

and pigs were weighed and bled weekly. Serum was analyzed for blood urea nitrogen (BUN), total bilirubin, alanine aminotransferase (ALT), and aspartate aminotransferase (AST). Pen feed intake was lower ( $P < 0.01$ ) in aflatoxin treated barrows (high and low) than control barrows from d 29 onward, and was lower ( $P < 0.05$ ) in high aflatoxin treated barrows than low aflatoxin treated barrows from day 42 onward. Average daily gain was lower ( $P < 0.01$ ) in high aflatoxin treated barrows than control barrows from d 49 onward, and was similar between control and low aflatoxin treated barrows except on d 69, when ADG was lower ( $P = 0.0449$ ) in aflatoxin treated barrows. High aflatoxin treated barrows had lower bilirubin than low aflatoxin treated barrows on d 27 ( $P = 0.0372$ ) and 62 ( $P = 0.0030$ ). Additionally, bilirubin was higher in high aflatoxin treated barrows than control barrows on d 55 ( $P = 0.0480$ ), 62 ( $P = 0.0052$ ) and 69 ( $P = 0.0304$ ). High and low aflatoxin treated barrows had lower BUN ( $P < 0.01$ ) than control barrows on d 6 and low aflatoxin treated barrows additionally had lower ( $P = 0.0018$ ) BUN than control barrows on d 20. These results demonstrate that performance and blood parameters in young growing barrows are affected by consumption of an aflatoxin-contaminated diet, especially when the concentration of aflatoxin is high ( $\geq 500$  ppb) and the diet is fed over an extended period of time ( $\geq 1$  month).

**Key Words:** aflatoxin, swine, production

**683 Effects of adding a pelleted protein supplement to processed corn in diets for nursery pigs.** S. M. Williams\*, E. F. Mader, S. M. Rogers, S. Issa, A. C. Fahrenholz, L. J. McKinney, J. D. Hancock, and K. C. Behnke, *Kansas State University, Manhattan.*

A total of 180 pigs (90 barrows and 90 gilts) were used in a 28-d experiment to determine the effects of adding a pelleted protein supplement to processed corn in diets for nursery pigs. The pigs (average initial BW of 7.5 kg) were weaned and allotted by sex, weight, and ancestry to 30 pens with 6 pigs/pen and 5 pens/treatment. All pigs were fed a common diet for 7 d post weaning and the experimental treatments for the next 28 d. Treatments were a corn-soybean meal-based control in mash form and the corn-soybean meal-based diet as pellets. For the remaining treatments, all ingredients were pelleted together except the corn which was finely ground, cracked, and steam-flaked before mixing with the protein supplement pellets. Pellet durability index for d 0 to 14 of the growth assay was 97 and 98% and for d 14 to 28 was 89 and 94% for the complete feed and protein supplement, respectively. For d 0 to 14, ADG was greater for pigs fed the mash control compared to all thermally processed treatments ( $P < 0.06$ ) and there was a trend ( $P < 0.10$ ) for pigs fed complete pellets to have greater G:F compared to pigs fed the supplement pellets/processed corn treatments. For d 14 to 28 and overall (d 0 to 28), pigs fed the mash control had greater ADG

and G:F compared to those given the thermally processed feeds and pigs fed complete pellets had improved ADG and G:F compared to those given the supplement pellets/processed corn treatments ( $P < 0.02$ ). Finally, among pigs fed the processed corn treatments, G:F was greater with steam-flaked corn vs ground corn for d 14 to 28 and overall ( $P < 0.007$ ). For pigs fed the mash, pellets, and protein supplement pellets with ground, cracked, and steam-flaked corn, overall ADG was 496, 472, 444, 421, and 451 g, overall ADFI was 661, 626, 651, 648, and 652 g, and overall G:F was 750, 754, 682, 650, and 692 g/kg. Our results indicated that steam-flaked corn was of benefit compared to ground corn, but compared to a mash diet or complete pellets, the separately processed corn treatments reduced growth performance in nursery pigs.

