-diabetic potentials of M. charanta and A. paniculata and their abilities to restore estrous cyle in Alloxan-induced diabetic rats. Extract and decoction of M. charanta and A. paniculata, respectively, were administered orally to Alloxan-induced diabetic rats from the day they showed diabetes through the blood and urinary glucose levels until the last day of the experiment. There were two groups of rats that served as positive (untreated Alloxan-induced diabetes) and negative controls. Rats treated with M. charanta and A. paniculata had higher body weight (BW) and lower feed and water intake compared with positive control starting from day 16 (D16) to D26 (P<0.05), though lower BW and higher feed and water intake compared with negative controls (P<0.05). Urinary glucose could not be detected in the M. charanta-and A. paniculata-treated rats from D11 to D26. The blood glucose levels in M. charanta-and A. paniculata-treated rats were significantly reduced from D11 to D26 compared with positive controls (P<0.05) and comparable with negative controls (P<0.05). M. charanta and A. paniculata demonstrated potentials in the restoration of estrous cyclicity at about 8.4 days from the day it was disrupted. The reduction of blood glucose levels and restoration of estrous cycle in Alloxan-induced diabetic rats treated with M. charanta-and A. paniculata indicate that the herbs possess anti-diabetic potentials that could restore impaired estrous cycle.

Key Words: Diabetic, Herbs, Estrus

T50 Induction of apoptosis by butyrate correlates with increasing level of protein ubiquitination in bovine kidney epithelial cells (MDBK). C. Li* and T. Elsasser, [1] *USDA-ARS, Beltsville, MD.*

While butyrate (BT) is largely regarded as the minor short-chain fatty acid ([butyrate]< [acetate] or [proiponate]) formed during microbial fermatation in ruminants, an increasing body of evidence has clearly shown effects beyond those attributable to its function in nutrition. BT modulates cell differentiation, cell invasion, proteolysis, adhesion, proliferation, motility and in particular apoptosis. The body of information in the literature on these effects have concentrated on established cancer cell lines and on the epigenetic effects of physiologic concentrations of BT and other short-chain fatty acid. Effects of BT at the cellular and molecular level in normal bovine cells have not been studied thus far. The aim of this study was to investigate the effects of BT on the established bovine kidney epithelial cell line (MDBK) as a possible model for cell apoptosis. We also compared the effects of BT to those of a known inducer of apoptosis, the histone deacetylase inhibitor, trichostatin A (TSA). MDBK cells were obtained from the ATCC, grown in standard DMEM + 5% serum medium , passaged once every 3 days in a 1:10 split, and used at 50 % confluence. BT (0 to 10 mM) and TSA (0 to 200ng/ml) were added for an overnight incubation and cells were harvested for asessment of DNA fragmentation (agarose electrophoresis) and protein ubiquitination (western blot). Our results indicated that both BT and TSA induce apoptosis in MDBK cells in a dose-dependent maner ($P<0.02$, quadratic effect). Increased protein ubiquitination ($P<0.05$, linear) was detected in whole cell lysates from MDBK cells treated with BT and TSA suggesting a possible pathway through which cell apoptosis may be operating. These results indicate that the MDBK cell line is a useful in vitro model to study factors that impact apoptosis in the ruminant. The cells are responsive to butyrate in terms of both apoptosis and ubiquitination.

Key Words: Apoptosis, Butyrate, Epithelial cells

T51 Anthelmintic efficacy in a Maryland small ruminant flock. C. M. Fletcher*, D. J. Jackson, and N. C. Whitley, *University of Maryland Eastern Shore.*

