ABSTRACTS
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Animal Behavior, Housing and Well Being

1 Swine production systems: animal welfare considerations. D.C. Lay Jr.*, *Agricultural Research Service-USDA*.

A general public perception is that it is easy to visualize when an animals welfare is adequate. Scientifically, this determination is quite difficult. The difficulty resides in our ability to objectively assess the animals physical and psychological state; as well as to determine the difference between a want and a need. Questions about animal welfare need to be addressed based on individual needs of animals. While productivity and economics can be measured at the group level, animal welfare must be measured at a individual level. Needs are both species and individually specific - dependent on age, sex, temperament, previous experience; characteristics that are lost at the group level. Science has provided a great deal of information that is useful in assessing the physical needs of swine. In contrast, information is lacking on required needs related to social requirements, motivational states, activities #both level and specific activity, as well as psychological needs. To critically address the question of animal welfare, specific questions need to be answered addressing all of the factors mentioned above. Unacceptable welfare in one factor translates to unacceptable welfare for the individual. Our challenge is to be able to define the point at which good welfare turns to poor welfare. However, like feelings of pain, hunger, cold, and thirst; welfare should be viewed on a continuum in which positive welfare becomes less positive and then worsens, or vice versa. Swine production systems should be evaluated as to whether the animals are free from pain, free from distress, free from fear, and as to whether the animals are both physically and psychologically fit.

Key Words: Stress, Welfare, Swine

2 Comparison of finishing systems: impact on health, performance, and carcass composition. J. G. Gentry*[1] and J. J. McGlone[2], [1]*Middle Tennessee State University, Murfreesboro, TN,* [2] *Texas Tech University, Lubbock, TX*.

Traditional or common swine finishing units today have totally or partially slatted concrete floors in a building that might be mechanically or naturally ventilated. Alternative systems include a variety of less common systems such as open buildings with natural ventilation and sunlight exposure (ex. hoop building), open building with outsides access, or outdoors either on pasture or dirt. Alternative systems may become more common as environmental and(or) animal welfare regulations increase. Research comparing performance during the growing/finishing phases of indoor and outdoor systems has been variable. Reasons for variation in production system effects include differences in pig birth and rearing environment, seasonal effects, geographical region, and quality of ground surfaces or bedding. In most reported literature, the health and performance of weaned pigs in an outdoor or alternative environment is comparable to indoor systems. Some studies report that outdoor-born pigs in milder weather or Southern regions have higher growth rates but more backfat, while other studies, generally in more Northern climates, find no difference or reduced feed efficiency among pigs in alternative systems. Increased space allowance, exercise, reduced respiratory pathogen exposure, and increased bacterial or parasitic exposure often are associated with pigs finished in alternative systems. This may account for differences in carcass composition (backfat and muscling) compared to pigs finished indoors. Pig health, including lung lesions and foot lesions, may be improved for pigs in a more extensive system than for those indoors on concrete slats, however, when pigs have a health problem while on bedded or outdoor systems, the disease break can be more intense and less manageable. Individual components of alternative systems (ex. space, bedding, group size, air quality) need to evaluated to find the features that favor improvements in pig health, productivity, carcass traits and welfare.

Key Words: Pigs, Finishing System, Carcass Composition

3 Environmental Enrichment of Swine Production Systems - Implications for Pork Quality? R.E. Klont*, E. Kurt, and A. Sosnicki, *PIC North America*.

Objective of this presentation is to show the potential implications of enriched housing conditions on pork quality. In recent years consumers have become more and more focused on the way that food is produced and intensive animal production is perceived as compromising the welfare of animals. Pork quality can be described by different attributes, which include technological, sensorial, nutritional, microbiological and ethical traits. Technological and sensorial pork quality traits are determined by the rate and extent of postmortem muscle metabolism. Stress in the period around slaughter is known to influence pork quality. Housing conditions may have an effect on the ability of the pigs to respond to preslaughter stress. Pigs that have more exercise than others show

