

($P > 0.05$; 47 to 57 AU). At birth (d 0) BP-2 was less in bST treated calves than C ($P < 0.05$; 35 vs 61 AU), but BP-2 were similar on d 3 and 5 in bST treated and C animals. Thus, in terms of the somatotrophic axis, calves respond to bST administration, even at birth.

Key Words: Somatotrophic axis, Hereford calves, Bovine somatotropin

96 Differential effect of mammary inflammation on albumin and β -casein concentration in porcine milk. A. C. W. Kauf*, D. C. Pighetti, D. A. Pape, A. L. Magliaro, and R. S. Kensinger, *Penn State University, University Park.*

Mastitis in lactating sows reduces growth performance of the nursing litter (Curtis, 1974; Dyck et al., 1987). Mastitis in dairy cows reduces milk yield and changes milk composition (Carroll and Jain, 1969; Shuster et al., 1991), but less is known about the effects of mastitis on milk composition in the sow. Our objective was to quantify the changes in albumin and β -casein in sow milk in response to an intramammary endotoxin challenge (Kensinger et al., 1999). Nine parity-one Yorkshire sows received intramammary infusions of endotoxin (1.5 $\mu\text{g/gland/kg BW}$) at 0700 on alternating days from d 2-10 of lactation. Endotoxin (ET) was infused into two functional, previously non-infused mammary glands on a total of three days. Milk samples were collected from both ET-treated and control mammary glands between 0900-1200 by manual expression during one or more nursing episodes. Albumin concentrations were determined by ELISA, and β -casein concentrations by Western blot analysis against a standard amount of β -casein. Data were analyzed by the Proc GLM option of SAS. Albumin concentrations in milk were elevated in ET-treated versus control glands (2.12 vs. 1.31 mg/ml, respectively; $P < 0.01$) on d 5-10 of lactation. β -casein concentrations in milk were decreased in ET-treated versus control glands (22.5 vs. 34.2 ng/mg total milk protein, respectively; $P < 0.01$) on d 5-10 of lactation. In addition, SDS-PAGE analysis of milk samples revealed a protein that co-migrated with a bovine lactoferrin standard. Concentrations of this band were greater in early (\leq d 4) versus mature milk (\geq d 5). However, there was little evidence for an effect of endotoxin challenge on the concentration of this putative lactoferrin in milk samples collected 2 to 5 hours post-intramammary infusion. This study shows that albumin increases and β -casein decreases in sow milk in response to intramammary infusion of endotoxin, and probably reflects host defense mechanisms in the sow.

Key Words: Porcine mastitis, Albumin, β -casein

97 Novel birth-weaning feeder reduces time spent learning to drink from an open vessel. R.W. Quinn*¹, T.G. Hartsock¹, N.C. Whitley², and L.W. Douglass¹, ¹*University of Maryland College Park*, ²*University of Maryland Eastern Shore.*

Teat seeking is an innate behavior of newborn pigs, allowing them to locate teats and begin suckling soon after birth. This behavior has proven to be problematic in the adaptation of neonatal pigs to artificial feeding systems. Piglets weaned into conventional group pens with milk replacer in troughs or modified poultry waterers continue to exhibit teat-seeking behaviors directed toward pen mates and objects within the pen and appear to discover the milk replacer "by accident." Consequently, many take longer than 12 hours to learn to drink unless assisted. A trough-style birth-weaning feeder was designed to take advantage of the

piglets' natural searching behavior in order to reduce the time to learn to drink from an open vessel. Immediately after birth, treatments were randomly assigned to 115 crossbred pigs from 15 litters as a two-by-two factorial. The pen treatments consisted of a novel trough-style Individual Pen feeder (IP, $n=60$) or a commercially available Group Pen feeder (GP, $n=55$). The second treatment designated piglets as Suckled ($n=58$) or Unsuckled ($n=57$) prior to weaning. Each piglet was observed for 6 hours following placement in a weaning pen. Data on time to first drink, general activity, nosing, sucking and aggressive nosing were recorded for each piglet. More IP piglets learned to drink than did GP piglets (82% vs. 16%, $p<.01$). However, in those pigs that did learn, average time to drink was not different between pens (GP 2.6h \pm .48h, IP 3.1h \pm .28h, $p=.21$). Prior suckling did not affect success in either pen ($p=.41$). GP piglets had higher levels of activity ($p<.01$) but there was a time x treatment interaction with GP activity being high and declining and IP activity remaining low and constant. GP piglets had higher incidences of nosing ($p<.01$), sucking ($p<.01$) and aggressive nosing ($p<.01$). Suckling did not affect activity levels, nosing or aggressive nosing ($p=.74$, .27 and .54, respectively). Unsuckled piglets had a higher incidence of sucking behavior that approached significance at $p=.053$.