**Key Words:** nursery pigs, particle size, steam-flaking

**684 Effect of a dry organic acid blend on pig performance during the Paylean® phase of growth.** R. J. Harrell\*<sup>1</sup>, F. Navarro<sup>1</sup>, J. Zhao<sup>1</sup>, M. Vazquez-Anon<sup>1</sup>, B. R. Hinson<sup>2</sup>, G. L. Allee<sup>2</sup>, and C. D. Knight<sup>1</sup>, <sup>1</sup>*Novus International, Inc., St. Charles, MO,* <sup>2</sup>*University of Missouri, Columbia.*

Organic acids have been broadly utilized in young nursery pigs as a growth promotant, presumably by providing antimicrobial activity. Less information is available on the performance benefits of organic acids in grow-finish pigs. The objective of the present study was to determine the effects of a dry organic acid blend (DOAB, ACTIVATE® Starter DA, Novus International, Inc.) on pig performance during the Paylean® (ractopamine hydrochloride) phase of growth, a period of limited antibiotic utilization. Data were generated from two separate trials conducted in the same facility with similar management at two different times. Pigs were fed a nutrient adequate corn-soybean meal based diets with TID lysine levels of 0.95% and 7.5 ppm Paylean for a period of 21 days. In each experiment pigs were fed either 0 or 0.1% of a DOAB throughout the grower and finisher phases. In experiment 1, there were 10 pens of 20-25 pigs/pen and experiment 2 there were 8 pens of 20-25 pigs/pen for control and 0.1% inclusion rate of a DOAB, respectively. No differences in performance were detected by the addition of DOAB from 0 to 63 or 0 to 74 days of study, respectively, for experiments 1 and 2. Initial body weights were not significantly different between trials at the start of the Paylean phase, but ADG, ADFI, and GF were affected by trial ( $P < 0.01$ ). The DOAB did not significantly affect final body weights or GF ( $P > 0.20$ ). The DOAB significantly increased ADG (1006 vs 955±12 g/d) by 5.3% ( $P < 0.01$ ) and tended ( $P = 0.12$ ) to increase ADFI (2651 vs 2563±12 g/d). There were no trial by treatment responses for any parameter tested ( $P > 0.25$ ). In summary, the DOAB increased pig growth rate during the Paylean phase of growth.

**Key Words:** organic acids, Paylean®, pigs

## Physiology and Endocrinology: Livestock Physiology

**685 Evaluation of sperm fertilizing capability in stored semen collected from boars fed a diet supplemented with organic selenium.** S. Speight\*<sup>1</sup>, M. Estienne<sup>1</sup>, B. Whitaker<sup>2</sup>, A. Harper<sup>1</sup>, R. Crawford<sup>1</sup>, and J. Knight<sup>1</sup>, <sup>1</sup>*Virginia Polytechnic Institute and State University, Blacksburg,* <sup>2</sup>*Ferrum College, Ferrum, VA.*

This study compared sperm fertilizing capability in stored semen collected from boars fed diets supplemented with organic or inorganic sources of selenium. At weaning, crossbred boars were assigned to one of three dietary treatments: I. basal diets with no supplemental selenium

(controls), II. basal diets supplemented with 0.3 ppm organic selenium (Sel-Plex, Alltech, Inc., Nicholasville, KY) and, III. basal diets supplemented with 0.3 ppm sodium selenite ( $n = 6$  boars/treatment). At sexual maturity, semen was collected, processed and stored in Androhep-Lite (Minitube of America, Inc., Verona, WI;  $3 \times 10^9$  sperm/85 mL semen and extender) at 18° C and was evaluated at d 1 and 8 post-collection (day of semen collection = d 0) using commercially obtained porcine oocytes (Bomed, Madison, WI; 100 oocytes/boar) and in vitro fertilization procedures. Data were analyzed using ANOVA and boar was