It was the objective of two EXP to determine anthelmintic efficacy in a flock of meat goats and hair sheep in Maryland. On d0 of EXP1, kids (n=27) and lambs (n=18) 112.9 ± 15.8 days of age were orally administered (n=15/treatment) two times the labeled sheep dosage of Ivomec (IVM), Tramisol (TRA), or Valbazen (VAL) and fecal samples were taken for determination of fecal egg counts (FEC). On d7, fecal samples were taken to determine percentage fecal egg count reduction (FECR). In EXP2, mature does (n=69) and ewes (n=47) were orally administered either the labeled dosage (ewes and all does treated with Cydectin; CYD; n=33) or two times the labeled dosage (does) of Safeguard (SGD; n=31) or Levasole (LVS; n=33) and fecal samples were collected as for EXP1 (d0). On d10, fecal samples were collected to determine FECR. Overall in EXP1, IVM, TRA, and VAL was effective (> 95% egg reduction) in 33.3, 13.3, and 40.0% of the treated animals, respectively with no differences among treatments, indicating overall reduced drug efficacy. FECR for all animals averaged 66.6 ± 7.6%. Moreover, there was an effect of species in which pre-treatment FEC was higher ($p<.04$) for goats (3532.2 ± 974.3 EPG) than for sheep (189.7 ± 1217.9 EPG), but there was no effect of species on FECR averaging 71.3 ± 9.4% for goats and 57.4 ± 13.3% for sheep. In EXP2, CYD (71.2 ± 7.7%) was effective in more animals ($p<.001$) than LVS and SGD (29.8 ± 7.9% and 30.2 ± 7.7%, respectively) indicating reduced drug efficacy. In addition, FECR was greater ($p<.006$) for CYD (92.7 ± 12.3%) than LVS (44.5 ± 12.6%) or SGD (38.3 ± 12.3%). FECR was less ($p<.001$) for goats (37.4 ± 8.4%) than sheep (79.7 ± 12.9%). Also, deworming was effective in more sheep (63.9 ± 8.1%; $p<.0001$) than goats (23.5 ± 5.3%). Results indicate parasite resistance to anthlemintics in this Maryland small ruminant flock as has been noted in other areas of the world. In addition, hair sheep were more resistant to parasite infection than meat goats under these grazing conditions.

Key Words: parasite, anthelmintic resistance, small ruminants

T52 Field trial evaluation of selected topical parasiticides in stocker cattle. T. A. Yazwinski*, C. A. Tucker, D. Hubbell, J. Robins, and Z. B. Johnson, *University of Arkansas, Department of Animal Science.*

According to a 1999- 2000 survey of cow/calf farmers in Arkansas, the majority of weaned calves are either not treated for internal parasites (30%), or given a broad-spectrum, topical parasiticide (32%). The remainder of the animals are administered an injectable (22%) or oral (16%) preparation. The current study was conducted to investigate the ramifications of the most popular practices, i.e. no treatment or topical endectocide. Crossbred weaned calves were grazed on replicated pastures of two herbage types (fescue and bermuda) over a 119-day post treatment period (4 treatment groups x 2 herbage types x 2 pastures x 5 animals). The pastures were adjoining, and except for herbage characteristics, all were equivalent in regard to prior contamination, maintenance and size (1.6 hectares). The topicals used in the study were those which contained ivermectin (Ivomec®Merial), doramectin (Dectomax®Pfizer) and eprinomectin (Eprinex®Merial). In regard to fecal, Trichostrongyle egg counts; (1) both doramectin and eprinomectin treatments provided significant reductions ($P < 0.05$) from control calf levels through day 119 for animals on bermuda grass, (2), ivermectin provided significant reduction only through day 82 when the animals were on bermuda grass and (3), regardless of parasiticide, egg count reductions for fescue-grazed cattle were significant only through day 42. Fecal egg counts were higher for fescue than for bermuda-grazed calves, with Cooperia and Ostertagia spp accounting for the difference. Contrastingly, Haemonchus placei eggs were of greater abundance from bermuda than from fescue-grazed calves. For each herbage type X parasiticide combination, average daily gains for the 119 day trial were improved from control levels, albeit not significantly ($P < 0.09$).