Key Words: Piglet, Behavior, Weaning feeder

98 Development of a new in vitro model for infant colonic fermentation with immobilized cells. C. Cinquin*¹, G. Le Blay¹, I. Fliss^{1,2}, and C. Lacroix^{1,2}, ¹*Dairy research institut STELA, Quebec, Qc, Canada*, ²*Institut sur les Nutraceutiques et les Aliments Fonctionnels (INAF), Quebec, Qc, Canada.*

Different in vitro models have been used to study human colonic microbiota. However, for many of these models, and particularly chemostats, bacterial concentrations (109 CFU/ml) were much lower than those measured in faeces (1010-1011 CFU/ml), and culture stability was limited. In this work a new colonic fermentation system with immobilized-cells was developed for infant colonic microbiota. Fecal bacteria samples from infant were immobilized in 1-2 mm diameter gel beads (2.5% gellan gum, 0.25% xanthan gum, 0.2% sodium citrate) using a double phase dispersion process. Continuous cultures were carried out in a single-stage chemostat inoculated with immobilized cells, and fed with a medium specially designed to simulate baby diet. Different fermentation conditions (pH and residence times) were tested with the objective to simulate conditions in different sections of the infant colon (proximal, transversal and distal colon). The composition and metabolic activities of the microflora were monitored during a 54-day continuous culture. High survival rates for the major bacterial groups of the fecal flora were measured after immobilization. Bacterial concentrations and metabolic activities measured at steady state in the reactor effluent were influenced by culture conditions. The total population measured in colonized beads after one-week culture was high (>1010 CFU/g), and remained stable afterwards. Cell concentrations for the major bacterial groups in beads were very similar to those measured in fresh feces used for immobilization. Our study showed that cell immobilization could provide an environment more akin to the infant gastrointestinal tract, compared to conventional liquid cultures. This new in vitro model could be used to test the effects of different factors, including probiotics and prebiotics, on the colonic microbiota.

Key Words: Immobilized-cells, Colonic fermentation, Continuous-flow culture

Animal Behavior and Well-Being Influence of Environment on Animal Well-Being

99 Environmental enrichment for neonatal pigs and its influence on post weaning aggression. E.S. Jolly, J.B. Gaughan*, and A.K. King, *The University of Queensland, Gatton, Australia.*

Aggression is a common behavioural reaction seen amongst pigs that are weaned and subsequently mixed with other pigs. Post weaning aggression is harmful in that it can give rise to behavioural vices, lead to decreased productive output, may cause injuries and infection and possibly death. Decreasing the incidence of post weaning aggression and encouraging the incidences of play behaviour may be beneficial. This study investigated the effects of environmental enrichment for neona-

tal pigs and its influence on the incidence of post weaning aggression (tail and ear biting, bites and mouth hits directed towards the head and shoulder). The four treatments used were (i) No enrichment (control), (ii) Toys (either a rubber ball, small rubber tire, PVC pipe, empty plastic drink bottle or ice cream container), (iii) Handling (picking up, patting and stroking piglets as soon as possible after birth, and then for 10 minutes/litter 4 times each week), (iv) Toy plus handling. Forty sows plus litters were used (10 per treatment). Toys were placed with the sow and litter from 5 d of age and rotated every three d. Following weaning (24 d of age) the pigs were allocated to weaner pens based on treatment and blocked for sex. Video surveillance was used to record piglet interactions throughout lactation and for the first 24 h post weaning. The pigs'

aggressive and play behaviours were quantified and analysed using SAS (Chi Square test). There was a significant association ($P < .05$) between treatment and play-aggressive behaviour. There was a positive association ($P < .05$) between the provision of toys and the behaviour displayed by the pigs post weaning (no toy = 821 aggressive bouts and 274 play bouts; toy = 514 aggressive bouts and 1476 play bouts). There was no difference ($P = .48$) in regard to piglet behaviour for either the control, handling or toy plus handling treatments. Environmental enrichment via the provision of toys appears to be a viable option for decreasing the incidences of post-weaning aggression and in turn decrease the occurrence of behavioural vices.

