as the slope of declining production from 100 to 195 DIM (M3) and in M2. Total milk yield was greater in P60 and P165 vs. C60 for both parities (P<0.05) in M1 and M2 in both L1 and L2. Milk yield was greater in P165 vs. P60 (P<0.05) during M2 for both parities in L1 but no difference was detected in L2. P165 Prim and Mult cows were more persistent vs. P60 (P<0.05) in late lactation (M2) during L1. No significant difference in persistency was detected in L2. Milk production at dry-off (MPD) for Prim cows was greater in P60 vs. C60 or P165 (P<0.05). MPD was not affected by treatments for Mult cows. Days dry was shorter (P<0.05) for all P60 cows vs. P165 cows in both lactations. Days dry was not different for C60 vs. P60. Days to first insemination after the VW were less for P165 cows vs. C60 or P60 cows in both lactations and both parities (P<0.05). A greater percentage of P165 Prim cows became pregnant in the L1 breeding period vs. P60 Prim cows (P<0.01). There was no difference in percent pregnant between P165 vs. C60 Prim cows in L1 or among any of the Mult groups in L1 or L2. There was no effect of POS or delayed breeding on mastitis case rate.

Key Words: Delayed breeding, Milk production, Reproduction

611 Induced lactation: the need for enhanced mammary development and differentiation. B. A. Crooker*[1], R. J. Collier[2], J. L. Vicini[3], M. F. McGrath [3], and W. J. Weber[1], [1]*University of Minnesota, St. Paul,* [2]*University of Arizona, Tucson,* [3]*Monsanto Agricultural Group, St. Louis, MO.*

Induction of lactation has the potential to increase farm profitability through retention of healthy reproductive culls for one or more additional lactations. Of the approximately 1 million dairy cows culled in the US due to reproductive failure each year, about half are healthy and in appropriate condition for another lactation. These potential culls would be retained if they were profitable. Methods to induce lactation have been described for more than 50 years and most utilize twice daily subcutaneous injections of 17β-estradiol (0.05 mg/kg BW/injection) and progesterone (0.125 mg/kg BW/injection) for 7 d with a secondary treatment such as dexamethasone (0.05 mg/kg BW/d). However, these methods have been plagued by considerable variation in the proportion of treated cows that actually produce milk and their subsequent milk yield. Recent efforts to improve the technique have included administration of bST during the induced lactation and inclusion of bST in both the induction treatment phase and subsequent lactation. Although these efforts have increased milk yield, variation in response and in yield relative to previous production remain greater than desired. Clearly the pregnancy and parturition dependent processes of extensive ductal and lobuloalveolar development, proliferation of alveolar cells, and terminal differentiation of these secretory epithelial cells is not mimicked adequately by current methods to induce lactation. More recent efforts to induce lactation have attempted to enhance mammary development and/or differentiation by intramammary infusion of mammogenic compounds. Results from a half-udder model indicate intramammary infusion of prostaglandin E_2 either enhanced mammary development or differentiation which resulted in increased milk yield from cows induced to lactate. Continued refinement of this technology is warranted and required before it can be considered as a practical on-farm technology.

Key Words: Induced lactation, Mammary development, Differentiation

Nonruminant Nutrition Symposium: Energy density of pig diets

612 Energy density of pig diets: effect of energy evaluation system, technology and pig body weight. J. Noblet*[1] and J. van Milgen[1], [1]*INRA, UMRVP, Saint Gilles, France.*