Key Words: Parasiticides, Cattle

T53 The impact of tunnel ventilation cooling and brown mid-rib (BMR) corn silage on heat stress in lactating dairy cows. R. J. Williams*[1], A. M. Chapa[1], T. O. Riley[2], D. O. Pouge[2], S. T. Willard[1], and T. R. Smith[1], [1] *Department of Animal and Dairy Sciences, Mississippi State University,* [2] *North Mississippi Branch Experiment Station, Holly Springs, MS.*

Four groups of 10 lactating Holsteins were used to measure the effects of tunnel ventilation cooling and diet on feed intake, milk production and the incidence of mastitis during periods of heat stress. Two groups were housed in a freestall barn equipped with tunnel ventilation cooling. The remaining two groups were housed in an outside freestall barn, cooled with fans and sprinklers. The maximum daytime temperature in the tunnel barn averaged 6 °C below that of outside freestall barns. Average exposure time to conditions of moderate heat stress (temperature-humidity index (THI) of 80-90) was reduced 6.75 h/day for cows housed in the tunnel ventilation barn. Maximal daytime rectal temperatures for cows housed inside averaged 0.28°C below ($P<0.0001$) those for cows housed outside. Furthermore, the maximal daytime respiration rate averaged 6.0 breaths/min lower ($P<0.0001$) for cows housed inside the tunnel barn than for cows housed outside. There were no significant differences in milk production, milk composition or the incidence of mastitis between housing units. To measure the effect of diet on dry matter intake (DMI) during periods of heat stress, one group in each barn received a diet based on BMR corn silage and the other group received a standard corn silage-based diet (Controls). DMI averaged 21.4 kg/hd/day and did not differ between the 2 dietary treatments. Cows fed the BMR silage averaged 0.5 kg/hd/day more milk than those fed the control silage, but the difference was not significant. Similarly, milk fat production was not affected by diet; However, milk fat percentage averaged 0.238 units lower ($P<0.0001$) in BMR fed cows than in controls, suggesting the improved milk production of BMR fed cows was real. These results suggest that tunnel ventilation cooling can be helpful in reducing the severity of heat stress on dairy cows in the southeastern U.S. BMR may be helpful to maintain production in heat stressed cows, however the BMR diet used in this study did not reduce the symptoms of heat stress.

Key Words: Heat stress, Tunnel ventilation cooling, Brown mid-rib corn

T54 The effect of biotin supplementation on milk yield, reproduction and lameness in dairy cattle. J. K. Margerison*[1], B. Winkler[1], G. Penny[1], and A. Packington[2], [1]*University of Plymouth, UK,* [2]*Roche Vitamins, UK.*

This study determined the effect of dietary biotin supplementation (0 or 22 2 mg/d) on the performance of Holstein-Friesian (n = 36) multiparoius cows, with 18 supplemented with biotin (SB) and 18 cows not supplemented with biotin (NSB). Treatment diets were fed from 14 d prepartum and continued until 120 d in milk (DIM). Total dry matter intake (kg/d) was not significantly different between treatment groups, NBS 24.35 and BS 24.34 (sem 0.510) cows. Biotin supplementation significantly increased (P<0.001) milk yield (kg/d) NBS 37.2, BS 39.2 (sem 0.32), fat corrected milk yield (kg/d) NBS 37.0, BS 39.4 (sem 0.32) and total milk fat yield (kg/d) NBS 1.48, BS 1.58 (sem 0.003). While milk fat content (g/kg) NBS 39.8, BS 40.2 (sem 0.50), protein content (g/kg) NBS 33.0, BS 33.0 (sem 0.20), total protein yield (kg/d) NBS 1.23, BS 1.2 (sem 0.003) were not significantly different between treatment diet. Biotin supplementation had no significant effect on postpartum interval (PPI) to first ovulation (d), NBS 41.7, BS 38.8 (sem 2.26), but first inter ovulation period (d) NBS 21.2, BS 24.5 (sem 0.73) and mean inter-ovulation period, NBS 21.3, BS 23.7 (sem 0.53) were significantly greater in cows supplemented with biotin. PPI to first insemination (d) NBS, 64.2, BS 73.4 (sem 3.61) or PPI to conception (d) NBS 68.7, BS 76.6 (sem 5.32) were not different between treatment diets. Sole lesion score sole at 150d pp was significantly (P0.05) lower in cows supplemented with biotin, NBS 3.06, BS 2.95 (0.04). Biotin had no significant effect on either weekly change in body live weight or condition score.