higher glycogen content and more drip loss. This presentation will focus on the effects of environmental enrichment on technological and sensorial aspects of pork quality. The effects of barren (common intensive conditions with slatted floors, 0.7 m2/animal, and 10 pigs/pen) vs. enriched (straw for manipulation and 1.0 m2/pig) were studied. Salivary cortisol concentrations were measured before transport and at the end of the lairage period. At 5 min, 45 min, 4 h, and 24 h postmortem pH, temperature and lactate concentrations were determined in the longissimus lumborum (LL) and biceps femoris (BF) muscles. Capillarisation of the muscle, mean muscle fiber area, color and drip loss after 2 and 5 d storage were determined for both muscle types. Postmortem lactate formation was significantly lower in LL muscles of enriched pigs at 4 an 24 h postmortem. Capillary density and mean muscle fiber area did not differ between both groups of pigs. The percentage drip loss at 2 and 5 d after storage of LL muscle samples from enriched housed pigs was significantly lower than those of the barren housed pigs. Similar results were shown in a recent comparison of meat quality between intensively and free-ranged pigs. It can be concluded that on-farm improvement of animal welfare by environmental enrichment can also lead to beneficial economic effects after slaughter.

Key Words: Housing System, Pork Quality, Welfare

4 A Comparison of Production Costs, Returns and Profitability for Pork Finishing System. J. Kliebenstein* and B. Larson, *Iowa State University*.

A main focus of this presentation will be identifying the economic factors which impact the profitability of the alternative pork production systems. There are many varied types of facilities used in pork production. They range from totally confined environmentally controlled systems to outdoor pasture systems. Moreover, there is a wide range of systems between these two. Examples would include partial confinement and hoop facilities. There are tradeoffs between systems. Totally confined systems are capital intensive but typically have better feed efficiency. Costs referred to as fixed costs such as depreciation, interest, etc. are higher while operating costs or variable costs are lower. Pasture type systems have lower capital requirements but factors such as feed efficiency are typically are not as good. This system has lower fixed costs and higher operating (variable) costs. This paper will provide an economic analysis of alternative pork production systems. It will identify economic factors that differ between systems. These differences can lead to different production decisions respective for pork production system under similar economic conditions.

Key Words: Production Costs, Return, Profitability

5 Effect of thermal and hormonal manipulation of developing chick embryos on post-hatch behavior and physiology. M.J. Toscano*[1], D.C. Lay, Jr.[1], K.A. Scott[1], H.K. Smith[1], and M.E. Wilson[2], [1]*USDA-ARS-Livestock Behavior Research Unit, West Lafayette, IN,* [2]*West Virginia University, Morgantown, WV*.

Stressors applied to pregnant mammals can affect the behavior and physiology of resulting offspring. However, specific mechanisms are difficult to determine due to confounding maternal variables. Developing chick embryos may provide an effective model in studying prenatal stress due their external development. Fertile eggs underwent one of 2 treatments: exposure to an elevated temperature in a 40.6C incubator on d 14, 17 and 19 of development for 24 h (HEAT, n = 176) or application of 60 ng corticosterone to the embryo on d 14, 16, 18 and 20 of development (CORT, n = 176). A third group served as a control and received no treatment (CONT, n = 125). All birds were weighed on d 1, 3, 5, 7,15, and 29. At 7 wk of age, birds underwent Tonic Immobility (TI , N = 58) and/or Open Field (OF, N = 42) tests. The OF was conducted in a pen measuring 3.7 x 2.4 m. Individual birds were placed in the pen for 15 min, after which a novel object was placed in the pen's center and a further 15 min of observations were conducted. Area traversed, time spent in outer, inner and corner areas, flapping of wings, and flying at the front of the pen were quantified. At 11 weeks of age, all birds were sacrificed and adrenal glands were collected and weighed. At hatch, CORT and CONT birds weighed more than HEAT ($p = 0.001$). CORT chicks were heavier than HEAT for the duration of the study ($p = 0.04$), while CONT birds weighed more than HEAT through week 4 ($p < 0.05$). No differences in duration of TI or the OF parameters were found among treatments ($p > 0.10$). Right adrenal glands of CORT birds weighed more than CONT ($p < 0.05$) but not HEAT birds ($p = 0.08$). Though behavior was not affected by treatment, the differences in body weight and adrenal gland weight indicate that prenatal stress affects the physiology of chicks. Paralleling related research in other species, the CORT treatment effectively altered the HPA axis suggesting the utility of this model for future research in the area of prenatal stress. Determining the effects of prenatal stress on behavior, if any, require more investigation.

