984 Efficacy of bacteriophage to prevent *Escherichia coli* respiratory infection in broiler chickens when administered in the drinking water prior to challenge. W. E. Huff*, G. R. Huff, N. C. Rath, J. M. Balog, H. Xie, P. A. Moore, Jr., and A. M. Donoghue, *PPPSRU/ARS/USDA Fayetteville, AR*.

Bacteriophage are viruses that can infect and kill bacteria. A study was conducted to determine if bacteriophage added to drinking water for 1 wk prior to respiratory challenge of broiler chickens with *E. coli* would provide protection. There were 12 treatments with 2 replicate pens of 10 chicks. The treatments consisted of birds on normal water challenged at 1 wk with either 10^3 or 10^4 cfu *E. coli* injected into the thoracic airsac, or with either 10^3, 10^6, or 10^4, 10^6 phage/ml in their water, respectively. Unchallenged birds were given either 10^3, 10^4, or 10^6 phage/ml in their water, and birds on normal water were unchallenged, challenged with the culture broth, or with phosphate buffered saline. The birds were necropsied at 3 wks of age. At 2 wks, birds challenged with 10^4 *E. coli* regardless of water treatment, and birds challenged with 10^3 *E. coli* on normal water had decreased BW, however, birds challenged with 10^3 *E. coli* and given water treated with either 10^3 or 10^6 phage/ml had higher BW than birds challenged with 10^3 *E. coli* on normal water. At 3 wks, unchallenged birds that received 10^3 phage, and birds that received 10^4 phage and challenged with 10^4 *E. coli* had decreased BW. At 1 wk, treatment of water with 10^6 phage/ml decreased mortality by 50% in birds challenged with 10^3 *E. coli*. Total mortality was 55% in the birds that received 10^4 *E. coli* alone, 35% when treated with 10^4 phage, and 40% when treated with 10^6 phage. These data indicate that treating the water of broiler chickens prior to a respiratory challenge with *E. coli* may have provided some protection immediately after challenge.

Key Words: Bacteriophage, Broiler chickens, *Escherichia coli*

985 Effect of feed supplementation with vitamin D metabolites in a dexamethasone-*Escherichia coli* challenge model of turkey osteomyelitis complex. G. R. Huff*, W. E. Huff, N. C. Rath, and J. M. Balog, *PPPSRU/ARS/USDA, Fayetteville AR*.

Supplementation with vitamin D_3 was previously shown to protect *E.coli* challenged birds which were immunosuppressed with dexamethasone (DEX) at 5 wk and at 12 wk of age. The purpose of this study was to determine the effects of continual dietary supplementation with either 10 g/kg 1,25 dihydroxyvitamin D_3 (1,25) or 99 g/kg 25-hydroxyvitamin D_3 (Hy-D) on disease resistance. Seven hundred twenty turkey poults were placed into 24 duplicated floor pens in a 3 X 2 X 2 design comparing each metabolite treatment to controls. At 5 wk of age half of the birds were treated with DEX and half of the DEX-treated birds were challenged with *E.coli*. All mortalities and lame birds were necropsied. At 9 wk all DEX-treated birds were treated with another series of DEX injections. At this time, the birds which had only been challenged with *E.coli* were also treated with DEX. Two weeks later 10 birds/pen were necropsied. After the first series of DEX injections, there was an increase in mortality in the Hy-D supplemented birds which were given both the DEX treatment and the *E.coli* challenge. After the second series of DEX injections the main effect mean body weights were lower in birds given 1,25 as compared to both controls and Hy-D supplemented birds. Mortality was higher in 1,25 supplemented birds which were challenged with *E.coli* at 5 wk and treated with DEX at 9 wk as compared to Hy-D supplemented birds. The 1,25-treated birds which were treated with DEX at both 5 wk and 9 wk and challenged with *E.coli* at 5 wk had higher mortality as compared to both controls and Hy-D birds. The main effect mean mortality was higher in birds given 1,25 as compared to controls and Hy-D birds. The percentage of birds with lesions of turkey osteomyelitis complex (TOC) was decreased from 27% to 0 by both Hy-D and 1,25 in the groups given 2 DEX treatments and *E.coli* challenge. This study suggests that continual supplementation with vitamin D metabolites at these levels can decrease TOC incidence, however this result may be related to a concomitant increase in mortality.