Key Words: Swine, Welfare

100 Heat stress in the outdoor lactating sow: Influence of shaded wallows on behavior, performance and physiology. A. K. Johnson^{*1}, F. M. Mitlöhner¹, J. L. Morrow², and J. J. McGlone, ¹*Pork Industry Institute*, ²*USDA-ARS*.

One hundred ten PIC USA sows and their litters were used to determine the effects of shaded (SH N=53) versus unshaded wallows (CO N=57) on sow behavior, performance and physiology. Sows ranged over five parities and were fed a completely balanced diet. Behavior data were collected by 15- min scan samples, over a 24 h period/wk for 15 wk. All sows were observed twice when litter age was 5 and 15 d respectively. Duration of standing, lying, walking, feeding, inactive, head down, drinking and location within the radial did not differ ($P > .05$) for wallow treatments. Performance parameters were collected from farrowing records but there were no ($P > .05$) differences for wallow treatments or temperature by wallow treatment interactions. Respiration rates (RR) breathes/min were collected on 49 sows over 7 wk when maximum air temperatures exceeded 32°C. Wallow treatments did not ($P > .05$) affect RR rates but there was a wallow treatment by temperature interaction for CO sows which had a higher ($P = 0.006$) RR compared to SH sows. Blood was collected from the sow on the d of weaning. Physiological parameters measured were total white blood cells (WBC) counts, differentials, acute phase proteins, neutrophil chemotaxis and chemokinesis, and packed cell volume. There were no ($P > .05$) differences for wallow treatments for most physiological measures. However, the treatment by air temperature interaction was significant in that WBC counts (103/L), neutrophil:lymphocyte ratio, and neutrophil chemokinesis decreased ($P < 0.05$) with warmer temperature, while % lymphocytes and eosinophils increased ($P < 0.05$) with warmer air temperatures. In conclusion, sows spent large percentages of their time budget inside the farrowing hut and little time at the wallow during warm weather. Shading wallows did not result in improved use or litter performance. While differences were seen in physiological measures all values were within normal physiological ranges for lactating sows indicating that these sows were adapting equally well to the shaded and unshaded wallows.

Key Words: Heat Stress, Sows, Outdoor

101 Effect of gestational stress on sow behavior and subsequent pig response to weaning. M.J. Toscano^{*1}, K.A. Scott¹, H.K. Smith¹, H.G. Kattesh², M.P. Roberts², and D.C. Lay¹, ¹*USDA-Agricultural Research Service -Livestock Behavior Research Unit*, ²*Department of Animal Science, The University of Tennessee*.

Exposing a pregnant sow to stress has been shown to have negative effects on resulting young. However, little knowledge exists regarding the mechanisms of this process or the effects due to specific stressful events. In this study, sows received i.v. injections of ACTH (1 IU/kg BW) (ACTH, n = 15), rough handling (RUF, n = 13), or no treatment (CONT, n = 15) once a wk during d 42 to 77 of gestation. To assess treatment effects, at approximately d 80, sows underwent either a modified open field test (O, n = 22) during which a person stood on one side of the test area or a startle test (S, n = 20) during which a hand was quickly placed directly in front of the sow and latency to touch recorded. Sow productivity data included: birth and weaning weights, litter size, weight gain, sex ratios, ratio of ano-genital to crown-rump (ag:cr) length at birth, viability of individual pigs, and number weaned. To assess the physiological effects of treatments on the pigs, blood was collected (one pig per litter, n = 35) immediately prior to weaning and then every other day for 10 d post-weaning and examined for cortisol and corticosteroid binding globulin (CBG). In the O test, latency to approach the human, number and duration of touches, inner and outer

squares entered, urination, and defecation were not affected by treatment. In the S test, ACTH sows had a greater latency to touch than CONT sows ($P < 0.04$), but not RUF sows ($P > 0.10$). Ag:cr in male CONT pigs was greater than ACTH or RUF pigs ($P < 0.0001$). At weaning CONT pigs had gained more weight than either ACTH ($P = 0.031$) or RUF ($P = 0.003$) pigs. Analysis for CBG revealed an effect due to repetitions ($P < 0.01$), thus repetitions were analyzed separately. In the first repetition, CBG concentrations in CONT pigs were greater than both stress treatments ($P < 0.003$) though were not different in the second repetition ($P > 0.46$). Pigs' cortisol concentrations were not affected by treatment ($P > 0.14$). Our results suggest that stress during the gestation period alters behavior of the sow and gender development, growth, and coping abilities of the offspring to weaning stress.