Key Words: Prenatal stress, Behavior, Poultry

6 Effects of weaning age on post-weaning belly nosing behavior and umbilical lesions in pigs. R.G. Main*, S.S. Dritz, R.D. Goodband, M.D. Tokach, and J.L. Nelssen, *Kansas State University, Manhattan*.

Our objective was to determine the effect of weaning age on post-weaning belly nosing behavior and associated umbilical lesions. Treatments included weaning litters of pigs from a 7,300-head sow farm at 12, 15, 18, and 21 days of lactation. Sixty-four nursery pens (16 pens per age group, 2,272 total pigs) were used in a randomized complete block design, with off-site nursery as the blocking factor. This study was completed in four blocks (4 pens/age group/block), and all pigs within each block were weaned on a single day into the same nursery. Each pig was individually identified and weighed prior to weaning. Using the individual pig weight and gender information, each nursery pen was allotted with an even number of barrows and gilts, and was representative of the normal weight distribution of pigs weaned within each age group. Each nursery pen was observed for 15 minutes on day 7, 14, and 21 after weaning, and the number of pigs demonstrating belly nosing behavior was recorded. The umbilical region of each pig was examined on day 21 post-weaning following the observation period. Umbilical regions were scored as per the amount of inflammation, swelling, and physical deformity observed (normal = 0, moderate lesion = 5, severe lesion = 15). The proportion of pigs exhibiting belly nosing behavior (21.3, 10.9, 8.9, 5.7 $\pm$ 1.2 %) and umbilical lesion scores (3.80, 2.02, 1.79, 1.75 $\pm$ 0.80) were reduced (quadratic, $P < 0.01$) as weaning age increased (12, 15, 18, or 21 days, respectively). Although numeric reductions in both belly nosing prevalence and umbilical lesion scores continued up through the 21 d old weaned pigs, the most pronounced decrease in prevalence and lesion scores occurred as weaning age increased from 12 to 15 d. This study indicates that weaning pigs less than 15 d of age was associated with increased belly nosing behavior and resulting umbilical lesions. Therefore, weaning age is an important factor to consider when investigating increased rates of belly nosing behavior or umbilical lesions.

Key Words: Weaning Age, Belly Nosing, Umbilical Lesions

7 Behaviors in stalled pregnant females and reproductive performance on a commercial swine farm. T. Sekiguchi* and Y. Koketsu, *Meiji University*.

Our objectives in this study were to observe behaviors in stalled females and to investigate associations between those behaviors and reproductive performances. A commercial farrowing-to-finish farm using a computerized recording system with approximately 300 female inventories was recruited. We visited the farm three times to observe three postural behaviors (lying, standing and sitting) and three stereotypies (vacuum chewing, drinker playing and bar-biting) of stalled females at 5 min intervals for 6 hours (one-zero sampling). Relative frequency of the postural behaviors and the sterotypies for 6 hours were calculated as observed frequency of each behavior divided by the 25 -time observations. Females were categorized into two or three groups by relative frequency of each behavior, because frequency distributions of these behaviors were not normally distributed. Statistical models for reproductive performance included each categorized behavior group, parity and visited month. Visited month was used as a random variable in the Mixed procedure of SAS. In 609 observed females, means in relative frequency of lying, standing, sitting, vacuum chewing, drinker playing and bar-biting for 6 hours were 60.1 $\pm$ 0.91, 32.3 $\pm$ 0.87, 7.6 $\pm$ 0.44, 12.7 $\pm$ 0.65, 0.4 $\pm$ 0.06 and 0.2 $\pm$ 0.05, respectively. Subsequent reproductive performance was extracted by a recording system. In 507 farrowed females, means of total pigs born, pigs born alive, pigs born dead, birth litter weight and adjusted 21days weight were 12.3 $\pm$ 0.13, 11.2 $\pm$ 0.12, 1.1 $\pm$ 0.06, 6.0 $\pm$ 0.19 kg and 17.1 $\pm$ 0.18 kg, respectively. Females showing no-vacuum chewing during gestation produced greater total pigs born (12.5 $\pm$ 0.25 vs. 11.5 $\pm$ 0.36) than those showing high relative frequency (##36%) of vacuum chewing ($P<0.05$). However,