Key Words: vitamin D, turkeys, *Escherichia coli*

Ractopamine at One Year of Commercial Application

986 Biological basis of the ractopamine response. S.E. Mills*, *Purdue University*.

Ractopamine belongs to a class of compounds that binds beta-adrenergic receptors (βAR) and promotes the accretion of muscle protein while reducing body fat. The growth response is observed across many species and with a variety of structurally related compounds, suggesting that a common regulatory pathway is involved. The βAR-selective agonist isoproterenol also stimulates muscle growth in rodents suggesting that βAR, and not other receptors, mediate the hypertrophic response. Three βAR subtypes have been cloned from several mammalian species and specie differences in the relative distribution and pharmacology of subtypes have been demonstrated. These specie differences likely account for the lesser or greater efficacy of specific compounds in specific species. In the pig, the β1AR is the predominant subtype expressed in the adipocyte (75%) and skeletal muscle (60%), followed by the β2AR (18 and 39%) and β3AR (7 and 1%). Ractopamine binds the porcine β1AR and β2AR with similar high affinity (Kd= 25 to 100 nM). Intracellular signaling through the βAR is achieved via activation of adenylyl cyclase and generation of cAMP. Ractopamine activates adenylyl cyclase but is only 20 to 40% as effective as isoproterenol and may more effectively signal through the β2AR than the β1AR. Ractopamine would be considered a partial agonist at both βAR subtypes. In adipose tissue, ractopamine stimulates triglyceride hydrolysis in vivo and in vitro through activation of adenylyl cyclase. Absolute rates of fat accretion are not consistently observed in feeding studies however, likely due to the combination of βAR down regulation with chronic feeding and the partial agonist activity. Ractopamine consistently increases the rate of skeletal muscle protein accretion in pigs, although the response is diminished with time. Down regulation of βAR is less evident in skeletal muscle, which may prolong the positive effect. It is not clear which βAR subtype(s) are linked to protein accretion and what intracellular pathways are involved. Answers to these questions may provide insights for the next generation of βAR agonist.

Key Words: pig, adrenergic, receptor

987 Impact of nutrition on the ractopamine response. W. C. Weldon* and T. A. Armstrong, *Elanco Animal Health, Greenfield Indiana*.

Proper nutrition is critical to effective implementation of ractopamine (Paylean®) in commercial swine production facilities. There is only a limited response to ractopamine if it is included in diets with limited amino acid fortification. Very simply, the ability of ractopamine to increase lean growth is limited by the availability of nutrients. To make an accurate estimate of the optimal nutrient concentration, it is critical to understand the potential lean growth response to ractopamine. The growth response to ractopamine is dramatic. Several studies have shown that the inclusion of ractopamine in the diet will increase ADG by as much as 275 g/d during the early weeks of ractopamine feeding. The improvements in growth performance decrease over time. Current recommendations are to feed ractopamine so that the majority of the pigs are marketed within four weeks of the initiation of ractopamine feeding. Practically, the primary adjustment necessary in diets containing ractopamine is to increase the amino acid concentration. A summary of four historical data sets indicates that the increased lean growth requires 3.6 to 7.5 g/d more true ileal digestible lysine during 28 d of ractopamine feeding (based on NRC 1998). If the increased lysine needs are distributed based on the relative response in ADG, the lysine requirement is greatest during the first few weeks of ractopamine feeding. The average increase in lysine requirements for the first 21 d of ractopamine feeding (based on historical lean growth data using NRC (1998) calculations) is 6.5 g/d of true ileal digestible lysine. Therefore, if pigs consume 2.5 kg of feed/d, the concentration of true ileal digestible lysine in the diet would need to be increased 0.26%. The results from ongoing studies will further define the interactions between dose and feeding duration

and allow for more specific nutritional recommendations. Feeding ractopamine in diets that are not adequately fortified, may severely limit the improvements in growth performance and carcass composition.

Key Words: Ractopamine, Swine, Nutrition

988 Genetic variation in the response to ractopamine. A.P. Schinckel*[1], B.T. Richert[1], and C.T. Herr[1], [1]*Purdue University*.

Several research trials have evaluated the impact of ractopamine (RAC, Paylean®, Elanco Animal Health) on barrows and gilts of various genetic populations (GP). Overall, the desirable response of RAC to increase daily carcass lean gain, improve feed efficiency, and increase carcass lean percentage has been observed in GP of substantially different lean growth rates and carcass lean percentages. Three trials have evaluated the magnitude of GP × RAC interactions. Carcass muscle accretion (g/d) increased with RAC to a greater extent in high lean gain (HL) barrows than low lean gain (LL) barrows ($P < .02$, Bark et al., 1992, J. Anim. Sci. 70:3391). Dissected fat accretion (g/d) was reduced by a greater magnitude in the HL than the LL barrows ($P < .04$). Gu et al. (1991, J. Anim. Sci. 69:2694) evaluated the RAC response in five GP of barrows and found significant RAC by GP interactions ($P < .05$) for daily carcass lean gain. Regression of GP means for carcass lean gain with RAC on the carcass lean gain of the control for the five GP indicated that the RAC response was best described as a constant percentage (25%) increase in daily lean gain above the controls. The third trial (Herr et al., 2001) evaluated the response of Paylean in 300 gilts in a 3 × 4 factorial with three GP (commercial terminal crosses) and four RAC levels (0, 5, 10, and 20 ppm). The GP had similar carcass lean percentage. No GP by RAC interactions were found ($P > .10$). Overall, the research indicates that RAC has a positive impact on barrows and gilts with substantially different genetic potentials for lean growth and carcass lean percentage. The RAC response to increase lean growth has been found to be proportional to the genetic potential of the GP. Recent research has found significant GP by environmental interactions for pigs reared in different health status environments. Environment by RAC and environment by RAC by GP interactions for compositional growth in pigs need to be evaluated.

