free-choice grass hay. Approximately 28 d after weaning, steers (n = 143) were transported 2,200 km to central Oklahoma. As an estimate of inflammation, concentrations of ceruloplasmin, fibrinogen, and haptoglobin were measured in blood samples collected at weaning, 24 and 72 h post-weaning, and on the day of shipping, 24 and 72 h after arrival. Fixed effects were breed type (n = 9 levels: straightbreds [RR, AA, BB], and crossbreds [RA, AR, RB, BR, AB, BA] where letters indicate breed of calfs sire then dam, respectively), herd, sex (weaning only), and sampling time. Animal was a random effect. Following weaning, the concentration of each APP increased ($P < 0.01$; 15, 17, and 19% in the interval from weaning to 72 h for ceruloplasmin, fibrinogen, and haptoglobin, respectively). Irrespective of breed of sire, concentration of each APP was lesser ($P < 0.01$) in calves derived from B dams (average APP concentration = 21.7 and 23.2 mg/dL, 102 and 124 mg/dL, and 2.9 and 3.3 mg HbB for ceruloplasmin, fibrinogen, and haptoglobin, respectively). Following transportation, concentrations of ceruloplasmin and fibrinogen decreased ($P < 0.05$; 10 and 17% in the interval from pre-shipping to 72 h after arrival for ceruloplasmin and fibrinogen, respectively). In contrast, average haptoglobin concentration increased 78% for all calves by 24 h following arrival. Increased haptoglobin concentration was most evident as heterotic effects for AR; i.e., crossbred (AR and RA) concentration (2.71 mg HbB) was greater ($P < 0.01$) than straightbred (AA and RR) concentration (1.41 mg HbB). These data suggest that certain breed effects impact the APP response to calf weaning and shipping.

Key Words: Acute Phase Proteins, Romosinuano, Brahman

M239 Effects of fasting and handling stress of market pigs on plasma concentrations of stress-associated enzymes and carcass quality. D. H. Kim*, J. T. Seo, D. M. Ha, and C. Y. Lee, *Regional Animal Industry Research Center, Jinju National University, 150 Chilamdong, Jinju, Korea*.

One hundred and forty-four cross-bred market pigs weighing approximately 110 kg were randomly divided into six groups in a 3 (duration of fasting prior to loading; 0, 12 and 24 h) x 2 (handling stress; minimal vs stimulated handling stress) factorial arrangement of treatments. The stimulated handling stress group received overally rough handling including electric prod stimulation during loading, transport and lairage at least once at each step. All the animals received 3-h lairage prior to slaughter. Blood and longissimus dorsi muscle (LM) samples were taken at slaughter and after overnight chilling of the carcass, respectively. Mean plasma glucose concentration, as expected, was less in the 12 h- or 24 h-fasting group than in the 0 h-fasting, whereas cortisol concentration was greater ($P<0.05$) in the 24 h- vs 0 h-fasting group. Plasma concentrations of stress indicators glucose, cortisol, creatine kinase and lactate dehydrogenase were greater in the stimulated vs minimal handling stress group. There were no interactions between the duration of fasting and handling stress in their effects on these blood variables. The incidence of pale, soft and exudative (PSE) carcass and drip loss of LM were reduced in the 12 h- or 24 h- vs 0 h-fasting group, whereas the 24-h postmortem LM pH and color including the lightness and redness were not affected by the duration of fasting. The incidence of PSE carcass and physico-chemical characteristics of LM, however, were not changed by the stimulated vs minimal handling stress. In conclusion, results suggest that fasting the market pig overnight prior to transport is desirable in terms of reducing the incidence of PSE carcass. Rough handling of market pigs may not affect the carcass quality of the animals when an enough lairage time is provided. However, rough handling inflicts a stimulated stress on the animal, which is manifested by increased blood concentrations of stress indicators, and therefore should be avoided for animal welfare.

Key Words: Pig, Stress, Carcass

M240 Economic evaluation of gestation crates versus loose-housing systems for gestating sows. M. Ellis, M. E. Kocher*, and G. D. Schnitkey, *University of Illinois, Urbana*.