Key Words: Pre-natal stress, Swine, Welfare

102 The isolation of simulated udder elements to decrease danger to piglets due to crushing. H.K. Smith^{*1}, K.A. Scott¹, M.J. Toscano¹, K.J. Daniels², and D.C. Lay Jr.¹, ¹*Agricultural Research Service - USDA*, ²*Purdue University*.

Three d post-farrowing is the critical period in which sows are more likely to overlay or crush piglets. Crushing accounts for 4.8 to 18 % of piglet mortality. Previous studies found that a simulated udder (SU) decreased the danger of piglet crushing by drawing the piglets away from the dam. The current study was designed to compare the possible attractants of heat, odor, and tactile properties when used with the SU. In each of the 3 experiments, 20 crossbred commercial sows (n = 10 per treatment) and their litters (mean = 9.5) were utilized. All farrowing stalls were equipped with heat lamps and video data were obtained using continuous time-lapse photography (1 frame/.4 s) from 12 to 72 h post-farrowing while the sow was standing using 1-min scan samples and recording the number of piglets using the specific SU or the control treatment. The data were analyzed using generalized estimating equations. Experiment 1 tested the original SU without the odor component of the dam's smell on the cloth against only a heat lamp as the control. Experiment 2 compared the dam's odor on the cloth compared to the cloth alone. Finally, Experiment 3 tested the cloth alone against the heat lamp. Piglet mortality due to crushing was not different in any of the experiments ($P > 0.10$). The results of Experiment 1 showed no differences between the SU without the dam's odor and the control heat lamp ($P > 0.10$). In Experiment 2, the only treatment difference was found in the 12 to 24 h period with the cloth without odor, attracting a higher number of pigs than the cloth with odor (.81 and .63 respectively, $P = 0.005$) Data from Experiment 3 indicate that more piglets were attracted to the cloth without odor (estimated probability = .85) compared to the control of the heat lamp alone (.67, $P = 0.005$). Thus, pigs are attracted to several stimuli, of those tested in these experiments, tactile properties are substantially potent. These results provide encouraging data for further explorations to decrease the crushing danger to piglets.

Key Words: piglet, crushing, behavior

103 Effects on production, health and behavior of two types of housing for gestating gilts. M.J. Harris^{*1}, A.D. Sorrells^{1,2}, S.D. Eicher², B.T. Richert¹, and E.A. Pajor¹, ¹*Purdue University, West Lafayette, Indiana*, ²*USDA-ARS Livestock Behavior Research Unit, West Lafayette, Indiana*.

The effects on production, health and behavioral time budget of housing gestating gilts during one parity in either individual stalls (n=14) or groups of 4 (n=8; 27 gilts) with individual feeding stalls were evaluated. Animals were limit-fed once per day. Floors were fully slatted with no bedding. All conditions, except for housing type, were identical for the two systems. Gilts were weighed and their backfat measured on d 7, 35, 63 and 91 of gestation. Skin health was evaluated using a 6-point scoring scale every 2 wk. Lameness was scored using a 6-point gait scoring scale when gilts were transferred to the farrowing room. Behavior was videotaped for 24 h at wk 4, 6, 8/9 and 13 of gestation. Stall- and group-housed gilts did not differ in body weight or backfat during the study. Group-housed animals gained on average 20% more weight during pregnancy, but this difference was not significant. There were no differences in skin lesion scores between gilts in the two housing systems on d 7, but by d 91 skin health for several regions of the head, face, body, feet and legs was significantly poorer in group-housed than stall-housed animals ($P < .05$). Lameness scores at transfer to farrowing

tended to be higher in group-housed than stall-housed gilts ($P < .1$). As gestation progressed, gilts spent less time standing ($P < .0001$) and more time lying ($P < .05$), but behavioral time budgets (percentages of time spent standing, lying, sitting, eating and drinking) of stall and group occupants did not differ. When not eating or drinking, grouped gilts spent 24.5% of their time in the feeding stalls and 75.5% in the communal area. In summary, while gilts grouped for one gestation showed more skin injuries and lameness than stalled gilts there were no production or behavioral time budget differences. Housing effects may emerge after several parities, and effects of group systems will vary with design, space allowance and group size.