Key Words: Ractopamine, Swine genetics, Lean Growth

989 Effects of ractopamine on meat quality. F. K. McKeith* and M. Ellis, *University of Illinois, Champaign-Urbana, IL*.

Ractopamine has been approved for use in pigs in the United States. Previous work on this compound has carefully characterized its effects on carcass growth and composition and some classical evaluations of fresh meat quality (color, firmness, and marbling) and palatability. The majority of the information available is a decade or more old. Results from these studies suggested that ractopamine had no effect on visual color, firmness, or marbling. Instrumental color was evaluated in one study and no effect was observed in L* value (lightness) but a* value (redness) was reduced. Water holding capacity (drip loss) and ultimate pH were not affected by ractopamine; however, ham curing yields were improved in two studies. The impact of ractopamine was inconsistent for Warner-Bratzler shear force (some studies reported an increase and other studies observed no difference). Sensory tenderness, juiciness, and flavor were not affected. Since its approval, several studies have been conducted using contemporary genotypes to help characterize the fresh meat quality attributes. Preliminary results from these studies are consistent with previous research. Detailed fresh meat quality evaluations suggest that visual color, firmness, and marbling were not affected. Instrumental L* was not affected; however, a* was reduced. Ultimate pH was significantly higher in ractopamine fed animals, but, drip loss and purge loss were not affected. Results from current studies and previous work suggest that ractopamine does not affect pork quality.

Key Words: Pork, Quality, Ractopamine

990 Potential impact of ractopamine on environmental stewardship. A.L. Sutton*, B.T. Richert, S.L. Hankins, S.A. DeCamp, and A.L. Carroll, *Purdue University*.

Numerous studies have shown that ractopamine hydrochloride (RAC) used in finisher swine diets increases the amount of lean tissue in pork carcasses and improves production efficiency (G:F and ADG). With increased body N retention, less feed consumed per unit of lean tissue gain and 4 to 6 d less to market weight, the use of RAC may lead to environmental benefits by reducing manure volume and N excretion. Theoretically, if the same total amount of US lean pork is maintained but with 12.7% improvement in G:F and 9.8% increased ADG due to feeding RAC, then fewer pigs would be required to generate this amount of lean. Consequently, significantly less feed resources (land required for crop production), fertilizer, chemicals, water usage and energy would be required. Little research has directly measured manure volume, nutrient excretion and odors from feeding RAC in commercial diets. A metabolism trial with 84-kg pigs and a 64-d manure incubation study were conducted to determine the effect of RAC on N excretion and odors in stored manure. A 13.8% CP, 0.80% Lys diet representing the industry standard diet for high lean gain pigs was compared to a current approved diet with 16.1% CP, 1.10% Lys + 20 ppm RAC. RAC decreased urine volume (12.6%) and tended to decrease total manure output (7.9%). Pigs fed the RAC diet excreted 14.9% less total N compared to the 13.8% CP standard non-RAC diet due to reduced urinary N excretion. In a 30-d feeding period and 4 less days to market, N excretion would be reduced 206 g per pig marketed. Slurry pH was reduced 0.5 units and ammonia was reduced 8-21% from pigs fed RAC. In an attempt to maximize N utilization and minimize N excretion, a 13.8% CP, 1.10% Lys + 20 ppm RAC diet was fed. The 13.8% CP + RAC diet reduced N excretion by 35.7% and decreased slurry ammonia and VFA production in stored manure to help reduce odors. The utilization of RAC in swine diets could result in additional environmental benefits and improved environmental stewardship.

Key Words: Pigs, Ractopamine, Nitrogen excretion

Teaching Techniques for Meat Judging Coaches

991 Preparing animal science graduates to think critically, compare logically, decide independently, solve problems rationally, communicate effectively and lead decisively. Gary C. Smith*, *Colorado State University*.

If the animal science curriculum is appropriately crafted and structured, undergraduate student majors can develop abilities to think critically, compare logically, decide independently, solve problems rationally and to communicate effectively in the formal course-work offerings. Additionally, though, livestock, meat and wool judging/grading/evaluation experiences provide opportunities for students to develop further those skill-sets, while simultaneously developing leadership skills. To qualify as an "educated" baccalaureate degree graduate, is it really important that a person be able to judge a class of stallions, assign Quality/Yield Grades to a beef carcass, grade a fleece or determine IMPS compliance of a pork loin? Yes, because those who pursue a career in animal agriculture will then be able to describe/discuss intelligently the industry's products and endproducts. But even if a person never intends to, and does not, pursue a career related to animal agriculture, there are huge personal benefits which accrue from learning the principles involved in mastering the generalities, concepts and specifics of the art and science of judging, grading and evaluation. Development of skills in comparative reasoning, application of memory standards, mental gymnastics, independent problem-solving, knowledge integration, written/oral communication and leadership will prove useful irrespective of one's career path. Animal science department administrators must insist that, within the B.S. curricula, there are opportunities for students to participate in clubs and intercollegiate competitions to serve as an integral part of the process of developing leadership skills.

Key Words: Leadership, Curriculum, Judging teams