

demonstrated that bacteriophage can be used to both prevent and treat colibacillosis in poultry and may provide an effective alternative to antibiotic use in animal production.

Key Words: E. coli, Bacteriophage, Therapy

18 Antibodies: an alternative for antibiotics? L. R. Berghman*¹ and S. D. Waghela², ¹*Departments of Poultry Science and Veterinary Pathobiology, Texas A&M University, College Station,* ²*Department of Veterinary Pathobiology, Texas A&M University, College Station.*

Infectious diseases of both humans and farm animals are re-emerging as significant problems, because our arsenal of effective anti-infective tools is not expanding proportionally. Thus, there is an urgent need for new approaches to the treatment of infectious disease, especially in cases of drug-resistant microbes, microbes for which therapy is not available, or in cases of host immune impairment. Recently developed technologies have opened up new avenues for the use of immunotherapy with pathogen-specific antibodies. While the idea is far from new (serum therapy in the early 1900s preceded the advent of antibiotics), for the approach to be affordable, an inexpensive, abundant source of specific antibodies is required. Polyclonal antibody sources therefore are limited to chicken egg yolk antibodies (also called IgY) and bovine colostrum antibodies. Numerous successful applications have been reported, ranging from treatment of rotaviral and cryptosporidial diarrhea to prophylaxis against dental caries. Monoclonal antibodies, while offering enhanced specificity, have long been disqualified, even for human treatment, due to lack of economical production systems. The recent introduction of transgenic animals and especially transgenic plants for production of therapeutic proteins has dramatically changed this perspective. Molecular farming of antibodies has made it possible to produce antibodies as complex as secretory IgA (sIgA) at a fraction (estimated at between 2-10%) of the cost of the conventional production systems. The plantibody approach is especially attractive for the production of recombinantly simplified antibodies, the so-called single chain variable fragments (scFvs). With decreasing cost of production, the potential to

tailor antibodies to very precise specifications and our increasing molecular knowledge of host-pathogen interactions, antibodies seem to have a bright future ahead as a redesigned tool for prophylaxis and treatment of infectious disease, both in animals and in humans.

Key Words: Antibodies, Therapy, Prophylaxis

19 Alternatives to Antibiotic Use - Natural food and feed amendments. S. C. Ricke* and M. M. Kunding, *Texas A&M University.*

Successful control of foodborne pathogens requires placement of antimicrobial hurdles during preharvest and postharvest food production. Chemical additives have traditionally included organic acids to control microbial contamination in animal feeds. However, there is some concern that continuous application of chemical antimicrobials can lead to a buildup of microbial resistance. This creates problems if foodborne pathogens evolve survival/resistance to a variety of environmental stressors that organisms encounter in pre- and postharvest animal production. To expand the diversity of potential antimicrobials that would have practical application for food animal production requires exploring the interaction between the food matrix and foodborne pathogens that become associated with it. Of particular interest is the potential for generating natural antimicrobial compounds during processing that originate from the food or feed. Possibilities include natural compounds formed during heating such as Maillard products and other chemically altered complexes and derivatives from foods and feeds which may possess antimicrobial properties for specific foodborne pathogens. Pathogens may also encounter natural antimicrobials in food products such as certain botanical compounds where they have historically been used for flavor enhancement as well as preservatives. Understanding the potential application for these natural compounds in foods and feeds will require examination of foodborne pathogen response under experimental conditions comparable to the environment where the pathogen is most likely to occur.