Key Words: Welfare, Swine, Gestation

104 Evaluation of housing stress on gestating gilts using immunological measures. A.D. Sorrells^{1,2}, S.D. Eicher¹, M.J. Harris², E.A. Pajor², and B.T. Richert², ¹USDA-ARS, West Lafayette, Indiana, ²Purdue University, West Lafayette, Indiana.

The use of gestation stalls in pork production remains a controversial topic in animal welfare. Immune and cortisol measures were determined for Landrace x Yorkshire gilts in groups of four ($n = 8$) compared to gilts housed in standard industry stalls ($n = 14$; 2.21 m x .61 m) to evaluate the stress effect of two housing systems. In an attempt to provide swine producers a practical alternative to controversial gestation stalls, the back gates of four stalls were removed to allow a group of four gilts to interact behind the feeder stalls (3.9 m x 2.4 m). Floors were fully slatted and substrate was not provided for either system. Acute phase proteins, including haptoglobin, α 1-acid glycoprotein (AGP), and fibrinogen, were determined along with granulocyte, lymphocyte and monocyte counts, and hematocrit percentages. Cortisol was determined from saliva 1 h after moving into farrowing crates (d 111), and 24 h and 7 d post-farrowing. Peripheral blood samples were obtained via jugular puncture on d 35, 63, and 91 of gestation and d 3 and 14 post-farrowing. Data analysis was performed using mixed models in SAS[®] as a repeated measures design. Cortisol was significantly higher for animals housed in groups 1 h after moving into farrowing crates and 24 h post-farrowing ($P = .038$). Cortisol concentrations decreased significantly over time for grouped and stalled gilts ($P = .0001$). A time effect also existed for the variables fibrinogen, hematocrit and granulocytes ($P < .0005$). Stalled gilts showed a trend for higher plasma AGP concentrations ($\mu\text{g/ml}$) over grouped animals at d 35 of gestation and d 14 post-farrowing ($P = .07$). Significant differences ($P < .05$) were not found between treatments at any time point for any of the immune measures we examined. These data provide little evidence that the group housing system used was a better or worse alternative to gestation stalls when utilizing acute phase proteins and leukocyte counts as an indicator of welfare.

Key Words: acute phase proteins, swine housing, gestation

105 Cooling during the dry period reduces stress and increases milk production in the next lactation. L. Avendaño-Reyes¹, D. Alvarez-Valenzuela¹, S. Saucedo-Quintero¹, A. Correa-Calderon¹, F. Rivera-Acuña¹, and P.H. Robinson², ¹Universidad Autonoma de Baja California, Mexicali, Mexico, ²UCCE, Dept. of Anim. Sci., UC Davis, Davis, CA.

Twenty four multiparous Holstein cows were blocked by body condition score and assigned to one of two treatments 60 d prior to their anticipated calving date. The treatments were: (1) no cooling system and (2) with a cooling system based on fans with water spray. The cooling system operated from 1000 to 1800 h daily during the entire dry period of the cows, which consisted of the hot summer months (extreme low and high temperatures of 19°C and 48°C). Cows were fed a totally mixed ration ad libitum twice daily at 700 and 1400 h consisting of alfalfa hay (60% of dry matter), wheat straw (18%), wheat grain (15%), wheat bran (5%), and a mineral/vitamin premix (2%). Rectal temperatures and respiration rates were recorded twice daily at 0930 and 1430 h on Tuesday and Friday of every week, and body condition was scored on the same days. Calf birth weights were recorded. After calving, all cows were moved to the same pen, which was provided with shades but had no fans or misters, and fed a ration appropriate for cows in early lactation. Cows were milked twice daily at 0500 and 1700 h. Milk yield was recorded weekly through week eight, and analyzed for fat and crude protein. Data were analyzed by a repeated measures design. During the dry period, when cows were cooled or not cooled, there were no treatment differences in respiration rates or rectal temperatures at 0930 h.