the experimental unit. On d 1, fertilization rate was greater ( $P < 0.01$ ) for the Sel-Plex-fed boars (77.8%) compared with the sodium selenite (67.4%) or control boars (68.5%). Polyspermy rate (16.5%) and male pronucleus (MPN) formation (94.1%) did not differ ( $P > 0.37$ ) among groups. On d 8, fertilization rates tended to be greater ( $P = 0.08$ ) for boars fed the diet supplemented with Sel-Plex (63.5%) compared with control (53.3%) or sodium selenite-fed (49.5%) boars. Polyspermy rate (10.7%) and MPN formation (91.2%) did not differ ( $P = 0.37$ ) among groups. Supplementation of boar diets with Sel-Plex selenium resulted in enhanced sperm fertilizing capability compared with boars fed an equal dietary concentration of selenium from sodium selenite or boars receiving no selenium supplementation. Moreover, enhanced fertility characteristics appeared to be maintained during long-term liquid storage at 18° C.

**Key Words:** boar, selenium, fertility

**686 Use of infrared thermal imaging of the muzzle as a measure of body temperature in sheep and cattle.** R. W. Godfrey\*<sup>1</sup>, R. C. Ketring<sup>1</sup>, S. S. Robinson<sup>1</sup>, and S. T. Willard<sup>2</sup>, <sup>1</sup>University of the Virgin Islands, Agricultural Experiment Station, St Croix, VI, <sup>2</sup>Mississippi State University, Department of Animal and Dairy Sciences and Department of Biochemistry and Molecular Biology, Mississippi State.

Previous work in our lab has shown a high correlation among rectal, vaginal and eye temperature (RT, VT and ET, respectively) using digital infrared thermal imaging (DITI) in hair sheep ewes. The objective of this study was to evaluate the relationship among VT, RT and ET and muzzle temperature (MT) in hair sheep and cattle. Sheep were evaluated in a state of normothermia ( $n = 35$  rams and 24 ewes) and after the administration of lipopolysaccharide (LPS; 0.2 ug/kg BW i.v) to induce a febrile state ( $n = 7$  treated and 7 control). Cattle ( $n = 43$ ) were evaluated in a normothermic state. In normothermic sheep and cattle ET and MT were measured using DITI, and RT and VT were measured using a digital veterinary thermometer. In LPS and control ewes VT was measured using data loggers, RT was measured using a digital veterinary thermometer, and ET and MT were measured using DITI. Correlation analysis was conducted to determine the relationship among RT, VT, ET and MT within species. In normothermic sheep, RT was moderately correlated with ET ( $r = 0.55$ ,  $P < 0.0001$ ) and MT ( $r = 0.35$ ,  $P < 0.006$ ) and MT was correlated with ET ( $r = 0.64$ ,  $P < 0.0001$ ). In rams RT and MT were not correlated ( $r = 0.22$ ,  $P > 0.10$ ) but they were in ewes ( $r = 0.55$ ,  $P < 0.005$ ). In normothermic cattle, RT was correlated with ET ( $r = 0.58$ ,  $P < 0.0001$ ) and VT ( $r = 0.78$ ,  $P < 0.0001$ ) but not MT ( $r = 0.22$ ,  $P > 0.10$ ). MT was only correlated with ET ( $r = 0.48$ ,  $P < 0.001$ ). In ewes treated with LPS, RT was correlated with VT, ET and MT ( $r = 0.97$ ,  $r = 0.87$  and  $r = 0.79$ ,  $P < 0.0001$ ). In these ewes MT was correlated with VT and ET ( $r = 0.79$  and  $r = 0.88$ ,  $P < 0.0001$ ). These results indicate that DITI can be used to measure ET and MT in sheep as an indicator of body temperature, as measured by RT or VT, in both the normothermic and febrile state. In cattle the relationship between MT and RT was not apparent in the normothermic state, but ET was correlated to RT. This study shows that DITI can be used as a non-invasive method of measuring body temperature in livestock.

