EXTENSION - SWINE

106 Swine Modeling: An Integrated Approach to Providing Complete Nutritional Solutions.

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Swine growth models, which predict the responses of pigs to nutrient inputs, have evolved considerably since Whittemore and Fawcett (1976) and Emmans (1981) published the first conceptual frameworks. A proposed integrated model that encompasses three components including a stochastic animal growth model, least cost formulation and an optimization algorithm has been developed and applied in commercial practice. The animal model introduces genetic variation to facilitate the prediction of individual animals and is essential for accurate nutritional optimization as well as for shipping management. The animal growth model is based on the theory that individual animals desire to eat and grow to their genetic potential but are constrained by physical capacity, dietary inadequacies, and environmental limitations, which inhibit the realization of this potential. Simulating individual animals within a population provides the opportunity to integrate the ability of an individual animal to cope with social stressors as well as the interaction between genetics, environment and health status to accurately predict their potential and actual feed intakes and growth rates. The optimization process is based on a genetic algorithm that combines the following: 1) ingredients and diet costs; 2) animal responses particularly feed intake; 3) variation in responses between individual animals; 4) variable and fixed production costs; and 5) a defined revenue generating process (e.g. grading grid).

The proposed integrated model incorporates a wide spectrum of nutritional and management processes that empower pork producers to make meaningful production decisions. This presentation will focus on the integration of two key components: health and social stressors, within the biological framework and provide examples of commercial applications.

Key Words: Nutrition, Performance, Swine

107 Effects of Dietary Chelated Minerals and Methionine during Rearing on Gilt Lameness, Growth, and Performance before and after Entering Production.

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Lameness is a multifactorial condition, cause of early culling, and thought to be influenced by genotype, nutritional components, growth rate, mechanical stress, and claw health. The present study evaluated the effect of key nutrients for cartilage and bone development fed to rearing gilts (134 d) on lameness, performance, body composition and any carry-over effect entering into the sow farm. Gilts (n=360) with 28.8 ± 8.8 kg of initial BW were blocked and allocated in 4 treatments: control (C, basal diet); adding 15, 20 and 50 mg/kg of chelated minerals Cu, Mn, and Zn, respectively (MIN); 102% methionine: lysine ratio (MET); and the combination (MM). Lameness, BW, and body composition were measured 7 times during growth; and over the first productive phases. At d 45 of rearing, all gilts were inoculated with field strain of PRRSV because an outbreak in the sow farm prompted prophylactic measures. The procedures ANOVA, repeated measures (including sow as random effect), logistic regression, and Fisher Exact test were used. Probabilities of lameness increased ($P<0.01$) with BW during rearing. Prevalence was 7.75% and lameness was detected in a BW confidence interval of 106.8 to 129.7 kg. After detection, lame gilts showed lower ($P<0.05$) BW and ADG than none-lame gilts. Highest probabilities of developing lameness during rearing were found for C (14% vs. <7% for others, $P<0.01$). In the sow herd, 21% of sows showed lameness with 56% eventually recovering. Of lameness, 24% were caused by claw lesions. Prevalence of lameness was 10.8% in control-service area, 8.5% after group-housing and 14.8% in lactation. Compared to other groups, C showed increased lameness risk during lactation (20% vs. <12%, $P<0.01$). Of sows entering the sow herd, 27.3% were culled before third gestation. Sow productivity was unaffected by treatments ($P>0.05$). Higher removal rate for lameness was observed for C (7:10) and MM (3:10) compared to no cases in MIN and MET ($P<0.01$). Lame gilts during rearing weaned 1.2 piglets less ($P<0.05$). On farm lameness caused 0.7 more stillborn ($P<0.10$), 1 mm more BF loss in first lactation ($P<0.05$), and increased weaning-to-estrus interval by 3 d. Therefore, trace minerals and methionine supplemented to rearing gilts can reduce gilt culling by decreasing lameness incidence and improving claw health. A positive relationship was

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not found between growth rate (926-944 g/d) and lameness in gilts fed ad libitum. Lameness appeared around 106 kg, risk increased with BW and after clinical signs compromised growth and further performance.