However, cooled cows had lower ($P < .01$) respiration rates (77.5 vs. 84.5 breaths/min) and lower rectal temperatures (39.1 vs. 39.3°C) at 1430 h. Body condition score was higher ($P < .01$) for cooled cows (4.03 vs. 3.93), but calf birth weights were only numerically ($P = .15$) higher (35.7 vs. 32.9 kg). Cooled cows had higher ($P = .03$) milk production (26.03 vs. 24.31 kg). Results show that cooling dry cows using fans with water spray reduced heat stress under these very hot conditions, as indicated by afternoon respiration rates and rectal temperatures, and resulted in higher milk production during the subsequent lactation when cows were treated identically and not cooled.

Key Words: Heat stress, Respiration rate, Rectal temperature

106 Effects of pre-haul management and transport distance on beef calf performance and welfare. M.E. Booth^{*1}, K.S. SchwartzkopfGenswein², T.A. McAllister¹, G.J. Mears¹, A.L. Schaefer³, N. Cook³, J.S. Church⁴, and D.H. Crews Jr.¹, ¹Agriculture and Agri-Food Canada, Lethbridge, AB, ²Alberta Agriculture, Food and Rural Development, Lethbridge, AB, ³Agriculture and Agri-Food Canada, Lacombe, AB, ⁴Alberta Agriculture, Food and Rural Development, Red Deer, AB.

Growth performance, morbidity rates, behavior and physiological indicators of stress were assessed in 174 steer calves (219.3 \pm SE 0.21 kg) for 30 d after transport from ranch to feedlot. Blocked by birth date, the calves were preconditioned (P) or not (N), and subjected to short- (3 h, S) or long hauling time (15 h, L), yielding treatments PS, PL, NS and NL. Upon arrival at the feedlot, they were blocked by weight and assigned to 16 pens (four pens per treatment, one of which was equipped with a radio frequency identification system (GrowSafe Systems) for continual monitoring of individual bunk attendance (15 calves). Steers were fed a barley silage/barley grain-based backgrounding ration and weighed every 7 d. In transit, PS steers recorded the lowest heart rate (HR, 67.4 bpm \pm SE 1.46; $P < 0.05$). During a mid-journey stop, a significant decrease in HR, as compared to in-transit HR, was observed in all PL and NL steers. During the first 24 h at the feedlot, PL calves drank 66% more often than NL calves; PS 46% more often than NS. A preconditioning \times hauling time interaction was observed on shrinkage ($P < 0.001$) and ADG ($P < 0.05$). Shrinkage was greater ($P < 0.001$) in PL than in NL steers, and in NL than in either PS or NS steers ($P < 0.001$). The lowest ($P < 0.005$) ADG was recorded for PL calves (0.986 \pm SE 0.073 kg), although their DM intake (6.75 kg/d \pm SE 0.13) was similar ($P > 0.05$) to calves in the other treatment groups. The PS calves had the highest ($P < 0.05$) DM intake, followed by PL which were not significantly larger than either NL or NS intakes. Morbidity rate was 5.17% with no treatment effect. For single source cattle, the effect of preconditioning was to increase intake and reduce in-transit HR. However, the interaction between preconditioning and long haul may impinge on short term performance.

Key Words: Cattle, Transport, Welfare

107 Cow distribution within two different types of free-stall barns at varying temperatures. K. A. Koudele*, L. D. Birney, and L. H. Adams, Andrews University, Berrien Springs, MI.

The objective of this study was to determine if cows housed in the greenhouse-style barn exhibited greater comfort than those in a steel-frame barn as defined by their distribution within each barn during varying ambient temperatures. The greenhouse structure was manufactured by Solar Barn[®]. Both barns were 30 X 90 m with 4.2 m high roll-up curtain sidewalls. The greenhouse barn roof was covered with white polypropylene. No shade cloth was used. The interiors of the barns were identical in size including alley widths and freestall dimensions. The grooved cement flooring had a slope of 1.5%. Ventilation was provided by the rolled-up sidewalls and by 1 m diameter fans located 6 m apart at eave height. The herd of 550 head was milked 3 times d in a double-12 parallel parlor, and had a RHA of 11,000 kg. The distribution of the cows within each barn was recorded prior to the start of the 1100 h milking. Temperatures were measured at cow head height in the middle of each barn. At 30°C the cows in both barns showed significant ($p \leq .05$) crowding with more than 85% in the upper half of each barn. At 8°C the cows in both barns were distributed significantly ($p \leq .05$) more evenly throughout the length of the barn. A more uniform distribution pattern was also seen at -3°C, however, there was a tendency ($p \leq .10$) for the cows to avoid the more open ends of the barn with fewer than 1% within 10 m of each end in the steel-frame barn.