The feed cost is the most important cost in pig production and energy represents the greatest proportion of this cost. Ad libitum energy intake depends on many animal and environmental factors in which feed energy density (or its chemical composition) play an important role. Under satisfactory protein supply, performance of animals depends directly on the energy supply. Finally, nutrient requirements must be expressed relative to energy intake in order, for instance, to take into account changes in the partitioning of energy gain between protein and lipid during growth. It is then important to express feed energy value on an appropriate basis. Both energy supply (a diet characteristic) and requirement (an animal characteristic) should be expressed using the same system. From that point of view, a NE system may be a good compromise. Energy density depends on the nutrient composition which differ markedly in GE content (23.0, 39.0, 17.4, and 18.4 kJ/g for CP, fat, starch (ST) and dietary fiber (DF), respectively). In addition, nutrient digestibility is variable so that the contribution of nutrients to DE supply in growing pigs ranges from 31.7 kJ/g for fat to 22.4 kJ/g for CP, 17.2 kJ/g for ST and only 3.2 kJ/g for DF. Nutrient composition also affects the metabolic utilization of ME: the ratio of NE to ME varies from 90% for fat to 82% for ST and 60% for CP. Consequently, the relative energy density of feeds for pigs depends on the energy system (DE, ME or NE). For instance, the energy values (relative to a conventional diet with corn, wheat, soybean meal and fat containing 14.2, 13.6 and 10.3 MJ/kg of DE, ME, and NE, respectively) of corn, soybean meal and animal fat are 100, 104 and 235 on a DE basis, 102, 99 and 244 on a ME basis, and 107, 79 and 289 on a NE basis. The existing confusion about energy systems is partly due to the existence of different NE systems and care has to be taken when combining values obtained from different systems. The energy density of pig feeds can also be affected by technology. For instance, pelleting increases markedly the fat and energy digestibilities in corn or full fat rapeseed. Finally, digestion of DF becomes more efficient with increasing BW with subsequent differences in energy density of feeds according to pig BW.

Key Words: Pig, Feed, Energy value

Animal Behavior & Well Being: Production challenges

613 Is iodide responsible for the heat-relief effects of *Ascophyllum nodosum*? P. A. Eichen*[1], M. J. Leonard[1], M. A. Kozma[1], B. M. Kronk[1], L. E. McVicker[1], D. E. Spiers[1], and D. P. Colling[1], [1]*University of Missouri, Columbia, MO,* [2]*Acadian AgriTech, Kansas City, MO.*

Previous studies indicate that adding seaweed (*Ascophyllum nodosum*) extract (Tasco-EX®) to the diet results in decreased core body temperature (Tc) in rats experiencing heat stress and fescue toxicosis. A rat model was used to test Tasco-EX (Acadian Seaplants Limited, Nova Scotia) versus ethylenediamine dihydroiodide (EDDI, International Nutrition, Omaha), at an iodide level equal to Tasco-EX (1215 μg I/g). Experiment I was designed to observe changes during each phase of treatment/temperature exposure. Diets contained no additive, 1% Tasco-EX or EDDI. Male rats (n=72; 372 g av BW) were maintained at thermoneutrality (TN; 21°C) for 5 days before treatment to record baseline feed intake and BW. Treatment diets were fed for seven days at TN, followed by exposure to heat stress (HS; 31°C) for 14 days, with a final seven days at TN. Body weight and feed intake were recorded daily. Six rats from each treatment were sampled for organ weight, and blood T3 and T4 at the end of each phase (four sample weeks). Experiment II was designed to look at Tc response to treatment/temperature. Male rats (n = 24; 288 g av BW) were implanted with telemetric temperature transmitters (Mini Mitter, Bend, OR) to record Tc and activity under conditions similar to Experiment I. At the end of week four, all rats were euthanized for determination of organ weights and blood T3 and T4 levels. Feed intake and weight gain were not different for any of the treatments. There were no T3 differences by treatment or sampling time. In contrast, T4 was lower in all treatment groups at the end of week three (P<.004), and was higher in rats receiving either Tasco-EX or EDDI (P<.007) compared to controls. Rats fed Tasco-EX or EDDI tended to have lower average daily Tc compared to control animals during HS. Average daily maximum Tc of rats receiving Tasco-EX was decreased below control level during a period of HS. These results indicate that dietary iodide is associated with some, but not all, responses to Tasco-EX.

Key Words: Heat stress, Seaweed, Telemetry

614 Monitoring fescue toxicosis in a pasture environment and evaluating the effect of prior treatment with *Ascophyllum nodosum*. D. E. Spiers*[1], L. E. McVicker[1], J. E. Williams[1], P. A. Eichen[1], L. Thompson[1], G. Rottinghaus[1], and D. P. Colling[2], [1]*University of Missouri, Columbia, MO,* [2]*Acadian AgriTech, Kansas City, MO.*