The objective of this study was to model the economics of a change from confinement to loose-housing of gestating sows using an economic engineering approach. Analysis was conducted with the base case of a 2,200 sow breeding to weaning operation with gestating sows housed in two alternative systems (crates or loose-housing/fed from electronic sow feeders). Annual total costs for each system were estimated on the basis of the following assumptions. Building and equipment costs were depreciated over 15 and 10 years, respectively, assuming an interest rate of 7%. Total fixed costs of $1,184,348 and $1,236,786 for a crate and loose-housed system, respectively, which consisted of costs of building ($656,613 and $623,996, respectively), equipment ($299,480 and $375,615, respectively), and ownership (i.e., depreciation, interest, repairs, taxes, and insurance) ($228,255 and $237,175, respectively). Operating costs (i.e., labor, genetics, feed, utilities, transportation, and veterinary and medicine) and sow productivity levels were assumed to be the same for both systems. Total cost for the system based on gestation crates was $1,311/sow/year (at a total floor space allowance of 1.67 m^2/sow). The costs of the loose-housed system varied with the floor space allowed per sow. At the same floor space assumed for the conventional crate system (i.e. 1.67 m^2/sow), the costs for the two systems were similar ($1,311 vs. $1,334 /sow/year, respectively.) However, costs per sow increased with increasing floor space in the loose-housed system (e.g. 2.04 m^2/sow = $1,521; 2.42 m^2/sow = $1,701; 2.79 m^2/sow = $1,875). In conclusion, the cost to the industry of a move from gestation crates to loose-housed systems will depend on the floor space necessary for successful operation of the loose-housed system.

Key Words: Sows, Housing, Economics

Horse Species

M241 Handling method influences equine urinary calcium and nitrogen. C. I. O'Connor*, B. D. Nielsen, and M. Mayack, *Michigan State University, East Lansing*.

Four mature geldings were used to study the effects of urine handling prior to analysis on Ca and N values. Urine was collected into a clean bucket and then poured through three layers of cheesecloth to remove any hair or debris. The urine was stirred to suspend any precipitate and 5 ml of urine was pipetted into 7-ml vials and the vials were tightly capped. An additional 500 ml of urine was poured into a total collection device (TCD) for later sampling. Urine from each of the 4 horses was blocked by horse and evaluated with twenty-one treatments. Seven combinations of holding time and temperature were examined (frozen immediately, 6 h at 30 C, 6 h at 10 C, 12 h at 30 C, 12 h at 10 C, TCD for 6 h, TCD for 12 h). There were 3 acidification methods evaluated for each combination (no acid, acid added just before freezing, or acid added after urine was thawed). Sample processing was completed within 45 min of collection. Acid was added at a rate of 20 μl of 12 M HCl/ml urine. All samples were frozen at -4 C until analyzed. Differences between treatments were determined by orthogonal contrasts using the mixed model procedure in SAS 8.2. Urinary Ca was higher when acid was added compared to when no acid was added (1.52 mg/ml $\pm$ 0.18 vs. 0.59 $\pm$ 0.18) regardless of holding time, temperature, or location ($P<0.01$). The addition of acid prior to freezing tended to result in samples having higher Ca than samples in which acid was added after urine was thawed ($P=0.07$), though no other variables had an effect. Urine N was unaffected by the addition of acid to the sample (1.04% $\pm$ .26 vs. 1.05 $\pm$ .26; $P=0.22$). There was a trend for urine placed in the TCD for either 6 or 12 h to have lower N than urine not placed in the TCD ($P=0.06$) and urinary N was higher when acid was added after thawing compared to before freezing (1.05% $\pm$ 0.01 vs. 1.01 $\pm$ 0.01; $P<0.01$). There was no difference in N based upon holding time ($P=0.77$). Vials were tightly capped and N was not able to volatilize, which may explain why other differences were not seen. These data suggest that urinary Ca is more sensitive to the addition of acid than urinary N but that urine handling methods do influence results.

Key Words: Horse, Urine Nitrogen, Calcium

M242 The effects of FEB-200 on serum progesterone and cortisol levels of pregnant mares in early gestation grazing on endophyte-infected tall fescue pastures. V. Akay*[1], R. Stepp[2], and P. Karnezos[1], [1]*Alltech, Inc., Nicholasville, KY,* [2]*Southern States Cooperative, Inc., Richmond, VA*.