**Key Words:** sheep, cattle, body temperature

**687 Relationship of rumen temperature with estrus in beef cows.**

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Angus x Herford cows, 4 to 8 yr of age, were used to evaluate changes in rumen temperature (RT) associated with estrus. Temperature boluses (SmartStock, LLC) were placed in the rumen with a bolus gun during gestation. Boluses were programmed to transmit RT hourly. Estrus of cows (BW = 539 ± 44 kg, BCS = 4.5 ± 0.4) was synchronized with PGF<sub>2α</sub> at 79 ± 14 d post partum in May ( $n = 25$ ) or December (Dec,  $n = 30$ ). The HeatWatch® Estrus Detection System (CowChips, LLC) was used to monitor onset of estrus. Consumption of water decreases RT (unpublished data), therefore, RT < 37.72°C were excluded from analyses. Mean RT for all cows was 38.2 ± 0.1°C and did not differ between seasons. Rumen Temperatures 96 h before to 96 h after estrus in May and 72 h before to 72 h after estrus in Dec were analyzed using the MIXED procedure (SAS). Mean RT the first 8 h after onset of estrus in May cows (39.1 ± 0.1°C,  $n = 17$ ) was greater ( $P < 0.001$ ) compared with RT during 16 to 32 h before estrus (38.1 ± 0.1°C,  $n = 15$ ) or 16 to 32 h after estrus (38.0 ± 0.1°C,  $n = 19$ ). Similarly, mean RT the first 8 h after onset of estrus in Dec cows (38.9 ± 0.1°C,  $n = 18$ ) was greater ( $P < 0.001$ ) compared with RT 16 to 32 h before estrus (38.4 ± 0.1°C,  $n = 21$ ) or 16 to 32 h after estrus (38.4 ± 0.1°C,  $n = 19$ ). Increases in RT for any 8 h period ≥0.7°C or ≥0.3°C greater than the mean for that cow during 13 to 84 h preceding the 8 h period were used as criteria to predict estrus. In Dec, an increase in RT ≥0.3°C predicted 95% of estrous cows while an increase in RT ≥0.7°C predicted 42% of estrous cows; 100% of May estrous cows were predicted using either method. An increase in RT ≥0.3°C falsely identified 36% of May cows and 40% of Dec cows as estrus. An increase in RT ≥0.7°C did not falsely identify any cows as estrus in May or Dec. Mean ambient temperatures (Oklahoma Mesonet) were 20.3°C in May and 2.4°C in Dec, and ranged from 5°C to 33°C in May and -9°C to 19°C in Dec. Ambient temperature may be important to consider when developing a model to predict onset of estrus with RT. The use of RT has potential application for estrous detection in beef cows.

**Key Words:** rumen temperature, estrus, beef cows

**688 Influence of blood sulfate concentrations on uterine pH.** G. A. Perry\*, B. L. Perry, S. D. Fields, J. A. Walker, and C. L. Wright, Dept. Anim. and Range Sci., South Dakota State University, Brookings.

Uterine pH has been reported to influence pregnancy success and early embryonic development. A recent report also indicated a significant correlation between blood sulfate concentrations and sulfate concentrations in oviductal and uterine fluids. Therefore, the objective of the current study was to evaluate the relationship between uterine pH and blood sulfate concentrations. Immediately following detection in estrus, heifers were divided into 3 groups ( $n = 6$  per group). The groups were fed a low (LOW; 6.4 kg hay and 0.01 kg urea/hd), medium (MED; 8.0 kg hay and 0.8 kg DDGS/hd) or high (HIGH; 6.2 kg hay, 2.9 kg DDGS and 0.03 kg urea/hd) sulfur diet (9.6, 18.08, and 31.34 g/d sulfur, respectively). Uterine pH and blood samples were collected on d 7 and 11 after estrus. Uterine pH decreased ( $P < 0.01$ ) from d 7 to d 11. Uterine pH tended to decrease among LOW heifers ( $P = 0.06$ ; 6.9 ± 0.08 and 6.7 ± 0.07 for d 7 and 11), and decreased from d 7 to 11 in MED ( $P = 0.01$ ; 6.9 ± 0.06 and 6.7 ± 0.06) and HIGH ( $P < 0.01$ ; 6.9 ± 0.08 and 6.5 ± 0.07). In addition, there was an effect of time ( $P < 0.01$ ) on blood sulfate concentrations. Sulfate concentrations increased from d 7 to 11 in LOW ( $P < 0.01$ ; 86.7 ± 9.57 and 125.6 ± 8.61 mg/L), MED ( $P < 0.01$ ; 88.9 ± 7.86 and 146.17 ± 7.86 mg/L), and HIGH ( $P = 0.01$ ;