Dietary administration of seaweed (*Ascophyllum nodosum*) extract (TascoEX^{TM}) to cattle produces a reduction in core body temperature (Tc) during heat stress. The present study was conducted to monitor Tc of Angus steers on endophyte-infected tall fescue pastures, and determine if previous treatment with Tasco14^{TM} meal could reduce the impact of fescue toxicosis. Cattle were implanted with telemetric temperature transmitters and fed daily either Tasco14 (1.0% DMI) or control diet for 48 days. They were then removed from the diets and, after 21 days, randomly assigned to either uninfected (E-) or infected pastures (E+; 187 ppb ergovaline average) for a total of 4 test groups (n = 6 per group). Hourly measurements included Tc and ambient conditions (air and black-globe temperatures, percent relative humidity) during onset of summer heat stress (61 days). An early period of heat stress occurred at 15-19 days followed by a second longer period at 35-55 days. Relationship between Tc and air temperature (Ta) for the entire period was a second-order polynomial equation, with a 2-hour delay in Tc behind Ta (R=0.84; P<0.001). Weight gain on pasture was highest for E- control group (33.1kg) and lowest for E+ control group (20.3kg). Both Tasco14 groups exhibited intermediate weight gain (25.4kg). The E+ group had higher Tc levels primarily during Ta increase (e.g., 15-19 days), with less evidence of a difference between E+ and E- groups over days of continuous heat stress. Evaluation of the first heat stress period showed that Tasco14 treatment reduced Tc response to Ta from E+ to E- level. Magnitude of the Tasco14-induced Tc reduction during this period was 0.3°C. Also, E+ control steers began to increase Tc at 12°C Ta, whereas E+ Tasco14 steers did not increase Tc until 17°C. These results suggest that pretreatment with Tasco14 meal treatment may produce a short-term reduction in Tc response to heat stress.

Key Words: Heat stress, Cattle, Fescue toxicosis

615 Effect of social regrouping and relocation on the hypothalamic-pituitary-adrenal axis and immune function of finishing beef steers. S. Gupta*[1,2], B. Earley[1], S. T. L. Ting[1,2], and M. A. Crowe[2], [1]*Teagasc, Grange Research Centre, Dunsany, Co. Meath, Ireland,* [2]*Faculty of Veterinary Medicine, University College Dublin, Belfield,Dublin 4, Ireland.*

To investigate the effect of repeated regrouping and relocation (mixing) on the hypothalamic-pituitary-adrenal (HPA) axis and immune function, 72 Holstein-Friesian (14-mo-old; 441±7.2 kg) steers were randomly assigned to either control (n=30; C) or regrouped (n=42; R) treatments and housed 6 per pen in 12 pens. The R steers were exposed to 6 mixing events over 102 d. New pen cohorts were allowed to stabilize for 14 d and none of the R steers were allowed to share the same pen or pen-mates where or with whom they were previously housed. C steers were housed in the same pen with the same pen-mates. The HPA-axis function, haptoglobin and concanavalin A (Con A)-induced in vitro interferon (IFN)-γ production were assessed 2 h before treatment, and 2 h after the first, third and sixth mixing. Median area under the plasma cortisol curve (AUC) was higher (P<.05) in R than C steers after first mixing, with no differences among treatments after the third and sixth mixings. Over time, median values for cortisol AUC in R steers decreased (P=.0001) following the third and sixth mixing compared with the first. However, median values for cortisol AUC in response to exogenous adrenocorticotrophic hormone (1.98 IU/kg metabolic BW, following administration of 20 μg/kg BW of dexamethasone at -12 h) after the third mixing were not different among treatments. Similarly, there was no difference (P<.10) in the cortisol AUC in response to exogenous bovine corticotrophin-releasing hormone (0.3 μg/kg BW) in C versus R steers after the sixth mixing. There were no differences (P<.10) among treatments in haptoglobin and Con A-induced in vitro IFN-γ after the first, third and sixth mixing. In conclusion, social regrouping and relocation increased plasma cortisol immediately after the first mixing. The HPA-axis of steers repeatedly exposed to regrouping and relocation adapted with a reduction in cortisol secretion.