Key Words: Dairy, Biotin, Reproduction

T55 Influence of a biogenic substance on growth, health, and meat quality in pigs[1]. O. Bellmann*, E. Kanitz, M. Tuchscherer, and K. Ender, *Research Institute for the Biology of Farm Animals, Dummertsorf.*

Growth potential, animal health, and meat quality are important parameters to describe the pork quality. Especially regarding the consumer expectation on production systems, animal health, welfare, and product quality makes it necessary to minimize the use of pharmacological active substances and replace them by biogenic substances as homeopathic substances are. We selected Engystol® (Heel GmbH, Germany) as a product known to improve health status and reduce stress fragility in animals. Pigs of the German Landrace were kept in four groups, two with a maximal number of pigs per pen concerning the German law (between 0.4 and 1 sqm. per pig depending on live weight), two groups below that density. One subgroup of each of them was treated with the biogenic substance Engystol® twice a week provided by drinking water for ten weeks. The trial started when pigs were 70 days old. The pigs were kept in a controlled environment piggery with partly slatted floor. Once a week the animals were weighted and a sample of saliva was taken. At the beginning and at the end of the treatment a blood sample of each animal was taken. With an age of about 170 days the animals were slaughtered and parameters of meat quality were determined. Differences between treated and not treated animals were found especially in the sub-groups with high population density. The not treated animals started tail biting after three weeks, the daily weight gain was reduced and the live weight was lower the in the treated sub-group. The carcass did show pleural and pulmonal alteration. No differences were found in the meat quality. Cortisol concentration in the saliva was higher in the control group of the highly occupied group compared to the treated highly occupied group. No differences were seen in the plasma cortisol concentration. The use of biogenic substances is one to improve animal health and welfare in a prophylactic or metaphylactic manner especially under conditions which are less suitable for animal (for instance high occupation density).

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Key Words: Meat quality, Homeopathic substance, Pork

T56 Effects of pretransit supranutritional levels of dietary selenium and D-α-tocopherol acetate on selenium content of specific tissues in wether lambs. J. B. Taylor*[1], N. K. Chirase[2,3], and T. Thelen[1], [1]*Agriculture Research Service, Dubois, ID,* [2]*Texas Agriculture Experiment Station, Amarillo,* [3]*West Texas A&M University, Canyon.*

Twenty-nine wether lambs (BW = 27.1 kg ± 0.36) were utilized to assess the effects of pretransit supranutritional levels of dietary selenium (Se) and D-α-tocopherol acetate (TOCO) on Se concentrations of specific tissues. Wethers were assigned to one of four treatments: adequate Se and no TOCO (CON; n = 9); high Se (HSE; n = 9); TOCO (HVE; n = 5); high Se and TOCO (SEVE; n = 6). Selenium was provided as high Se wheat (6.1 ppm) delivering 110 μg/kg BW, and TOCO was provided as a daily bolus delivering 3.8 IU/kg BW. Wethers were weaned (d 0), fed treatment diets from d 0 to 20, subjected to transit stress on d 21, and received a common diet similar in nutrient composition to CON for an additional 20 d (d 22–42). Four wethers from CON and HSE were withheld from the transit stress, euthanized (d 21), and blood, skeletal muscle and liver were collected. Likewise, at the end of the receiving period (d 42), all other wethers were euthanized and tissues collected. Pretransit dietary Se resulted in HSE having 66%, 80% and 42% higher ($P < 0.001$) Se concentration in muscle, liver and serum, respectively, than CON. However, this gain for HSE was followed by a 30%, 51% and 34% decrease (d 21 vs. d 42; $P < 0.001$), respectively, during the receiving period. When fed alone (HVE), TOCO had no effect ($P > 0.05$) on tissue Se concentration; however, in combination with high Se (SEVE), TOCO decreased ($P < 0.03$) Se concentration in liver, but increased ($P < 0.04$) Se in the skeletal muscle. Both HSE and SEVE had higher ($P < 0.0001$) concentrations of Se in liver, skeletal muscle, and serum than HVE and CON treatments. Feeding high Se wheat resulted in higher Se tissue concentrations both pretransit and post-receiving. D-α-tocopherol acetate seemed to affect level of Se incorporated and(or) retained in liver and muscle tissue.