Key Words: Natural Antimicrobial Compounds, Foodborne Pathogens, Feed

Animal Behavior & Well Being I

20 Effects of photoperiod on the immune function of multiparous gestating sows. S. R. Niekamp*, M. A. Sutherland, G. E. Dahl, T. L. Auchtung, and J. L. Salak-Johnson, *Department of Animal Sciences, University of Illinois, Urbana.*

Photoperiod manipulation has provided a non-invasive, easily implemented, effective, method to improve immune status while enhancing productive efficiency in gestational dairy cattle. In this study, our objective was to evaluate the impacts of photoperiod manipulation on endocrine and immune responses of gestating sows. At d83 of gestation, sows were moved to gestation crates and kept on a 12L:12D photoperiod during an adjustment period. At d90, sows were allotted to either long day (LD; 16L:8D) or short day (SD; 8L:16D) photoperiod until farrowing. Blood samples were taken at d 90, 97, 103, and 110 of gestation to evaluate cortisol (CORT), prolactin (Prl), total white blood cell (WBC), lymphocyte (Lymph), and neutrophil (Neut) counts, IgG concentrations, lymphocyte proliferation (LPA), neutrophil chemotaxis (CHTX), and neutrophil phagocytosis (PHAG). At d97, IgG concentrations were higher ($p < 0.05$) in animals experiencing LD than those on SD. Sows on SD photoperiod had higher ($p < 0.05$) conacavalin A and LPS-induced ($p < 0.01$) LPA responses compared to LD sows. CORT concentrations also tended to be higher ($p = 0.18$) in SD than LD animals. At d103, the only treatment effect was on LPA in response to LPS which was higher ($p < 0.05$) in LD sows than SD animals. There were no treatment differences at d110. While there were treatment differences at certain time points, there were no trends of treatment effects over the period of the experiment. It appears that photoperiod is affecting immune status and endocrine responses but may have no long term effects. Further investigation is needed to determine the precise effects of photoperiod on gestational sows and their piglets.

Key Words: Sows, Immune, Photoperiod

21 Effects of photoperiod on immune function in 7 and 21 day old piglets. S. R. Niekamp*, M. A. Sutherland, G. E. Dahl, and J. L. Salak-Johnson, *Department of Animal Sciences, University of Illinois, Urbana.*

Photoperiod manipulation provides a non-invasive, easily implemented, effective, method to improve immune status while enhancing production efficiency. The objective of this study was to evaluate the impact of photoperiod manipulation pre- and post-gestational on piglet immune responses. Piglets' dams were subjected to either long day (LD; 16L:8D) or a short day (SD; 8L:16D) photoperiod at d90 of gestation. During farrowing-lactation some of the sows remained on their original photoperiod (LD:LD or SD:SD) treatment while others were switched to the opposite treatment (LD:SD or SD:LD). Blood samples were taken from piglets at 7 d of age for cortisol (CORT), total white blood cell counts (WBC), and IgG concentrations. At 21 d of age, blood samples were obtained for CORT, WBC, neutrophil counts (Neut), lymphocyte counts (Lymph), lymphocyte proliferation (LPA), neutrophil chemotaxis (CHTX), and neutrophil phagocytosis (PHAG). At 7 d of age, piglets subjected to LD:SD had higher ($p < 0.05$) total WBC compared to all other treatment groups. Plasma CORT was higher ($p < 0.05$) among piglets kept under a LD:SD photoperiod but lower among SD:SD and SD:LD treated piglets. Plasma IgG tended to be lower ($p < 0.07$) for piglets on SD:SD and SD:LD compared to animals on LD:LD and LD:SD photoperiod. At 21 d of age, piglets whose dams were on SD:LD had higher total WBC ($p < 0.05$) compared to all other treatment groups. LPA response to conacavalin A was higher ($p < 0.01$) among piglets on SD:SD than any other treatment group. A similar trend was apparent with LPA in response to LPS ($p < 0.07$). There was also a tendency for piglets subjected to LD:LD to have higher ($p < 0.1$) PHAG compared to animals on LD:SD. These data support the concept that photoperiod manipulation can alter immune function in piglets during gestation and before weaning.