110.82 ± 9.58 and 145.4 ± 8.61 mg/L) heifers. There was a significant positive correlation between time and sulfate concentrations ( $P < 0.01$ ;  $R^2$  0.56) and a significant negative correlation between sulfate concentrations and uterine pH ( $P < 0.01$ ;  $R^2$  0.32). As time on these diets increased blood sulfate concentrations increased and as blood sulfate concentrations increased uterine pH decreased. In summary, on these diets concentrations of blood sulfate increased and uterine pH decreased with time following estrus.

**Key Words:** blood sulfate, uterine pH, estrus

**689 Impact of long-term genetic selection for age at puberty on postpartum reproductive physiology in cows.** G. A. Bridges<sup>\*1</sup>, N. C. Amyes<sup>2</sup>, M. C. Berg<sup>2</sup>, M. J. D'occhio<sup>3</sup>, and M. L. Day<sup>4</sup>, <sup>1</sup>Purdue University, West Lafayette, IN, <sup>2</sup>AgResearch, Ruakura Research Centre, Hamilton, New Zealand, <sup>3</sup>The University of Queensland, Brisbane, Australia, <sup>4</sup>The Ohio State University, Columbus.

The aim of the present experiment was to determine the impact of > 20 yr of genetic selection for age at puberty on postpartum reproductive function in beef cows. Objective 1 was to compare the duration of postpartum anestrus in mature ( $\geq 3$  yr of age) and 2-yr old (2y) beef cows that had been genetically selected to have either an early age (age-: mature;  $n = 32$  and 2y;  $n = 17$ ) or late age (age+: mature;  $n = 27$  and 2y;  $n = 14$ ) of puberty. Blood samples were collected weekly beginning when cows entered their 5<sup>th</sup> wk postpartum until the 6<sup>th</sup> wk of the breeding season. Blood was analyzed for progesterone concentrations and the duration of postpartum anestrus was calculated as 7 d before progesterone concentrations in weekly samples were indicative of normal luteal function. Statistical analyses were performed separately for mature and 2y cows. Length of postpartum anestrus was shorter ( $P < 0.05$ ) in age- (least squared mean [LSM];  $81.0 \pm 2.0$ ) than age+ (LSM;  $88.1 \pm 2.2$ ) mature cows, whereas, no difference was detected in 2y cows ( $92.6 \pm 3.5$ ). Objective 2 was to compare follicular wave dynamics during the postpartum anestrus between a subset of age- (mature;  $n = 11$ , 2y;  $n = 4$ ) and age+ (mature;  $n = 11$ , 2y;  $n = 4$ ) cows used for objective 1. Beginning approximately 30 d postpartum, ovarian ultrasonography was conducted daily until a complete follicular wave from each animal was recorded. More ( $P < 0.05$ ) follicles emerged at initiation of this wave in the age+ ( $15.9 \pm 1.4$ ) than the age- ( $12.3 \pm 1.2$ ) cows. However, number of d from emergence to maximum diameter of the dominant follicle ( $5.8 \pm 0.2$ ), maximum diameter of the dominant follicle ( $14.6 \pm 0.4$  mm), and length of the follicular wave ( $7.9 \pm 0.2$  d) did not differ between genetic lines. In conclusion, long-term, divergent selection for age at puberty resulted in variation in duration of postpartum anestrus between the genetic lines.