Key Words: Selenium, Transit stress, α-Tocopherol

T57 Silymarin PHYTOSOME* against AFB1 in broilers. D. Tedesco*[1], S. Galletti[1], S. Steidler[1], M. Tameni[1], O. Sonzogni[1], and P. Morazzoni[2], [1]*Department VSA, University of Milan, Italy,* [2]*Indena S.p.A., Milan, Italy.*

Silymarin, the bioactive extract of *Silybum marianum*, is used as a natural hepatoprotector in man and is a potent anti-hepatotoxic agent. This study focused on determining the effect of silymarin PHYTOSOME *, a silymarin complexed form with phospholipids from soy, on reducing the toxic effects of aflatoxin B_1 (AFB_1) in broiler chickens. Toxic effects of AFB_1 were studied in a batch of 28 male broiler chickens during their complete commercial growth cycle (from day 14 to day 51). Chickens were randomly allotted in four groups and treated as follows: group C) control group fed on a basal diet alone; group B_1) AFB_1 at 0.8mg/kg of feed; group B_1+Sil) AFB_1 at of 0.8mg/kg of feed plus silymarin at 200 mg/kg body weight; group B_1+Phyt) AFB_1 at of 0.8mg/kg of feed plus silymarin PHYTOSOME* at 600 mg/kg body weight. Chicks were weighed individually every week. Feed intake was recorded daily in the last two weeks of experimental period. At necropsy, liver weight was recorded for each animal and two animals for each group were randomly selected for histological studies on liver tissue. Considering the whole growth cycle, body weight gain and feed intake were significantly decreased in AFB_1 treated animals with respect to control (P<.05). On the contrary, animals receiving AFB_1 plus silymarin PHYTOSOME or silymarin grew at the same rate of the control animals and their body weight gain and feed intake were significantly different with respect to AFB_1 treated animals (P<.05). No differences were noted on the weight or on macroscopic observations of the liver between groups. Histological liver sections of AFB_1-treated animals showed multifocal portal infiltration and necrosis in zone 1. Those changes were less severe in silymarin PHYTOSOME and silymarin treated groups. In conclusion, our results suggest that silymarin PHYTOSOME can provide a protection against the negative repercussion of AFB_1 on performance of broiler chicks. * PHYTOSOME is a trademark of Indena S.p.A.

Key Words: Aflatoxin B1, Silymarin PHYTOSOME, Broiler

T58 Inhibition of fungal growth with OmniGen-AF: a new anti-fungal feed additive. Y. Wang*, S. Puntenney, and N. Forsberg, *Oregon State University*.