However, in the greenhouse barn the actual number of cows within 10 m of each end was not different from expected ($p \geq .05$). These results indicate that at 30°C and at 8°C there was no difference in cow comfort based on animal distribution between the two types of barns. However, at -3°C the cows in the greenhouse barn utilized more of the floor space thereby reducing crowding and increasing cow comfort. This could be due in part to the radiant heating that occurred within the greenhouse barn but not the steel-framed barn.

Key Words: Dairy Cattle Behavior, Greenhouse Barn, Temperature

108 Factors affecting cow preference for stalls with different freestall bases in pens with different stocking rates. A.M. Wagner-Storch and R.W. Palmer*, *University of Wisconsin-Madison*.

Stall use was monitored using a closed circuit television system in a 4-row, 104-stall freestall barn. Stall status was recorded four times each day, 1400, 2000, 0400, and 0900 h, for a 9-mo period, 5/9/01 to 2/9/02. Two measures of cow preference, stall with cow lying or stall occupied (cow lying or standing in stall). The objective was to compare percentages of cow preference measures for each factor affecting use of stalls with different freestall bases. Six factors were analyzed: freestall base, distance to closest water, stall located at the end of a stall type section (END vs. NotEND), row of stalls (INTERIOR vs. EXTERIOR (wall side)), inside barn temperature (TEMP), and length of time animals exposed to freestall bases (XPOSR). One pen had a low stocking rate (LowSR, 66%), five different freestall bases [mattresses-MATR1 and MATR2, waterbeds (WATR), soft rubber mats (SRMAT), and concrete (CONC)], and cows were milked with a robotic milker. The other pen had a 100% stocking rate (100%SR), the same five freestall bases, plus a sand (SAND) freestall base, and cows were milked 2X in a herring-bone parlor. Each pen was analyzed separately because of different stocking rates and cow movement control. Freestall bases were grouped with 3 to 7 stalls/section and randomly placed in each row. Results show both sides of the barn having significant differences ($P < .05$) between all freestall bases for lying and occupied. Stall usage for the 100%SR side for lying was SAND (69%), MATR1 (65%), MATR2 (57%), WATR (45%), SRMAT (33%), and CONC (23%), whereas, occupied was MATR1 (88%), MATR2 (84%), SAND (79%), SRMAT (65%), WATR (62%), and CONC (39%). Stall usage for the LowSR side for lying was MATR1 (45%), MATR2 (39%), WATR (26%), SRMAT (12%), and CONC (10%), whereas, occupied was MATR1 (60%), MATR2 (55%), WATR (34%), SRMAT (19%), and CONC (16%). Lying and occupied was highest ($P < .05$) for stalls 1) the farthest distance from water, 2) NotEND, and 3) on EXTERIOR for both sides. Lying and occupied varied for XPOSR and TEMP for each freestall base. Cows spent more time on mattress bases, but highest percentage lying was in sand bases. Cows may prefer to stand on mattress bases to concrete alleys. Location appears to impact lying in or occupying stalls.

Key Words: Freestall Base, Cow Preference, Stocking Rate

109 Rubber flooring affects behaviour of dairy cows, especially animals with hoof injuries. J Fregonesi, F Flower, T Vittie, C Tucker, and DM Weary*, *Animal Welfare Program, Faculty of Agricultural Sciences, University of British Columbia*.

Flooring surfaces can affect the comfort of animals housed indoors, such as dairy cows in free-stall barns. The impact of flooring features may be particularly important for animals with hoof injuries. In the current experiment, four groups (each of 12 cows) were alternately housed

in sections of a free-stall barn with either rubber flooring or grooved concrete covering the area in front of the feed alley. Each group was followed for a 3-wk period on each surface, and individual behavioral responses were scored using 24 h time-lapse video recordings. Cows on the concrete surface spent 12.9 % of the available time standing inactive. This value increased to 15.5 % when cows were on the rubber flooring (s.e. = 0.4 %, $P < 0.001$). The increased standing time on the rubber was due in part to reduced time lying in the free stall (52.1 vs. 53.7 % lying, s.e. = 0.4, $P < 0.05$). Cows spent 20% of their time feeding, regardless of the flooring. The presence and severity of hoof lesions was assessed after hoof trimming. Cows with more lesions spent less time lying in the stall ($r = -0.42$, $P < 0.01$), and more time standing with their front two feet in the free stall ($r = 0.64$, $P < 0.001$), particularly when on concrete flooring (floor * lesion interactions, $P < 0.05$). Cows with lesions also spent less time feeding ($r = -0.39$, $P < 0.01$), but there was no interaction between this effect and the flooring. In conclusion, flooring for dairy cattle can have important effects on their behavior, especially for those cows with injured feet.