**Key Words:** puberty, beef cattle, genetic selection

**690 Liver transcript profiles due to prepartum dietary energy level and bacterial lipopolysaccharide challenge in dairy cows early postpartum.** D. E. Graunard<sup>\*</sup>, S. L. Rodriguez-Zas, R. E. Everts, H. A. Lewin, J. K. Drackley, and J. J. Loor, *University of Illinois, Urbana.*

Immunosuppression renders cows highly susceptible to mastitis pathogens as well as metabolic diseases after parturition. We hypothesized that plane of dietary energy pre-partum can affect tissue response to inflammatory challenges through changes in gene expression. Twenty-eight Holstein cows with average composite SCC of ~128,000 in the previous lactation were assigned ( $n = 14$ /diet) to a control (high-straw;  $NE_L = 1.52$  Mcal/kg) or moderate-energy (ME;  $NE_L = 1.64$  Mcal/kg)

diet during the entire dry period. All cows were fed a common lactation diet ( $NE_L = 1.69$  Mcal/kg) postpartum. At 7 DIM, cows ( $n = 7$ /prepartum diet) were assigned to receive an intramammary bacterial lipopolysaccharide (LPS) challenge (200  $\mu$ g) in one rear mammary quarter or served as controls. Cows used were bacteriologically-negative in all mammary quarters. A percutaneous liver biopsy was collected at 2 h post-LPS challenge for transcript profiling using a 13,257 annotated bovine oligonucleotide microarray. LPS challenge of cows fed ME prepartum resulted in >140 differentially expressed genes (DEG;  $P < 0.01$ ). The most-enriched biological functions among DEG were regulation of biological process ( $n = 34$ ) and programmed cell death ( $n = 18$ ). Genes identified are associated with inflammatory response (e.g. *S100A12*), chemotaxis (e.g. *CXCL2*), and phagocytosis (e.g. *RBED1*) as well as neutrophil apoptosis (e.g. *IFNG*). In the comparison of ME vs. control-fed cows receiving LPS postpartum there were >30 DEG due to prepartum diet. Among the most enriched biological functions were regulation of biological process ( $n = 10$  genes), response to toxin ( $n = 9$  genes), and immune response regulation (e.g. *IL10*, *ARNT2*, *IL1R2*). Results showed that a mammary inflammatory challenge early postpartum caused rapid alterations in liver gene expression profiles. However, the hepatic transcriptomic response to inflammation was not greatly affected by prepartum dietary energy level.

**Key Words:** transcriptomics, inflammation, mastitis

**691 Heat stress abatement for dry cows: Does cooling improve immunity status?** B. C. do Amaral, S. Tao<sup>\*</sup>, J. Bubolz, J. Hayden, and G. E. Dahl, *University of Florida, Gainesville.*

Heat stress during lactation and the dry period reduces milk production of dairy cows. Emerging evidence suggests that heat stress may influence immune status as well. The objective of the study was to evaluate the effect of heat stress prepartum on cellular immune function of periparturient Holstein cows ( $n=21$ ). Cows were dried off 46 d before expected calving date and assigned to treatment by mature equivalent milk production. The treatments were: 1) Heat stress (HT) and 2) Cooling (CL). Both treatments had a photoperiod of (14L:10D). Rectal temperature was measured 2X daily whereas respiration rate was measured 3X weekly at 1500h during the dry period. After calving, cows were housed in freestalls with cooling, and milk yield was recorded daily up to 140 DIM. Neutrophil function and lymphocyte proliferation were measured in blood collected at dry off, -20, +2, and +20 d relative to calving and production of cytokines (IFN- $\gamma$ , IL-4, IL-6, and TNF- $\alpha$ ) on postpartum samples for cows on HT ( $n=12$ ) and CL ( $n=9$ ). HT cows produced less 3.5% FCM (30.8 vs. 35.7 kg/d;  $P = 0.07$ ) and had greater afternoon rectal temperatures (39.4 vs. 39.0°C;  $P < 0.01$ ) and respiration rates (78 vs. 56 respirations/min;  $P < 0.01$ ) during the prepartum period compared with CL cows. Relative to HT cows, lymphocytes had less proliferation (45 vs. 169% of baseline;  $P < 0.05$ ) in CL cows. Lymphocyte production of IFN- $\gamma$  (69 vs. 52 ng/mL), IL-4 (406 vs. 265 pg/mL), and IL-6 (5 vs. 5 ng/mL) did not differ ( $P > 0.05$ ) among treatments. However, TNF- $\alpha$  production was lower (27 vs. 70 pg/mL;  $P < 0.05$ ) for lymphocytes from HT cows compared to CL cows. Neutrophil phagocytosis (61 vs. 42% and 62 vs. 49% for 2 and 20 DIM, respectively) and oxidative burst (47 vs. 33% and 52 vs. 36% for 2 and 20 DIM, respectively) were greater for CL cows at 2 and 20 DIM compared to HT cows (treatment by DIM interaction;  $P < 0.05$ ). These results supports the concept that heat stress abatement in the dry period increases milk production and improves immune status in the subsequent lactation.