Fifty pregnant mares in early gestation from a commercial horse farm in Lexington, KY were used to evaluate the effects of modified gluco-

mannan ergot alkaloid adsorbent (FEB-200, Alltech, Inc., Nicholasville, KY) on serum progesterone and cortisol levels. Pregnant mares (36.2 d pregnant) were maintained on endophyte-infected fescue pastures. Fifteen of these 50 mares received 909 g/head/d of pelleted horse feed (EI-FESCUE). The remaining thirty-five pregnant mares received 909 g/head/d of pelleted horse feed, which included 20 g of FEB-200 (FEB-200). Mares began receiving their respective pelleted feed on June 2, 2003. Pasture tiller analysis indicated that endophyte infection level was higher than 80% in all endophyte-infected tall fescue pastures. Blood samples were drawn into evacuated tubes without anticoagulant every 21 d from May 29, 2003 through Aug 21, 2003. Samples were allowed to clot at room temperature, centrifuged at 1800 x g for 20 min, transferred into small vials, and then frozen (-20°C) for later analysis. Serum samples were analyzed for progesterone (P4) and cortisol levels by the University of Kentucky. Data were analyzed as completely randomized design using PROC MIXED procedure of SAS. PDIFF test was used to examine differences between means of treatments. Differences were declared significant at P #8804 0.10. Serum progesterone levels were higher for FEB-200 compared to EI-FESCUE (10.739 vs. 9.678 ng/dl, respectively). At the onset of the experiment, serum cortisol levels were 7.229 and 6.049 μg/dl for EI-FESCUE and FEB-200, respectively. Change in serum cortisol levels was similar (P #8805 0.10) between EI-FESCUE and FEB-200. Pregnant mares grazing on endophyte-infected tall fescue pastures and supplemented daily with FEB-200 had higher serum progesterone levels compared to pregnant mares grazing on endophyte-infected tall fescue pastures without FEB-200 supplementation.

Key Words: Fescue, Progesterone, FEB-200

M243 The effect of MOS supplementation on immune response of mares and their foals. K. R. Spearman* and E. A. Ott, *University of Florida, Gainesville*.

Previous research in other species suggests that mannan oligosaccharide (MOS) supplementation to the diet has positive effects on immune function, including increased serum and colostrum immunoglobulin levels. The objective of this trial was to identify the effects of MOS supplementation to the diet on colostrum and serum immunoglobulin concentrations in the pregnant mare and serum immunoglobulin concentration in her foal. Twenty-six pregnant Thoroughbred (n=21) and Quarter Horse (n=5) mares were paired by expected foaling dates and assigned at random to the treatment or control group. Treatment mares received 10g of MOS mixed in 45g of ground corn in the morning ration. Control mares received 55g of ground corn in the morning ration. All mares were fed a concentrate designed to provide NRC recommended or higher nutrient intake when fed with Coastal bermudagrass hay or bahiagrass pasture *ad libitum* in season. Both treatments began 56 days prior to the expected foaling date (day-56) for each mare and continued through 28 days post-parturition (day 28). IgG, IgM, and IgA values were determined on mare serum at days -56, 0, and 28. IgG, IgM, and IgA values were determined on colostrum collected before the foal had nursed. IgG, IgM and IgA values were determined on foal serum collected at 0 hour (before foals had nursed), 6-10 hours post-parturition, and at days 7, 14, 28, 56, and 112 of age. The mares receiving MOS supplementation had higher colostrum IgA (p=0.008), IgG (p=0.033), and tended to have higher IgM (p=0.076) concentrations when controlled for prelactation colostrum loss, age, and breed. Prelactation adversely affected colostrum IgG (p=0.006) and IgA (p=0.008) immunoglobulin concentration, but had no effect on IgM concentration. There were no significant differences between treatments for mare or foal IgG, IgM, and IgA serum levels at any collection period. This trial suggests that MOS supplementation to pregnant mares increases colostrum immunoglobulin content.

Key Words: Colostrum, Mannan Oligosaccharide, Immunoglobulin

M244 Influence of extender and processing method on fertility and motility of cold stored stallion semen. C. L. Dekat*, G. W. Webb, and K. E. Harrison, *Southwest Missouri State University, Springfield*.