no associations between vacuum chewing and other performances were found. No postural behaviors and other stereotypies were found to be related with reproductive performance. Additionally, farrowing rate was not associated with any postural behaviors and stereotypies in logistic regression models (P>0.05).

Key Words: Vacuum Chewing, Stereotypies

8 The effect of toys on performance and behavior of weanling pigs housed in littermate or mixed groups. C. M. Wood*, B. Osborne, S. Meder, A. Young, A. Damon, J. Joseph, M. Ashby, T. O'Hare, and L. A. Kuehn, *Virginia Tech*.

Two trials were conducted to determine if the addition of a commercially available toy and the mixing of litters had any effect on weanling pig behavior and performance. In each trial, crossbred pigs (n=96) were assigned to treatments at weaning from outcome groups based on litter, gender, and weight. Both trials were conducted in two similar environmentally controlled nursery rooms containing 12 double deck pens each. Each pen (84 cm x 117 cm x 60 cm) housed four pigs. Treatments (toy/no toy and littermate/mixed) were randomly assigned to pens within room in a 2x2 factorial arrangement. All pigs received the same diets, which met or exceeded NRC requirements. Trial 1 lasted two weeks, and Trial 2 lasted four weeks. In Trial 1, five observers recorded pig behavior for a defined period of time in 13 sessions. In Trial 2, one of the five observers recorded behavior four times during the study. In Trial 1 (avg. initial wt = 8.5 kg), pigs with toys tended to gain more (P < .06) than pigs without toys. Pigs with toys also displayed fewer vices (P<.05), but fought more often (P<.05) than pigs without toys. Mixing of litters did not affect growth rate, but pigs in mixed pens did fight more (P<.05) than littermates housed together. In Trial 2 (avg. initial wt = 7.5 kg), littermates gained faster the first week (P<.05), but there was no effect of toy on gain throughout the trial. There were more pig-to-pig interactions among pigs without toys (P<.05) but there were no other significant behavioral differences. There were very few behavioral differences between mixed and littermate pigs, although pigs in mixed pens were observed to drink more often (P<.05). The results of these trials suggest that toys can be effective in reducing unwanted behavioral vices in weanling pigs and may help them to gain faster, but more work needs to be done to clarify results.

Key Words: Weanling Pigs, Behavior, Growth Rate

9 Use of dietary seaweed treatment to reduce heat strain in cattle. L.E. McVicker*, D.E. Spiers, J.E. William, K.J. Barnhart, L.N. Thompson, A. Al-Haidary, and D.P. Colling, *University of Missouri-Columbia*.

Heat stress results in an increase in heat load in cattle, which ultimately reduces productivity. A 50-day study was conducted to determine if a seaweed-derived feed additive, Tasco Meal^{TM} can reduce heat strain in cattle. Twenty-four steers (avg. BW 300 kg) were housed in the Brody Climatology Laboratory at the University of Missouri-Columbia. Each animal was randomly assigned to treatment groups that received either a top dressing of Tasco Meal or control feed daily. Initially half of the animals were exposed to a 13-day heat challenge (HC) reaching air temperatures of 36C during the day and 26C at night. A second 10-day HC period increased night low temperature to 33C and left the high at 36C. During the last portion of the study, animals that had been continuously housed at thermoneutral (TN) were exposed to HC for 12 days to evaluate their heat stress response after receiving Tasco for an extended period. Steers were fed twice daily at 0800 and 1600 with water available ad libitum. Feed intake was recorded daily. Thermal status was measured using telemetric, temperature transmitters (CowTemp, Model BV-010) implanted in the peritoneal cavity. Skin temperatures and respiration rate were taken four times daily. Few significant differences (p≥0.05) were noted between Tasco-treated and control groups. Animals fed Tasco and initially exposed to heat exhibited a visibly lower core temperature (∼0.5C) than control animals. However, there were no significant group differences (p≥0.05) in core temperature. In contrast, animals that received Tasco and were exposed to TN conditions initially showed a visible increase in core temperature above the control animals when exposed to HC after 37 days with no differences in group temperature. Treatment with a seaweed-derived feed additive appears to offer some benefit during early heat stress, but additional studies are needed to verify this benefit.