**Key Words:** heat stress, dairy, immune status



**692 Association between seasonality, cleavage timing and gene expression in bovine oocytes.** Z. Roth\* and M. Gendelman, *Faculty of Agriculture, The Hebrew University of Jerusalem, Israel.*

Developmental competence of bovine oocytes is known to decrease during the hot season. It includes reduced ability to undergo maturation and fertilization, to cleave and to develop to a healthy embryo. The aim of the study was to examine whether seasonal induced alteration is associated with variations in oocyte genes expression. Bovine oocytes were aspirated from ovaries collected from a local slaughterhouse during the hot (Jun-Sep) and cool (Dec-May) seasons. Oocytes were in-vitro matured, fertilized, and cultured (KSOM) for 8 days. The proportion of oocytes cleaved into 2- and 4-cell stages and developed to blastocysts was assessed at 27h, 42-44h and 8 days post-fertilization (PF), respectively. Data was analyzed by one way ANOVA (JMP-6; SAS) followed by student t-test. In each season (4 replicates) and for each developmental stage, samples of 2-, 4-cell stage embryos and blastocyst (n=10, 5, and 3, respectively) were collected. Total RNA was isolated using 500 µl Trizol reagent, cDNA was generated using M-MLV reverse transcriptase (1 h; 42°C) and qPCR was carried out with primers for GDF9, POU5F1, C-MOS and GAPDH using 18S as reference genes and analyzed (MxPRO QPCR). The percentage of embryos developed to the blastocyst stage was higher in the winter than in the summer ( $23 \pm 2.3$  vs.  $9 \pm 3.5\%$ , respectively;  $P < 0.05$ ). The average cleavage rate to the 2- to 4-cell stage (44h PF) did not differ between seasons. However, the proportion of 2-cell stage in the summer was two fold higher than that of 4-cell, suggesting a delayed cleavage. Examination of gene expression in both early (27h PF) and late (42h PF) first-cleaved embryos revealed that the expression of GDF9 and POU5F1 was lower in late- than in early-cleaved embryos in both seasons. At the 4-cell stage embryos (48h PF), opposite patterns were noted between seasons, with decreased expression of GDF9 in the winter and of POU5F1 in the summer. Findings suggest that seasonality has a deleterious effect on the ovarian pool of oocyte as reflected by delayed cleavage and reduced blastocyst formation in association with variation in gene expression.

**Key Words:** seasonality, oocyte competence, cleavage timing

**693 Cytochrome P450 activity, liver blood flow and progesterone clearance in dairy cows fed a high starch versus a high fiber diet.** C. O. Lemley\*<sup>1</sup>, K. A. Vonnahme<sup>2</sup>, K. M. Krause<sup>1</sup>, and M. E. Wilson<sup>1</sup>, <sup>1</sup>West Virginia University, Morgantown, <sup>2</sup>North Dakota State University, Fargo.