Key Words: HPA-axis, Social regrouping, Steers

616 Restaurant audits have maintained high standards of stunning and handling at beef slaughter plants. T. Grandin*, *Colorado State University, Fort Collins, CO USA.*

From 1999 until the present, restaurant companies such as McDonald/s Corporation, Wendy/s and Burger King have been auditing stunning and handling at beef slaughter plants for animal welfare. This has resulted in great improvements in stunning and handling. To pass the audit, a plant must comply with the American Meat Institute guidelines at an acceptable level of performance. On a 100 animal audit, 95% or more of the cattle must be stunned with one captive bolt shot, 100% rendered insensible on the bleed rail, 75% moved without an electric prod and only 3% of the cattle vocalize during handling and stunning. Data collected prior to the restaurant audits indicated the following percentages of plants at the acceptable level were stunning 30%, insensibility 90%, electric prod use 43% and vocalization 43%. Four years of restaurant audit data (1999 to 2001) indicate an improvement in the percentage of plants at the acceptable level. For stunning, the percentage of plants passing the audit were 90%, 90%, 91% and 94%. Insensibility was 97%, 98%, 93% and 95%. Vocalization was 71%, 80%, 86% and 91%. Electric prod use as 76%, 67%, 76% and 82%. The number of plants audited was 1999, N=41; 2000, N=49; 2001, N=44 and 2002, N=57. Data from 2002 indicated that 54 plants that were experienced with audits all passed the stunning audit and only one had a partially sensible animal. Three out of four new plants did not know what was expected and they performed poorly. Two of these plants stunned less than 90% of the cattle with one shot. Plants that have good internal auditing usually perform better than plants which do not have internal auditing. On the 2001 data, inter-observer agreement was compared on the percentage of plants scored acceptable on stunning by three different auditors. There was no significant difference between auditors (Chi Square .077 p < 0.75).

Key Words: Restaurant audit, Stunning and handling, Beef

617 The pharmacological effect of small doses of naloxone on sexual exhaustion in white New Zealand male rabbits. V. O. Fuentes*, C. Villagran, R. Orozco, and J. J. Alvarez, [1]*Centro universitario de los Altos, Universidad de Guadalajara.*

Rationale: Reproductive behaviour is modulated by endogenous opioids. The study of these neurohormones will give further information related to the control of reproduction. Objectives: To study the effect of small doses of naloxone in the sexually exhausted New Zealand white male rabbit. Methods: Six young rabbits (6 to 12 months old) and six mature (14 to 20 months old) male rabbits were used. Three days prior to the start of the experiment, naloxone was administered through a subcutaneous implant of 8 mg. With a previous three day rest, male rabbits were first studied to find out how many females they were capable of mounting and ejaculating before becoming sexually exhausted. For this purpose oestrous females were introduced to the male's cage and four minutes were given for mating to occur, when mated the female was replaced with a new oestrous female, this procedure continued until the male refused to mate with a new female. Results: It was observed that young rabbits mated 9 to 10 females and mature male rabbits mated 6 to 8 times to reach sexual exhaustion (p=0.002). After naloxone treatment young rabbits mated 11 to 12 females and mature rabbits mated 9 females to reach sexual exhaustion (p<0.001). I Conclusions: Naloxone treatment increased sexual activity in the male white New Zealand rabbits, giving further support to endogenous opioids as modulators of sexual behaviour.

Key Words: Rabbits, Sexual exhaustion, Naloxone

618 The pharmacological effect of implanted and injected naloxone on plasma testosterone levels in bucks during the breeding and non-breeding seasons. V. O. Fuentes*, J. G. Ruiz, P. I. Fuentes, and R. Sanchez-Gutierrez, [1]*Centro universitario de los Altos, Universidad de Guadalajara.*

The objective of this work was to study the effect of naloxone on plasma testosterone, when administered through a subcutaneous implant and by i.m. injection during the non-breeding and breeding seasons in bucks. For this purpose, during spring (March, April, May) and autumn (September, October, November). Fourteen bucks were selected and allocated at random in to three groups, 1 (n=5), 2 (n=5) and 3 (n=4). Group 1 was treated with 0.5 mg of naloxone by intramuscular injection at 12 hour intervals for 15 days. Group 2 was implanted with a

cristaline microcelulose pellet with 15 mg of naloxone. And, group 3 was injected with saline solution at the same intervals as group 1. Testosterone in plasma samples was determined by RIA at the beginning of the experiment and at 7, 15 and 21 days during treatment. During the non-breeding season testosterone levels in naloxone treated bucks was significantly increased from a control concentration of 0.5 ng/ml to a plasmatic concentration of 1.7 ng/ml, and 1.6 ng/ml of naloxone as compared with 0.5 ng/ml in the control group ($p<.01$). When bucks were treated during the breeding season (autumn) the administration of naloxone did not affect the concentration of plasma testosterone. It was concluded that naloxone antagonism was more effective when administered to bucks in the non-breeding season.