Key Words: Longevity, Animal welfare, Osteochondrosis

108 Evaluation of Floor Space Allowance for Group-Housed Gestating Sows: Application of Allometric Principles.

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Floor space allowances for young pigs are determined using allometric principles and change with body weight of the pig. In contrast, recommended floor space allowances for breeding sows are static and expressed on per sow basis without consideration of variation in sow BW. The objective of this study was to evaluate floor space allowances using allometric principles. Gestating sows (n = 760, parity 1 to 9) group-housed in pens with electronic sow feeders (ESF) were used. Four floor space allowances (1.5, 1.7, 1.9, and 2.04 m^2/sow) were evaluated in four pens (42 to 51 sows/pen) over a period of 18 months. Sows were moved to pens 5 wk after mating and remained there until d 109 of gestation when moved to farrowing quarters. The following data were recorded: total duration of fighting among sows immediately after mixing, d 2 and d 7 after mixing in pens, skin lesions and salivary cortisol concentrations d 2 after mixing and before moving for farrowing, lateral and sternal lying during wk 3 and wk 9 after entering pens, BW change in pens, and farrowing performance. The k-value was calculated for sows in each pen using individual body weight at entering pens. Average weight for sows in each pen across floor space treatments ranged from 196 to 223 kg at entering pens. The k-value was 0.044 to 0.046, 0.047 to 0.051, 0.054 to 0.057, and 0.059 to 0.062 for 1.5 m^2, 1.7 m^2, 1.9 m^2 and 2.04 m^2 of floor space allowance, respectively. These results indicate that the k-value varied from 0.002 to 0.004 within the same floor space allowance treatment, depending on body weight of sows in the pen. There was no correlation between the k-value and any variable of sows that were measured (all R^2 <0.16, all P > 0.13), suggesting that increasing k-value from 0.044 to 0.062 did not affect sow performance and welfare. Across floor space treatments, total duration of fighting at mixing was 32 sec/sow/2 h, farrowing rate 93.7%, litter size farrowed live 12.4 and weaned 10.4. The minimal floor space allowance for gestating sows group-housed under conditions of the current study may be calculated using the equation: A (m^2/sow) = 0.044 $BW^{0.66}$, where A is area in m^2 and BW is body weight in kg. The k-value of 0.044 derived from this study needs further research for validation and it may change under different conditions from the current study.

Key Words: Floor Space, Gestating Sows, Allometric Principles

109 Electrical and Thermal Energy Consumption in Midwest Commercial Swine Facilities.

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Consumers are demanding increased sustainability and reduced carbon emissions within agricultural systems. However, fossil fuel consumption data within pork production systems is scarce. The objective of this study was to measure total electricity and heating fuel use and determine specific areas of high consumption in commercial swine barns. Data were collected from six commercial swine barns representative of typical Midwest production systems: two breed-to-wean barns, two nursery barns, and two finishing barns. Electricity and propane use were monitored across calendar years 2015 and 2016. Multiple electric loads were monitored on the barn side of the electric utility meter to reveal areas of highest usage. Within production phase and across years, the mean and standard deviation in consumption of electricity and propane were calculated on a per pig produced basis (Table 1). Electricity and propane usage ranged from 11.32 to 11.91 kWh and 1.17 to 1.29 L, respectively, in breed-to-wean barns despite large differences in annual pig production (29,200 pigs). Heat lamps used the highest proportion of total electricity in both breed-to-wean barns. Electricity and propane usage ranged from 2.10 to 2.38 kWh and 1.55 to 1.63 L, respectively, in nursery barns despite an annual production difference of 50,000 pigs. Ventilation accounted for the largest proportion of the total electricity used by each nursery. Total amounts of electricity used to produce one market pig ranged from 4.12 kWh (curtain-sided barn) to 14.40 kWh (tunnel-ventilated barn). Propane use ranged from 1.85 (curtain-sided) to 1.29 L (tunnel-ventilated). Despite barn design

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