Key Words: Flooring surface, Behavior, Welfare

110 Effects of stall surface on occupancy and postural changes in dairy cows. D. C. Lay Jr.*¹, L. L. Timms², and D. R. Thoreson², ¹ARS-USDA-Livestock Behavior Research Unit, West Lafayette, IN, ²Iowa State University, Ames, IA.

A great deal of concern is allotted toward dairy cow comfort in order to optimize both cow welfare and milk production. Toward this end, producers are utilizing various stall surfaces in order to optimize cow comfort, while at the same time decreasing health concerns. Experiment 1 was designed to determine which surface the cow preferred. We compared 6 different free-stall surfaces: A. 2" rubber mat-Dynamatrix[®]; B. Sand; C. Mattress - AgroMatic[®]; D. Mattress - Pasture Mat #1[®]; E. Sand with Sand Saver; F. Mattress - Pasture Mat #2[®]. Our goal was to allow the cows to choose the surface on which they preferred to lie. Therefore, a free stall barn was built to include 60 free-stalls that were randomly assigned to receive one of the six stall surface types. The barn was stocked at 95% capacity. The study was conducted between July and December, during which 7 d of observations were collected during each of three separate study periods. Data collected included whether the stall was occupied and the cows body position in the stall. Experiment 2 was conducted using tie stalls which were either bedded with sand or used a mattress (Pasture Mat[®]) for flooring ($n = 8/\text{trt}$). Data were collected for 17 d (Rep 1), when the flooring was new, and then again, two years later, for a 22 d period (Rep 2) to record cow position. During Rep 2, data were collected for 8 days, cows were moved to the alternate flooring, and data were again collected 6 d later for an 8 d duration. Data for Exp. 1 shows a distinct seasonal affect, with cows occupying stalls in treatment B>E>C,D>F>A ($P < 0.0001$) during July, but this pattern changed to D,E,F>A,B,C ($P < 0.0001$) by late September. A very similar pattern of usage was seen for late November. Data from Experiment 2, Rep 1, found that cows on mats were more likely to be found lying ($P < 0.001$), compared to cows on sand. However, by Rep 2, we found no differences in resting behavior between treatments ($P > 0.10$). Collectively, these data indicate that cows do have a preference for the type of surface on which they lie, and that these preferences can change during the season. However, behavior of cows in tie stalls may not be fully indicative of these preferences.

Key Words: dairy, stall, comfort

Animal Health Immunology and Management

111 Immunological and growth performance responses of finishing steers supplemented with menhaden fish oil. T. J. Wistuba*, E. B. Kegley, and M. E. Davis, *University of Arkansas, Fayetteville AR / USA*.

Inclusion of fish oil in ruminant diets may fortify the fatty acid composition of meat and modulate the immune system. Therefore, an experiment was conducted to determine the effects of supplemental menhaden fish oil on growth performance and immune function of beef calves. The 72-d study used 20 crossbred steers (438 ± 28 kg initial BW; 2

calves/pen; 5 pens/dietary treatment). Dietary treatments consisted of either a control (75% corn, 11% soybean meal, and 10% cottonseed hull) diet or the control diet with 2% fish oil. Steers were weighed on d 0, 1, 21, 42, 63, 72, and 73. On d 0, 21, 42, and 63 all calves were bled by jugular venipuncture, and *in vitro* blastogenic response of peripheral lymphocytes to phytohemagglutinin (PHA), concanavalin A (CONA) and pokeweed mitogen (PWM) was measured. Fish oil supplementation decreased ADFI (14.52 vs. 13.28 kg, $P < 0.05$, as-fed); conversely, it had no effect on ADG or gain/feed (2.08 vs. 1.89 and 0.14 vs. 0.14;