Commercial livestock production is adversely affected by mycotic infection of feed and gastrointestinal tract and via invasive mycoses. Mycotic infections have potential to reduce performance, to potentiate disease, to adversely affect reproduction and to cause death. The goal of this study was to test the hypothesis that a new commercial feed supplement (OmniGen-AF), consisting of "GRAS products", inhibited fungal growth and thereby had potential as an anti-mycotic. A mixed fungal culture containing both *Aspergillus fumigatus* and *A. flavus* was obtained from a sample of mill run on a dairy farm which had experienced incidence of hemorrhagic bowel syndrome (HBS; also known as jejunal hemorrhage syndrome). The antifungal properties of OmniGen-AF were tested in four different experiments. In the first experiment, the fungi were cultured on a Sabouraud agar plate (with chloramphenicol and gentimycin present). Drops of the OmniGen-AF product were added directly to the fungal streaks and growth was observed over the next 48 hr. Addition of the product to the fungal streaks inhibited growth. In a second experiment, fungi were grown in Sabouraud liquid medium at 27 degrees C in the presence and absence of OmniGen-AF. Logrithmic growth was noted beginning at 20-24 hr post-inoculation and maximal culture density was reached within 30-34 hours post-inoculation. Addition of OmniGen-AF directly to the culture delayed entry into log-phase growth by 4-6 hr; however, it did not prevent later fungal growth. In a third study, the OmniGen-AF product was added to a broiler feed and moisture content of the feed was increased to 20%. Temperature of the feed was monitored over 1-month. The untreated feed increased in temperature (an index of fungal respiration) to 37 degrees C within 1 week whereas the OmniGen-AF-treated feed did not change in temperature until 1-month. Untreated feed accumulated clumps of *A. fumigatus* and *A. flavus*. Finally, efficacy of the product on clearance of a mycotic infection was evaluated in steers intentionally infected with *A. fumigatus*. Steers treated with OmniGen-AF product cleared *A. fumigatus* from blood more rapidly than untreated steers. Our data indicate that this product has potential to prevent mycotic growth in feed, in liquid culture and *in vivo*.

Key Words: Mycotic infections, Aspergillus fumigatus, Aspergillus flavus

T59 Effects of swainsonine on digestion in wethers consuming locoweed. M. M. Reed[1], B. S. Obeidat*[1], J. R. Strickland[1], C. R. Krehbiel[2], J. B. Taylor[3], C. A. Loest[1], G. S. Bell[1], W. D. Bryant[1], J. D. Rivera[1], and J. L. Jim[1], [1]*New Mexico State University,* [2]*Oklahoma State University,* [3]*USDA, ARS, USSES*.

A trial was conducted to study the effects of swainsonine (SW) on digestion. Mixed breed wethers were assigned to one of three treatments. Wethers received blue grama hay plus 1.6 mg SW/kg BW (n=5), 0.2 mg SW/kg BW (n=6), or no SW (control; n=6). Swainsonine was administered by feeding locoweed (428 ug SW/g dry matter). Blood was collected via jugular venipuncture at 12 h intervals on d #1, 8, 11, 14, and 18 to determine serum SW, alkaline phosphatase, and aspartate-amino transferase activity. Rises ($P< 0.05$) in alkaline phosphatase and aspartate amino transferase activity indicated subclinical toxicity in treated wethers. Rumen samples were collected from 0 to 48 h in 8 h intervals to determine effects on ammonia and volatile fatty acid concentrations. Ammonia concentrations were lower ($P <0.05$) for controls than treated animals at 8 h and higher ($P<0.05$) at 24 and 48 h. Volatile fatty acid (VFA) concentrations essentially were not affected ($P>0.08$) showing no time by treatment effect for all VFA except valerate. Valerate concentrations increased ($P<0.05$) at h 8 in 1.6 mg SW/ kg BW wethers. In situ samples contained 5 g of treatment diets and placed into the rumen representing h 0, 3, 6, 9, 12, 24, and 48. Treatments were 0.2 mg SW/kg BW (n=4), 1.6 mg SW/kg BW (subacute exposure; n=4), 0@1.6 mg SW/kg BW (acute exposure; n=3), or no SW (n=3). Dry matter digestion was greatest ($P<0.05$) for both the 1.6 mg SW/kg BW and 0@1.6 mg SWkg BW treatments. Organic matter, NDF, ADF, and CP showed no effects ($P>0.1$) on digestion. Duodenal and fecal flow rates were apparently unaffected ($P>.09$). Enzyme and swainsonine activity levels in serum indicated subclinical toxicity. However, lack of consistent results in digestive parameters indicates limited effects of swainsonine on digestive processes.

Key Words: Swainsonine, Locoweed, Digestion

T60 Development of quantitative diagnostic assays for assessment of mycotic infections. N. Forsberg*, S. Puntenney, and Y. Wang, *Oregon State University*.