Key Words: Piglet, Immune, Photoperiod

22 Farrowing performance and injury in a group housing system for gestating sows. M. J. Séguin*, T. M. Widowski, and D. Barney, *Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada.*

The University of Guelph research station converted one of two gestation rooms from 108 dry sow stalls to group housing with floor feeding. The new floor plan eliminated all alleyways, but was used to house the same number of sows (3.2m²/sow). Reducing the floor space allotment would make the system more economical. The objective of this study was to determine the performance and injuries of gestating multiparous sows housed in static groups at three floor space allotments and compare their performance records to that of the referent herd housed in stalls. Yorkshire sows were mixed after d 35 post-breeding into pens measuring 2.3, 2.8 or 3.2m² per sow. Group sizes ranged from 11-31. Body condition (5 point range) was scored upon entering and leaving gestation. The number and severity of superficial skin scratches on the shoulders (6 point range) were scored 24 h pre-mixing, 24 h post-mixing and on a weekly basis thereafter for five weeks. Mean, change and variation in body condition scores were not affected by group housing at any of the space allowances ($P > 0.1$), but the herd tends to be over-conditioned (average score: 3.5 ± 0.04). The day after mixing, 42.9 ± 8.3, 28.2 ± 7.7 and 28.0 ± 10.6 % of sows within a group had multiple skin scratches (scores 5-6) when housed at 2.3, 2.8 and 3.2m² per sow ($P > 0.1$), respectively. By two weeks post-mixing, most of the scratches had healed and by the end of the first month and for the remainder of gestation, fewer than 5% had multiple scratches. Shoulder scratches were a short-term consequence of group housing.

Farrowing performance (mean ± SEM)	2.3m ²	2.8m ²	3.2m ²	Stalls
Number of groups	4	5	6	.
Number of sows	88	77	82	98
# Born alive*	10.5±0.1	10.3±0.3	10.2±0.5	9.6±0.3
# Mummy	0.2±0.1	0.2±0.1	0.2±0.1	0.4±0.1
# Stillborn	1.0±0.1	0.9±0.1	1.2±0.1	1.4±0.2
Average Piglet Birth Weight (kg)*	1.59±0.01	1.61±0.03	1.56±0.03	1.52±0.03

*Mean of groups compared to sows in stalls as referent population ($P < 0.05$)

Key Words: Housing, Gestation, Sow

23 Application of guar hull by-product as a full-fed molting supplement. C. Zhang*, A. L. Cartwright, J. B. Carey, and C. A. Bailey, *Department of Poultry Science, Texas A&M University, College Station.*

A 5 × 5 Latin square experiment was conducted to explore the feasibility of molting hens by feeding relatively high concentrations (15 or 20%) of guar hull by-product. A total of 125 Bovan laying hens (64-week-old) of similar body weight were assigned to 5 groups of 5 replications with 5 hens in each replication, and were induced to molt by feed withdrawal (FW), or feeding 15 or 20% guar hull with or without β-galactomannase (Hemicell[®] at 250,000 unit/kg) for 14 days. Feed withdrawal birds, hens fed 15 or 20% guar hull without enzyme, and 20% guar hull with enzyme ceased laying at day 6, 10, 8 and 10 of treatment, respectively but hens fed 15% hull with enzyme continued to lay throughout the 14-day molting period. Feed withdrawal hens resumed laying in week 3 of post-molt, and reached 50% hen-day egg production in week 4. Full-fed groups laid eggs in the first week of post-molt, and reached 50% egg production in week 3. No differences ($P > 0.05$) were observed on egg production between FW hens and full-fed groups during the 8-week post-molt period, except that in week 7 fasted birds had lower egg production than the 20% guar hull-fed hens. The 20% guar hull-fed hens also had higher production than hens fed 15% hull with or without enzyme in week 6, 7 and 8. Fasted hens had higher mortality than all full-fed groups. All hens had higher egg weight, improved Haugh unit and shell quality, but decreased yolk color, when compared with the pre-molting period. No difference in egg quality was observed between each group except that FW hens had higher egg weights than full-fed hens. The results showed

that feeding guar hull by-product at 20% of complete diet may be a preferable molting approach to complete feed withdrawal.