Breeding with cold stored stallion semen has become commonplace in the horse industry. Addition of antioxidants to combat the deleterious effects of reactive oxygen species have been shown to improve motility and conception rate in cattle and sheep. Therefore, an experiment was designed to determine if pregnancy rates of could be increased by supplementing the diluents used to store stallion spermatozoa with a Tyrode's media containing pyruvate and lactate. Semen was collected from a mature stallion on an every other day basis. At least one aliquot from each ejaculate was diluted in a commercially available 2.4% skim milk-5% glucose extender (SKMG) (Exodus Breeder's Supply, York, PA) at a ratio of 3:1 (extender: semen). Additional aliquots were centrifuged at 400 x g for 10 min to remove the majority of seminal plasma. The sperm pellet was re-suspended with the same extender used in the other treatment supplemented at a ratio of 2:1 with a Tyrodes (Sigma # T2145) media (TLP) which contained 20mM lactate (Sigma #L1375) and 6mM pyruvate (Sigma # P4562). Following processing aliquots were stored for 48 h in a commercially available cooling device (Equine Express®, Exodus Breeder's Supply, York, PA). After storage aliquots were analyzed for spermatozoal motility (CASA system) and used to inseminate mares. Thirteen mares were assigned to extender treatment on an every other mare basis when a follicle of 30 mm was visualized by trans-rectal ultrasonography. At d 14 post ovulation mares were examined for pregnancy, administered prostaglandin, and assigned to the alternate extender treatment for the resulting estrus. No difference ($P > 0.05$) in pregnancy rates between SKMG, TLP, and fresh were realized even though spermatozoa stored in TLP had higher means for total and progressive motilities ($P < 0.05$). Findings of this study indicate that removal of seminal plasma by centrifugation and the addition of a Tyrode's media supplemented with lactate and pyruvate to long term storage media had a significant effect on motility but not conception rates.

Key Words: Stallion, Semen, Pyruvate

M245 Affect of pyruvate and cholesterol on post thaw motility of frozen stallion spermatozoa. K. E. Harrison*, G. W. Webb, and C. L. Dekat, *Southwest Missouri State University, Springfield*.

Inclusion of Tyrode's salt solution, pyruvate and/or cholesterol as components of semen extender has been shown to be beneficial for some stallions. The purpose of this study was to determine if either cholesterol or pyruvate, or the combination of the two, would be beneficial when stallion spermatozoa were frozen with an extender consisting of skim milk glucose supplemented with Tyrode's salt solution. Four ejaculates were collected from each of two stallions. After centrifugation at 400 x g to remove the majority of seminal plasma the sperm pellet was re-suspended in one of six extender treatments. Two treatments were re-suspended with 2.4% skim milk-5% glucose extender supplemented with a Tyrode's solution (Sigma # T2145) that contained 20mM lactate (Sigma # L1375) with(TLP) and without (TL) 6mM pyruvate (Sigma # P4562). The same diluents were used for two additional treatments with a further supplementation of a cholesterol-cyclodextrin complex (TLPC, TLC). The fifth treatment served as a control and was re-suspended in SKMG without Tyrode's solution. The first five treatments all contained egg yolk (4%) and glycerol (3%). The last treatment consisted of a commercially available Lactose-EDTA extender (E-Z Freezin, ARS, Chino, CA). Semen was packaged in 0.5 mL straws and frozen in liquid nitrogen. Following minimum 24 h storage, thawed samples were analyzed by CASA for total and progressive motility of sperm, VAP, VCL, VSL and elongation after 5, 10 and 15 min of warming. After 5 and 10 min of warming, motility ($P < .001$) and progressive motility ($P < .001$) of both aliquots that contained cholesterol (TLC, TLPC) were higher than all treatments. The inclusion of cholesterol as a component of a modified Tyrode's salt media used to supplement SKMG improved the post thaw motility of stallion spermatozoa.

Key Words: Stallion, Pyruvate, Cholesterol

M246 Influence of season and cooling device during commercial shipment of stallion semen. G. W. Webb*[1], M. J. Arns[2], M. A. Harris[2], and C. L. Dekat[1], [1]*Southwest Missouri State University, Springfield,* [2]*University of Arizona, Tucson*.