Key Words: Bucks, Testosterone, Naloxone

Animal Behavior & Well Being: Housing environments

620 Behavioral and physical variation among cloned litters of pigs. G. S. Archer*[1], T. H. Friend[1], J. Piedrahita[2], C. H. Nevill[1], and S. Walker[2], [1]*Department of Animal Science, Texas A&M University, College Station,* [2]*College of Veterinary Medicine, Texas A&M University, College Station.*

A series of tests were used to quantify the variation in food preference, temperament, and time budgets of two genetically identical cloned Duroc litters (n = 5,4) and their matched naturally bred controls (n = 4,4). Food preference was determined for all pigs using apples, bananas, crackers, and carrots. Each food type was offered ten times per trial for two trials. To assess variation in temperament a Towel Test, Back Test and Pick-up Test were used. The Towel Test consisted of recording the average time for each pig to remove a towel from its head ten times in each of three trials. The Back and Pick-up Tests were conducted only on the second set of matched litters at 7 weeks of age. They consisted of counting the number of vocalizations and escape attempts each pig made during one-minute of restraint when held on its back and picked up by a person. Time budgets of the pigs were determined for three consecutive 24 h periods at three different ages using time-lapse video. Time spent lying in bedding, lying on concrete, standing, feeding, and play/fighting was quantified. An F-test was used to determine if any differences in variation between litters existed. The cloned litters were found to be similar or more variable ($P < 0.05$) than the naturally bred controls: in their preference for the foods in thirteen of the sixteen comparisons; in five of the eight comparisons during the Towel Test; in all four comparisons in the Back and Pick-up Tests; and in all ten of the comparisons in the time budget analysis. Physical variation among the clones was also observed: one clone had curly hair while the rest had straight hair, one clone developed hyperkeratosis while the others did not, and one clone had 13 teats and the rest had 14. These results indicate that environmental and epigenetic phenomena have major effects on the behavior and physical development of cloned pigs and question the feasibility of using cloning by nuclear transfer to replicate animals with specific behavioral or physical characteristics.

Key Words: Clone pig, Variation, Behavior

621 Effect of stressors on serum concentration of acute phase proteins and performance in pigs. C. Pineiro*[1], E. Lorenzo[1], J. Morales[1], E. Gomez[2], and G. G. Mateos[3], [1]*PigCHAMP Pro Europa S.A., Spain,* [2]*CPP Hontalbilla, JCyL, Spain,* [3]*UPM, Spain.*

Two trials were conducted to assess the effect of stressors on serum concentration of acute phase proteins (APP), pig-MAP (MAP) and haptoglobin (HPT), and performance of pigs. In trial 1 we studied the effect of room temperature in young piglets. A total of 208 piglets were allotted at weaning (21 d) into two identical rooms with eight pens of 13 piglets each. Room temperatures were reduced from 32 C at 28 d to 28 C at 40 d in the control group (CON) and from 26 C at 28 d to 24 at 40 d in the cold room (COOL). From 40 to 60 d room temperature was identical for both groups. From 21 to 28 d of age COOL piglets grew less (73 vs 119 g/d; $P = 0.0003$) and had worse feed conversion (1.17 vs 2.05 g/g; $P = 0.0003$), than CON piglets, but the differences disappeared thereafter. From 21 to 28 d of age APP concentrations increased (0.74 vs 1.2 mg/ml for MAP and 0.22 vs 0.37 mg/ml for HPT at 21 and 28 d, respectively; $P < 0.05$). At 40 d of age APP concentrations decreased in CON group but not in COOL group (1.02 vs 0.75 mg/ml for MAP; $P = 0.12$ and 0.43 vs 0.10 mg/ml for HPT; $P = 0.006$ for COOL and CON groups respectively). In trial 2 we studied in growing pigs (74 to 116 d of life) the effects of feeding frequency on the same parameters. A total of 240 pigs were randomly distributed in 24 pens. The experimental treatments consisted of pigs fed ad libitum (AL) or disorderly (DIS). Total feed intake was kept constant in both groups. From 74 to 102 d of age, AL pigs grew more than DIS pigs (542 vs 482 g/d; $P < 0.05$) but no differences were observed at the end of the trial. Serum APP were higher for the DIS group than for the AL group ($P = 0.004$ for MAP and $P = 0.001$ for HPT). We conclude that stressors impair pig performance and that the impairment can be detected through measuring the variation in serum concentration of Pig-MAP and HPT. When the stressors disappears pigs compensate for the losses in performance and serum levels of APP return to basal levels.