Key Words: Guar, Laying Hen, Egg Production

24 A comparison of the behavior of broiler chickens raised on two different bedding types. S. J. Shields*, J. P. Garner, and J. A. Mench, *University of California, Davis.*

Exercise may be important for reducing leg problems in broiler chickens. A previous study (Shields et al., *in press*. Appl. Anim. Behav. Sci.) showed that sand bedding was preferred by broiler chickens for one form of exercise, dustbathing. The aim of this study was to determine the effect of sand bedding on the general behavioral activity of broiler chickens. In Experiment 1, 6 pens were divided down the center and bedded half with sand and half with wood shavings. Male broiler chickens (N=10/pen) were observed to determine day and nighttime behavioral time budgets on each side of the pens; nighttime behavior was videorecorded under red light. Each pen was observed 5 times per wk for 6 wk beginning when the chicks were 1 wk of age. Each observation period lasted for 1 hr during which scan samples of behavior were taken every 5 min. There was a significant behavior x bedding x week interaction ($F_{9,675} = 4.39$, $p < 0.0001$). During the day, drinking, dustbathing, preening, and sitting all increased on the sand (to 2.0%, 1.9%, 3.1% and 37.7 % of the time budget, respectively) but decreased on the wood shavings (to 0.1%, 0.0%, 1.1%, and 22.1% of the time budget). At night, resting increased on the sand (from 13.9% to 61.2% of the time budget). In Experiment 2, eight pens (N=50 birds/pen) were bedded either in sand or wood shavings. In contrast to the first experiment, bedding type did not affect time budgets (GLM: $F_{12,566} = 0.53$, $p = 0.8946$) or dustbathing ($F_{1,38} = 0.12$, $p = 0.73$). Thus, while in the first experiment some active behaviors were performed increasingly more often on the sand side of the pens, the results of the second experiment indicated that broilers will use wood shavings for these behaviors if it is the only substrate available. Therefore, although sand is a preferred substrate, providing sand bedding is unlikely to increase overall activity levels.

Key Words: Broiler Chicken, Behavior, Sand Bedding

25 Incidence of bone breakage in three strains of end-of-lay hens. K. L. Budgell¹ and F. G. Silversides^{2,3}, ¹*Nova Scotia Agricultural College, Truro, Nova Scotia,* ²*Crops and Livestock Research Centre, Charlottetown, Prince Edward Island, Canada,* ³*Pacific Agri-Food Research Centre, Agassiz, British Columbia, Canada.*

Bone fragility in commercial end of lay hens leads to breakage before slaughter which is a significant welfare concern, and after slaughter which is a concern because it reduces the value of the carcass. When 72 weeks old, 180 spent hens of three genetic lines were slaughtered at a provincially inspected plant. The carcasses were subsequently frozen for storage, then thawed and dissected to determine the number of bone fractures. Fractures were separated into those that showed signs of healing, an indication of breakage before shipping, those surrounded by tissue trauma, indicating breakage during depopulation and shipping, and those with no healing or soft tissue damage, indicating that they occurred after the hens were dead. Two lines of commercial layers, ISA-Brown and Babcock B300, had higher incidences of old (11.1% and 11.7%) and shipping breaks (7.9% and 10.0%) than a heritage line of Brown Leghorns (0.0% and 3.5% respectively). Most bones were broken during processing, and all hens had at least some broken bones. The ISA-Brown and Babcock B300 hens had a higher average number of breaks (13.5 and 18.9 respectively per bird) than Brown Leghorn hens (8.7 per bird). The majority of breaks were of the pubis, ischium, sternum, and rib cage, with 97.8, 90.6, 89.4, and 71.7% respectively of the hens experiencing breaks in these bones by the end of evisceration. These results show that spent laying hens suffer broken bones before, during, and after depopulation and slaughter. Differences between the lines in the incidence of broken bones suggest that selection of commercial layers for high egg production may have affected bone strength.

Key Words: Layers, Strains, Bone Breakage