Producers have several commercially available cooling devices available for use during the transportation of stallion semen. Some concern has been expressed regarding disposable static cooling devices in regards to their ability to maintain satisfactory cooling rates and/or storage temperatures. In the current study, Smart Button temperature loggers (Empire Instrument, Big Bear Lake, CA) were incorporated within diluted semen packaged according to manufacturers instructions for two commercially available transportation devices. One of the devices was a disposable unit and the other a standard rigid/plastic device designed for multiple shipments. A temperature logger was also attached externally

to measure ambient temperatures. Semen was collected from each of two stallions diluted at a ratio of 3:1 (extender: semen) with a commercially available stallion semen extender (Exodus Breeders Supply, York, PA) and packaged into each of the containers. Three sets of containers per season (winter and summer) where commercially shipped from Tucson, AZ to Springfield, MO with overnight delivery. Spermatozoal motilities were evaluated utilizing CASA following shipment. Containers were exposed to ambient temperatures that range from a high of 41°C during the summer to a low of 5.5°C during flight in the winter. Values for progressive motility of spermatozoa following 24 h of storage and shipment were similar ($P > .05$) for both cooling devices. Final storage temperatures following 24 h were similar ($P > .05$) for both devices. These data suggest that during both the winter and summer months in the southwestern United States, disposable cooling devices can be used to ship or cool stallion spermatozoa for 24 h.

Key Words: Stallion, Semen, Shipment

M247 Massage as a recovery method in exercising horses. C. A. S. Porr* and K. Bennett-Wimbush, *Ohio State University, Wooster*.

Delayed onset muscular soreness (DOMS) is a painful condition which often occurs after unaccustomed or intense exercise. While no current therapy prevents DOMS, massage is a one that may alleviate pain more quickly, potentially allowing athletes to compete more effectively in subsequent exercise that may occur within a short time period. With regard to horses, the weight and ability of a rider can compromise proper back function, resulting in shortened strides, stiffened posture, and resistance to riders cues. The objective of this research was to evaluate the effects of massage as a recovery aid on subsequent performances of an exercise test in horses. Ten geldings, five Thoroughbreds (TB) and five Quarter Horses (QH), were randomly divided into two groups and subjected to two exercise tests. A test consisted of two exercise bouts with a 30 min recovery between them and a two hr data collection period following the second bout. Recovery between bouts was either control (walking and standing) or 30 min massage. Massage included a combination of Swedish and sports techniques, and was performed by a single certified equine massage practitioner. Horses in Group 1 received a massage recovery during the first test and a control recovery during the second while horses in Group 2 had reversed treatments. All horses received the same recovery after the second bout of exercise, and 10-12 d elapsed between exercise tests. Heart and respiration rates and plasma for lactate were collected before and after each exercise bout and at 5, 10, 20, 30, and 120 min post exercise. Serum for creatine kinase was collected before and after each exercise bout and at 120 min post exercise. Horses showed lower heart rate (46 ± 8 vs 52 ± 7; $P<.03$) and respiration rate (57 ± 15 vs 69 ± 13; $P<.05$) during the second exercise test, most likely due to lower environmental temperatures (24.9 vs. 20.8). Also, QH had higher serum lactate concentrations than TB ($P<.01$). There were no effects of massage on any parameters measured, though there were expected effects of exercise on each ($P<.0001$).

Key Words: Massage, Exercise, Horses

M248 Comparisons of behavioral testing on Morgan horses at different training levels. K. M. Holt and M. C. Nicodemus*, *Mississippi State University, Mississippi State*.