Elevated rates of steroid clearance may lead to lower reproductive success in dairy cows. We have recently demonstrated an insulin induced decrease in the activities of the progesterone catabolic enzymes, cytochrome P450 2C and 3A. The current objectives were to determine liver blood flow, cytochrome P450 activity and metabolic clearance rate of progesterone in dairy cows consuming isoenergetic diets formulated to cause divergent insulin secretion. Holstein dairy cows (n = 11) were randomly assigned to a high starch or high fiber diet in a cross-over experimental design consisting of two 14 d periods. Dry matter intake ( $25.7 \pm 0.7$  kg/d), milk yield ( $38.4 \pm 1.4$  kg/d) and milk lactose yield

were not different between the two diets ( $P > 0.51$ ). Milk protein yield tended ( $P = 0.06$ ) to be elevated in cows fed the high starch diet, while milk fat yield was elevated ( $P < 0.01$ ) in cows fed the high fiber diet. Energy balance was improved ( $P = 0.03$ ) in cows fed the high starch diet. Insulin concentrations over the 10 h sampling period were increased ( $P = 0.01$ ) by 22% in cows fed the high starch diet, and both cytochrome P450 2C ( $P = 0.01$ ) and cytochrome P450 3A ( $P = 0.03$ ) activities were decreased by 50%. Liver blood flow was not different ( $P = 0.47$ ) between the two diets ( $1891 \pm 91$  l/h). Metabolic clearance rate of progesterone tended ( $P = 0.06$ ) to be lower in cows fed the high starch diet ( $25 \pm 5$  l/h\*BW<sup>0.75</sup>) versus the high fiber diet ( $40 \pm 6$  l/h\*BW<sup>0.75</sup>). The half-life of progesterone was increased ( $P = 0.01$ ) in cows fed the high starch diet ( $73 \pm 10$  min) versus the high fiber diet ( $24 \pm 10$  min). In summary, cows with elevated insulin concentrations and lower enzyme activity showed a decrease in progesterone clearance without any changes in liver blood flow, dry matter intake or milk yield. This relationship between insulin and enzyme activity may be a useful approach to decrease high rates of progesterone clearance during pregnancy.

**Key Words:** insulin, cytochrome P450, progesterone clearance

**694 The effect of high and low doses of naloxone on the ovulation rate of Suffolk ewes during the breeding season.** V. O. Fuentes\*, A. Bernal-Canseco, and P. I. Fuentes-Castro, *Centro Universitario de los Altos Universidad de Guadalajara, Tapatlan, Jalisco, Mexico.*

In previous work it was observed that the administration of low doses of naloxone in the ewe facilitated the expression and duration of estrus. It was considered of interest to study the effect of naloxone in high and low doses on the ovulation rate of Suffolk ewes during the breeding season. During the breeding season of November 2007, 60 ewes were selected from an intensive ovine herd, and allocated at random in to three groups. Group A (n = 20) received an intravaginal sponge with 40 mg of medroxyprogesterone acetate (MAP) for 14 days and since one day before and two days after the sponges were withdrawn, all ewes of this group received an im injection of 2 ml of saline solution at 12 hrs intervals. Group B (n = 20) was treated as ewes of group A but one day before and two days after sponge withdrawal a naloxone iv infusion of 1 mg/kg in saline solution was administered at 12 hrs intervals. Group C (n = 20) was treated as group A, and since one day before and three days after sponge withdrawal they were injected im at 12 hrs interval with 0.5 mg naloxone in saline solution. Between 6 and 10 days after estrus was displayed laparoscopy was carried out under ketalar/xilazine anesthesia and ovulation rate was noted. Ovulation rate in ewes of Group A was  $1.8 \pm .3$ , and in ewes of group B ovulation rate was  $1.9 \pm .5$ . In ewes of group C ovulation rate was  $2.9 \pm .6$ . The statistical analysis showed a high degree of significance when comparing groups C with groups A and B ( $p < 0.01$ ). Naloxone administered in low doses was more effective to induce an increase in ovulation rate. It was concluded that endogenous opioids are important modulators of reproductive behavior and ovulation in Suffolk ewes.

**Key Words:** naloxone, ewe, ovulation