Key Words: Cattle, Heat Stress, Seaweed

Breeding and Genetics

10 An equivalent single trait animal model to obtain standard errors for estimates of genetic correlations between two traits measured on distinct subsets of animals. K. A. Nephawe*[1], S. D. Kachman[1], and L. D. Van Vleck[2], [1]*University of Nebraska, Lincoln, NE,* [2]*USDA, ARS, USMARC, Lincoln, NE*.

Estimates of genetic correlations among traits are required for economic selection indexes for calculation of expected responses to selection. Such correlations are often estimated using bivariate REML methodology with, for example, MTDFREML programs of Boldman et al. (1995). With two-trait analyses, MTDFREML is able to estimate parameters for bivariate models but the package does not calculate the approximate sampling variances for the estimated (co)variances unless the two traits are measured on all animals. When the two traits are measured on two non-overlapping subsets of animals, the appropriate standard errors can be calculated by reparameterizing the bivariate model to an equivalent single trait model. Reparameterization is done by assigning dummy levels to all fixed and random factors associated with the missing trait when the other trait was measured so that the reparameterized data file contains no missing values. Under the equivalent single trait model, the two direct genetic effects are fitted as two correlated genetic effects so that their covariance is the direct genetic covariance between the two traits. A limitation of the software (not of the approach) is that this equivalent model works only for situations with no true maternal genetic effects for the two traits. The two models can be shown to have the same residual covariance structures. The equivalence was further demonstrated with a numerical example. The standard error for genetic correlation was computed using the equivalent single trait model. An equivalent single trait model could be useful for obtaining the standard error of estimate of genetic correlation between two traits for some situations for which the MTDFREML program currently will not compute the sampling variances.

Key Words: Reparameterization, Sampling Variances, Genetic Parameters

13 Models for a composite trait such as litter weight weaned for Polypay ewes. L. D. Van Vleck*[1], K. J. Hanford[1], and G. D. Snowder[2], [1,2]*USDA, ARS, USMARC,* [1]*Lincoln, NE,* [2]*Clay Center, NE*.

Litter weight weaned (LWW, kg) is the product of a rate trait (number of lambs weaned) and the average weight per lamb weaned and, in this case, is a composite maternal trait of the ewe. Litter weight weaned can be defined on a per ewe exposed basis, on a per ewe lambing basis, or on the basis of a ewe weaning at least one lamb. Depending on which definition is used, the biological and economic meanings of the trait will be different. Variance components for these definitions were estimated from analyses of 9,075 records of 3,487 Polypay ewes from the USSES, Dubois, Idaho. The basic model included fixed effects of age of ewe, year of birth, type of birth and rearing, and random genetic and permanent environmental effects associated with the ewe. For a specific per ewe definition, various covariates which affect LWW also will affect the biological interpretation of estimates of variance components. For example, on a per ewe exposed basis with no other fixed effects, estimates of heritability, repeatability, and phenotypic variance were: 0.04, 0.08, and 531. With 3 covariates to account for fraction of litter weaned being wether or ram or ewe lambs, the estimates were: 0.04, 0.07, 181. With the covariate of number of lambs born, the estimates were: 0.06, 0.11, and 432. With the covariate of number of lambs weaned, the estimates were: 0.11, 0.12, and 45. This pattern was similar per ewe lambing or weaning at least one lamb. When analyzed with either number of lambs