Horses with an early, successful show career are more profitable and while locomotive studies have been able to predict show performance, limited research has been done on behavioral characteristics that demonstrate show aptitude. The objectives were to quantify behavior in 2 training levels of Morgan horses by performing standardized behavioral tests: 1) 2-year olds in the initial stages of show training (Group 1) and 2) Adult horses (7-13 years old) successfully showing at an advanced level (Group 2). Comparisons of tests results should indicate that if Group 1 has similar results as Group 2 then they are more likely to demonstrate the same success in the future training process as Group 2. 6 registered Morgan horses, 3 for each group, were selected according to the following criteria: 1) consistently managed in the same program (W.H. Miner Agricultural Research Institute); 2) similar training and training levels within each group; and 3) were clinically healthy and sound. The following standardized behavioral tests were randomly performed in a consistent manner on the same day and location: 1) Learning retention- time for the horse to select a previously taught symbol; 2) Problem solving- time to find a reward placed under an obstacle; 3) Touch stimulus- amount of pressure on the skin before the horse reacts; 4) Auditory stimulus- time to re-approach a point where a loud noise was sounded; and 5) Visual stimulus- time to re-approach a point where an unfamiliar object was introduced. If the horse did not immediately and correctly perform test 1 or 2, "failing" was assigned. Both groups were similar in their results except for the learning retention test in which the adult horses were disinterested in the test, both the teaching and testing process, while the young horses were curious. While the similarity between group reponses may indicate that the young horses, similar to the adult horses, should be successful in their future training process leading to a more promising show career, unforeseen events may hinder or further future performance. Larger sample populations with different backgrounds may result in more variations.

Table 1. Means (SD) of behavioral testing results for the young minimally trained (Group 1) and adult advanced-trained (Group 2) Morgan horses.

	Group 1	Group 2
Learning Retention	100% Pass	100% Fail
Problem Solving	67% Fail	67% Pass
Touch Stimulus (psi)	2.7(.8)	2.7(1.2)
Sound Stimulus (s)	3.7(4.1)	2.5(.5)
Visual Stimulus (s)	5.6(.8)	5.2(.9)

Key Words: Morgan Horses, Behavioral Testing, Training

Physiology and Endocrinology: Female Reproduction

M249 Residual feed intake (RFI) and serum concentrations of insulin in developing Brangus heifers from sires with differing EPDs for growth and scrotal circumference. K. L. Shirley*[1], M. G. Thomas[1], D. H. Keisler[2], D. M. Hallford[1], D. M. Montrose[1], G. A. Silver[1], and M. D. Garcia[1], [1]*New Mexico State University, Las Cruces,* [2]*University of Missouri, Columbia*.

Objectives were to evaluate growth, feed intake characteristics, and metabolic hormones related to puberty in Brangus heifers from a desert breeding program. Heifers were from sires with EPDs (accuracy) for yearling weight and scrotal circumference of 28.5 (0.55) and 0.2 (0.44) for a large growth-moderate scrotal circumference sire (LG-MSC), 17.2 (0.61) and 1.0 (0.49) for a moderate growth-large scrotal circumference sire (MG-LSC), and 19.5 (0.54) and 0.5 (0.44) for a sire with balanced EPD values. Eight heifers per sire were weaned at 6 mo of age, trained to a Calan gate system for daily feed intake evaluation, and fed a diet of 11.6% CP and 79.4% TDN until 15 mo of age. Heifers were bled twice weekly to determine concentrations of progesterone and metabolic hormones via RIA and BW was measured every two weeks. In 2003, results of ANOVA among sires were reported for growth traits, level of feed intake, serum concentrations of leptin, and puberty (J. Anim. Sci. 86(Suppl.1):236). These analyses suggested that heifers from the Balanced EPD sire achieved puberty (i.e., progesterone concentrations > 1ng/ml) 1 mo earlier than heifers from LG-MSC or MG-LSC sires. Heifers from the Balanced EPD sire also consumed less feed from 11 to 13 mo of age, but no differences in serum concentrations of leptin were observed among sires. Further analyses suggest serum concentrations of insulin were lower ($P < 0.05$) in heifers from a sire with balanced EPDs relative to heifers from LG-MSC ($2.8 < 5.1 \pm 0.7$ ng/mL). Since a strong ($R^2 = 0.96$) regression was observed between BW and time, residual feed intake (RFI) was estimated by predicting daily feed intake with metabolic midweight ($BW^{0.75}$) and ADG. In heifers born to the sires with Balanced and LG-MSC EPDs, RFI was less ($P < 0.05$) than in heifers born to the MG-LSC sire ($-0.59 = -0.38 < 0.70 \pm 0.30$ kg/d). Results suggest Brangus heifers from a sire with balanced EPDs for growth and scrotal circumference appear to have concentrations of