Key Words: Stressors, Acute phase proteins, Pig performance

622 Effects of pre-natal stress on immunological response and weight gain during the grower finisher period. M. J. Toscano*[1], K. A. Scott[1], H. K. Smith[1], J. E. Cunnick[2], M. J. Daniels[3], and D. C. Lay, Jr.[1], [1]*USDA-ARS-MWA-LBRU,* [2]*Iowa State University,* [3]*University of Florida.*

Pre-natal stress, stress applied to the pregnant dam which potentially affects development of subsequent young, works through unclear mechanisms. In the current study, sows received one of two treatments once a week during d 42 to d 77 of gestation: injections of ACTH (i.v., 1 IU/kg BW) (ACTH, n=19), or forcefully moved up and down an alley and received 3 shocks from a standard electric prod over a 10-min-period (ROU, n=15). A third group served as a control and received no treatment (CONT, n=18). Subsequent progeny were separated into groups of 6 (2 pigs/trt/grp) upon weaning. To assess the affect of the treatments on immunological function, at 106 ± 0.51 d of age, a single pig from each litter received a 6-mm punch biopsy to assess healing and then regrouped with other test pigs maintaining groups of six. A base blood sample was taken before the procedure (d 0) and then d 2, 4, 7, 9, 11, 14, 21, 28, 35, 42. To provide a record of punch biopsy healing, digital pictures were taken of the wound at each sampling time until d 21. Collected blood provided an immunological cell profile and each wound picture was scored for severity by 3 observers blind to treatments. Average daily gain from farrowing to d 146 ± 1.0 of age was calculated. Granulocytes as a percentage of white blood cells was least in the ACTH group followed by CONT and ROU, respectively (51.5 ± .82 vs. 53.4 ± .94 vs. 56.08 ± .84 %; $p<.05$). Eosinophils tended to be least ($p>.08$) in the CONT, followed by ROU and ACTH, respectively (1.9 ± .13 vs. 2.01 ± .14 vs. 2.14 ± .34 5^{10} cells/L). A score given to biopsy healing progress was most improved in ROU, followed by CONT and ACTH, respectively (2.12 ± .06, 2.26 ± .06 , 2.34 ± .06; $p > .04$). Average daily gain was not affected by treatment (.65 ± .01 kg/d, $p>.45$). Our results suggest pre-natal stress is a factor in granulocyte production and the body/s ability to heal a small biopsy. Continued research is needed to develop a complete understanding of pre-natal stress/s effects.

Key Words: Pre-natal stress, Swine , Immune

623 Evaluation of drop versus trickle feeding for crated and penned pregnant gilts: productivity measures. J. McGlone*[1], J. Morrow[2], and J. Smith[1], [1]*Texas Tech University,* [2]*USDA-ARS.*

Eighty three Camborough-22 (PIC USA) gilts with known estrus dates were used to determine the effects of two penning systems (crates vs. pens of 5) and feeding system (drop fed vs. trickle fed) on reproductive performance. The four treatments were arranged in a 2 X 2 factorial. Drop-fed gilts (DROP) received their entire 2.7 kg daily meal in a single drop. Trickle-fed (TRICK) gilts were fed 2.7 kg over a 30 min period. Gilts with a known estrus date and a predicted next estrus date were randomly selected and moved from their acclimation group pen to their assigned treatment. Estrus detection, maintenance of pregnancy and litter performance measures were collected. Measures of behavior and physiology will be reported elsewhere. Overall farrowing rate was not different among treatments. However, more gilts were not bred (not detected in estrus) among penned (4.9%) than crated gilts (0.0%). Fewer gilts recycled after mating when in TRICK-Pen (15%) than in TRICK-Crate (25%), DROP-Pen (29.2%), or DROP-Crate (24.2%) treatments.