The goal of this research was to develop a quantitative PCR-based assay for the detection of fungal genomic DNA in tissues and blood of domestic animal species. We based our assay on published ITS-1 and -2 fungal genomic sequences which lie between the fungal 18S, 5.8S and 28S ribosomal genes. The ITS-1 and -2 sequences have shown sufficient variation across species that specific PCR methods may be used to detect individual species. Methods for two particularly pathogenic fungal species *A. fumigatus* and *A. flavus* were developed. Forward and reverse primers, which generated 62 bp and 55 bp products, were developed and used in a Sybr Green real-time quantitative PCR assay. An ABI7700 thermocycler was used in all assays. Samples of DNA were extracted from blood and tissues using the Qiagen "tissue" method. Standard curves for both *A. fumigatus* and *A. flavus* were developed using purified genomic template DNA samples which were obtained from a commercial source in Belgium (Dr. F. Symoens). Following completion of thermocycling, the melting temperatures of the PCR products were examined. The melting temperatures of the *A. fumigatus* and *A. flavus* PCR products were 84 degrees C and 76 degrees C, respectively. Examination of the melt temperatures of individual reactions thereby allowed us to ensure reactions were specific. Both assays were very sensitive and specific. The assays were capable of detecting as little as 10 femtograms of *Aspergillus* genomic DNA in a 25 ul sample of blood or 25 ug sample of tissue. Furthermore, the assays were species-specific. The *A. fumigatus* primers did not generate a PCR product using *A. flavus* or *A. niger* genomic templates. Similarly, the *A. flavus* primers did not generate a PCR product from the *A. fumigatus* or *A. niger* genomic templates. These methods may be used to assess mycotic infection and efficacy of anti-fungal treatments in livestock.

Key Words: Mycotic infection, Aspergillus fumigatus, Aspergillus flavus

T61 The impact of tunnel ventilation cooling and brown mid-rib (BMR) corn silage on heat stress in lactating dairy cows. R. J. Williams*[1], A. M. Chapa[1], T. O. Riley[2], D. O. Pouge[2], S. T. Willard[1], and T. R. Smith[1], [1]*Department of Animal and Dairy Sciences, Mississippi State University,* [2]*North Mississippi Branch Experiment Station, Holly Springs, MS*.

Four groups of 10 lactating Holsteins were used to measure the effects of tunnel ventilation cooling and diet on feed intake, milk production and the incidence of mastitis during periods of heat stress. Two groups were housed in a freestall barn equipped with tunnel ventilation cooling. The remaining two groups were housed in an outside freestall barn, cooled with fans and sprinklers. The maximum daytime temperature in the tunnel barn averaged 6 °C below that of outside freestall barns. Average exposure time to conditions of moderate heat stress (temperature-humidity index (THI) of 80-90) was reduced 6.75 h/day for cows housed in the tunnel ventilation barn. Maximal daytime rectal temperatures for cows housed inside averaged 0.28°C below ($P<0.0001$) those for cows housed outside. Furthermore, the maximal daytime respiration rate averaged 6.0 breaths/min lower ($P<0.0001$) for cows housed inside the tunnel barn than for cows housed outside. There were no significant differences in milk production, milk composition or the incidence of mastitis between housing units. To measure the effect of diet on dry matter intake (DMI) during periods of heat stress, one group in each barn received a diet based on BMR corn silage and the other group received a standard corn silage-based diet (Controls). DMI averaged 21.4 kg/hd/day and did not differ between the 2 dietary treatments. Cows fed the BMR silage averaged 0.5 kg/hd/day more milk than those fed the control silage, but the difference was not significant. Similarly, milk fat production was not affected by diet; However, milk fat percentage averaged 0.238 units lower ($P<0.0001$) in BMR fed cows than in controls, suggesting the improved milk production of BMR fed cows was real. These results suggest that tunnel ventilation cooling can be helpful in reducing the severity of heat stress on dairy cows in the southeastern U.S. BMR may be helpful to maintain production in heat stressed cows, however the BMR diet used in this study did not reduce the symptoms of heat stress.

Key Words: Heat stress, Tunnel ventilation cooling, Brown mid-rib corn